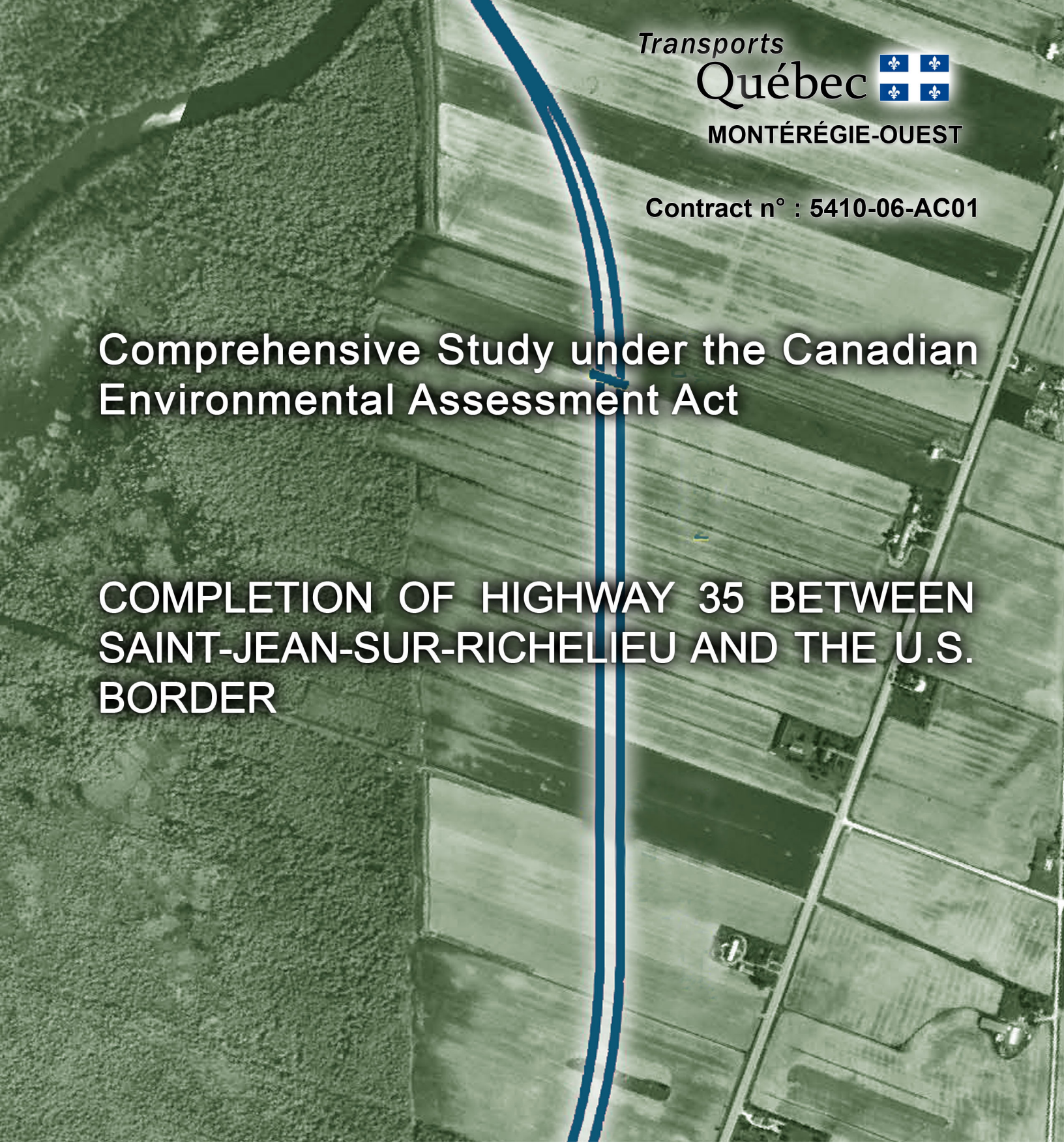

Transports Québec

MONTÉRÉGIE-OUEST

Contract n° : 5410-06-AC01

Comprehensive Study under the Canadian Environmental Assessment Act

COMPLETION OF HIGHWAY 35 BETWEEN SAINT-JEAN-SUR-RICHELIEU AND THE U.S. BORDER

Consortium :

DESSAU

SM*i* AMÉNATECH INC.

DATE : July 2008

N./D. : 99285-2587/F062844-001

IF THERE IS A DISCREPANCY BETWEEN THE ENGLISHVERSION AND THE FRENCH VERSION OF THIS COMPREHENSIVE STUDY REPORT, THE FRENCH VERSION WILL PREVAIL.

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Reference to cite:

CONSORTIUM DESSAU - AMÉNATECH. 2008. Étude approfondie en vertu de la Loi canadienne sur l'évaluation environnementale. Parachèvement de l'autoroute-35 entre la frontière américaine et Saint-Jean-sur-Richelieu. Rapport du consortium Dessau - Aménatech au ministère des Transports du Québec, 198 pages and appendices.

Executive Summary

The Quebec Department of Transport (MTQ), the proponent of the Highway 35 completion project, wishes to build a stretch of highway consisting of two 2-lane carriageways over a total distance of 38 km between the existing Highway 35 in Saint-Jean-sur-Richelieu, Quebec and the U.S. border. The project will be mainly within a right-of-way already owned by the MTQ. The new stretch of Highway 35, 7.6 km shorter than the current journey via Highway 133, will help improve safety on Highway 133, air quality in the towns it crosses, travel comfort, travel time, and economic development in the region.

The possibility of a financial contribution from the Canada Strategic Infrastructure Fund and the Border Infrastructure Fund, which are administered by Infrastructure Canada (INFC) and Transport Canada (TC), triggers the federal environmental assessment procedure under the *Canadian Environmental Assessment Act* (CEAA). The need for an authorization from Fisheries and Oceans Canada (DFO) under the *Fisheries Act* and a permit from TC under the *Navigable Waters Protection Act* are further triggers. Pursuant to paragraph 2i) of the *Comprehensive Study List Regulations,* the project must undergo a comprehensive study because the route of the highway encroaches slightly on the Phillipsburg migratory bird sanctuary. TC, INFC and DFO are the three responsible authorities that must ensure that an environmental assessment is carried out in accordance with the requirements of the *CEAA*. The Quebec regional office of the Canadian Environmental Assessment Agency has the role of federal coordinator.

The comprehensive study deals mainly with the environmental components specified in the scope established by the responsible authorities. i.e. hydrology, groundwater, surface water, soils and sediments, geology, noise, air quality, vegetation, wetlands and protected areas, species at risk, species of special status, fish and their habitat, visual environment, activities related to fishing and birdwatching, archaeology, and the built heritage.

Based on the main concerns expressed by the public during the federal process, as well as requests from the federal responsible authorities, the MTQ made certain improvements in the project: designing the western approach to the bridge over the Brochets River so as to limit the bridge's encroachment on the floodplain; limiting the potential for de-icing salts to enter sensitive wetlands and aquatic environments; reducing the affected forested area at the Saint-Alexandre interchange and near the Philipsburg migratory bird sanctuary. In addition, special mitigation measures were added to integrate the project with the environment, with a specific emphasis on the protection of fish habitat.

The comprehensive study has demonstrated that if the proposed mitigation measures are implemented, the project is unlikely to have significant adverse environmental effects.

Furthermore, there will be a compensation project to limit deterioration, destruction and disturbance of 1.64 ha of fish habitat (0.7 ha resulting from permanent structures to be built at the Brochets River, and 0.94 ha for loss of habitat at other crossings of water courses).

There will be a follow up program for several components to ensure that the mitigation measures are relevant and effective, and there will be a monitoring program to ensure that these measures are properly implemented.

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List of Abbreviations

$: Canadian dollars
$B: billions of dollars
$M: millions of dollars
%: percent
AADT: average annual daily traffic
AAST: average annual summer traffic
AAWT: average annual winter traffic
Average Leq: logarithmic sound level for a given period
BAPE: office of public hearings on the environment
CEAA: Canadian Environmental Assessment Agency
cm: centimetres
CO: carbon monoxide
dBA: A-weighted decibel
DFO: Fisheries and Oceans Canada
EC: Environment Canada
g: gram
GPS: global positioning system
h: hour
ha: hectare
HC: Health Canada
I-: Interstate
INFC: Infrastructure Canada
ISQ: Institut de la statistique du Québec
km/h: kilometres per hour
km: kilometres
km^2: square kilometres
kV: kilovolt
m: metres
M: million
m^2: square metres
m^3: cubic metres
MDDEP: Quebec department of sustainable development, environment and parks
mg/l: milligrams per litre
mg/m^3: milligrams per cubic metres
min: minute
mm: millimetre
MRC: regional county municipality
MTQ: Transport Quebec
NO: nitrogen monoxide
NO_2: nitrogen dioxide
Nox: nitrogen oxides
NRC: Natural Resources Canada
O_3: ozone
ºC: degrees Celsius
ppb: parts per billion
ppm: parts per million
SO_2: sulphur dioxide
TC: Transport Canada
$\mu g/m_3$: micrograms per cubic metre
µm: micrometre

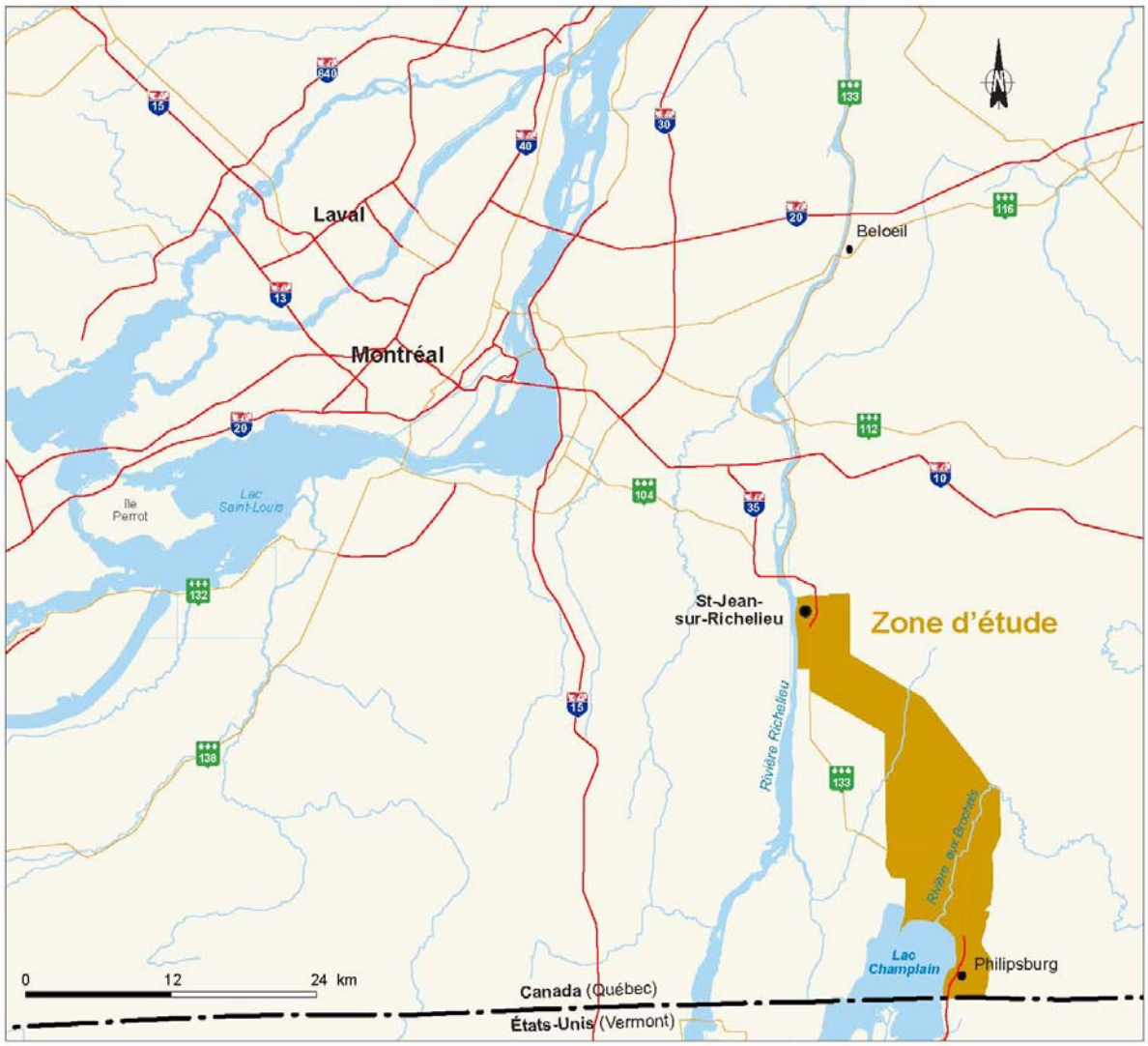
1 INTRODUCTION

1.1 Project Overview

Transport Quebec (MTQ, the proponent) is proposing a construction project for the stretch of Highway 35 between the U.S. border and St-Jean-sur-Richelieu in Quebec in order to complete the missing highway link between Interstate 89 (I-89), accessible from south of the American border, and the existing section of Highway 35, which ends east of the Richelieu River.

As the segment between Iberville and the American border is not complete, drivers use Highway 133. This highway serves a major population base, including Montreal and Montérégie to the northeast and five New England states (Vermont, New Hampshire, Massachusetts, Rhode Island and Connecticut) to the south (figure 1.1).

Figure 1.1 Project location



Source: Génivar, 2005.

The Highway 35 project consists of constructing a 38-km four-lane divided highway (accessible only through interchanges) linking the two existing highways, I-89 and Highway 35. This project will be constructed mainly within a right-of-way already owned by Transport Quebec (MTQ).

Once it is completed, this segment of Highway 35, which is 7.6 km shorter than the current Highway 133 route, will, according to the proponent:

- Contribute to the economic development of Montreal, Montérégie and other regions of Quebec by facilitating trade with New England;
- Improve safety on Highway 133 by reducing through traffic;
- Improve the quality of life in area communities;
- Make travel more comfortable;
- Enable motorists to travel through this area faster.

In the context of trade with the United States, this highway would consolidate a major border crossing, which could replace the current Highway 133 infrastructure.

1.2 Legal framework and implications for the federal government

1.2.1 Regulatory context

In accordance with subsection 5(1) of the *Canadian Environmental Assessment Act* (the Act), an environmental assessment of a project is required if a federal authority is the proponent of the project; provides financial assistance to the proponent; has the administration of lands and has the authority to dispose of those lands through sale or lease; or issues a permit or licence or grants an approval under the provisions of the Regulations. These functions are known as triggers of the Act and, consequently, an environmental assessment is required before a federal authority exercises its duties or functions in respect of a project.

In the case of the Highway 35 construction project, a possible financial contribution under the Canada Strategic Infrastructure Fund and the Border Infrastructure Fund, administered by Infrastructure Canada (INFC) and Transport Canada (TC) to enable the project, are triggers for the environmental assessment procedure under the Act. In addition, issuance of an approval by Fisheries and Oceans Canada (DFO) under the *Fisheries Act,* and issuance of a permit or licence by Transport Canada under the *Navigable Waters Protection Act* are also triggers.

As the project partially affects the Phillipsburg migratory bird sanctuary, it must undergo a comprehensive study pursuant to paragraph 2 i) of the *Comprehensive Study List Regulations*:

> 2.i) The proposed construction, decommissioning or abandonment, in a wildlife area or migratory bird sanctuary, of a railway line or public highway.

TC, INFC and DFO are therefore the three responsible authorities for ensuring that an environmental assessment of the project is completed. Environment Canada (EC), Natural Resources Canada (NRCan) and Health Canada (HC) are also providing expertise on project issues that fall under their respective areas of jurisdiction in order to enable the responsible authorities to make a well-informed decision.

In the context of the “comprehensive study” environmental assessment, the Quebec regional office of the Canadian Environmental Assessment Agency (CEAA) serves as federal environmental assessment

coordinator for the project because it is also subject to the provincial procedures under section IV.1 of the Quebec *Environment Quality Act*. Its role is to ensure that federal authorities participate in the environmental assessment process and to facilitate communication and cooperation with the other stakeholders.

1.2.2 Scope of Environmental Assessment

This section deals with the information contained in the document entitled "Track Report to the Minister of the Environment on the environmental assessment process" prepared by TC, INFC and DFO for this project on November 5, 2005, as well as supplementary information received by federal authorities in two series of questions and comments sent to MTQ regarding the project.

1.2.2.1 Type of Environnemental Assessment

The responsible authorities reviewed the results of the public consultation on the scoping document for the environmental assessment of the Highway 35 project. The public comments did not touch on the matter of whether a comprehensive study or a panel review would be the best way to conduct the assessment. The responsible authorities therefore recommend continuing with a comprehensive study, which they believe will make it possible to address the environmental issues related to the project.

1.2.2.2 Project Scope

The scope of the project includes the construction, operation and maintenance of the infrastructure built or modified as part of the project (a 38-kilometre stretch of new highway between St-Jean-sur-Richelieu and the U.S. border at St-Armand). More specifically, the scope of the project includes the following works and activities:

- the highway (including rights-of-way, foundations, etc.) and service roads;
- interchanges, connectors and modifications to existing highways necessary for integration with the new highway, and water crossings;
- rest areas, weighing check-points and border posts, as needed;
- modifications to existing structures, or their moving or removal;
- operation, closure or restoration of borrow pits, dumping grounds or storage areas, and the activities and temporary structures required to complete the project (e.g. tree felling, coffer dams, riprap, embankments, bank naturalization, revegetation, etc.);
- snow removal and use of abrasives and de-icing salt (or other ice melters);
- any other structures or activities that could impact one or more of the components in the table below entitled “Summary of factors to review”.

1.2.2.3 Factors to review

Table 1.1 shows the factors to be reviewed in this comprehensive study.

Table 1.1 Summary of factors to review

	Factors
Physical environment	• hydrology (including navigation) and the substrates of watercourses, including sediments; • quantity and quality of surface and groundwater (drainage, rainwater management, consumption-directed uses); • geology, geomorphology, nature of soil, productivity of soils and seismology (including management of any contaminated soil and sediment); • extreme weather events, special climatic conditions, climate changes; • noise and vibrations (including sensitive sites, ambient noise, expected changes, and measures to reduce); • air quality (including odours, emissions, dust and greenhouse gases).
Biological environment	• terrestrial and aquatic vegetation; • wetlands and protected areas; • species at risk and species of special status (animals and plants); • wildlife and their habitats, in particular fish and migratory birds and their habitats.
Human environment (human occupation and use of land and aquatic resources)	• public safety and limitations on managing protected areas; • utilization of lands and resources (by Aboriginals for traditional purposes); • activities related to fishing and birds; • aesthetics and landscape; • heritage, cultural, historical, archaeological and paleontological resources.

The environmental assessment includes the study of the following factors set out in sub-paragraphs 16(1) *a)* to *e)* and in subsection 16(2) of the *Canadian Environmental Assessment Act*:

- the environmental effects of the project, including the environmental effects of malfunctions or accidents that may occur in connection with the project and any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out;
- the significance of the effects referred to in paragraph *(a)*;
- comments from the public that are received in accordance with the *Canadian Environmental Assessment Act* and its regulations;
- measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project;
- the purpose of the project;

- alternative means of carrying out the project that are technically and economically feasible and the environmental effects of any such alternative means;
- the need for, and the requirements of, any follow-up program in respect of the project; and
- the capacity of renewable resources that are likely to be significantly affected by the project to meet the needs of the present and those of the future.

According to subsection 2(1) of the *Canadian Environmental Assessment Act*, "environmental effect" is defined as any change that the project may cause in the environment, including any change it may cause to a listed wildlife species, its critical habitat or the residences of individuals of that species, as those terms are defined in subsection 2(1) of the *Species at Risk Act,* any effect of such changes on health and socio-economic conditions, physical and cultural heritage, the current use of lands and resources for traditional purposes by aboriginal persons, or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance, or any change to the project that may be caused by the environment.

1.2.2.4 Scope of factors to review

The environmental assessment will consider the possible effects of the project within certain spatial and temporal limits, namely the periods of time and the geographical areas within which the project may potentially interact with or have an effect on components of the environment. The limits may vary with the issues and factors considered and will be based on:

- the construction, operation, decommissioning, clean up of sites and cessation of operations, or other activities proposed by the proponent or that will likely be carried out jointly with work proposed by the proponent, including mitigation measures and habitat replacement;
- the natural variation of a population component or ecological component;
- the timing of sensitive life cycle phases of wildlife species in relation to the scheduling of the project;
- the time required for an effect to become evident;
- the time required for a population component or ecological component to recover from an effect and the estimated degree of such recovery;
- the area affected by the project; and
- the area within which a population component or ecological component functions and within which a project effect may be felt.

With regard to the possible cumulative environmental effects of the project, the environmental assessment should identify other projects or activities that have or will be carried out in the area under study, including projects that are reasonably foreseeable, that is, projects that have already been approved or are in the process of receiving regulatory approval, and indicate how these projects or activities environmental effects could interact temporally or spatially, with the project under study.

1.3 Required authorizations

Section 5(1) of the *Navigable Waters Protection Act* states that works such as bridges, booms, dams and causeways that may substantially interfere with navigation require formal approval, with the registration of plans and the publication of a notice. The MTQ will therefore apply to TC under the *Act* for approval of the plans for and site of a work that crosses a watercourse deemed 'navigable' by TC's Navigable Waters Protection Group, i.e. Rivière aux Brochets. Under section 9 of the Act, the proponent will submit the plans and a description of the proposed site to the Minister and will also submit copies of these documents to the registry office (in Bedford) of the registration division of Missisquoi. The conditions on the permit issued under the *Act* will be observed by the MTQ and its agent.

The MTQ will furthermore submit to DFO an application under section 35(2) of the *Fisheries Act* in order to obtain the necessary authorizations for the 32 water body crossings needed to complete the highway in question. The conditions on the authorization issued under the *Act* will be observed by the MTQ and its agent.

Since the project is also subject to the provincial environmental assessment process, in accordance with section 31.1 of the *Environment Quality Act* (R.S.Q., c. Q-2), the MTQ submitted an environmental impact study to the MDDEP (Quebec department of sustainable development, environment and parks) in March 2005. The BAPE (office of public hearings on the environment) held public hearings from November 14, 2005 to March 14, 2006.

2 SUMMARY OF PUBLIC CONCERNS

As per section 21(1) of the *Canadian Environmental Assessment Act*, there was an initial public consultation period from August 30 to September 21, 2005 to obtain the public's comments on the scope of the environmental assessment and what type of assessment should occur. The responsible authorities received no comments on the scope or type of environmental assessment, but one individual did make known his concerns about the effects of the project on quality of life as well as the socio-economic effects, particularly with respect to depopulation of the area.

A second consultation by federal authorities in early 2008, concerning the preliminary results of the comprehensive study, elicited three comments from residents of the areas in question. They raised concerns about:

- Conservation of the largest possible number of trees between the access ramp, the highway and Montée de la Station;
- The possibility of buying back land that was expropriated by the MTQ several years ago and is not required for the project;
- The impacts of the project and mitigation measures in relation to farmland drainage systems and displacement of the municipally regulated water course;
- Snow removal and use of abrasives and road salt;
- Total cost of the project.

Appendix A contains the responses sent to the members of the public.

As provided for in section 22 of the CEAA, the public will have a third opportunity to make comments on the project and on the environmental assessment, during a period for public comment on this present report. The Agency will facilitate public access to the CSR and administer the formal consultation period. Any comments made by the public on the findings and recommendations of the report will be passed on to the RAs and will be included in the Registry. The comments will be taken into consideration when the Minister makes his decision on the significance of the environmental effects and suggested mitigation measures.

Public hearings for the provincial environmental assessment process

The following were the main concerns raised by the public at the provincial hearings that took place from November 14, 2005 to March 14, 2006:

Rationale for project
Some participants questioned the need for the project. In their view, work to improve the state of Highway 133 would be sufficient. Others thought that the Government of Quebec should improve public transit and develop rail transportation rather than build a new highway.

Road safety
Some participants said that Highway 133 is dangerous and needs corrective work. Two specific problems were mentioned: the road is old and there are use conflicts between local traffic and through traffic. Others said that speed limits are not observed in the Saint-Pierre-de-Véronne-à-Pike-River area, and that the shoulders are in disrepair between Pike-River and Saint-Sébastien.

Agriculture

Several participants mentioned that the quality of the farmland would be degraded by the project. Also, construction of the road could further urbanize an agricultural area, and this would mean even more loss of farmland. Protection and conservation of farming seem to be important to the area's sustainable development.

Drainage

Some participants expressed a hope that the MTQ might restore farmland drainage before construction begins. This would allow farmers along the future highway to continue their activities.

Vegetation in right-of-way

Some farmers are worried about invasive plants in the right-of-way; some species are harmful to the crops grown next to the future highway. For example, reed grass roots can block underground drains and cause land drainage problems.

Ecosystems

Certain participants mentioned that the project would cause the loss of significant forested lands. Others asked that wildlife and ecologically sensitive environments be properly protected. Many people demanded special works to protect wildlife and wildlife habitats.

Saint-Alexandre and Saint-Sébastien interchanges

Some participants mentioned that it would be better to build diamond rather than cloverleaf interchanges in order to reduce encroachment on farmland as much as possible.

Noise

Certain participants, specifically residents of Saint-Gérard, expressed fears that the project would mean more noise in their neighbourhood.

Control post and rest area

Residents of Saint-Armand are concerned about the park proposed by the MTQ, specifically its size, its location, and the services that would be available. Following the public hearings and investigation by the BAPE (office of public hearings on the environment) between November 14, 2005 and March 14, 2006, the MTQ abandoned the plan for a rest area but retained the plan for a roadside control post (MTQ, 2006).

Road salt

Some participants mentioned the need to limit salt spreading and to manage snow removal and water runoff in such a way as to capture the salt.

Quality of life and social acceptance

Some participants said that efforts should be made to improve the landscape. They expressed a hope for better cooperation among project leaders, residents, retailers and farmers. Some people also raised the nature of compensatory measures.

3 PROJECT BACKGROUND AND DESCRIPTION

3.1 Project background and context

The Highway 35 construction project, previously called the New England Highway and now known as the Vallée-des-Forts Highway, was initiated in the 1960s in order to provide southern Quebec with a safe and efficient road link to New England (I-89), between Highway 10 and the Saint-Armand border crossing[1].

In the early 1970s, the first section in the form of an expressway with grade intersections was built between Highway 10 (exit 22 about 25 km from Montreal) and Iberville in Saint-Jean-sur-Richelieu. In 1999, this 19.2 5km expressway was redeveloped to meet the standards of a highway with interchanges. The section of the highway that is subject of this study corresponds with the last 38 km to completely link I-89 and Highway 10.

3.2 Project justification and purpose

The project justification is based on an analysis of the geoeconomic context, a study of the geometry of Highway 133, and local and cross-border traffic, which also involves road safety considerations. As the results of findings that justify improving the highway link, several solutions were analyzed to identify which one would best address the project objectives.

3.2.1 Geoeconomic context

The project is part of the south sector of the Haut-Richelieu regional county municipality (MRC) and the west sector of the Brome-Missisquoi MRC. The affected part of the Haut-Richelieu MRC includes part of Saint-Jean-sur-Richelieu[2] corresponding with the former municipalities of Iberville and Saint-Jean-sur-Richelieu, Saint-Athanase sector, as well as various rural communities (Sainte-Anne-de-Sabrevois, Saint-Alexandre, Henryville, Saint-Sébastien, Venise-en-Québec and Saint-Georges-de-Clarenceville). Three rural municipalities of the Brome-Missisquoi MRC are also affected: Saint-Pierre-de-Véronne-à-Pike-River, Saint-Armand at the US border, and Notre-Dame-de-Standbridge slightly east of the planned highway alignment.

The study area consists of a major regional centre (Saint-Jean-sur-Richelieu), a few urbanized sectors and an essentially agricultural plain area in the Haut-Richelieu MRC. It also includes agricultural and forest areas in the Brome-Missisquoi MRC. The Missisquoi Bay sector (Venise-en-Québec and Saint-Georges-de-Clarenceville) is a major resort area.

The Highway 35 completion project is very welcomed by the regional and border community. The various regional socioeconomic stakeholders as well as governments of the New England states involved have been advocating for this project for a number of years (CCHR, 2002). While Highway 35 and Highway

1 The Highway 133 border crossing is located in the former municipality of Philipsburg, which is now part of the municipality of Saint-Armand. For simplification purposes, we are referring to the Saint-Armand border crossing in accordance with the official nomenclature used in MTQ documents.

2 The new city of Saint-Jean-sur-Richelieu is the result of the amalgamation of the former municipalities of Saint-Jean-sur-Richelieu, Saint-Luc and L'Acadie on the west shore and Richelieu, Iberville and Saint-Athanase on the east shore

133 are designated by MTQ as part of the strategic transportation network in support of external trade, Highway 133 is the only interregional link in this network that is not served by freeway infrastructure.

3.2.2 Geometry, traffic and safety

Highway 133, the only link between Highway 35 and the I-89 in United States, serves as both a regional and an international link. According to MTQ standards, a national highway must serve priority traffic movements, thereby promoting traffic mobility. Access must be controlled to protect this primary goal.

Highway 133 is a three-lane undivided highway on the majority of its length, with the third lane used for passing or left turns. At Saint-Armand, the road is a four-lane divided highway with grade intersections. Automobile traffic is increasing to the north of the highway because of urban development, while increased traffic to the south is essentially due to increased trucking.

According to the data provided in the project's environmental impact study, the annual average daily traffic (AADT) of Highway 133 in 2000 varied from 12,900 veh./d at Saint-Jean-sur-Richelieu to 3,500 veh./d at the Saint-Armand border crossing. Traffic decreases progressively southwards, to 4,100 veh./d between Saint-Jean-sur-Richelieu and Sainte-Anne-de-Sabrevois, to 3,300 veh./d between Sainte-Anne-de-Sabrevois and Saint-Pierre-de-Véronne-à-Pike-River and to 2,000 veh./d between Saint-Pierre-de-Véronne-à-Pike-River and the US border. In 2002, the AADT of the I-89 to Vermont was 2,900 veh./d.

Traffic growth varies depending on the section and time of year. From 1974 to 2001, higher growth rates were recorded south of de la Grande-Ligne Rd. (Saint-Jean-sur-Richelieu, Saint-Athanase sector) where traffic increased by 3.2% per year. At the other counting stations, the long-term growth rates for this period were between 0.4% and 1.4%. Traffic grew at a higher rate during the 1980s at Saint-Jean-sur-Richelieu (Saint-Athanase sector) and at the US border with annual average growth rates of 5.6% and 3.3% respectively. Between Sainte-Anne-de-Sabrevois and Saint-Sébastien, traffic hardly increased at all or even decreased slightly. Traffic growth resumed in this area after 1990 with AADTs of 0.6% to 2.3%. At Saint-Jean-sur-Richelieu (Saint-Athanase and Saint-Armand sectors) after peaking in 1992 to 1994, traffic has decreased or remained steady.

There are also seasonal and monthly variations due primarily to fluctuations in automobile traffic during summer vacation periods. Truck traffic remained constant throughout the year.

During an investigation conducted in November 2002, the daily number of trucks on Highway 133 varied between 1,050 veh./d at Saint-Armand and 1,600 veh./d at Saint-Jean-sur-Richelieu, Saint-Athanase sector. Trucks account for between 13 and 30% of the north-south traffic. Trucking is therefore a significant component of the traffic on Highway 133, and the majority of the trucks are tractor semi-trailers (96.3% at Saint-Armand and 68.4% at Saint-Jean-sur-Richelieu, Saint-Athanase sector 3).

From 1974 to 2001, trucking traffic at the US border increased significantly. It increased from 387 veh./d in 1984 to 858 veh./d in 1993, peaking in 1999 with 1,368 veh./d., which is equivalent to an average annual growth rate of 8.8%. However, due to US economic conditions and the drop in exports, the volume of trucking decreased in 2000 to 1,050 veh./d. The average annual growth rate between 1993 and 2000

3 GENIVAR Survey, November 5 and 7 2002. Calculation based on MTQ (2002), *Comptages Route 133, données agrégées validées*, [Highway 133 counts, aggregated validated data] MTQ, Est et Ouest-de-la-Montérégie, gives a proportion of 91.2% of tractor semi-trailers at Saint-Armand.

was 2.9%, which is still rather high, taking into account economic cycles. Traffic growth at the border crossing is clearly indicative of the robustness of cargo transport as compared with personal travel.

The traffic growth analysis showed that the dynamic may vary by section, for example the increase in traffic at Saint-Jean-sur-Richelieu is related to urban development of the suburb, while the growth at the border is mostly due to growth in the trucking sector.

According to the studies conducted by MTQ, traffic forecasts were based on an average annual growth rate of 3.0% at Saint-Jean-sur-Richelieu and Sainte-Anne-de-Sabrevois between 2001 and 2016, 2.0% between 2017 and 2021, and 1.5% in the other shoreline municipalities on Highway 133, including the border crossing. The hypothesis for segments of the southern section of the study is based on the following factors:

- between 1991 and 2001, overall Quebec exports to the United States increased by an average of 12% annually, while truck traffic to the Saint-Armand border crossing increased by 2.9% between 1993 and 2000;
- the intensity of cross-border trade will depend on the health of the US economy, American open trade policies, and the relative value of the Canadian dollar; if, in the short term, these three factors combine to slow Quebec trips to New England (and this trend has already started), in the long term these trips should grow but more moderately compared with the growth that followed NAFTA and the strong expansion in certain industrial sectors in the 1990s;
- a study by the Eastern Border Transportation Coalition (EBTC) on the future of border transportation in eastern Canada and United States predicts an overall increase in traffic at the eastern borders with annual growth rates of between 4% and 7% through 2015;
- trucks account for about one third of vehicles at the Saint-Armand border crossing;
- automobile traffic in the south portion of the section being studied remained steady or experienced modest average annual increases of 0.2% to 1.1% between 1990 and 2000;
- trucking remains the predominant mode of transportation for trade between Canada and the United States, despite the increase in rail transport in recent years;
- the municipalities of Henryville, Saint-Sébastien, Saint-Pierre-de-Véronne-à-Pike-River and Saint-Armand are not expected to experience population growth.

Traffic forecasts for Saint-Jean-sur-Richelieu and Sainte-Anne-de-Sabrevois are based on the following observations:

- population growth was 1.3% per year on average between 1981 and 2001 at Saint-Jean-sur-Richelieu and should be 1.7% between 2001 and 20164;
- municipalities near Saint-Jean-sur-Richelieu such as Sainte-Anne-de-Sabrevois and Saint-Alexandre are expected to experience greater population growth than the municipalities further south;

4 MTQ (1999). *ES-3, Projections de la population et des ménages, 1996-2021 : Le modèle, sa mise en œuvre et ses résultats*. [Population and household projections, 1996-2021: Model, implementation and results] MTQ, Service de l'économie et du plan de transport, Quebec City, QC, computer file.

- the average annual traffic growth rate on Highway 133 at Saint-Jean-sur-Richelieu, Saint-Athanase sector, was 4.5% between 1980 and 2000, and 3.4% between 1990 and 2000.

Table 3.1 shows the traffic forecasts on sections of Highway 133 for 2021.

Table 3.1 AADT on Highway 133, 2000-2021.

Location	2000	2021
Saint-Jean-sur-Richelieu, Saint-Athanase sector	11,700	20,000
Sainte-Anne-de-Sabrevois, north of Highway 225	8,800	15,000
Sainte-Anne-de-Sabrevois, south of Highway 225	6,500	8,800
West of Saint-Sébastien	5,000	6,900
Saint-Armand	3,500	4,400

Source: MTQ and GENIVAR (2002). Highway 133 counts, validated aggregated data.

Highway 133 has a significantly higher rate than national highways with adjoining lanes in rural areas. The accident rates are higher within and at the borders of population centres, especially Saint-Pierre-de-Véronne-à-Pike-River and Henryville. However, accidents are more serious in agricultural areas where traffic travels at higher speeds.

There is a certain incompatibility between Highway 35/I-89's function as a cross-border link and its function as a link across four population centres and an agricultural community, resulting in local and agricultural traffic. Access to farms and the fact that the highway goes through several population centres, where it has pronounced curves, combine to reduce Highway 133's capacity to ensure mobility and safety. The existing levels of traffic flow, comfort and safety do not meet the requirements of through or local traffic.

3.2.3 Alternatives to the project

In order to address future demand in the Highway 133 corridor, several solutions have been proposed and subject to a comparative analysis based on technical, economic and environmental criteria.

After the investigation report was filed and the public hearing by the office of public hearings on the environment (BAPE), MTQ analyzed the proposal and concluded that this solution was difficult to achieve from a technical perspective, unsafe, and would have a major impact on the built environment and the Brochets River, in addition to cutting through several farming enterprises. Nevertheless, MTQ has adjusted its project to improve the alignment (option 5 improved) based on certain opinions given during the public hearings and by BAPE in its report. Table 3.2 summarizes the comparative analysis of the *status quo* and the four solutions initially studied, as well as the option that was selected.

Section 3.4.4 sets out the details of the alignment selected as a result of the provincial assessment process (Décret 599-2007), which is the subject of this comprehensive study.

Table 3.2 Description and comparative analysis of possible solutions

	Option 0 Status quo	Option 1 Minor improvements to Highway 133	Option 2 Widening Highway 133	Option 4 Undivided highway on the Highway 35 axis	Option 5 Completing Highway 35	Option 5 improved Completing Highway 35
Description of the option studied						
	• No action	• Modifications to sections with characteristics that are likely to cause accidents • Bypassing four villages that do not have right of access	• Expanding Highway 133 to four lanes on its current alignment	• Building a highway with three adjacent lanes on the Highway 35 right of way • Variation: building a highway with two lanes separated by a guard rail	• Building Highway 35 between Saint-Jean-sur-Richelieu and the US border as a four-lane divided highway	• Building Highway 35 between Saint-Jean-sur-Richelieu and the US border as a four-lane divided highway
Economic criteria						
Preliminary cost estimate		• Moderate cost (no detailed estimate) (+)	• Moderate to high cost, including acquisition and expropriation costs (no detailed estimate) (-)	• Moderate cost ($130M, $160M for the variation) (+)	• High cost ($250 M) (-)	• More expensive (more than $250 M) (-)
Support to economic development	• No change (-)	• Slight improvement (=)	• Slight improvement (=)	• Significant improvement (+)	• Significant improvement (+)	• Significant improvement (+)
Quebec's image	• No change (-)	• Very slight improvement of the continental gateway (-)	• Very slight improvement of the continental gateway (-)	• Relative improvement of the continental gateway (+)	• Significant improvement of the continental gateway (+)	• Significant improvement of the continental gateway (+)
Technical criteria						
Feasibility		• The Henryville and Saint-Sébastien would probably be bypassed with a single bypass.	• Expropriations probably required all along the alignment (-) • Difficulty fitting highway in population centres and in the Saint-Jean-sur-Richelieu – Sainte-Anne-de-Sabrevois	• No specific difficulties	• No specific difficulties	• No specific difficulties

	Option 0 Status quo	Option 1 Minor improvements to Highway 133	Option 2 Widening Highway 133	Option 4 Undivided highway on the Highway 35 axis	Option 5 Completing Highway 35	Option 5 improved Completing Highway 35
			section (-)			
Traffic flow	• Maintains the coexistence of through traffic and local urban traffic (-) • Maintains speed limits of 50 km/h and 70 km/h in population centres (-) • Maintains the coexistence of through traffic and agricultural traffic (-)	• Eliminates conflicts between through traffic and local urban traffic (+) • Speed limit of 90 km/h on most of the route (+) • Maintains the coexistence of through traffic and agricultural traffic (-) • Urban development pressures may result in more accesses and reduced flow in the long-term (-) • Reduced travel time, to be determined (+)	• More passing opportunities (+) • Maintains the coexistence of through traffic and local urban traffic (-) • Maintains speed limits of 50 km/h and 70 km/h in population centres (-) • Maintains the coexistence of through traffic and agricultural traffic (-)	• Improves traffic flow (+) • Speed limit 90 km/h (=) • Control method used for new intersections to be determined, traffic lights or traffic circles may be necessary (-) • Reduction in travel time to be determined (+)	• Improves traffic flow (+) • Speed limit 100 km/h (+) • No grade intersections (+) • Reduces travel time by about 10 minutes (+)	• Improves traffic flow (+) • Speed limit 100 km/h (+) • No grade intersections (+) • Reduces travel time by about 10 minutes (+)
Accessibility	• Maintains direct accessibility (+) • Difficulty exiting accesses due to high traffic levels on Highway 133 (-)	• Accessibility of population centres by local road (-) • Difficulty exiting the local road that provides access to Highway 133 (-)	• Maintains direct accessibility (+) • Difficulty exiting accesses due to high traffic levels on Highway 133 (-)	• Maintains direct accessibility (+) • Reduces difficulty exiting accesses because there will be less traffic on Highway 133 (+)	• Maintains direct accessibility on 133 (+) • Reduces difficulty exiting accesses because there will be less traffic on Highway 133 (+)	• Maintains direct accessibility on 133 (+) • Reduces difficulty exiting accesses because there will be less traffic on Highway 133 (+)
Environmental criteria						
Adding a bicycle lane				• Possibility of adding a bicycle lane to Highway 133 (+)	• Possibility of adding a bicycle lane to Highway 133 (+)	• Possibility of adding a bicycle lane to Highway 133 (+)
Existing built-up environment		• Accessibility to population centre by local roads (-) • Difficulty exiting the	• Acquisitions or expropriations required (-) • Reduces the current	• Potential loss of commercial activities (-) • Acquisitions or	• Loss of existing residential buildings (8 houses including 3 on the chemin	• Loss of existing residential buildings (8 houses including 4 on the chemin

	Option 0 Status quo	Option 1 Minor improvements to Highway 133	Option 2 Widening Highway 133	Option 4 Undivided highway on the Highway 35 axis	Option 5 Completing Highway 35	Option 5 improved Completing Highway 35
		local roads that provide access to Highway 133 (-)	setback for existing buildings (-) • Reduces the number of parking spaces near businesses (-)	expropriations required (-)	Archambault (km 28,8), 5 houses on Montgomery street (km 35,2) (-)	Archambault (km 28,8), 5 houses on Montgomery street (km 35,2) (-) [1] One house outside the right-of-way has been bought in addition to the 3 situated inside the right-of-way after discussion with the owner because the noise impact was estimated as moderate
Quality of life	• Nuisances that increase as traffic increases (noise, vibrations, dust, emissions) for citizens living near Highway 133 (-)	• Nuisances that increase as traffic increases (noise, vibrations, dust, emissions) for citizens living near Highway 133 (-)	• Reduces nuisances (noise, vibrations, dust, emissions) for citizens living near Highway 133 due to the reduction in traffic and trucking (+)	• Reduces nuisances (noise, vibrations, dust, emissions) for citizens living near Highway 133 due to the reduction in traffic and trucking (+)	• Nuisances that increase as traffic increases (noise, vibrations, dust, emissions) for citizens living near Highway 133 (-)	• Minimize impacts on citizens living near Highway 133 with a lozenge-shaped interchange (+)
Security	• Mainteance of conflicts transit/local traffic (-) • Maintenace of problems related to passing (-)	• Punctual security problems solved (+) • Decrease of accidents in population aggregates (+) • Maintenace of problems related to passing (-) • Mainteance of conflicts transit/agricultural traffic (-) • New zones of conflicts at the new intersections new and old highway (-)	• Mainteance of conflicts transit/local traffic (-) • Elimination of accidents related to passing (+)	• Elimination of conflicts transit/local traffic in rural and urban areas (+) • New zones of conflicts at the new intersections (-) • Potential of major accidents at high speed if no separation of traffic ways (-)	• Elimination of conflicts transit/local traffic in rural and urban areas (+) • No conflicts on the new highway due to no grade intersection (+) • Elimination of accidents related to passing (+)	• Allow safe circulation of agricultural machinery on local roads (chemin de la Grand-Ligne, Highway 133 and 3e Rang Sud) (+) • Facilitate circulation of agricultural machinery with the realisation of access routes at the extremities and the construction of

	Option 0 Status quo	Option 1 Minor improvements to Highway 133	Option 2 Widening Highway 133	Option 4 Undivided highway on the Highway 35 axis	Option 5 Completing Highway 35	Option 5 improved Completing Highway 35
						one agricultural overpass in the middle of the plain (+)
Impacts on agricultural zone	• None (+)	• Important encroachment on agricultural lands (-) • Barrier effect between house and land (-)	• Encroaches on the only excluded lots in the permanent agricultural zone, which can be developed in the municipality (-)	• Encroachment in the agricultural land resources (-) • Cuts through some cultivated lands (-)	• Encroachment in the agricultural area (-) • Cuts through some cultivated lands (-)	• Limit the impact on the agricultural zone with the realisation, near Highway 227, of a lozenge-shaped interchange as well as the maintenance of the actual highway axis (+) • Ensure a good drainage of the Highway and agricultural lands with the planning of watercourses (double) (+)
Impacts on urban area	• None (+)	• Urban destructuration and pressure on exurbanization (-)	• Important disturbance of implementation in population aggregates (-) • Nuisances that increase (noise, dust) as the road gets closer to urban area (-) • Maintenance of speed tendency in population aggregates (-)	• Potential loss of commercial activity (-)	• Potential loss of commercial activity (-)	• Favour the increase in customer traffic in business centers with new signage in the municipality of Saint-Pierre-de-Véronne-à-Pike-River (+) • Favour enhancement of heritage sites in the Philipsburg area (Saint-Armand Sud) (+) • Facilitate local

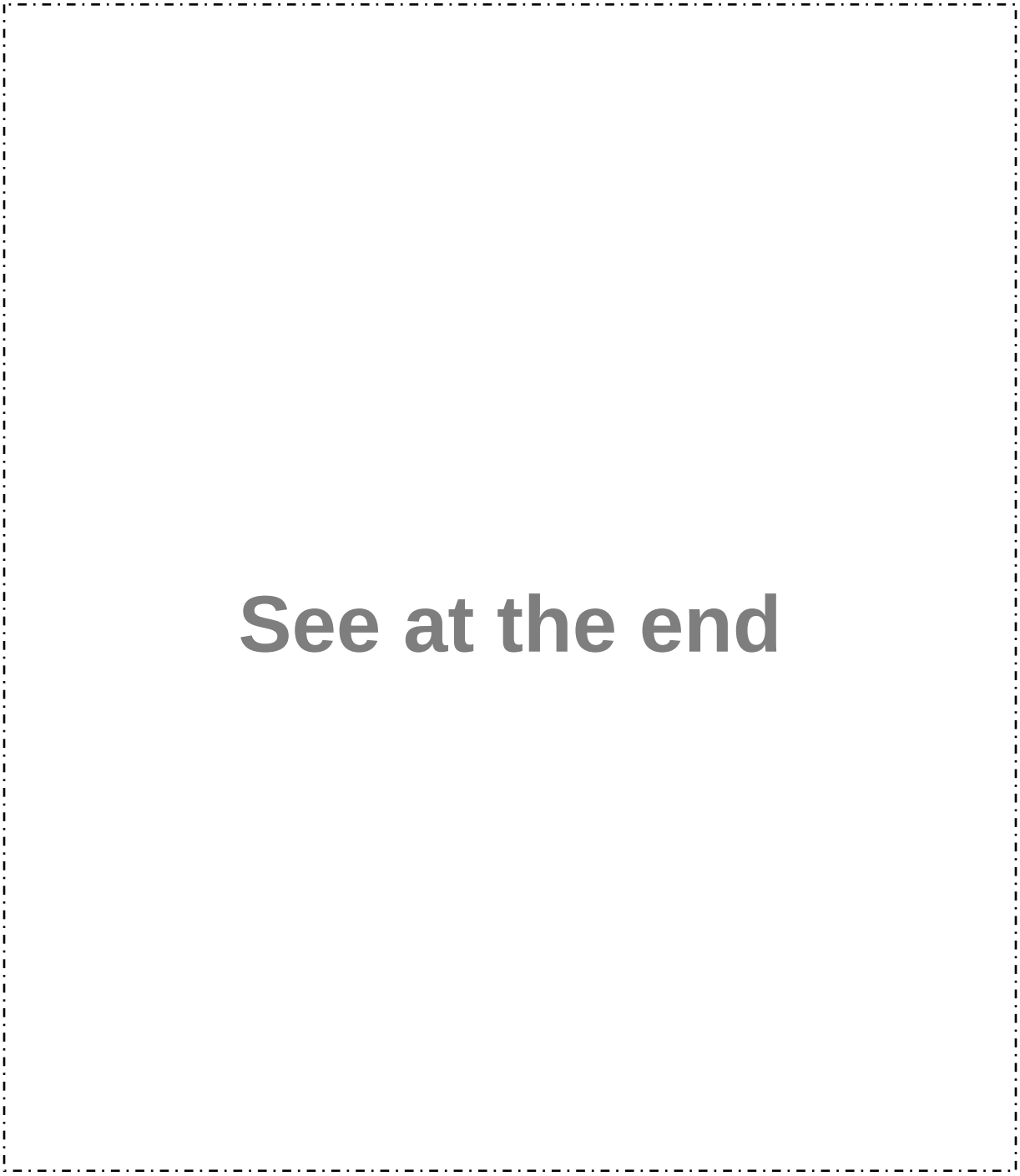
	Option 0 Status quo	Option 1 Minor improvements to Highway 133	Option 2 Widening Highway 133	Option 4 Undivided highway on the Highway 35 axis	Option 5 Completing Highway 35	Option 5 improved Completing Highway 35
						exchanges (+)
Water courses	• No anticipated impact	• Impact on the Brochets River due to the increased vertical curve of Highway 133 and the construction of a new bridge if the city core is bypassed (-)	• Potential impact on the Brochets River due to construction of a new bridge (-)	• Potential impact on the Brochets River due to construction of a new bridge (-)	• No anticipated impact	• No anticipated impact
Natural environment				• Possible encroachment on the migratory bird sanctuary and Streit Pond (-)	• Possible encroachment on the migratory bird sanctuary and Streit Pond (-)	• Limited encroachment on the migratory bird sanctuary (-) • Minimize the need of right-of-way with the narrowing of roadways near the floodplain (+) • Favour the protection of the Brochets River's floodplain (+) • Minimize the losses of silver maple forests (+)

(+) Advantage, (-) Disadvantage

3.3 Summary description of the environment

Since the environmental factors that fall under the scope of the comprehensive federal study are described in detail in the analysis of residual effects of the project in section 5.0, this section sets out a summary description of the project environment by presenting an inventory of the natural and human environments of the study zone (Figure 3.1).

Figure 3.1 Inventory of the physical and human environments of the study zone



The project cuts through primarily agricultural zones and low-density inhabited sectors concentrated on urban centres that are often located at the intersection of two roads. There are also resort villages, especially on the Brochets River and Missisquoi Bay, where several residences are occupied year round.

The highway alignment set out in the project impact study submitted for the provincial process slightly encroaches the Phillipsburg migratory bird sanctuary. As indicated in section 1.2.1, the encroachment on the migratory bird sanctuary is the reason why a comprehensive environmental assessment under the federal environmental assessment process is required. A portion of the Highway 133 right-of-way is already included in the bird sanctuary, whose boundaries were established based on cadastral divisions rather than which areas are used by birds during migrations. The area of the sanctuary affected by the Highway 35 right-of-way corresponds with the off ramp of Highway 35 north, i.e. 11,325 m^2, and consists primarily of a steep grassy slope. The justification for the encroachment and the effects of the project on the sanctuary are discussed in detail in section 5.

3.4 Technical Specifications of Project

The project's technical description first outlines standard cross sections of the proposed rural sector highway and existing roads, describes engineering works and other structures, and outlines related construction work and the redevelopment of collector roads. The technical constraints associated with the project are then listed, followed by a description of MTQ optimization efforts, particularly as they pertain to the crossing of the Brochets River.

3.4.1 Standard cross sections

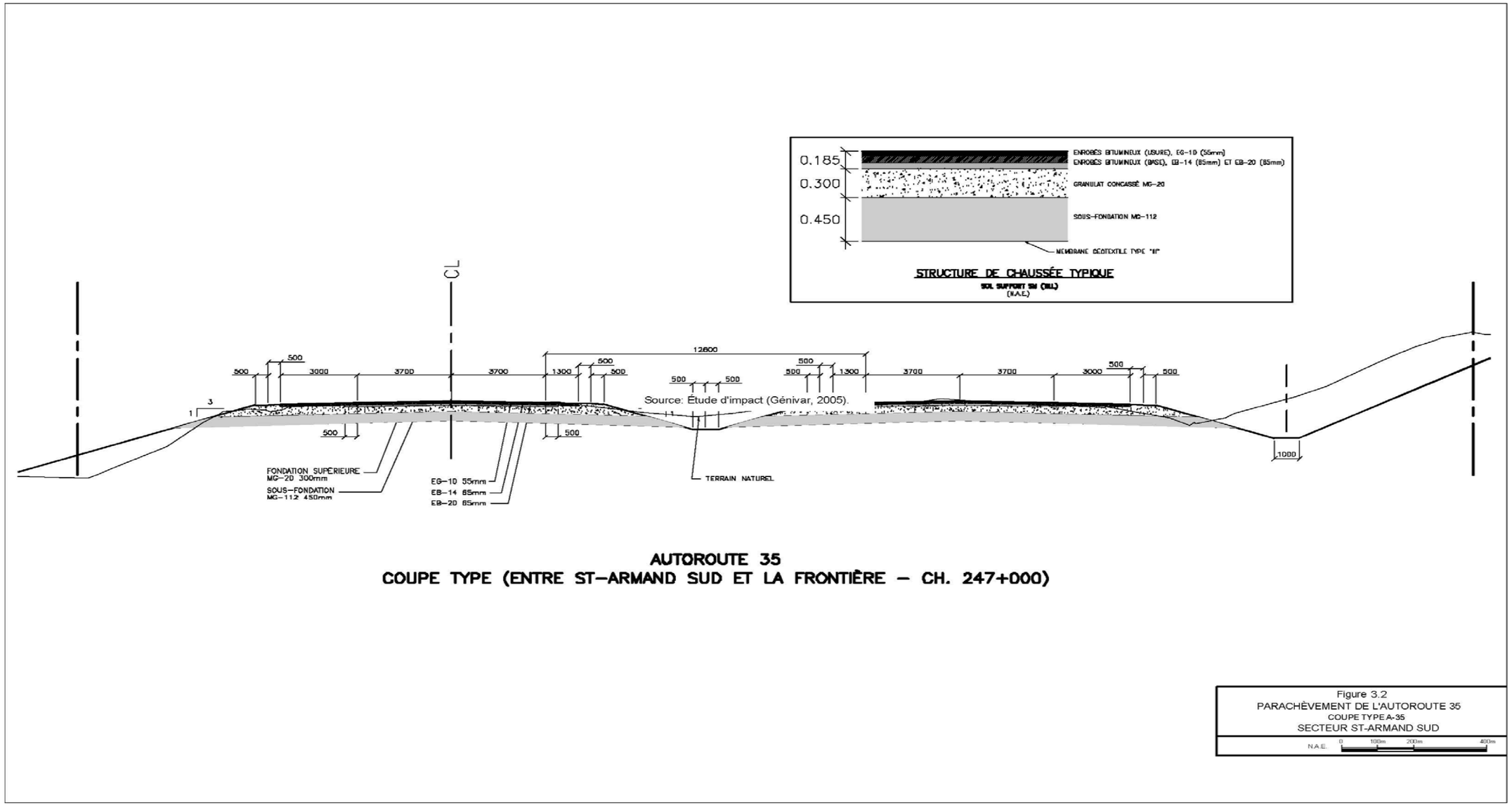
3.4.1.1 Highway 35

The Highway 35 project will connect to Iberville north of the existing Highway 35, and for the last five kilometres to the south it will overlap a section of Highway 133 as a divided highway. The general cross-section proposed for the project as a whole is that of a rural highway for 33 of the 38 km (standard design 001, Volume 1 of Road Structure Standards). It will have the following features (Figure 3.2):

- four 3.7 m lanes (of a divided highway) with 1.3 m left shoulders and 3.0 m right shoulders;
- a 26 m wide median;
- exterior slopes with grades of 1V: 6H or less.

This cross section requires a right-of-way of approximately 90 m in width.

Figure 3.2 Highway 35 Standard cross section – Rural sector



Source: Étude d'impact (Génivar, 2005).

Source: Impact study (Génivar, 2005).

Along the southern portion, where a 5 kilometre section of Highway 35 overlaps the existing Highway 133, the cross-section will be adjusted to accommodate both the available right-of-way (approximately 60 m) and the existing geometric configuration. The proposal is to enlarge the existing divided highway in order to create a divided highway of four 3.7 m lanes with paved 1.3 m left shoulders and 3.0 right shoulders. The width of the median (such as it currently stands) will be 12.5 m (Figure 3.3). Considering the average annual daily traffic, it is not necessary to install a safety barrier to reduce the risk of median crossing.

3.4.1.2 Highway 133

The proposed cross section for this highway is that of a rural area main road (type C) with an average annual daily traffic (AADT) < 2000, consisting of 3.5 m lanes with 2.5 m paved shoulders. This standard cross section was used during the design of the Highway 35 overpass, with the addition of a centre lane to allow left turns at the two intersections with on and off-ramps (standard design 003, Volume 1 of Road Structure Standards).

3.4.1.3 Chemin de la Grande-Ligne

The proposed cross section for this road and for the Highway 35 overpass is a collector road with AADT > 2000 (road type D), consisting of 3.3 m lanes with paved 2.0 m shoulders (standard design 004, Volume 1 of Road Structure Standards).

3.4.1.4 Highway 227

The proposed cross section for this highway and for the Highway 35 overpass is a regional road (road type C) with AADT > 2000, consisting of 3.5 m lanes with paved 2.5 m shoulders (standard design 003, Volume 1 of Road Structure Standards).

3.4.1.5 Highway 202

The proposed cross section for this highway and for the Highway 35 overpass is a regional road (road type D) with AADT between 500 and 2,000, consisting of 3.3 m lanes with paved 2.0 m shoulders (standard design 004, Volume 1 of Road Structure Standards).

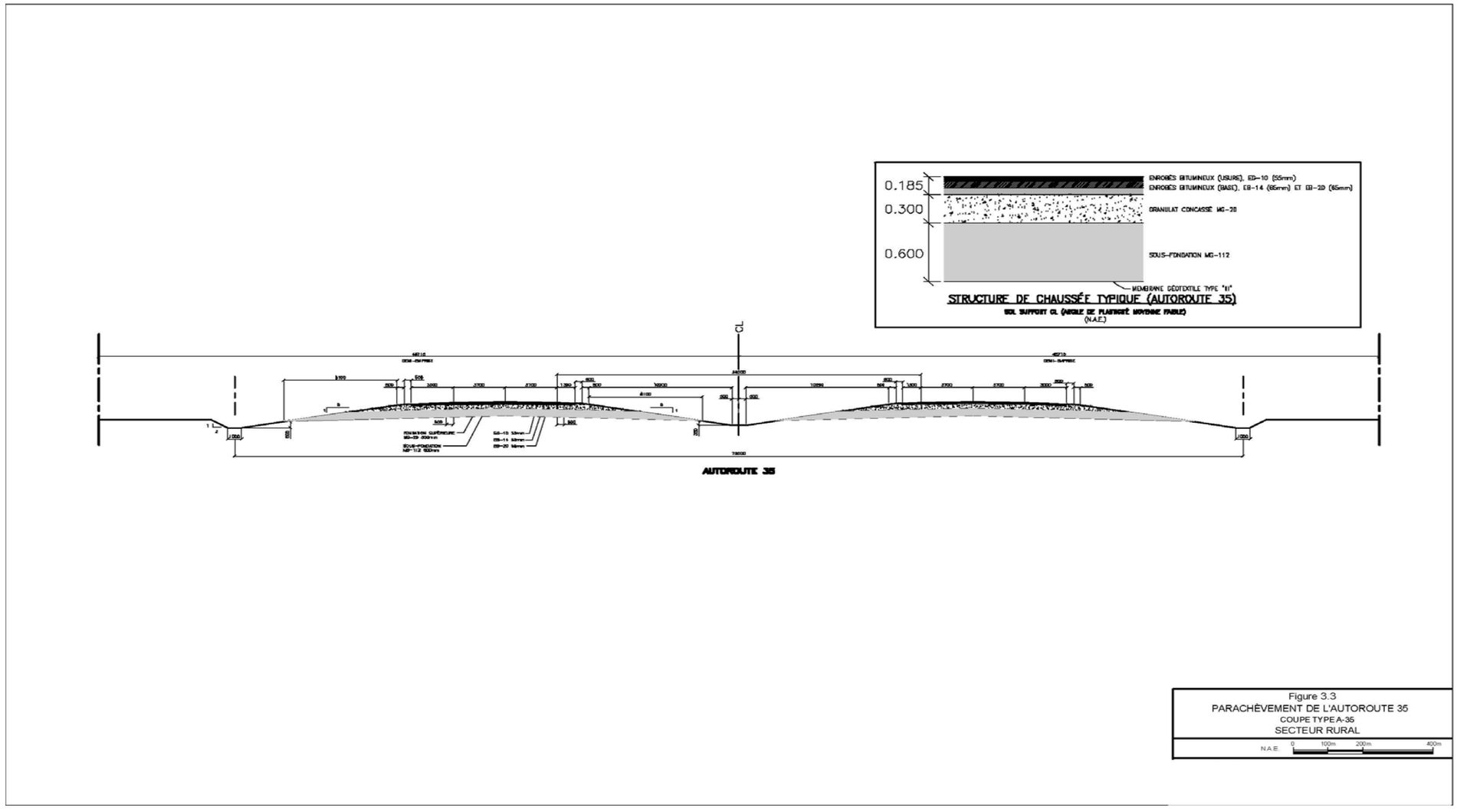
3.4.1.6 Champlain Street

The proposed cross section for Champlain Street is a collector road (road type E) with AADT between 500 and 2,000, consisting of 3.0 m lanes with paved 1.5 m shoulders (standard design 005, Volume 1 of Road Structure Standards). However, because the Highway 35 overpass will curve, and act as the transition between Champlain Street and Highway 133, the width of its lanes and shoulders have been designed to provide better visibility, with 3.5 m lanes and paved 2.5 m shoulders (standard design 003, Volume 1 of Road Structure Standards).

3.4.1.7 Montgomery Street

The proposed cross section for Montgomery Street (Highway 35 overpass) was designed to meet turn clearance requirements, so that (WB-17 type) trucks could make turns in any direction. This necessitates 5.0 m lanes with paved 3.0 m shoulders. A sidewalk is planned solely for the north side of the overpass, to join with the existing sidewalk on Montgomery Street.

Figure 3.3 Standard cross-section – Saint-Armand South Sector



Source : Impact study (Génivar, 2005).

3.4.2 Engineering works and other structures

The Highway 35 project requires the construction of the following 8 engineering works:

- bridge over the Brochets River;
- Highway 133 overpass in Iberville;
- chemin de la Grande-Ligne overpass in Saint-Athanase;
- overpass for the new Highway 227 in Saint-Alexandre;
- Highway 133 overpass in Saint-Sébastien;
- Highway 202 overpass in Venise-en-Québec;
- overpass in Saint-Armand;
- Montgomery Street overpass in Saint-Armand with retaining walls for the foundation of Highway 35.

The above overpasses are designed in compliance with the following documents, itemized in priority sequence:

- les Manuels de conception des structures du MTQ, Volume 1 et 2 [MTQ Structural Design Manuels, Volumes 1 and 2];
- le tome III – "Ouvrages d'art" des normes d'ouvrages routiers du MTQ [volume III – "engineering structures" – of MTQ road structure standards];
- le tome VII – "Matériaux" des normes d'ouvrages routiers du MTQ [volume VII – "materials" – of MTQ road structure standards];
- the Canadian Highway Bridge Design Code CAN/CSA-S6-00.

The constraints listed in the following documents are also taken into account:

- survey of existing geology, summary report of LVM-Fondatec;
- geotechnical study carried out by LES LABORATOIRES SHERMONT INC (2005);
- bathymetric survey of the Brochets River (to be crossed by Highway 35) carried out by MTQ in December 2004;
- vertical bridge clearance over the Brochets River, determined through studies following consultation with Transport Canada (fall 2004);
- "Recommandations pour la conception de traversées de cours d'eau où le libre passage du poisson doit être assuré" [Recommendations for the design of water course crossings where the free passage of fish must be ensured] (Fisheries and Oceans Canada, March 2007)

3.4.2.1 Environmental carrying capacity

Results of bore drilling indicate that the load of the proposed structures could be supported by natural deposits, as described in Section 3 of the Geotechnical Study Report. The natural soil under the footing

blocks must be intact (not remodeled) free of organic matter and protected from frost at all times. These conditions being met, the carrying capacities outlined in the geotechnical study could be used in calculating foundations.

Since the natural soil (predominantly silt) at the proposed level of the culvert rafts is highly sensitive (particularly in the presence of water), a sand or stone dust cushion or a thin layer of concrete will be added to the excavation base (where needed) as a precautionary measure against remodeling.

Future Interchange

The load of future structures could be relayed to the subgrade by conventional footing blocks resting in intact (not remodeled) natural deposits, which must be free from organic matter and protected from frost at all times.

These conditions being met, the capacities outlined in the geotechnical study (which are only preliminary since the location, depth and dimensions of future structures are currently unknown) could be used to study variables. A complete geotechnical study should be carried out prior to the final structural design.

Water table

Considering the high water table level (average of 1.6 metres in depth) and because the work will be carried out near watercourses, outfalls or drainage ditches, it is highly probable that there will be seepage into the excavations. This water, as well as all precipitation and run-off water, must be drained in order to maintain sufficient dryness in the excavation during construction.

3.4.2.2 The Brochets River Bridge

A bridge must be built over the Brochets River. Although the river and its banks are not designated protected areas, they are nevertheless environmentally sensitive. Steps must be taken to protect them and/or mitigate the project's impact.

The initial design included the construction of a symmetrical bridge, aligned with the river's centre line, consisting of three continuous spans of 67.3 m, 66 m and 67.3 m in length, for a total length of 222.6 m. According to this initial design, the two exterior spans were supported at the banks by abutments, made of lightweight embankments, and by piers located outside the primary riverbed supporting the central span. This design kept the footings under the high water mark (HWM), allowing for the largest possible through-flow area, and encouraging the movement of wildlife through the current natural river corridor. Following discussions with federal responsible authorities, the selected design will be a compromise of the design of the additional span of the bridge that requires the installation of a retaining wall. The approved design, as well as the specific mitigation measures to be applied to minimize the effects on the environment are presented in section 5.2.4.

More precisely, the deck will be 25.15 m wide and will consist of a 0.25 m thick concrete slab resting on seven rust-proof steel beams. The beams will have a width of 3.60 m, which allows for sliding construction. The height of the central span's deck will be 3.85 m, 1/23 of the total. The abutments with be 9.05 m in height and will be filled with lightweight material. The abutments and the two piers will be mounted on two pilings tapered to the rock. Due to the potential for major lateral seismic forces during an earthquake, the piling bases will be fitted with tie rods anchored to the rock in order to prevent any and all uplifting. The piers will be placed out of the stream, at a minimum distance from the bank of 2.0 m, and

will be designed to offset the low height and significant width of the bridge. Each pier will consist of three shafts held up by girders connected to the portal cap beam. The shafts will have a longitudinal batter of 1/20 in order to reduce their thickness. An air draught of at least 6.0 m is required between the annual high water mark and the bottom of the proposed bridge.

With regards to earthquake-resistance, the bridge falls under the category of “rescue bridge“, and must be made to withstand the highest possible degree of seismic force. The bridge will be fully accessible to emergency, security and defense vehicles immediately following a major earthquake. It will be designed to withstand earthquakes with return periods of 475 years.

3.4.2.3 Overpasses

With regards to earthquake resistance, the overpasses fall under the category of “emergency bridge“. In comparison with the highest category (rescue bridges), the CAN/CSA-S6-00 standard specifies that an emergency bridge must, at the very least, remain open for emergency vehicles and for defense and security purposes immediately following an earthquake.

Choice of structure type

Primarily, two design types have been chosen for the construction of overpasses: a mixed steel-concrete deck and a post-tensioned ribbed concrete deck.

In general, the mixed steel-concrete deck is recommended for locations where the skew and/or the span is very large. This is the case for the overpasses in Iberville (Highway 133) and Saint-Armand Nord (Highway 133 – Champlain Street). The post-tensioned ribbed concrete deck is proposed for the other sites, where the span is average (< 40 m) and where the skew is negligible.

The latter type of deck is chosen for several of the structures since it is durable and economical, and because the construction sites where this type of deck is proposed are conducive to the use of strutting. This is a heavier type of deck however, with resulting higher degrees of strain under seismic stress. This could be detrimental depending on the soil conditions at any given construction site. The use of post-tensioned ribbed concrete decks should therefore be re-evaluated at the final design stage, on a site-by-site basis, based on conclusions obtained during the geotechnical study.

Foundations

A pedological study based on available data (such as the one carried out for the Brochets River Bridge) served as the basis to establish preliminary foundation unit designs. However, the data from this study is incomplete, and must be refined prior to finalizing the design.

Currently, it is assumed that all foundation units (abutments and piers) will rest on 10 m pilings driven into the rock. This hypothesis was validated by drill hole trials and detailed geotechnical studies carried out at each construction site.

Site Integration

Since all of these bridges are conventional structures, their appearance could be improved through the design of the central piers and the approved walls. The same texture could be applied to the abutments' back walls and face-walls, to assure a harmonious transition between these structures and the elements of the approved walls.

3.4.2.4 Related construction work

In addition to construction related to road infrastructure and engineering structures, the Highway 35 project also involves building a highway inspection station, redeveloping collector roads and opening and operating quarries and sand pits. Those responsible for each of these infrastructure elements have met on-site, and the siting strategy of these structures has been finalized in accordance with applicable operational regulations.

Highway inspection station

The highway inspection station must be located as close as possible to the Canada-US border (maximum 4 km), on the north-bound side, and must allow for the eventual installation of a Weigh-In-Motion system (WIM) on the roadway to the right of Highway 35. Such a system (not currently proposed but not excluded in the long term), must be built in a location where trucks can maintain a consistent speed, excluding the initial kilometers set aside for the station's location.

The first potential site is located between 4 and 5 kilometres from the border crossing, between km 33 and 34. Although there is an off-ramp prior to the proposed highway inspection station (at the south Saint-Armand interchange), this is acceptable according to inspection station personnel. This site presents few environmental constraints since it is located outside of protected farmland. In terms of technical feasibility, the terrain is relatively flat and is located on a sector on the highway offering good visibility.

Redevelopment of collector roads

The proposed redevelopment of main roads, regional roads and collector or local roads as part of the Highway 35 completion project are presented below.

Iberville Boulevard

The current intersection of Iberville Boulevard and Highway 133 in Saint-Athanase will be reconfigured as an urban intersection with 90 degree approaches and traffic lights. The westward portion of Iberville Boulevard that joins Highway 133 (with a tapered type entrance) will end in a cul-de-sac.

Chemin de la Grande-Ligne

Due to the construction of an overpass on Chemin de la Grande-Ligne over Highway 35A, a section of approximately 700 m must be rebuilt. Considering this reconfiguration, and for security reasons, a new T-intersection is recommended with the 3rd row at the first curve east of the new overpass.

Saint-Alexandre Interchange

The Saint-Alexandre interchange has been designed to minimize encroachment on farmland. A diamond-shaped interchange will be built at the crossing of Highway 227, which will maintain its current route. On the west side of Highway 35, Montée Lacroix will end in a cul-de-sac, while on the east side it will be joined to Montée de la Station.

Other collector roads

- 900 metres of Highway 133 at the Saint-Sebastien interchange will be rebuilt with a newly designed geometric configuration, where a left-turn lane will be added to provide access to the highway ramps, so drivers can cross Highway 35.
- 750 m of Highway 202 in Venise-en-Québec will be rebuilt so drivers can cross Highway 35.
- Currently, Highway 133 in Saint-Armand Nord begins as a section of four adjoining lanes in the Saint-Pierre-de-Véronne-à-Pike-River sector, and changes at Champlain Street to a divided highway stretching to the border and leading to the village of Pilipsburg. The project will modify this geometry since Highway 133 will now end at the intersection of Highway 35 with on-ramps and off-ramps. Champlain Street will provide access to the village of Pilipsburg via the geometric continuity of Highway 133.
- South Street will be extended as a local road up to Frères des Écoles Chrétiennes college, providing border crossing access to authorized vehicles only.

3.4.2.5 Opening and operation of pits and quarries

In order to meet the requirements of the MTQ, the highway's construction will require a large amount of aggregate material). Although engineering details have not yet been finalized, the MTQ estimates that approximately 2,350,000 metric tons (MT) of aggregate 112 (0-112 mm in diameter), and 1,100,000 T of aggregate 20 (0-20 mm in diameter) will be needed. The MTQ, or its authorized agent, must conform to the provincial Regulation respecting pits and quarries, and must obtain the necessary authorizations to open new quarries.

3.4.3 Technical constraints associated with the project

Existing aboveground and underground utilities that intersect or run alongside the proposed Highway 35 may have to be relocated.

3.4.3.1 Aboveground Network

The following aboveground network lines could potentially conflict with the completion of Highway 35 and should be considered for relocation:

- Chemin de la Grande-Ligne: south side power lines, including Hydro-Québec (low voltage), Bell Canada and Vidéotron;
- Highway 35 (at km 0.8): Hydro-Québec power lines that intersect;
- Highway 35 (at km 7.8): Hydro-Québec power lines (120 kV) that intersect Highway 35;
- New Highway 227: Intersection of power lines including Hydro-Québec (low voltage) and Bell Canada close to existing Chemin de la Grande-Ligne (west side);
- Existing Highway 227: west side power lines including Hydro-Québec (low voltage) and Bell Canada that will be relocated because this portion of Highway 227 will no longer intersect Highway 35;
- Montée de la Station: south side power lines including Hydro-Québec (low voltage) and Bell Canada, that will be relocated because this portion of Montée de la Station will end in a cul-de-sac and no longer intersect H-35;
- Highway 35 (at km 22.9): Hydro-Québec power lines (120 kV) that intersect with Highway 35;

- Highway 133 at Saint-Sébastien interchange: south side power lines, including Hydro-Québec (low voltage) and Bell Canada;
- Highway 202: Hydro-Québec (low voltage) power lines (north side);
- Highway 35 (at km 30.6): Hydro-Québec power lines (low voltage) that intersect Highway 35;
- Highway 133 at interchange Saint-Armand North: power lines along the west side of Highway 133, including Hydro-Québec (low voltage) and Bell Canada. This line intersects the proposed Saint-Armand North interchange north east quadrant ramps. Also, this line runs along the edge of the right-of-way of Highway 133 until the U.S. border. This interchange will be relocated to the end of the on ramp of the southwest quadrant of Highway 35;
- Champlain Street: South side power lines, including Hydro-Québec (low voltage) and Bell Canada.

3.4.3.2 Gaz Métropolitain

Gaz Métropolitain has a pipeline that runs along the west side of Highway 35 in the Saint-Alexandre interchange area, and crosses the proposed Highway 35 along the relocated Highway 227. The current placement of the gas pipeline, which should be reviewed, is 625m in length, in the areas where the pipeline no longer crosses the proposed roadways at the right depth or at a 90 degree angle. The pipeline along the existing Highway 227 should also be considered for relocation.

3.4.3.3 TransCanada PipeLines

A TransCanada PipeLines gas pipeline overlaps Highway 35 in some areas. This pipeline was built in the 1960s before MTQ's preferred alignment for Highway 35 and the interchanges was established. Also, the pipeline will be relocated in two places: on the north side of the Brochets River Bridge and between the Saint-Alexandre and Saint-Sébastien interchanges.

3.4.4 Alignment optimization

During the comparative analysis of alternatives summarized in section 3.2.3 that helped identify the preferred alignment, select and finalize configuration of the interchanges and determine environmental monitoring measures, the Department applied the principles of adaptive management (maintenance no net loss and rehabilitation) regarding wetlands, the use of road salts and the application of the precautionary principle. The main advantages and disadvantages of each of the alternatives studied, in particular to the right of the Brochets River and Barbotte Creek, are presented in detail in section 5.

It should be noted that in the designing of the alignment alternatives for the Brochets River crossing, the Department outright rejected the preferred alignment, designed in the 1970s, that crossed the wetlands of the swamp forest, thereby contributing to habitat conservation and maintaining the biodiversity of this exceptional natural ecosystem.

As part of this project's impact study (Genivar, 2005), the MTQ designed and compared many alignment alternatives while considering the environmental issues identified by each alternative. For example, the development of an alternative with a proposed crossing of the Brochets River north of Highway 202, thereby avoiding the wetlands of the swamp forest, is a reflection of the Department's effort to adhere to the principles of maintenance, no net loss and rehabilitation, recommended by the Federal Policy on Wetland Conservation, with regard to fragile ecosystems in this area.

There were provincial public hearings on the Highway 35 completion project held from November 15 to December 15, 2005. The Bureau d'audiences publiques sur l'environnement (BAPE) [public environmental hearings office], tasked to review this project, filed its report on March 14, 2006, and this was made public on May 12, 2006.

Following the BAPE public hearings and the filing of the survey report in March 2006, MTQ made some modifications to the project to include some of the observations and opinions raised in the BAPE hearings by the public (MTQ, 2006.)

The modifications made to the alignment were in the following areas:

- constructing a diamond-shaped interchange at Highway 227 in Saint-Alexandre and keeping Highway 227 as an access road to the town;
- constructing a diamond-shaped interchange at Highway 133;
- reducing the roadways in the flood plain area;
- acquiring a right of way with a maximum width of 75m in the flood plain;
- constructing an agricultural viaduct in the middle of the flood plain to improve access to areas between the highway and the swamp forest;
- abandoning the rest stop project under its current form (but keeping the highway inspection station);
- maintaining the current maximum width of the right-of-way in the Philipsburg area.

Figures 3.4 to 3.7 show the different modifications made to minimize the effects of the project on the natural and agricultural environments.

The federal environmental assessment resulted in additional minor improvements to the alignment. These improvements include specific mitigation measures that address some components under federal jurisdiction that are presented in detail in section 5.0.

Figure 3.4 Segment 1 of the preferred alignment: from Saint-Jean-sur-Richelieu (Iberville area) to Saint-Alexandre (Highway 227)

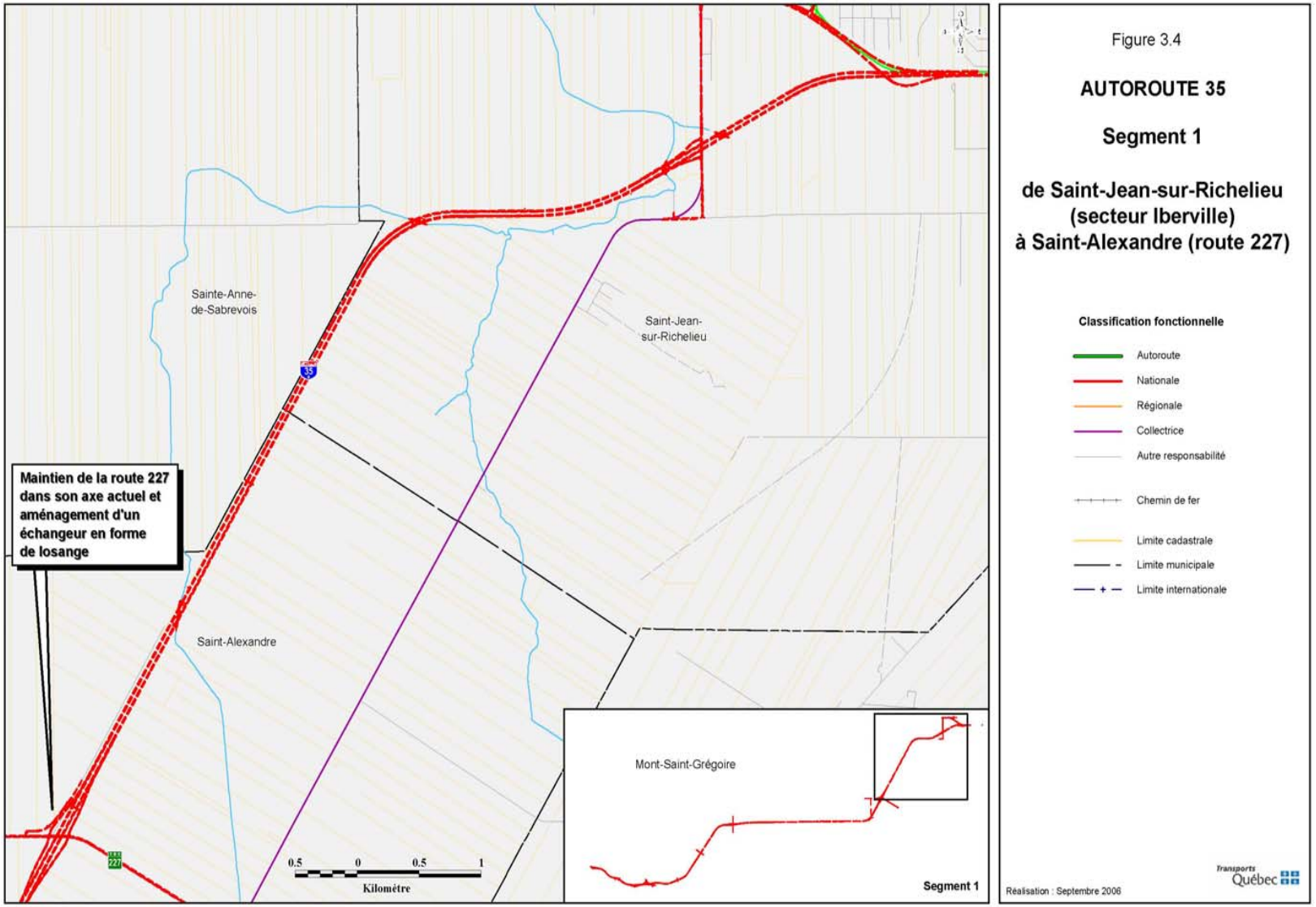


Figure 3.5 Segment 2 of the preferred alignment: from Saint-Alexandre (Highway 227) to Saint-Sébastien

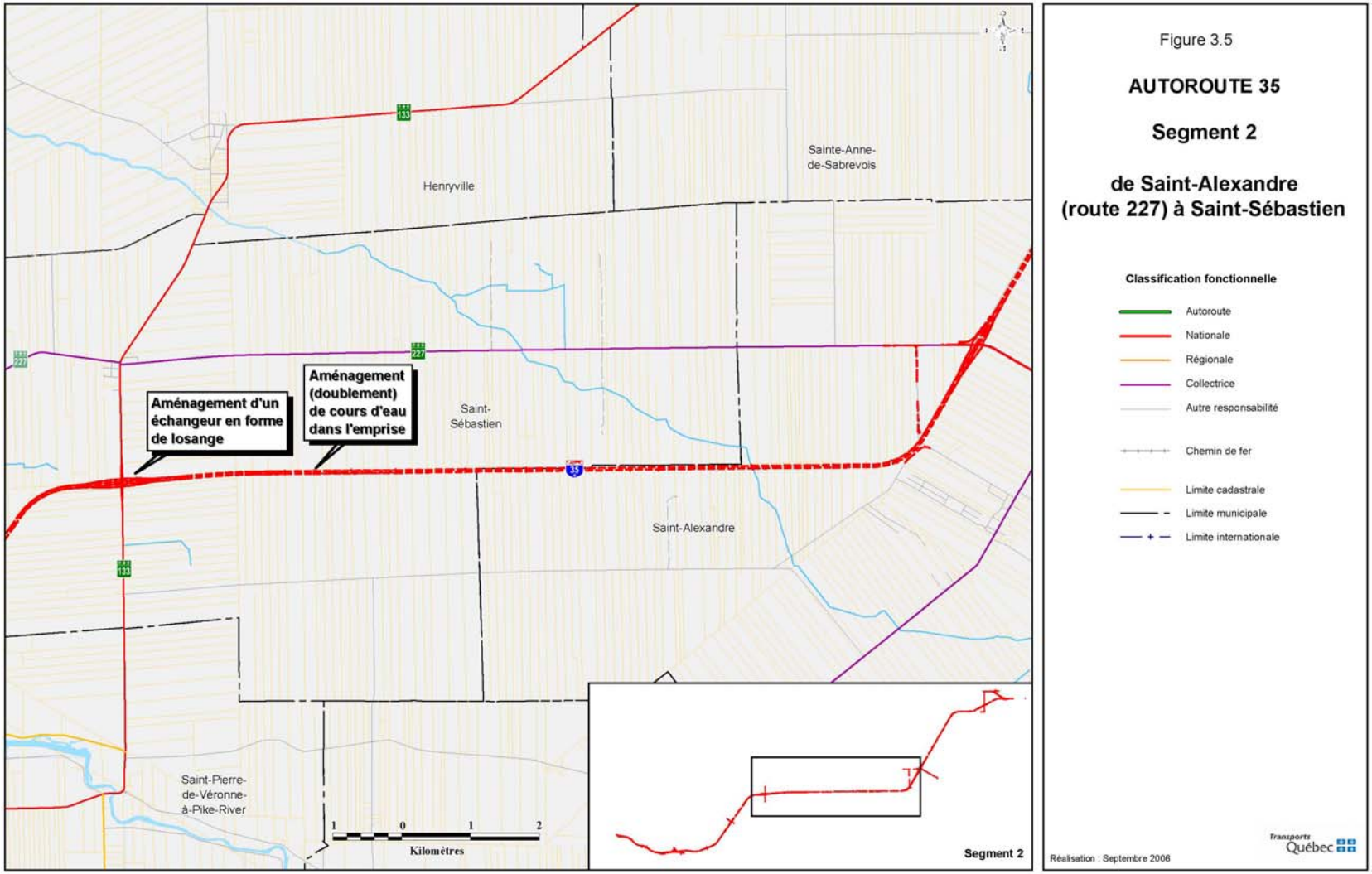


Figure 3.6 Segment 3 of the preferred alignment: from Saint-Sébastien to Saint-Armand

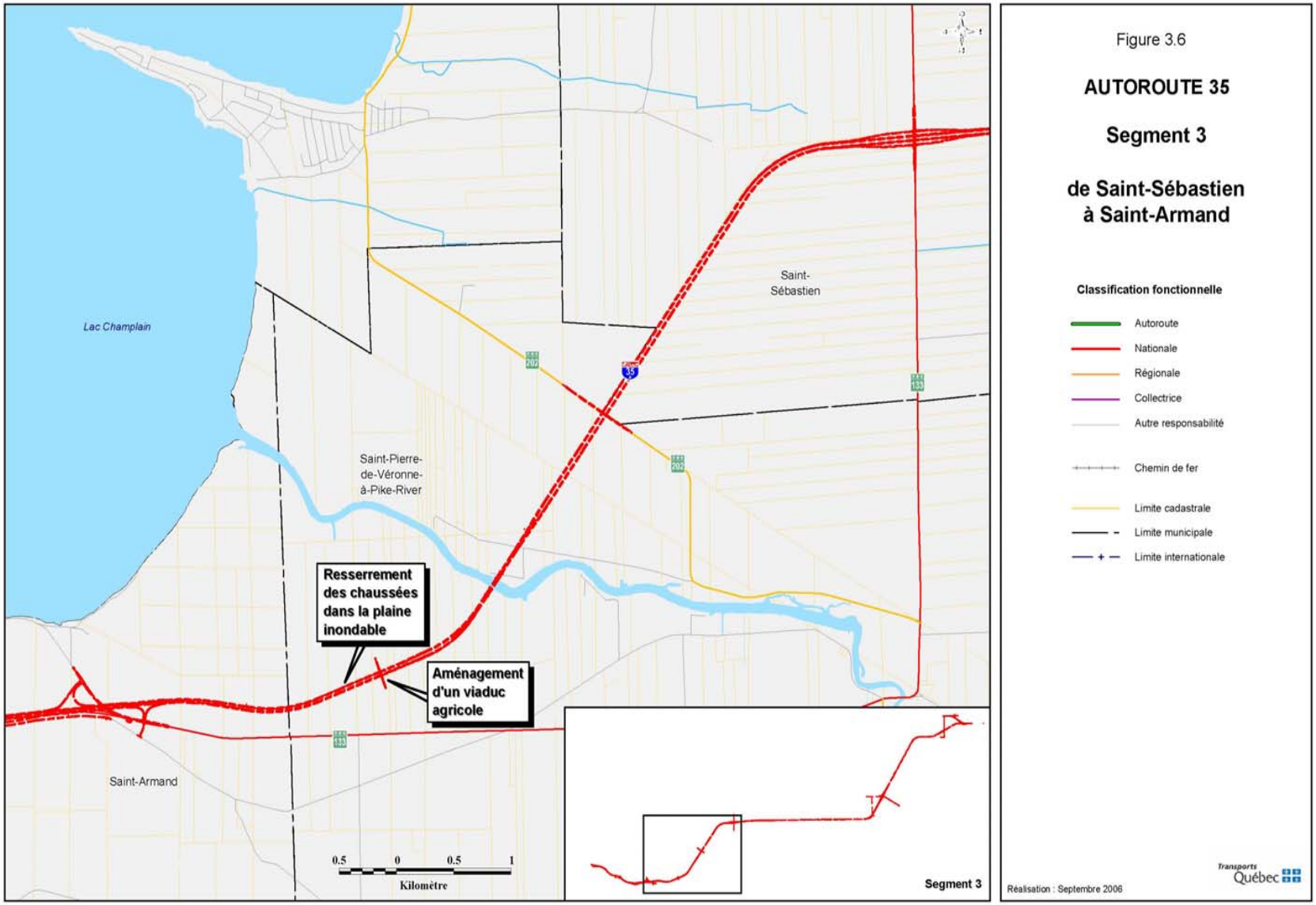
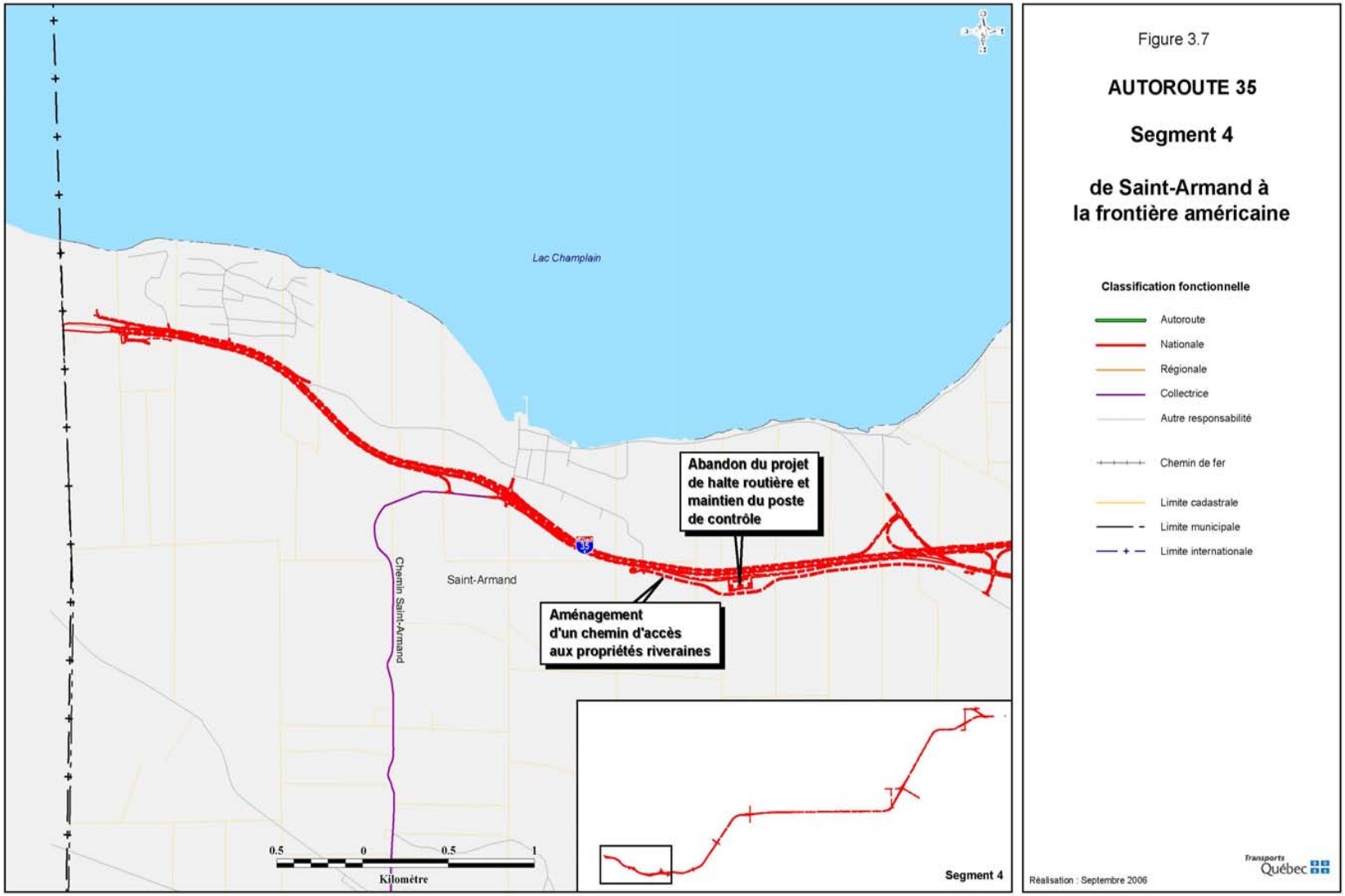


Figure 3.7 Segment 4 of the preferred alignment: from Saint-Armand to the U.S. border



3.5 Construction Activities

The main construction activities required to complete Highway 35 that will likely have the greatest impact on the receiving environment are:

- Access road construction;
- Site facilities development;
- Provision for vehicle and machinery traffic at the site;
- Tree felling;
- Excavation and earthworks;
- Boring and blasting;
- Highway and related infrastructure construction;
- Relocation of utilities infrastructure;
- Shore and aquatic environment work;
- Redevelopment and cleaning up of work areas;

The building construction environmental protection provisions that should be respected by various contractors in charge of the completion of Highway 35 are presented in detail in section 3.9.

3.6 Signage and traffic maintenance

Maintaining and managing traffic during a road construction project are key factors to the success of a project to ensure adequate service to the public, business owners and road network users. Sound management also ensures that the contractor has adequate space to work and ensures the quality of the work performed.

The Highway 35 completion project is located in a mostly rural area and affects few densely populated areas or high-traffic urban infrastructures. However, some areas, where traffic needs to be maintained during the work, should be considered in this study:

- the link between the existing Highway 133 and the extension of Highway 35 towards the south;
- the construction of overpass bridges on the following roadways: Chemin de la Grande-Ligne, Highway 227, Highway 133, Highway 202, Champlain Street and Montgomery Street;
- bringing up to code the existing section of two roadways between Saint-Armand North and the border (last 5km);
- the construction of the Saint-Alexandre interchange and the impact on Montée Lacroix and Montée de la Station;
- the construction of the Saint-Armand South interchange with moderate depression.

In general, considering the traffic flows on the road network that are part of the study, the maintenance of a traffic lane by direction at all times is sufficient for all work areas. An existing traffic lane could be used or a new one could be built specifically as a traffic maintenance measure.

3.7 Completion Schedule

Construction activities for Highway 35 will be developed and completed over many years. A preliminary completion scenario has been developed based on the following assumptions:

- two years are required, after obtaining the necessary approvals, before acquiring all the areas and the relocation of public utilities. Therefore, the first proposed construction sites are those that involve few to no acquisitions and few public utilities to relocate or other issues;
- this scenario was designed to give road users progressively more highway kilometres each year.

Table 3.3 identifies the completion steps by indicating the length of the segment that will be built, the major engineering works that will be completed as well as the completion schedule. Overall, the construction of each segment will be done over two years. According to this schedule, the work is expected to be completed by the end of 2013 but the first two segments will be open to road users by the end of 2011.

Table 3.3 Completion schedule

Segment	Length (km)	Works*	Years
1	11	• Highway 133 overpass • Grande Ligne overpass	2009 to 2011
2	12.7	• Saint-Alexandre overpass • Highway 133 overpass	2008 to 2011
3	9.1	• Highway 202 overpass • Brochets River Bridge • Saint-Armand Nord overpass	2012 to 2013
4	5	• Saint-Armand Sud overpass • Relocation of the customs area • Access roads to shoreline properties • Inspection station	2011 to 2012

3.8 Maintenance and operation procedures

Maintenance activities essentially involve road de-icing and snow removal, vegetation control on rights-of-way, and maintenance of overpasses, viaducts and the roadway itself.

3.8.1 Snow removal and use of road salts

Snow removal will be done according to the measures currently used for rural and urban sections of the MTQ network, such as pushing the snow past the highway platform, within the limits of the right-of-way. There are no specific measures when it comes to clearing the snow off the new highway.

With regard to road salt management, the proponent undertakes to abide by the new “Road Salts Code of Practice” published by Environment Canada (2004.) The main objective of this is plan is ensure environmental protection while also ensuring the necessary conditions for road safety.

Also, to ensure sound management of road salts, the MTQ chose to focus on a collaborative approach between its various partners and develop a *Plan québécois de gestion environementale des sels de voirie* [Quebec environmental salt management plan] that can serve as a model for all road salt managers in the province. This plan is based on Environment Canada's Code of Practice for the Environmental Management of Road Salts (2004), Transportation Association of Canada’s Syntheses of Best Practices

(TAC, 2003), the knowledge and experience of MTQ with regard to winter road maintenance and the internationally recognized work they have done.

All road authorities in Quebec must use this plan as a basis for drafting, adopting and carrying out their own salt management plan. Each plan must be developed across the area covered by the managing unit and under each division of the MTQ.

The following measures are among those that will be put in place by MTQ and that should be included in the Quebec environmental salt management plan:

- remove snow contaminated by road salts;
- apply the right amount of salt to the right areas at the right time (use the most recent advancements in the application of winter maintenance anti-icing and de-icing materials);
- foster a natural filtration of drainage water via the infrastructure ditches (ecological ditch maintenance);
- use technologies that further optimize the use of road salts;
- use environmentally, technically and economically feasible alternatives to road salts;
- locate patrol yards and snow disposal sites outside of vulnerable areas;
- cover salt piles and blended sand-salt piles;
- use handling practices that prevent uncontrolled releases;
- collect and treat wash water;
- train personnel and monitor the effectiveness of road salt application techniques;
- develop intervention procedures that can be applied in case of salt runoff that could have a negative impact on the environment.

3.8.2 Ecological vegetation management

Throughout the new highway, the Department will promote, as mentioned in the environmental impact study, ecological vegetation management. This new approach, which consists essentially of letting the local vegetation develop, is unlike the traditional maintenance method that promotes the systematic clipping of vegetation in the area around the highways, all the way to the channels and sometimes up to the edge of the right-of-way. With regard to the highway's drainage ditches, this approach includes the removal of vegetation only at the end of the ditch while leaving the plants that cover the walls in place (maintenance method for the lower third section). The ditches covered in vegetation help reduce the amount of sediment reaching the natural water bodies (apart from suspended matter), reduce, through better filtration, the pollutant load of drainage water, including road salts, and reduce the speed of water drainage in the ditches and increase the buffering capacity of the ditch network with regard to possible flooding downstream.

For the banked edges, above the lower third section of the highway's right-of-way, the growth of woody plants, shrubs and trees is acceptable, according to the type of environment in question, in order to further integrate highway infrastructure into the receiving environment.

All the watercourses that have been identified as fish habitats (section 5.2.4), as well as the fish habitats that will be restored, should not be maintained and any nearby vegetation should be conserved.

3.8.3 Maintenance of roadways or structures

The maintenance of structures that will be built throughout the project will be done over the years, using the measures recommended for the entire MTQ road network. The roadways will be regularly maintained to ensure a safe surface for Highway 35 users.

3.9 Mitigation measures integrated in the project

A series of ongoing mitigation measures will be integrated in the project and applied to reduce negative impacts from the construction and operation associated with highway construction work. These measures can be found in the MTQ's *Cahier des charges et devis généraux* [general specifications] or in the *Cahier des clauses générales* [general conditions of contract], in section 10.4 and in the *Normes de construction du MTQ* [MTQ's 2003 standards for construction.]

All the ongoing measures that will be implemented for the Highway 35 completion project are outlined by theme below. They apply to all sections of the highway in the study and to the related construction work and collector roads affected.

The specific mitigation measures that apply to particular areas along the projected alignment are presented in section 5. All of these measures are considered in the project's residual impact evaluation.

3.9.1 Contingency plan

- Anticipate a contingency plan for the work period:
    - Determine the dangers as well as the protection measures and expected responses in case of incident;
    - Provide contact information for the people in charge, on the construction site and in other areas (see section 6.0 of this report.).

3.9.2 Traffic and road safety

- provide information to the local news media on the changes to the road network as well as the location, dates and schedules of the construction sites;
- maintain the free flow of vehicle traffic and install adequate signage to ensure the safety of road users at all times;
- install proper signage on relocated sections;
- evaluate the functionality of the riverside roads and maintain their accessibility during the junction work with the highway that is being constructed or relocated and replace the signage;
- clean up the highways being used by machinery and transport vehicles in order to remove any accumulated debris throughout the duration of the work.

3.9.3 Protection of ambient air quality

- Use dust suppressants as needed to avoid fine particles in the ambient air. The suppressants must comply with Quebec standard NQ 2410-0300 *Abat-poussière pour routes non pavées et autres surfaces similaires* [dust suppressants for unpaved roads and other similar surfaces], or must be approved by the MDDEP.
- Avoid use of salt solutions near sensitive areas (wetlands, watercourses, etc.).

Other measures will be applied to limit impacts on air quality, including not only particles but also exhaust gases:

- See that all pollution control systems in vehicles and equipment are operational and comply with provincial regulations on air quality;
- Avoid idling when trucks are waiting, in order to limit exhaust gases;
- Use a route away from residential areas for transporting excavated and fill material and the like, in order to limit dust, exhaust and noise;
- Cover truckloads of loose material with securely anchored tarpaulins during transportation;
- Prohibit burning of waste at construction sites.

3.9.4 Construction site facilities and access roads

- Build temporary roads and access points in the right-of-way of the future highway;
- Locate access roads, parking areas, and areas set aside for activities that may impair environmental quality (storage and handling of oil or other dangerous goods, cleaning and maintenance of equipment, etc.) at least 60 m from any permanent water course and at least 30 m from any intermittent water course;
- Recover stripped materials that have been set aside during construction of access roads off the right-of-way so as to be able to re-use them when the access roads are redeveloped;
- Have site supervisor approve location of areas set aside for activities that may impair environmental quality (storage of oil or other dangerous goods, cleaning and maintenance of equipment, recovery of dangerous wastes, etc.).

3.9.5 Movement of construction equipment and vehicles

- Limit movement of construction vehicles and equipment to marked access roads and work areas, avoiding areas with low load-bearing capacity and those with slopes over 30 degrees;
- Prohibit movement of heavy machinery outside the right-of-way and in areas that are to remain forested;
- Keep shoreline transitional strip intact by prohibiting movement of construction equipment within 30 m of a permanent water course and within 5 m of an intermittent water course. Prohibit mobile equipment from entering water courses;
- Outside the right-of-way, regularly flatten ruts so as not to impede the flow of surface runoff. Scarify compacted soil to a depth of at least 15 cm in order to break it up and facilitate regeneration of plants.

3.9.6 Tree felling and protection of vegetation

- Keep tree felling to a minimum, especially at the sides of water courses and water bodies, and preserve a 20 metre strip along water courses and lakes when possible;
- Avoid removing trees and brush from the nesting habitats of migratory birds during the breeding

season (May 1 to August 15 for forest bird habitats; early April to mid-June for waterfowl habitats);

- Signpost areas where trees are to be felled with proper visual markers and show the boundaries of these areas on the construction plans;
- Protect trees situated outside these boundaries. If necessary, install tree protectors and protect the root systems of trees and shrubs;
- Set aside the surface layer of topsoil, the stumps and the roots and pile them up at a distance of more than 20 m from a water course for future use, for example for replanting on fill work or on abandoned stretches of the existing highway;
- Fell trees in a manner that does not damage the forest edge and avoids letting trees fall outside the boundaries of the tree felling area or into a water course. If necessary, the contractor responsible for tree felling shall be required to clean up the watercourse and remove residues of tree felling to a location outside the riparian strip;
- Do selective cutting in the 3-metre transitional strip at the side of the right-of-way so as to remove dead or diseased trees and avoid a situation where mature trees will fall;
- Take unusable materials or debris from tree felling work to a disposal site that has been authorized by the MDDEP;
- Strip top soil in erosion-prone locations immediately before grading in order to avoid exposing the soil to erosive forces for a long period;
- Prohibit fording of a watercourse without formal approval of DFO; the contractor responsible for tree felling must use existing bridges and culverts;
- As work proceeds, divert any ruts within 20 m of watercourses;
- Recover trees of merchantable size before work begins.

3.9.7 Visual environment

- Plan regrading work in such a way that the profile of the new road is in harmony with the natural forms of the surrounding landscape: embankments should have shallow slopes and the route should follow the relief;
- Plan laying of topsoil and seeding on all ground which has been disturbed;
- Plant trees on embankments extending more than 12 m from the roadway, taking care to vary the edge of the treed area in order to achieve visual integration;
- Replant with species of trees and shrubs which have a stabilizing effect, match the mix of existing species at the location, are suited to the soil type and moisture content, and are resistant to salt spray;
- Mark out at sites the boundaries of areas where trees will be felled and plan measures to protect treed areas before work begins;
- Create a transition strip extending 3 metres from the right-of-way in order to avoid mature trees falling on the road, in addition to a strip in which trees are cut level with the ground;
- Grade banks and shores, with shallow embankment slopes that are rounded off at the point where they connect with natural banks and shores;
- If necessary, use stabilizers (riprap, geomembrane, etc.);
- Restore stabilized embankments to a natural state by seeding banks and shores and planting shrubs above the high water mark in a varied arrangement so that they are visually integrated, taking care to select species that will stabilize the banks/shores and will match the mix of existing

species at the location;

- Within the right-of-way of the old road, do grading work in harmony with major relief features, with due attention to conditions for plant growth to resume;
- Make slopes shallow and see that they are properly connected to their surroundings;
- Cover ground with sufficient topsoil to enable plant growth to resume; depending on how much topsoil is available, give priority to the ends of stretches of the old road in order to foster growth of trees that will create a screen. Where no topsoil is being applied, use a suitable mix of grasses.
- Create visual screens consisting of hillocks and large plants at the intersection of the new roadway with stretches of the old road, as well as on visually exposed hillsides.

3.9.8 Archaeology

- Make a thorough archaeological inventory (visual inspections plus exploratory soundings) wherever construction work will be done. Evaluate any sites thus discovered that may be directly or indirectly threatened by the work. If necessary, carry out a dig;
- Submit the inventory and any proposed digs through the procedure set out in Quebec's *Cultural Property Act* in order to obtain an archaeological research permit. In accordance with the Act, reports will have to be submitted on the inventory and digs;
- Have the research done by archaeologists reporting to the MTQ before construction work begins. Regardless of the results of the inventory work, inform those in charge at construction sites of their obligation under the Act to report to the prime contractor any fortuitous discovery and if necessary to interrupt work at the location of the discovery until an assessment can be completed by archaeologists.

3.9.9 Use of explosives

- Comply with laws, regulations, federal and provincial orders-in-council and municipal bylaws, and take necessary precautions to protect people and property;
- Do blasting work during the least busy times of day (noon and 5 pm) and advise waterside residents;
- Inspect buildings, works and structures located near the site before work begins;
- Notify waterside residents of timetables for work that may cause damage such as blasting, and take all precautions needed to protect people and property;
- When blasting near residences, monitor carbon monoxide concentrations.

3.9.10 Excavation and grading

- Minimize encroachment of filling work on wetlands, water bodies and water courses;
- Place suitable visual markers at locations where filling work is under way;
- Prevent sediment from entering water through systematic use of geotextiles (depending on the length of the slope, the nature of the soil and the presence of groundwater), filter berms, straw bale filters or settling tanks that must be emptied when half full;
- Use ground protectors (wood fibre matting) and seed lengthy erosion-prone slopes;
- Cover with topsoil, then seed and plant, depending on the specifics of the location;

- Build ditches to limit runoff at the tops of embankments; stabilize the ditches through seeding or use of riprap;
- See that all measures are taken to limit erosion when construction sites are temporarily closed, especially in the autumn;
- Manage excavated materials in conformance with the *Soil Protection and Rehabilitation of Contaminated Sites Policy,* the *Lakeshores, Riverbanks, Littoral Zones and Floodplains Policy* and the *Act respecting the preservation of agricultural land and agricultural activities*;
- Store excavated materials in such a way that mounds are minimally visible, with stable and smooth slopes.

3.9.11 Crossings of watercourses

The routine mitigation measures for the Department's projects, aimed at controlling erosion and protecting water (Standards, Volume 4, Chapter 6), as well as additional mitigation measures required by the DFO, shall be applied during the construction work.

DFO additional measures:

General measures

- Notify DFO as soon as possible of any change in the project (plan, timetable, etc.) or any unexpected impact on fish habitat.
- Observe periods where work in water is restricted.
- Avoid having a quarry, dump or storage site within 20 m of the ordinary high water mark of any water course, and see that they do not negatively impact fish habitats (by bringing in suspended matter, modifying drainage, etc.).
- Prohibit installation of electrical poles below the ordinary high water mark of watercourses. This applies as well to watercourses that will be relocated or will dry up during the project.

Temporary works

- Ensure that water can flow freely at all times and that there is sufficient water for the various fish habitat functions (feeding, spawning, hatching) downstream from the construction area. Take necessary measures to avoid negative impacts (e.g. flooding, land emergence, suspended matter and erosion) both upstream and downstream from the work area.
- Temporary diversion of water courses:
    - Unless otherwise specified, fish must be able to move freely through diversion canals at all times.
    - The bed and banks of the diversion canal must be stabilized with non-erodable riprap and a geomembrane or impermeable membrane at all times.
    - A written description and a plan for temporary works being used for the diversion must be sent to DFO for information, before the diversion work begins. The works in question include, but are not limited to, open-cut or metal/plastic conduit canals, dykes, caissons, cofferdams and temporary culverts.

  - The documents must show that the components of the diversion were designed to withstand floodwaters that may occur during the period of construction, and that they have been stabilized sufficiently to prevent erosion and transportation of sediment downstream.
  - Plans must indicate the locations and dimensions of works as well as the materials used to stabilize banks and the canal. Also provide the length and elevations of the planned canal, widths at the base and top, and depth. All sizes must describe the canal after addition of riprap.

- Use clean granular material (free of fine particles) for cofferdams. Preferably use a membrane or other fine material to achieve impermeability.
- Temporary works must be protected against erosion through stabilization, using for example a geomembrane or riprap. They must also be designed to withstand floodwaters that may occur during the construction period.

Tree felling

- During tree felling, special measures must be applied within 20 m of the Ordinary High Water Mark on either side of water courses;
- Manually cut trees within 20 m of the OHWM and dispose of the trunks, branches and stumps at an authorized site.
- No machinery must move within 20 m of the OHWM unless fording proves necessary.
- Pay special attention to preserving soil integrity.
- Leave stumps, branches and other vegetation, including shrubs, in place until one week before work starts within 20 m of the OHWM.
- Plan soil protection measures (e.g. sediment barriers) when sediment may come in direct contact with a ditch or water course.

Control of erosion and resuspension of sediment

- Maintain in good condition all works that are protecting the environment.
- Take all necessary precautions to prevent transport of fine particulates into the aquatic environment beyond the immediate area of construction work.
- Stabilize all locations that have undergone change, in particular slopes of embankments, and do so as the work progresses. If a delay is necessary for permanent stabilization, erosion control measures must remain in place to prevent erosion and capture any eroded matter.
- Dispose of excavated materials at a site designated for this purpose.
- Do not dump any debris, concrete residues or wet mortar into the aquatic environment. Any debris accidentally entering the aquatic environment must be removed as quickly as possible.
- Do no grading or excavation work near water courses during high water periods or heavy rains.
- Divert drainage ditches toward stable, planted areas over 20 m from the OHWM. If diversion is not possible, potential sediment arriving from structures must be controlled through a system that can prevent leaching.

- Install confinement structure, filtering berms, sedimentation basins or sediment traps in sufficient quantity in work areas to prevent transport of sediment into the water. However such structures must not built outside the work area in fish habitats. Structures must be functional at all times.
- Install ditches to capture runoff water along temporary roads in order to prevent erosion and transport of fine sediment.
- Take all necessary measures to prevent soil erosion when temporarily shutting down a construction site.
- Limit tree felling, soil stripping, excavation and grading of work areas to what is strictly necessary.

Machinery

- Carry out general maintenance and refuelling, as well as handling and storage of oil, at a distance of more than 30 m from the OHWM, and make sure that the risk of contaminating aquatic fauna remains negligible.
- Outside the right-of-way, avoid letting machinery move within 20 m of the OHWM.
- Prohibit fording of watercourses by machinery.
- Restrict vehicles to proposed and clearly identified routes.
- Install an absorbent floating boom for oil in watercourses, downstream from the work area, in a location with a slow current, and in lakes (for work along the shore), for the entire duration of the work.
- Take machinery away from watercourses when it is no longer in use.
- Use clean machinery that is in good operating condition in order to avoid leaks of grease or fuel.
- Take used oil from machinery, as well as waste, to a site designated for that purpose.
- Have on site, and know how to use, equipment for dealing with an accidental spill. In the event of a spill of oil or some other harmful substance, immediately alert Environment Canada (1-866-283-2333) or Quebec's MDDEP (1-866-694-5454).

Blasting

Blasting work must comply with the Guidelines for the Use of Explosives in or near Canadian Fisheries Waters (Can. Tech. Rep. Fish. Aquat Sci. 2107, Wright & Hopky, 1998). Proponents unable to meet the guidelines values must apply for authorization under section 32 of the Fisheries Act, providing the following information:

- The approximate dates on which blasting is planned;
- The theoretical lethal range, i.e. the distance within which overpressure exceeds 100 kPa (according to the equations in Appendix II of the above-mentioned document);
- The number of blasts, the type of explosive to be used, the total weight of the explosives, the weight of individual shots / weight per delay, charges / hole, shot pattern, detonation depth, method of detonation, etc.;
- Potential impacts of blasting on fish habitat and on the particular species present;
- Mitigation measures planned to reduce impacts on fish habitiat and on the particular species present;
- Anticipated residual effects and force of these on fish habitats and species present;

- Safety, storage and emergency plan for explosives.

Site restoration

- Restore ditches damaged by machinery (damage to gradient, shoulders of embankments, etc.).
- Restore banks using recognized techniques of stabilization through planting, taking into account stability, propensity to erosion, slope and height of embankment. Replanting must be done as soon as possible after grading work is complete, with preference given to indigenous species.
- Restore diversion canal to original state after filling it in.
- Limit riprip on banks of watercourses to the ordinary high water mark and replant starting at the edge of the riprip, which shall be composed of clean stones free of fine materials.
- Restore banks and bed of watercourses to original state (particle sizes, bed profile, etc.) after temporary structures have been dismantled.

Operation of road

- Place pits to capture fine sediment along drainage ditches in order to avoid impacts on fish habitats. Sedimentation pits must be functional at all times.
- Limit maintenance of drainage ditches to excavation of their lower third in order to maintain stability of replanted slopes.

In addition, the specific mitigation measures described in section 5.2.4 of the report will be used at certain water crossings to control impacts on fish habitat.

3.9.12 Accidental contaminant spills

- Lubricate, fill up, clean and empty oil from vehicles and machinery in locations set aside for this purpose over 60 m from water courses;
- See that machinery is in good condition, clean and free of leakages of oil or other contaminants;
- At work sites, have emergency kits on hand at all times (absorbent tubes and cotton, impermeable containers, sumps, etc.) as well as the personnel to immediately confine any accidental spill of contaminants
- Have an emergency plan in case of an accidental spill of contaminants. Post a sign within view of workers that describes emergency structures and lists the names and telephone numbers of those in charge.

3.9.13 Residual land and stretches of old road no longer in use

- Scarify and reprofile the ground to give it a more natural topography;
- Eliminate culverts, re-establish natural drainage and restore banks, making sure that sediment does not enter the water;
- Lay topsoil to help restore natural state;
- Plant residual land and stretches of old road no longer in use with commercial species, and check that natural seeding returns quickly and is maintained.

3.9.14 Restore sites

- Restore sites as soon as the work is complete, so that interference with private or public property is as brief as possible;
- Remove all debris and unused materials;
- Clean ditches and water courses.

3.9.15 Winter road maintenance

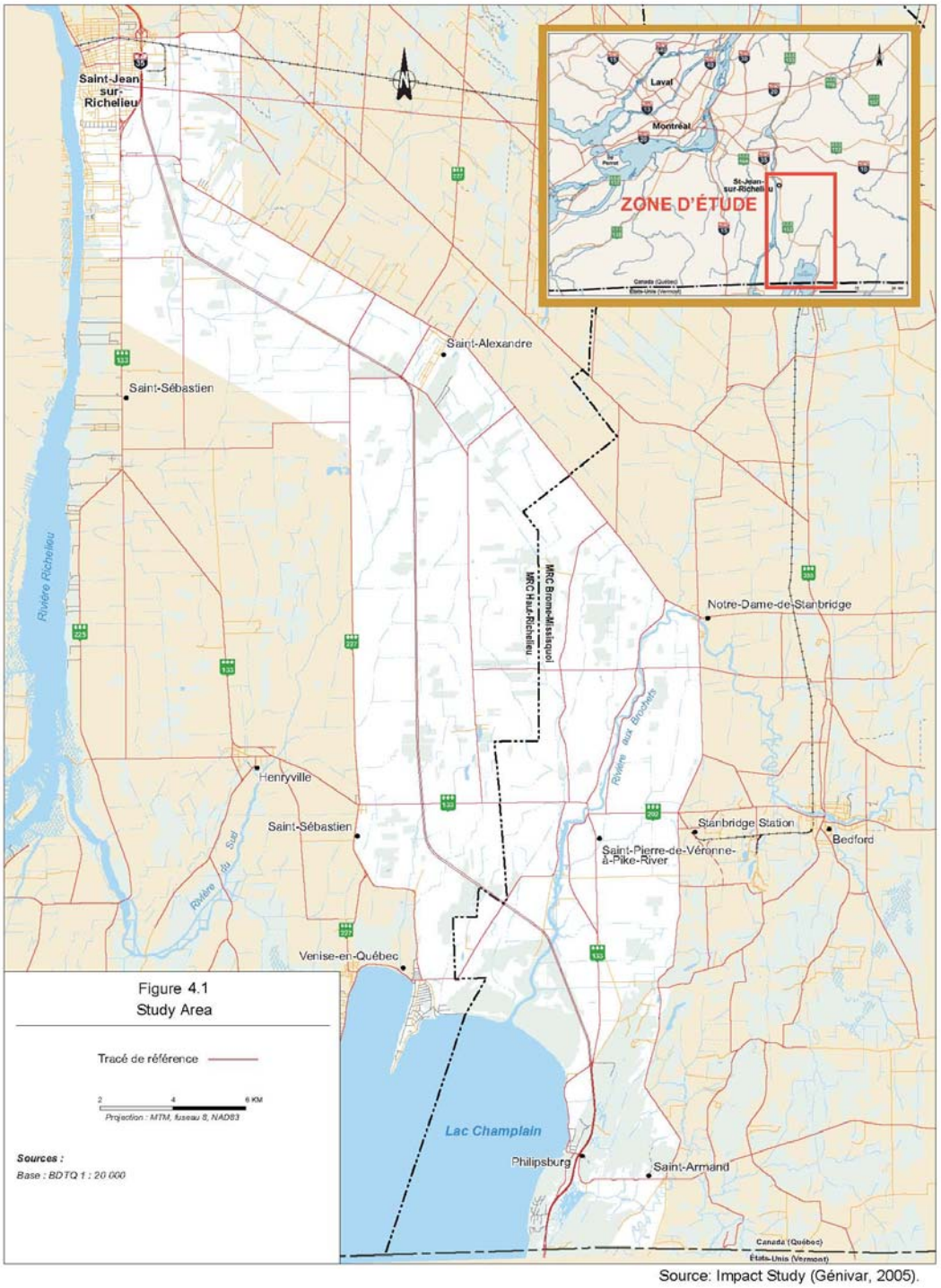
- Direct water into ditches and the drainage network to avoid an accumulation of salt and thus the formation of salty puddles in poorly drained areas;
- Establish at suitable locations metal sumps with laterals to collect water and salt which will then infiltrate the soil;
- If necessary install one or more tanks to capture fine sediment (sands) in ditches downstream from the drainage network before the natural hydrological system is affected, so as to avoid disturbing fish habitats and in particular to avoid silting up spawning grounds;
- Regularly empty sumps when they are half full and make them accessible at all times.

4 ENVIRONMENTAL ASSESSMENT METHODOLOGY

4.1 Description of study area

The study area for purposes of the comprehensive study is bounded to the north by Highway 104 in the Iberville portion of Saint-Jean-sur-Richelieu, to the west by the Richelieu River, Highway 133 and Highway 227, to the east by the border between the 3rd and 4th concession lines (Bleury), chemin de la Grande-Ligne, rang Saint-Henri and chemin Bradley, and to the south by the U.S. border. These boundaries, based on local knowledge, were set with a view to developing variants on the MTQ's reference route that would be acceptable environmentally and technically feasible.

Figure 4.1 Study area



Source: Impact Study (Génivar, 2005).

4.2 General approach

The proposed general approach to identifying and determining the significance of environmental impacts is based principally on the federal approach, but also on lessons learned from environmental impact and monitoring studies related to earlier road construction projects, which are highly relevant to determining the nature and extent of certain impacts that tend to recur from one project to another, as well as the actual effectiveness of certain mitigation and compensation measures (Figure 4.2).

The approach starts out from:

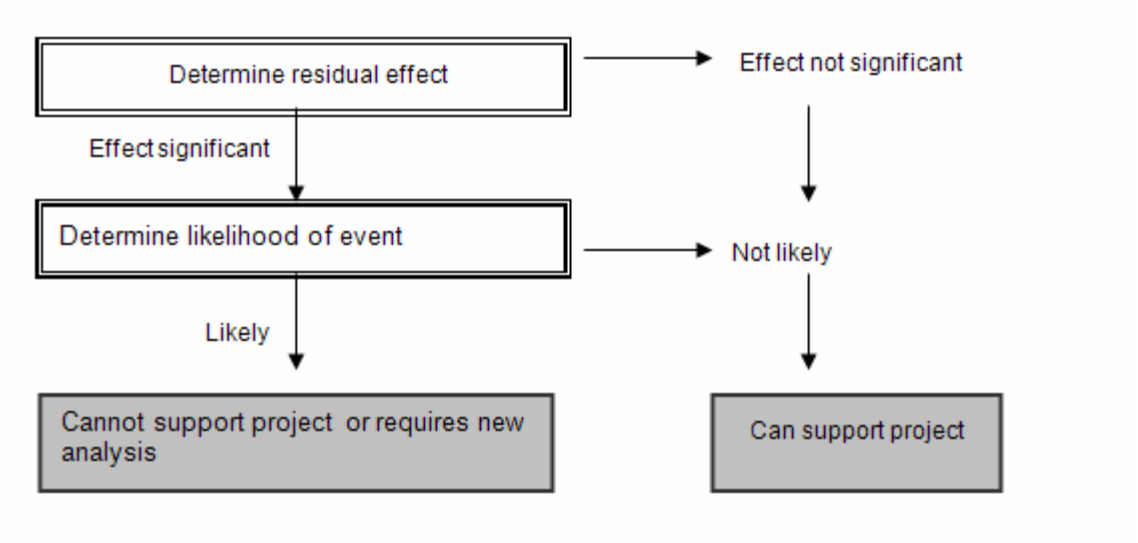
- the description of the project, which makes it possible to identify sources of impacts based on the technical characteristics of the planned road and the activities, methods and timetable for construction;
- a knowledge of the ecological and social context, so that any issues can be identified;
- community concerns vis-à-vis the project, so that, again, key issues can be identified.

The comprehensive study looks at the physical, biological and human components of the federal scope that are most likely to undergo a significant impact and have a significant effect on choices and decisions.

The following steps are followed for each component:

- current status of the component, i.e. environmental conditions prior to construction, with an appropriate level of detail;
- assessment of the physical change and the biological or human impact, i.e. a forecast of changes in relation to the project and the environment, taking into account routine and special mitigation measures during construction and operation;
- recommendation of applicable compensation measures.

Figure 4.2 Determining significance



4.3 Methodology for assessing environmental impacts

4.3.1 Determining residual effects

Physical changes and biological and human impacts are assessed using three criteria: the intensity of the disturbance, its extent and its duration. Routine and project-specific mitigation measures are also taken into consideration.

4.3.1.1 Intensity

For a physical component, intensity refers solely to the level of disturbance caused by the project. For biological and human components, intensity refers to the level of disturbance caused by the physical changes, but the value judgment also takes into consideration the ecological and social context and the value placed on the component. Several factors are considered when making this value judgment:

- Existence of legal or other protected status;
- The social value the public places on the component, as expressed during consultations;
- Level of concern for conserving or protecting the component;
- Status of the component in the study area, e.g. is it already subject to environmental stress due to pollution or resources use?;
- Abundance and distribution of a species (and its habitat) in the study area, with the attendant issues of uniqueness, rarity, diversity, etc.;
- Tolerance of the component for the physical changes in habitat. For wildlife, this means considering their ecological requirements (sensitive species or not) and their resilience (ability to re-establish themselves after a change in the environment);
- Ecosystemic function of the component, i.e. its role in the food chain.

The intensity of an adverse disturbance must be justified by reference to the above factors. Three degrees are distinguished:

- **High:** For a natural (physical or biological) component, intensity is high if it destroys or adversely alters the integrity of the component to a significant degree, i.e. one which may lead to its decline or to a major change in its general distribution in the study area.
- **Medium:** For a natural component, intensity is medium if it destroys or adversely alters the component to a lesser degree, not compromising its integrity but nevertheless leading to a limited change in abundance or in general distribution in the study area.
- **Low:** For a natural component, intensity is low if adversely alters the component to only a small degree, not compromising its integrity and not leading to a reduction or significant change in its general distribution in the study area.

4.3.1.2 Extent

The extent of a disturbance means the size of the area affected and proportion of the population affected. The extent may be:

- **Regional:** The extent is regional if disturbance of a component is felt throughout the study area or if it affects a large proportion of the area's population.
- **Local:** The extent is local if the disturbance of a component is felt in a relatively restricted part of the study area or if it affects a fairly small proportion of the area's population.
- **Limited:** The extent is limited if the disturbance of a component is felt in a very small, circumscribed part of the study area or if it affects just one or a few individuals.

4.3.1.3 Duration

The duration of a disturbance means the period during which the impacts are felt in the environment. The impact may be:

- **Long:** The duration is long if a disturbance is felt continuously over the life of the stretch of road in question.
- **Medium:** The duration is medium if a disturbance is felt continuously over a period less than the life of the stretch of road but greater than the construction period.
- **Short:** The duration is short if a disturbance is felt only during the construction period.

4.3.2 Mitigation measures

A set of routine mitigation measures will be applied to reduce adverse impacts during construction and operation. If necessary, a set of special mitigation measures, i.e. measures applicable at special locations along the planned route, will also be implemented. All these measures are considered when determining the residual effects of the project.

4.3.3 Significance of the residual effect

The significance of the effects on the physical environment and on the biological and human environments, is determining by combining the three criteria of intensity, extent and duration. Table 4.1 shows how an overall judgment of significance is made by integrating the three criteria. Each criterion has the same weight.

Table 4.1 Determining the significance of the residual effect

Intensity	Extent	Duration	Significance of effect
High	Regional	Long	Significant
		Medium	Significant
		Short	Not significant
	Local	Long	Significant
		Medium	Not significant
		Short	Not significant
	Limited	Long	Not significant
		Medium	Not significant
		Short	Not significant
Medium	Regional	Long	Significant
		Medium	Not significant
		Short	Not significant
	Local	Long	Not significant
		Medium	Not significant
		Short	Not significant
	Limited	Long	Not significant
		Medium	Not significant
		Short	Not significant
Low	Regional	Long	Not significant
		Medium	Not significant
		Short	Not significant
	Local	Long	Not significant
		Medium	Not significant
		Short	Not significant
	Limited	Long	Not significant
		Medium	Not significant
		Short	Not significant

In accordance with the *CEAA*, two classes of residual effect are recognized: significant and not significant. For an effect to be deemed significant, at least two of the criteria must have the highest value while the third criterion has either the highest or the middle value. All other effects are deemed not significant, in terms of the CEAA.

The significance of the effects is assessed in the light of mitigation measures designed to minimize the effects. As a result, what is assessed are residual effects, i.e. those that remain once the mitigation measures are taken into consideration. While effects are described for each source (e.g.: deforestation, activities affecting water), significance is assessed globally, for the entire period of construction (including related activities) and then for the entire period of the operation and presence of the infrastructure.

4.3.4 Determining probability of occurrence

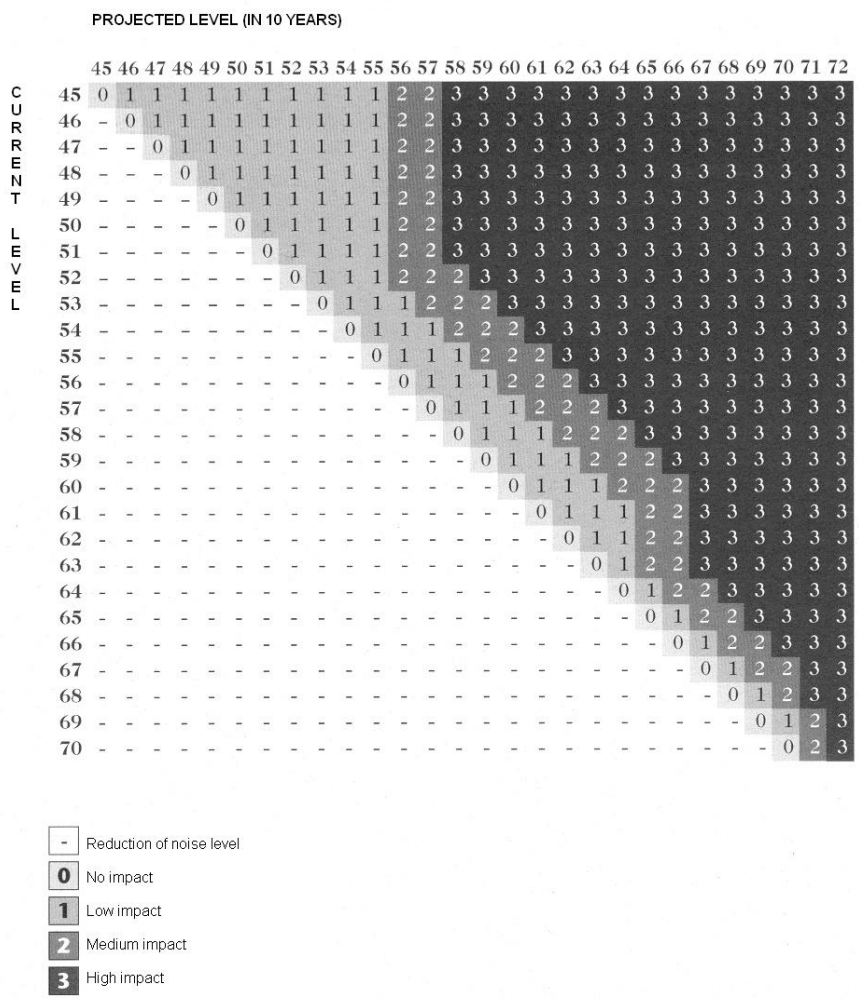
Once the residual environmental effect has been determined to be significant, the likelihood of the effect occurring must be determined.

According to the Responsible Authority's Guide**,** part of the Canadian Environmental Assessment Act Procedural Manual of the Canadian Environmental Assessment Agency, if there is a high probability that the identified significant adverse environmental effects will occur, obviously they are likely. Conversely, if there is a low probability of occurrence, the significant adverse environmental effects are unlikely.

4.4 Special method for noise

The method used to assess the effects of the project on the acoustic environment is the one given by the MTQ in its *Politique sur le bruit routier* (road noise Policy). See Figure 4.3.

Figure 4.3 Assessing noise levels (Leq_{24h}, dBA)



Source: Politique sur le bruit routier (MTQ, March 1998).

The noise measurements were made by a qualified company. Locations for making the measurements were five metres from sensitive buildings, and the instrument was placed at a height of between 1.2 and 1.5 metres above the ground. The measurements were made when the temperature was greater than -10°C, the winds were less than 20 km/h, the relative humidity was less than 90 % and the roadway was dry.

All the following were observed when the measurements were made:

- Leq, L95 and L10 were measured every hour for 24 consecutive hours to determine daytime (7 am to 7 pm) and nighttime (7 pm to 7 am) noise levels;
- Sketch of the site showing the locations where measurements were made and the distances separating these from the roads and from any other buildings;
- Date, time and duration of measurements;
- Weather conditions (temperature, humidity, wind speed and direction);
- Nature of surface between location of measurement and source of noise (highway);
- Noise-making events occurring while measurements were being made;
- Traffic counts on Highway 35, with classification of vehicles;

A class 1 integrating sound level meter was used, compliant with ANSI 5.1.4 – 1983 (R 1990), "Specification for sound level meters".

5 ASSESSMENT OF EFFECTS AND MITIGATION MEASURES

This environmental assessment has been prepared in accordance with the methodology described in a previous section of the Comprehensive Study, and takes account of all mitigation measures that MTQ has undertaken to implement during the construction and service life of the new highway. In addition to the mitigation measures included in the project, and already described in section 3.9 of the report, the environmental assessment of each component has resulted in the addition of specific mitigation measures and compensation measures to reduce or eliminate certain anticipated impacts.

Section 5 of the report presents, for each element examined, a description of its current condition, followed by an assessment of effects associated with the construction period, including related activities, as well as those associated with the presence and operation of the new highway throughout its service life. The related activities considered here as potential sources of impacts are the rehabilitation of national, regional, collector or local roads and the operation and opening of quarries and sand pits required to provide the borrow material for the highway construction. Where relevant, specific mitigation measures are added in order to supplement the measures included in the project, as described in section 4.8 of the report. The significance of the residual effect on each component is then estimated, taking into account the intensity, extent and duration of the anticipated impact.

5.1 Effects on the physical environment

As specified in the federal scoping document submitted to the proponent, the elements of the physical environment subject to assessment concern hydrology (including navigation) and streambed substrate, the quantity and quality of surface and groundwater, geology, geomorphology, the nature and productivity of soils and seismology, noise and vibrations, and air quality. Any identified socioeconomic effects associated with changes to the physical environment components analyzed under this heading are also presented.

5.1.1 Hydrology

5.1.1.1 Description

Current and future hydraulic conditions in the Brochets River

Hydraulic regime

The hydraulic study conducted as part of the environmental impact study (Génivar, 2005) made it possible to assess the impact of the proposed new infrastructure (highway and bridge) on flow conditions in the Brochets River under 20- and 100-year flood flows, and to reinterpret the boundaries of the areas subject to flooding with the presence of this new infrastructure. Using HEC-RAS software (version 3.1.1), two separate simulations were performed: the first with the current topographic and bathymetric conditions in the study area, and the second with the presence of the future infrastructure (highway and bridge).
According to the analysis of current hydrological conditions in the study area (Génivar, 2003), changes to the configuration of the watersheds and hydraulic conditions of the streams to be crossed by the highway should be minor. Section 5.2.5, dealing more specifically with fish habitat, describes the 20 or so streams involved, and specifies the design of the required works and mitigation measures.

Ice regime

There is very little information available on ice dynamics and more specifically on ice jams in the reach of the Brochets River under study. A check with the Quebec Civil Protection agency revealed no reports of any particular ice jam problems in the sector planned for construction of the future bridge. However, some local residents mentioned that ice jams had already occurred in the reach of the river under study. The three conditions considered favourable to the formation of ice jams in the river are a reduction in water surface slope, a change in the direction of flow, and a narrowing of the flow channel.

The reach of the river under study is characterized by a very gentle and constant water surface slope. In other words, the slope of this reach is not such as to promote the formation of ice jams. However, upstream from the planned bridge site, there is a change of flow direction that would favour the build-up of ice and the formation of ice jams in the outside of the curve. As this sector will not be affected by the work, the project should not increase the risk of ice build-up along the left bank. According to witnesses, there have been occasional build-ups of ice at this site. However, on those occasions the ice cover has either melted at the site or has been carried downstream before the peak of the spring flood.

The Highway 35 work will require the construction of an embankment in the floodplain, primarily along the right bank of the river and outside the wetlands area. The hydrodynamic modelling showed that the impact on flow conditions, and particularly on water levels, is not significant. The flow section will be only partially diminished, specifically during high flow periods.

It should be noted that the floodplain is inundated only during major hydrological events (> 2-year flood). The ice cover generally retreats at the very beginning of the spring freshet, when the flow is still far from its peak. Thus, when there is a lot of floating ice, the flow is normally confined to the lower bed of the river and consequently the presence of the embankment will not increase the risk of ice jams.

Current navigation conditions

The Brochets River is a navigable waterway, specifically in the reach of the river between its mouth at Missisquoi Bay on Lake Champlain and the Langlois Marina on the right bank, 5 km upstream from the mouth. Further upstream, the river is not readily accessible. Its average annual flow is 15 m^3/s. Since 1990, navigation on the river has declined because of the presence of cyanobacteria (blue-green algae) (Chantal D'Auteuil, Corporation Bassin Versant Baie Missisquoi, pers. comm., July 11, 2006). The river's low flow and the fact that its rocky bed is shallow, at between 1.5 and 3 m downstream from Saint-Pierre-de-Véronne-à-Pike-River to the mouth, are factors that restrict its use (BAPE, 1990).[1]

Several types of pleasure boats use the river, including fishing boats (see section 5.3.4), pleasure boats and pontoon boats. Motor boats are used primarily for fishing and pleasure boating. A survey of residents along the Brochets River (municipality of Saint-Pierre-de-Véronne-à-Pike-River) revealed that the most popular motorboats are 4.2 and 4.8 m (14 and 16') in length. On average, the local residents' boats require a draft of between 0.45 m (18") and 0.6 m (24") (BAPE, 1990).[5]

Water skiing is also possible, particularly at the mouth of the river in Missisquoi Bay. There are no sailboats on the Brochets River (Lyne Boivin, Municipality of Saint-Pierre-de-Véronne-à-Pike-River, pers. comm. July 13, 2006). It should be noted that the river is not navigable at low water (Chantal D'Auteuil, Corporation Bassin Versant Baie Missisquoi, July 11, 2006).

[5] Bureau d'audiences publiques sur l'environnement (BAPE). 1990. *Projet de dragage en regard de la rivière aux Brochets, dans la baie Missisquoi*. Rapport d'enquête et d'audience publique. 360 pages. January 12, 1990.

5.1.1.2 Mitigation measures during construction and significance of residual effects

During highway construction, the effects on navigation and streambed substrate will not be substantial, because the piers for the bridge over the Brochets River are not in the water. MTQ has incorporated proven mitigation measures into the project that will make for adequate control of the anticipated effects of stream crossings, including the installation of culverts and sediment control in the runoff waters that could enter the water system (section 3.9.11).

The construction of crossings over streams considered "navigable" will require a permit under the *Navigable Waters Protection Act*. MTQ will file an application with TC pursuant to the *Navigable Waters Protection Act* for approval of the plans and the placement of the bridge crossing the Brochets River (see section 3.4.2). MTQ will respect the conditions attached to the permit issued under the Act.

Because there will be little alteration to hydrological conditions during construction, the intensity of the impact is considered low, and its extent will be limited, since the disruption is confined to a short reach of the streams affected. As construction time will be short, the residual effect of construction works on the hydrology is therefore considered not significant.

5.1.1.3 Mitigation measures during operation and significance of residual effects

With respect to the drainage pattern, the simulations performed in the course of the EIS show that the presence of a highway on the floodplain will have a minor effect on the flow section and the level of the river upstream from the future bridge. The increases in water level are estimated at 2 cm, 3 cm and 5 cm under 2-, 20- and 100-year flood conditions, respectively.

These increases will be insignificant and barely perceptible in the flood zones. However, the presence of the highway in the low-flow floodplain (100-year flood) will result in slight changes to the boundaries of the flood-prone areas, despite the presence of culverts that are designed to allow water to run from one side of the highway to the other.

The presence of the highway and the bridge over the Brochets River will not increase the risk of ice jams. The residual effect is therefore considered not significant. However, to verify this opinion, at least one observation of flow conditions will have to be conducted as the ice cover on the Brochets River breaks up and melts. In the event of an ice jam, appropriate adaptive measures will be taken (see monitoring program, section 7.2).

The design of the bridge over the Brochets River (at km 28.9) calls for a vertical clearance of 6 m above the high water level, in keeping with TC requirements (Navigable Waters Protection Service). Given that this minimum clearance will allow for the passage of the boats that currently use the river, with the exception of a single vessel (a catamaran) for which MTQ has discussed compensation with the owner, the presence of the bridge will not hinder recreational navigation. The residual effect on hydrology associated with the presence of a new highway is therefore considered (1) of low intensity, as it alters this component very little; (2) of limited extent, confined to a small portion of the study area and concerning specifically one boat owner; and (3) of medium duration, since the effect could be felt over short periods of time (the summer season for navigation, and the spring thaw for ice jams). The residual effect is thus considered not significant.

5.1.2 Groundwater

5.1.2.1 Description

Groundwater flow is from east to west, towards the Richelieu River in the sector of Saint-Jean-sur-Richelieu and Saint-Alexandre. Near Notre-Dame-de-Stanbridge and Saint-Sébastien, respectively to the east and west of the study area, the flow shifts south towards Missisquoi Bay (Prévost, 1972).

The rock formations that characterize the study area, both the sedimentary formations and the formations of the Appalachian complex, have weak potential as aquifers because of their low permeability (Globensky, 1981 and 1987).

Surficial deposits also offer little potential for groundwater exploitation, because the low permeability of the till and marine clay deposits severely limits groundwater availability. However, the littoral gravel and sand deposits constitute good aquifers.

According to data from MDDEP's hydrogeological information system (SIH) on wells drilled in the area of Saint-Jean-sur-Richelieu and Saint-Armand, the depth of the water table varies from 1.5 m to more than 10 m.

Groundwater is generally of good quality. However, two sampling programs in 1990 and 1996 confirmed a problem of groundwater contamination by nitrates and nitrites in rural areas. That type of contamination is usually attributable to poor manure storage and fertilization practices (MDDEP, 2001).

A large extraction zone extends from Saint-Armand (Philipsburg sector) to the municipality of Bedford. This zone includes some 10 abandoned or active quarries.

5.1.2.2 Mitigation measures during construction and significance of residual effects

Given the nature of the work and the mitigation measures included in the project protecting groundwater, and which will also contribute to protecting the water table, the anticipated residual effects of the highway construction on groundwater quality are considered not significant, because of their low intensity (there is little risk of resource alteration), their localized nature (directly downstream from the construction sites), and their short duration (the construction period).

Related activities

The operation of quarries and sand pits could lower the water table when the material removed is located below that level. It could also affect the groundwater quality.

Existing quarries and pits for which authorization has been issued by the Department of Sustainable Development, Environment and Parks are MTQ's priority sources for borrow material. If the quality or quantity of borrow materials is inadequate for the project, new or old sources will have to be found and authorized by MDDEP pursuant to the Quebec *Regulation Respecting Pits and Quarries* (R.Q., 1981, c. Q-2, r. 2) before they can be used. It is important to note that the tender documents that will be issued for construction of the highway will clearly indicate that borrow materials must come from sites duly authorized by MDDEP. Finally, to obtain the operating permit, the owner of the borrow site must file a restoration plan and must undertake to carry out that plan at the end of the site's life.

Given that the mitigation measures contained in the *Regulation Respecting Pits and Quarries* will be applied, such as determining the piezometric level before operations begin and limiting the depth that can be worked, the anticipated changes in groundwater quality during the related activities are considered not significant. They will be of low intensity, as the integrity of the resource is not compromised, localized in

extent (confined to the extraction areas and downstream from them) and of short duration (during operation of the borrow pits required for building the new highway).

5.1.2.3 Mitigation measures during operation and significance of residual effects

While MTQ applies operation and maintenance procedures designed, among other things, to protect the water table, it will implement a program for monitoring potable water wells located along the highway that are considered at risk. This monitoring will go on for at least two years and will be repeated if a contamination problem is found to persist beyond that time. If necessary, a permanent solution to the problem will be implemented.

The residual effect on groundwater during the life of the new highway is assessed as not significant: it will be of low intensity (as the quality of the resource will not be significantly altered); localized in extent (bordering the highway); and of long duration (throughout the life of the infrastructure).

5.1.3 Surface waters

5.1.3.1 Description

In the farming portion of the study area, surface water is channelled into ditches or captured in agricultural drainage systems. It then enters the river system. In inhabited areas, surface water is channelled into sewers, or discharged into ditches. While there has been no specific characterization of these waters, their quality is determined by runoff from farmlands and lawns (nutrients, fertilizers and pesticides) as well as active erosion sources that may produce sediments.

Along the proposed Highway 35 corridor, only the banks of Barbotte Creek (km 2.5) have been identified as sensitive to erosion in the municipal development plan of the regional county municipality of Haut-Richelieu. However, given the nature of the surficial deposits (see section 5.1.5) covering the study area and the various activities planned, it is reasonable to assume that the streams crossed by the new highway (Brochets River, listed creeks and farm drainage ditches) are also sensitive to erosion and thus likely to introduce sediments into runoff waters if they are not protected.

5.1.3.2 Mitigation measures during construction and significance of residual effects

The various activities associated with land clearing, excavation, earthworks and the placement of bridges and culverts during highway construction are the principal sources of impacts that could alter the quality of surface waters surrounding the construction sites. The exact nature of changes to water quality will vary according to the site, as a function of such factors as the type of surficial deposits, the nature of the materials used, meteorological conditions, the season in which the work is performed, and the type of machinery used. Generally speaking, construction activities can temporarily affect streams located downstream from the work by bringing fine sediments into suspension, thereby increasing water turbidity.

During bridge construction and other work near streams, routine mitigation measures adapted to this type of work (section 3.9.11) will be applied. In addition, the following special mitigation measures will be taken for the zones considered most sensitive:

- Soil stabilization as the works progress.
- Strict surveillance, particularly during the spring and fall high-water periods, or in the case of exceptional meteorological events.
- As a temporary erosion control measure, hay bales or geotextile barriers will be secured to the embankments to capture fine sediment in runoff, or filter berms and sediment traps will be placed in the ditches upstream from the streams.

With application of all these measures, the anticipated changes in surface water quality during construction are considered not significant: they will be of low intensity, as the integrity of the resource is not compromised; localized in extent (directly downstream from the construction sites); and of short duration (the construction period of each stretch of highway will last at most a few months).

Related activities

The operation of quarries and pits could lead to changes in surface water quality.

To counter these effects, the standards for the siting and operation of quarries and pits contained in the *Regulation Respecting Pits and Quarries* will be met:

- The site of any new pit or quarry must be located at a minimum horizontal distance of 75 m from any stream, river, lake, ocean, swamp or sandbank.
- Every new pit or quarry must be located at a minimum distance of 1 km from any well, water, source or other water intake used to supply a municipal waterworks or a waterworks network, unless the operator submits a hydrological study in support of his request and the operation of the new pit or quarry is not likely to affect the yield of the well which supplies such waterworks network.
- Comply with the following concentrations for water discharged to the environment:
    - 25mg/l of oil, grease, or tar of a mineral origin
    - 25 mg/l of suspended matter
    - pH: between 5.5 and 9.5

Consequently, the anticipated changes in surface water quality during related activities are considered not significant: they will be of low intensity, as the resource will be little altered; localized in extent (downstream from the extraction areas); and of short duration (during operation of the borrow pits required for building the new highway).

5.1.3.3 Mitigation measures during operation and significance of residual effects

During the highway operating phase, the increased flow of drainage water from the right-of-way into the river system could promote the development of erosion sites that could affect the stability of the highway embankments and streambanks, thereby contributing to the transport and suspension of fine sediments in the streams. Special mitigation measures will be applied in order to drain runoff waters from the roadway and the bridge over the Brochets River to a point beyond the floodplain and thus protect the adjacent wetlands (section 5.2.2). Finally, one or more sediment basins will be created in the floodplain of the Brochets River between km 28 and km 33 to reduce sediment loadings to the surface hydrographic network.

In addition, winter roadway maintenance will require the use of significant quantities of de-icing salt and abrasives. During snowmelt, some of the salt and abrasives used will be carried by runoff into the highway's drainage system and into streams located near the highway. Winter maintenance activities could therefore lead to a change in the quality of surface waters near the highway, through the accumulation and suspension of fine particles (salt and abrasives) in streams.

With the application of the special mitigation measures described above, routine mitigation measures for winter maintenance (section 3.9.15), and the ditch maintenance method used by MTQ, which will reduce pollutant loads through enhanced filtering of drainage from the right-of-way, the anticipated impacts are considered to be (1) of low intensity, as they will not compromise the quality of the resource; (2) localized in extent (the area surrounding the highway); and (3) of short duration (winter season). The anticipated changes to surface water quality during the operation of the future Highway 35 are therefore considered to be not significant.

5.1.4 Soils and sediments

5.1.4.1 Description

Preliminary soils characterization

The preliminary environmental characterization of the soils along the proposed route of Highway 35, between the U.S. border and Saint-Jean-sur-Richelieu, identified certain past or present activities that present a potential environmental impact. These activities are listed and briefly described below.

- A sanitary landfill is currently in operation at the far north of the study area, in the industrial park of the Municipality of Saint-Jean-sur-Richelieu (Saint-Athanase sector). Three former solid waste landfills are located within the study area: the first is near Saint-Alexandre west of the town limits, the second is in Saint-Sébastien, and the third is in the Municipality of Saint-Armand, east of Highway 133, near the village of Philipsburg.
- The sewage treatment plant of the Municipality of Saint-Alexandre is located to the south of the town limits, at the boundary of Concession 5 and Concession 6.
- A dry waste disposal site is located on Rang Sainte-Marie in the Municipality of Saint-Sébastien.
- An automotive parts recycling site is located near the dry waste disposal site, on Rang Sainte-Marie, in the Municipality of Saint-Sébastien.
- A major mineral resources extraction zone extends from Saint-Armand (Philipsburg sector) to the Municipality of Bedford. It contains roughly 10 operating or abandoned quarries. Some operators of these sites have been received notices of violation from MDDEP regarding air quality (dust).
- Two service stations were identified in the study area, one at Saint-Jean-sur-Richelieu (Saint-Athanase sector) and the other at Saint-Pierre-de-Véronne-à-Pike-River. These two service stations are located more than 1 and 4 kilometres, respectively, from the right-of-way of the future Highway 35.
- A Hydro-Québec power line (120 kV) approaches the route of the future highway at two points: at Saint-Alexandre, where it runs parallel to the right-of-way for more than 1.5 km, and then crosses the highway, and at Saint-Sébastien, where it crosses the Highway 35 corridor. The Saint-Sébastien transformer station of Hydro-Québec is also located in the same sector.
- A Gaz Métropolitain pipeline runs along the path of the future Highway over more than 5 km in the Saint-Alexandre sector, and crosses the right-of-way south of the town. A TransCanada Pipelines transmission line crosses the proposed highway right-of-way at three points, in Saint-Sébastien, in Saint-Pierre-de-Véronne-à-Pike-River west of the Brochets River crossing, and in Saint-Armand, in the Philipsburg sector.

5.1.4.2 Mitigation measures during construction and operation and significance of residual effects

Most of the proposed route runs through farmland. While fertilizers, pesticides or manure (solid or liquid) may have been applied to this land, there is little risk of soil contamination within the right-of-way.

Moreover, according to data compiled in MDDEP's contaminated lands inventory (*Répertoire des terrains contaminés*) and soil and industrial waste disposal sites inventory (*Répertoire des dépôts de sols et de résidus industriels*)[6], there are no contaminated or potentially contaminated sites within the areas bordering the proposed Highway 35 corridor.

During construction, the emergency plan will be activated in the event of accidental spills. During the operating phase, the management and maintenance procedures and response measures included in the emergency plan for dealing with contaminant spills will allow the potential effects to be adequately handled.
The impact of construction, operation and the presence of the highway on soil and sediment quality is considered not significant: it is (1) of low intensity, as there will be no significant change; (2) localized in nature, i.e., confined to a restricted area; and (3) of short duration, since immediate response measures are planned in the event of any environmental incidents.

Related activities

The operation of pits and quarries could entail changes in soil stability conditions.

The *Regulation Respecting Pits and Quarries* contains the following standard: "The operation of a quarry must not emit into the environment impulsive or discontinuous seismic waves whose ground speed, measured at less than 30 m from any structure or immovables contemplated in section 11 or from any artesian well, is greater than 4 cm per second", and this standard will be respected. Consequently, the residual effect on soils and sediments is considered not significant: it will be (1) of low intensity, because the standards have been set to avoid environmental changes; (2) localized in extent (at the periphery of the extraction areas); and (3) of short duration (during sporadic activities in the course of quarry and pit operations).

5.1.5 Geology

5.1.5.1 Description

Geology and geomorphology

Most of the study area is contained within the St. Lawrence Lowlands physiographic region, while the Philipsburg sector to the south is located on Logan's Line, which marks the western extension of the Appalachian physiographic and structural province.

The St. Lawrence Lowlands (from Saint-Jean-sur-Richelieu to Philipsburg) are underlain by horizontally bedded sedimentary rock formations that were folded slightly during the formation of the Appalachians. They consist of Ordovician rocks of the Lorraine Group, represented by the Nicolet Formation, and the

[6] The *Répertoire des terrains contaminés* and the *Répertoire des dépôts de sols et de résidus industriels* of MDDEP contain general and technical information on lands contaminated by industrial and commercial activities, or by accidental spills. MDDEP makes it clear that these are not exhaustive inventories, but rather compilations of cases brought to the attention of the Department.

Sainte Rosalie Group, represented by the Iberville and Sainte Sabine and Les Fonds (Globensky, 1987) formations.

The Nicolet Formation occupies the northern portion of the study area and includes the town of Saint-Jean-sur-Richelieu. It is bounded on the south by the Tracy Brook fault, which runs southwest-northeast and marks the geological contact with the Iberville Formation to the south. This formation in turn rests on the Aston fault, which marks the geological contact with the Sainte Sabine and Les Fonds formation to the southeast of the study area (Globensky, 1987). The Nicolet Formation is composed of dark grey silty shale inter-bedded with sandstone and siltstone, as well as a few fossiliferous limestone beds. Minute mica flakes are ubiquitous. In addition, the high content of kaolin, an aluminum silicate produced by the alteration of certain minerals, would explain the rate at which the rock is disintegrating.

The Iberville Formation consists of dark grey, non-calcareous laminated mudstone (shale), regularly layered with dolomitic siltstone lamina or actual beds of fine-grained, orange-brown dolomite. This formation constitutes a mixture of Appalachian and oceanic sediments and represents a lateral facies of another formation, the Stony Point Formation. The Sainte Sabine and Les Fonds Formation consists of grey to dark grey slate interbedded with detrital and dolomitic sediments. Massive or laminated banks of argillaceous limestone and calcareous mudstone are found locally (Globensky, 1987).

The Sainte-Sabine Formation is composed of 80% slate in 10-cm to 1-m beds, and 20% detrital and dolomitic sediments in 1 to 10-cm interbeds (Globensky, 1981).

The outcrops along the Brochets River provide the best display of the Iberville Formation in the region. All along the river, the rock has retained the characteristics of the Iberville Formation, i.e. laminated non-calcareous, black mudstone, rhythmically interbedded with lamina and thin beds of orange-brown dolomitic siltstone (Globensky, 1981). On the left bank of the river, downstream from Malmaison, a number of graptolites can be found. In the Appalachians, the metamorphosed Ordovician rocks appear in the form of strongly folded thrust sheets. In the Philipsburg sector, the rock formations are primarily associated with the Philipsburg thrust slice, which is intercalated with the Stanbridge nappe (Stanbridge Group) (Globensky, 1981).

The Philipsburg thrust slice, extending 3.2 km to the east from Missisquoi Bay, is composed of the Philipsburg Group, which comprises about ten different rock formations, the main ones in the study area being the Rock River and the Strites Pond formations (Globensky, 1981). Several limestone quarries from which “marbles” are extracted have been and are still operating in the Philipsburg sector.

The Stanbridge Group comprises a limestone conglomerate and a clay and silty-clay slate (Globensky, 1981).

Unconsolidated deposits

General description

Two types of unconsolidated deposits are found in the study area: undifferentiated till and marine clays. Local deposits of littoral sand and gravel as well as reworked till are also present. Recent alluvia and organic sediments characterize the banks of the principal streams (Ministère de l’Énergie et des Ressources, 1984).

The sector between Iberville and Saint-Alexandre in the northern portion of the study area is characterized by vast expanses of till, broken up by localized deposits of reworked till and marine clays. Further south, near Saint-Alexandre, a broad, southwest-northeast band of littoral sand and gravel marks the contact between till veneer and marine clay. Toward the south, the deposits become increasingly spatially fragmented and the till is intercalated with littoral sands and gravels as well as marine clays. Till and bedrock alternate in the approach to the Appalachian foothills, particularly in the Philipsburg sector. The mouth of the Brochets River, at the extreme south of the study area, is characterized by broad

expanses of organic deposits, while the river's many meanders are composed of recent alluvia (Ministère de l'Énergie et des Ressources, 1984).

More specifically, between Rang des Dussault in the Municipality of Saint-Alexandre, and Highway 133, in the Municipality of Saint-Sébastien, three distinct units are found along the path of the future highway: i) Champlain Sea sediments, consisting of clay, silty clay and silt, with occasional laminates of sand and silt; ii) reworked till or Champlain Sea shore sediments consisting of coarse sand and gravel; and iii) glacial till, heterogeneous non-stratified material, presumably Saint-Jacques till (Labo SM, 2006).

Detailed description based on geotechnical studies conducted in the study area

A geotechnical study was conducted in 2005 by the Laboratoire d'inspection et d'essai du Saint-Laurent (LIE) to determine the nature and properties of the materials constituting the soils, as well as the groundwater level in the study area. The 13.19-km segment of the Highway 35 corridor selected for study is located between Rang des Dussault and Highway 133, i.e., within the boundaries of the municipalities of Saint-Alexandre and Saint-Sébastien (LIE, 2005). More specifically, Rang des Dussault is located in the Municipality of Saint-Alexandre, while the intersection of the future Highway 35 with Highway 133 is located in the Municipality of Saint-Sébastien. For purposes of this study, 68 exploratory cores were collected.

This survey of the materials showed that the entire segment under study has a surface cover of organic soils, and more specifically of topsoil. The topsoil has an average thickness of nearly 300 mm, and its organic content averages 6%.

In addition, at most of the sites where exploratory drilling was carried out, pebbles and blocks were found at various depths, ranging from the soil surface to a depth of 3 m, which was the maximum core depth.

The study segment was divided into seven homogeneous sections, from chainage 20+830 to 22+150 (section 1), from chainage 22+150 to 23+600 (section 2), from chainage 23+600 to 24+600 (section 3), from chainage 24+600 to 28+200 (section 4), from chainage 28+200 to 32+000 (section 5), from chainage 32+000 to 33+000 (section 6) and from chainage 33+000 to 34+020 (section 7).

Section 1 is characterized by the presence of basement rocks at shallow depths, ranging from 0.75 to 2.0 m. The topsoil layer, ranging from 0.25 to 0.30 m in thickness, lies primarily on horizons consisting of sandy clay with traces of gravel (classified as CL and CH), or silt and sand with a little gravel (classified as ML).

Section 2 is characterized primarily by sandy soils. The topsoil layer is 0.20 to 0.15 m in thickness and overlies horizons consisting of sand, with differing proportions of silt or clay (8.6 to 46%, average 28%) and gravel (0 to 35%, average 18%); classified as SM and SW.

The soils of section 3 include a topsoil layer, ranging from 0.2 to 0.30 m in thickness. The underlying sand layer ranges from 0.50 to 1.2 m in thickness and is classified as SM or SC, with varying proportions of silt or clay (33 to 47%, average 38%) and gravel (1 to 11%, average 5%). The sand layer overlies horizons made up of silt (ML), clay (CL or CH) or sand (SM, SW or SC).

In section 4, soils overlie a topsoil layer ranging in thickness from 0.20 to 0.40 m. This topsoil layer is underlain primarily by a horizon of sandy clay with traces of gravel, classified as CL and CL-ML. Rock was found at depths ranging from 2.5 to 3.3 m.

The soils of section 5 are characterized by alternating horizons of sand and clay and the presence of rock at shallow depth. The soils of this section consist first of a layer of topsoil, ranging in thickness from 0.15 to 0.40 m. This layer of organic material overlies alternating horizons of clay classified as CL or CL-ML (or CH without gravel) and containing varying proportions of sand (2 to 40%, average 14%) and gravel (0 to

30%), or sand classified as SW and containing varying proportions of gravel and silt. Rock was reached at depths ranging from 1.5 to 3.2 m, for an average depth of 2.2 m.

The soils of section 6 are characterized by the presence of materials formed primarily of sand. The in-situ topsoil layer ranges from 0.15 to 0.20 m in thickness and overlies a horizon of clayey sand or of sand and clay with traces of gravel, classified as SC.

The soils of section 7 are characterized by the presence of a clay horizon overlying a sand deposit. The soils consist first of a topsoil layer, ranging from 0.25 to 0.40 m in thickness. This organic matter layer overlies a clay horizon, varying in thickness from 0.60 to 2.15 m. More specifically, the clay contains varying proportions of silt, sand and gravel, classified as CL, CH and CL-ML. This clay horizon overlies a bed of sand and clay or clayey sand containing traces of gravel, classified as SC.

Also in 2005, Les Laboratoires Shermont Inc. conducted a geotechnical study of the locations planned for construction of culverts on the future segment of Highway 35 located between chainages 20+740 and 34+100 m within the municipalities of Saint-Alexandre and Saint-Sébastien (segment 2). More specifically, 12 drill holes were completed at the planned culvert sites along the segment under study (Les Laboratoires Shermont Inc. 2005).

At the surface, a brown silt/sand deposit extends to a depth of 0.6 to 2.6 m. This is a mixture of silt and brown sand, occasionally containing traces of gravel and clay. At the surface of this deposit, a layer of organic matter ranges from 0.5 to 1.0 m in thickness. The density of the silt/sand deposit and the organic material is described as loose to compact.

Below this unconsolidated deposit is a grey silt/sand horizon that extends down to the rock or to the bottom of the drill holes, which vary in depth from 3.0 to 7.6 m. These horizons are formed of grey silt containing varying proportions of sand and gravel. The proportions of gravel increase near the rock.

At some of the drill holes, horizons of blocks and pebbles, varying in thickness from 0.2 to 3.5 m, are mixed with or precede the moraine deposit. The density of the silt/sand deposit is described as loose to compact at the surface, becoming denser near the rock, while at other drill holes the deposit is described as dense to very dense.

The rock, consisting of bedded grey-black shale, in places silicified, was reached at depths ranging from 3.0 to 5.3 m during drilling.

In general, the water table lies at a depth of 1.6 m, and is considered high.

At the site of the future interchange, near Highway 133, a surface deposit of brown silt/sand that continues to a depth of 2.2 m. As well, organic material was observed to a depth of 0.6 m. Below this horizon, a dense grey silty moraine deposit (till), was intersected to a depth of 3.9 m. This deposit was followed by a horizon consisting of blocks and pebbles, and the rock was reached at a depth of 5.3 m.

A complementary geotechnical study was carried out in 2006 by Labo S.M. Inc. in the context of culvert construction on the future route of Highway 35 in the municipalities of Saint-Alexandre and Saint-Sébastien. More specifically, the study examined a segment of about 13.27 km between chainages 20+830 (Municipality of Saint-Alexandre) and 34+100 (Municipality of Saint-Sébastien) (Labo SM, 2006).

There are few local elevation changes along the proposed route of Highway 35, but regionally the elevation of the land drops from around 50 m at the north end of the route, near Route 227 at Saint-Alexandre, to about 35 m in the south, near the intersection with Highway 133 at Saint-Sébastien.

A total of 31 geotechnical boreholes were completed along both sides of the existing ditches, as access constraints permitted. At these borehole sites, the stratigraphy of the soils consists of a layer of organic topsoil or fill (soil disturbed by agricultural activities), consisting largely of sand. This layer is underlain by either a deposit formed of a mixture of sand and silt, generally loose to compact, or a thin layer of silty clay or of clayey silt from the Champlain Sea, followed by Saint-Jacques till. These materials are followed by granular soils and finally by quartz-bearing pelitic rock with shale interbeds.

Most of the boreholes intercepted a layer of natural soil, less than 2.0 m thick, consisting of a mixture of silt and sand with occasional small quantities of gravel and clay. The density of the natural soil layer ranges from loose to compact, and is sometimes very loose, while the natural water content varies from 10% to 24%. Granulometric analyses found proportions of gravel ranged from 2 to 5%, sand from 25 to 57%, and fine fractions (passing a 0.08 mm sieve) from 43 to 73%. The samples taken from the sand deposit (Chambly Formation) were found to range from silt and sand, with traces of gravel, to sand and silt, i.e., erodible material.

The silt and sand layer is underlain by a thin layer of silty clay or clayey silt, ranging in thickness from 0.3 to 1.5 m. This layer is characterized by a consistency ranging from firm to stiff. The clayey silt has a water content ranging from 22 to 36%, while the liquid limit is 28% and the plasticity limit is 13%. The clayey silt, with a plasticity index of 15%, is a type-CL soil.

Below the horizons is a till of heterogeneous composition and density, the latter ranging from very loose to very dense. Pebbles and blocks were also found within this till deposit. The natural water content of the deposit varies from 8 to 17%. In samples taken from the deposit, measured percentages of gravel range from 4 to 30%, sand from 28 to 52%, and fine fractions (passing a 0.08 mm sieve) from 22 to 73%. Because of the elevated percentages of fine fractions, this material is typically considered to be a frost-susceptible soil.

The till layer is underlain by a granular deposit formed by the sediments of the Châteauguay Formation. The density of this soil ranges from loose to very dense, but is generally compact to dense. The natural water content of this deposit varies from 8 to 15%. In the samples collected, measured percentages of gravel range from 0 to 46%, sand from 44 to 67%, and fine fractions (passing a 0.08 mm sieve) from 10% to 37%. This granular soil is described as ranging from silty sand to gravel and sand with traces of silt. This formation normally overlies the basement rock.

During drilling, the rock was encountered at depths ranging from 1.52 m to more than 6 m. The samples reveal alternating black shale and quartz-bearing pelitic rock, with occasional siltstone beds. According to tests on samples collected and then left in the open air, the resistance of the rock is moderately high.

On the basis of the surveys, it was determined that the water level is close to the surface, ranging in depth from 0.6 to 2.2 m.

Because of the high silt content, the natural soil will be extremely sensitive to disturbance by the weather (rain, frost and snowmelt), and by the movement of heavy machinery and construction equipment.

Seismicity

The seismic station closest to the study area is located in Montreal. This automatic station is part of the Canadian National Seismograph Network. Since it began operating in 1995, no event has been detected in the study area. In fact, no seismic event was reported in the study area between 1900 and 2001 (Natural Resources Canada, 2006).

Although no seismic event has been detected, the construction standards applied to Highway 35 overpasses correspond to the “emergency bridge” category, i.e., the overpasses will accommodate emergency as well as security and defence vehicles immediately after an earthquake.

Soil productivity

The study area is part of a broad agricultural plain characterized by productive soils.

5.1.5.2 Mitigation measures during construction and significance of residual effects

During construction, as mentioned in section 3.4.2, MTQ will ensure the stability of the infrastructure to be built (roadways, structures etc.) while minimizing impacts on the receiving environment by using different methods to ensure the stability of the installations, depending on the specific geotechnical conditions at each site. The methods considered by MTQ to be possible solutions in sectors where the soil bearing capacity is low include anchoring the structures into the bedrock using piles, installing vertical drains or using lime by-products (lime kiln dust) to consolidate surface deposits considered unstable and using light fill material. If blasting is required, the current mitigation measures applied by MTQ will be respected.

The construction activities are not expected to have any residual effects on the geology, geomorphology or nature and productivity of soils in the study area.

5.1.5.3 Mitigation measures during operation and significance of residual effects

During operation of the highway, environmental incidents, such as an oil spill, could affect the nature and productivity of soils for short periods. The effect would be of medium intensity because the disruption would alter a portion of the soils near the accident site, localized in nature (confined to a restricted site), and of short-term duration, as emergency work and restoration would then be undertaken. Consequently, the residual effect is considered not significant. The presence and operation of the highway are not expected to have any effects on the geology/geomorphology component.

5.1.6 Noise environment

5.1.6.1 Description

The boundaries of the noise assessment study area were defined by establishing a 300-m corridor along either side of the proposed right-of-way. The study area begins at Saint-Jean-sur-Richelieu, in the Iberville district, and ends at the U.S. border.

The noise impact study, which is covered in detail in Appendix 13 of the impact study (Génivar, 2005), encompasses the following aspects:

- inventory of environmental components;
- assessment of the existing noise environment;
- assessment of existing noise disturbances;
- assessment of the projected noise environment;
- assessment of projected noise disturbances;
- assessment of noise impacts during the construction phase;
- assessment of noise impacts during the operational phase;
- identification of mitigation measures.

Environmental features

The noise study area was divided into five sectors: Iberville, Saint-Alexandre, Saint-Sébastien, Saint-Pierre-de-Véronne-à-Pike-River and Saint-Armand. Only sectors that comprise sensitive residential and institutional areas lying within the noise study area were retained for analysis.

Iberville

The existing Highway A-35 ends in this sector, where it becomes Highway 133 in the direction of Sabrevois. Land use to the east of the A-35 is urban residential and includes a school on Yvon Street. West of the A-35, land use is industrial. Part of the noise study area for the Iberville sector is rural and occupied by a few isolated single-family homes along Chemin de la Grande-Ligne, Princesse Caroline Street, Montée Bertrand and Rang Grand-Sabrevois.

Saint-Alexandre

Saint-Alexandre is a largely rural sector. Most homes are located along Highway 227 (Rang des Dussault). Part of the residential sector of the municipality of Saint-Alexandre is located in the noise study area along Montée Lacroix and Montée de la Station. The residences there are primarily single-family homes. There is also an industrial plant on Montée Lacroix.

Saint-Sébastien

This is a rural sector. All the residences in this sector are located along Highway 133, which is the main street of the municipality of Saint-Sébastien. These residences are isolated single-family homes.

Saint-Pierre-de-Véronne-à-Pike-River

This is a rural sector. There are cottage-type dwellings along Archambault Road; the other houses are isolated single-family homes along Molleur Road.

Saint-Armand

Unlike the other sectors, where the topography is flat and sparsely wooded, this sector is hilly and more densely wooded. Houses in this sector are primarily isolated single-family homes. Those that lie within the noise study area are located along Highway 133 and Quinn Road, and in the residential area of Philipsburg, east of Highway 133. There are a few businesses and homes inside the noise study area.

Current noise environment

The study of the existing noise environment is based on the measurement of existing noise levels in the environment. These measurements permit observations that can be used to describe the environment and the nature of the noise sources that it contains. The study of the noise environment is also based on simulations of ambient noise levels generated by road traffic; these simulations were performed in order to differentiate noise sources in the various sectors under study.

An inventory of the current noise environment was performed using MTQ's methodology (MTQ, 1998). The key noise survey findings are presented in the table below.

Table 5.1 Results of noise surveys carried out November 6-7, 2003.

Measurement position	Duration (h)	L_{eq} level[1] (dBA)
Point 1	24	61.8
Point 2	0.25	44.8
Point 3	0.25	43.0
Point 4	1	47.3
Point 5	1	51.2
Point 6	24	54.8
Point 7	1	58.0
Point 8	1	58.4
Point 9	1	62.9
Point 10	24	65.7
Point 11	1	70.2
Point 12	1	38.9
Point 13	24	65.3
Point 14	0.25	63.6
Point 15	0.25	59.3
Point 16	1	57.4
Point 17	1	60.7

[1] Ref.: $2x10^{-5}$ Pa.

Source: Impact study (Génivar, 2005).

With the exception of point 12, the primary noise source at each point was road traffic. The other noise sources identified included sources of human origin (local activity, property maintenance, children, etc.), sources of mechanical origin (planes, tractors, etc.), and natural sounds (song birds, barking dogs, rustling leaves, etc.).

Simulation of the noise environment and degree of disturbance

The current noise environment was analyzed in the noise study area using TNM 2.5 software, which is the software required by MTQ for noise impact studies. The mathematical model was calibrated using the results of the noise surveys performed in the noise study area.

The noise environment was evaluated for the year 2010, which is to say one year before the date at which the A-35 extension between Saint-Jean-sur-Richelieu and the U.S. border is expected to open. The simulations were based on average summer daily traffic (ASDT) data, determined according to counts performed by MTQ and carried forward to the year 2010, based on annual variations in traffic volume in previous years. The distribution of trucks was 1/3 intermediate-size trucks and 2/3 heavy trucks. Wooded areas were not taken into account (conservative approach), but the topography of the natural terrain was taken into consideration.

The intensity of noise disturbances inside the noise study area was determined on the basis of the results of the software-based simulations and the indications presented in the following table:

Table 5.2 Noise environment quality assessment grid.

Noise environment	Level of disturbance
65 dBA ≤ L_{eq} (24 h)	High
60 dBA < L_{eq} (24 h) < 65 dBA	Moderate
55 dBA < L_{eq} (24 h) ≤ 60 dBA	Low
L_{eq} (24 h) ≤ 55 dBA	Acceptable

Source: Impact study (Génivar, 2005).

Counts of homes in each sector were performed, based on the level of disturbance within the noise study area; the results of these counts are presented in tables 5.3 to 5.7.

Table 5.3 Level of existing noise disturbance without the A-35 extension (2010 – Iberville sector).

Level of noise disturbance		Number of residences	Percentage (%)
Acceptable	L_{eq} (24 h) ≤ 55 dBA	174	90
Low	55 dBA < L_{eq} (24 h) ≤ 60 dBA	15	8
Moderate	60 dBA < L_{eq} (24 h) < 65 dBA	5	2
High	65 dBA ≤ L_{eq} (24 h)	0	0
Total		**194**	**100**

Source: Impact study (Génivar, 2005).

The primary noise source is highway traffic. Residual noise from the residential sector and from local roads is no longer negligible in relation to the highway noise starting from Yvon Street. Most residences (98%) experience an acceptable or low level of noise disturbance.

Four (4) houses in the first row along the A-35 experience a moderate level of noise disturbance. The fifth house to experience a moderate level of noise disturbance is located further south along Highway 133.

With the exception of two houses along Chemin de la Grande-Ligne, which experience a low level of noise disturbance, homes in the rural segment (Chemin de la Grande-Ligne, Princesse Caroline Street and Montée Bertrand) experience an acceptable level of noise disturbance.

Table 5.4 Level of existing noise disturbance without the A-35 extension (2010 - Saint-Alexandre sector).

Level of noise disturbance		Number of residences	Percentage (%)
Acceptable	L_{eq} (24 h) ≤ 55 dBA	22	100
Low	55 dBA < L_{eq} (24 h) ≤ 60 dBA	0	0
Moderate	60 dBA < L_{eq} (24 h) < 65 dBA	0	0
High	65 dBA ≤ L_{eq} (24 h)	0	0
Total		**22**	**100**

Source: Impact study (Génivar, 2005).

All of the residences in this sector experience an acceptable level of noise disturbance. Traffic flow is relatively light.

Table 5.5 Level of existing noise disturbance without the A-35 extension (2010 - Saint-Sébastien sector).

Level of noise disturbance		Number of residences	Percentage (%)
Acceptable	L_{eq} (24 h) ≤ 55 dBA	0	0
Low	55 dBA < L_{eq} (24 h) ≤ 60 dBA	0	0
Moderate	60 dBA < L_{eq} (24 h) < 65 dBA	5	63
High	65 dBA ≤ L_{eq} (24 h)	3	37
Total		**8**	**100**

Source: Impact study (Génivar, 2005).

All homes in this sector experience a moderate to high level of noise disturbance. The proximity of the residences and the percentage of trucks are the primary sources for the noise level perceived by residents.

Table 5.6 Level of existing noise disturbance without the A-35 extension (2010 - Saint-Pierre-de-Véronne-à-Pike-River sector).

Level of noise disturbance		Number of residences	Percentage (%)
Acceptable	L_{eq} (24 h) ≤ 55 dBA	16	100
Low	55 dBA < L_{eq} (24 h) ≤ 60 dBA	0	0
Moderate	60 dBA < L_{eq} (24 h) < 65 dBA	0	0
High	65 dBA ≤ L_{eq} (24 h)	0	0
Total		**16**	**100**

Source: Impact study (Génivar, 2005).

All the residences in this sector experience an acceptable level of noise disturbance. Traffic flow is light.

Table 5.7 Level of existing noise disturbance without the A-35 extension (2010 - Saint-Armand sector).

Level of noise disturbance		Number of residences	Percentage (%)
Acceptable	L_{eq} (24 h) ≤ 55 dBA	97	73
Low	55 dBA < L_{eq} (24 h) ≤ 60 dBA	17	13
Moderate	60 dBA < L_{eq} (24 h) < 65 dBA	17	13
High	65 dBA ≤ L_{eq} (24 h)	1	1
Total		**132**	**100**

Source: Impact study (Génivar, 2005).

Most residences (86%) in this sector experience an acceptable or low level of noise disturbance.

The homes that experience a moderate or high level of noise disturbances are distributed as follows:

- eight along Highway 133 north of Champlain Street;
- eight along Highway 133 vis-à-vis Quinn and Allen Streets;
- two in the area close to the U.S. border.

5.1.6.2 Mitigation measures during the construction phase and scale of residual impacts

During a visit to the urban area lying west of the current A-35, between the A-35/R-133 interchange and the Canadian Pacific railway in the Iberville and Saint-Athanase sectors, no hospitals, schools (except the Hamel school located at 635 Yvon Street in Iberville, Saint-Jean-sur-Richelieu), daycare centres or seniors' residences were identified as likely to experience noise impacts during the construction and operational phases, nor was any such establishment identified in the course of an analysis of zoning and land uses authorized by the City of Saint-Jean-sur-Richelieu.

Table 5.8 outlines the noise thresholds that must be respected for the nearest noise-sensitive buildings (such as residences, the Hamel school, etc.) during construction of the A-35 extension, pursuant to the impact study and the MTQ specifications respecting construction noise management programs.

Table 5.8 Noise thresholds to be respected during the construction phase for the nearest noise-sensitive buildings

Time of day	Maximum L_{10} noise level[(1)]
Day (7 a.m. to 7 p.m.)	75 dBA or ambient noise [(2)] without construction work plus 5 dBA if greater than 75 dBA
Night (7 p.m. to 7 a.m.)	Ambient noise[(2)] without construction work plus 5 dBA

Source: Impact study (Génivar, 2005).

(1) Indicates that noise levels exceed the specified level for 10% of the sampling time. The sampling time is 30 minutes.

(2) Represented by an Leq (equivalent continuous noise level) measured over a minimum period of 24 hours (Leq_{24}) on at least two occasions (two non-consecutive days) before construction work begins.

The noise-generating equipment likely to be used during construction of the A-35 extension produces noise levels that range between 67 and 88 dBA at a distance of 15 metres.

It is not possible to predict the noise levels that will be perceived by residents since the noise levels ultimately generated by the construction project will vary according to several factors, including the distance between the noise-generating equipment and the residences in question, the duration of noise episodes, the type and number of machines operating simultaneously, etc. In the present case, much of the work will be performed in rural areas at a distance from any residences.

However, the construction zone will be within 50 metres of some residences at some point during the project. At these times, noise impacts may exceed the threshold permitted by MTQ for daytime work (75 dBA). Consequently, a noise monitoring program will need to be implemented in areas where there are residences less than 150 metres from the construction zone, once the equipment and timelines have been determined by the contractor.

The school is located more than 450 metres from the zone in which work to connect the existing roadway and the planned highway will take place (near Larivière Avenue). While the nature of the various construction activities, as well as the number, type, location and use frequency of various pieces of equipment are likely to vary considerably, it is possible, based on past experience and studies of similar

projects, to estimate the L10 noise levels that are likely to be generated. Table 5.9 presents these noise levels.

Table 5.9 Estimated L_{10} noise levels at a distance of 450 metres[7]

Construction phase	Estimated L_{10} level in dBA
Construction of access road / topsoil management	65
Foundation work	62
Earth moving	64
Paving	64

Source: Impact study (Génivar, 2005).

A construction site noise management program should be designed to limit construction noise to the greatest extent possible. The movement of trucks at the highway construction site should have no impact near the school, since no access road directly links the A-35 to the residential sector. Therefore, no trucks will pass near the school. The only routes for trucks are the current A-35 and Highway 133 (located further south), where truck traffic is already quite heavy. Furthermore, speeds should be reduced around the construction site, which will help to reduce noise levels.

Also, cut-off roads to divert traffic should be built along the current A-35 to permit construction at the extremity of the current highway. The noise generated by traffic along these cut-off roads, near the MTQ right-of-way, should be no greater than those currently generated along the A-35, since the speed limits on cut-off roads are generally lower (45 to 75 km/h) than those permitted on highways (100 km/h).

It should be noted that the work schedule for this sector will be forwarded to the school before the work begins.

However, mitigation measures to comply with the noise thresholds outlined in Table 5.8 should address the following aspects in particular:

- noise sources;
- noise propagation path between the construction zone and the residential area.

In view of the mitigation measures described in section 3.9.5 above, which will reduce to a minimum any noise disturbance caused by on-site work and traffic, the residual impact has been evaluated as not significant, owing to modification of the perceptible noise environment during certain construction activities, and of low intensity, owing to minimal increases in projected noise levels, the localized nature of the disturbance (within the vicinity of the construction sites), and its short-term duration (construction phase only).

Furthermore, no blasting-related noise impacts are anticipated for the time being; it is unlikely that blasting will be required given the absence of rock outcrops in the segment of the A-35 extension that is in the vicinity of the school.

[7] It is important to note that the noise levels for the Hamel school will be lower than this, since several buildings act as a screen between the school and the construction zone. Generally speaking, additional noise attenuation on the order of 1 to 7 dBA per row of houses can be achieved, depending on density and the height of houses.

Associated activities

The operation of quarries and sandpits may cause an increase in noise levels due to the excavation, loading and transportation of materials.

In order to control potential noise impacts, the following standards from the *Regulation Respecting Pits and Quarries* will be followed:

- It is prohibited to establish a new pit or quarry the operating site of which is located in a territory zoned by municipal authorities for residential, commercial or mixed purposes.
- It is also prohibited to establish a new quarry less than 600 metres from such territory or to establish a new pit less than 150 metres from such territory, including any school or other educational institution, place of worship, campground or any institution within the meaning of the *Act Respecting Health Services and Social Services* (R.S.Q., c. S-5).
- The operating site of a new quarry must be located at a minimum distance of 600 metres from any dwellings; in the case of sandpits, the minimum distance required is 150 metres. A new pit or quarry may nevertheless be established at a distance that is under the distances prescribed if the operator submits in support of his request an estimate of the maximum noise level that will be emitted into the environment by the operation of the new pit or quarry, and if the noise measured at the boundary of any residential, commercial or mixed zone and any structure or immoveable (school or other educational institution, place of worship, campground, or any institution within the meaning of the *Act Respecting Health Services and Social Services*) does not exceed 40 dBA between 6 p.m. and 6 a.m. and 45 dBA between 6 a.m. and 6 p.m.;
- It is prohibited to dynamite between 7 p.m. and 7 a.m. in a quarry situated less than 600 metres from a structure or immoveable mentioned above, even if such quarry was already in operation on August 17, 1977.

In view of the mitigation measures that will be applied, the residual impact of associated activities carried out during the construction phase on the noise environment has been evaluated as not significant owing to the moderate intensity of anticipated noise levels, the localized nature of the anticipated disturbance (in the vicinity of the extraction areas) and the short duration of the activities (period of quarry and pit operation required to build the new highway).

5.1.6.3 Mitigation measures during the operational phase and scope of residual impacts

Evaluation of the projected noise environment

The projected noise environment in the noise assessment study area when the A-35 extension opens and 10 years later has been determined through simulations performed with TNM 2.5 software, based on MTQ traffic volume projections. The distribution of trucks was 1/3 intermediate-size trucks and 2/3 heavy trucks.

A new count of existing residential buildings, based on the projected level of noise disturbance once the A-35 extension is in service (2011), was performed using the method described earlier. This was followed by a count of existing residential buildings 10 years later (2021).

Tables 5.10 to 5.14 present the residential building counts based on the projected level of noise disturbance for the years 2011 and 2021, in accordance with the criteria defined in Table 5.2.

Table 5.10 Projected level of noise disturbance (2011 and 2021 – Iberville sector).

Level of noise disturbance		In-service year (2011)		10 years later (2021)	
		Number of residences	Percentage (%)	Number of residences	Percentage (%)
Acceptable	L_{eq} (24 h) ≤ 55 dBA	169	87	159	82
Low	55 dBA < L_{eq} (24 h) ≤ 60 dBA	21	11	31	16
Moderate	60 dBA < L_{eq} (24 h) < 65 dBA	4	2	4	2
High	65 dBA ≤ L_{eq} (24 h)	0	0	0	0
Total		**194**	**100**	**194**	**100**

Source: Impact study (Génivar, 2005).

Most residences (98%) in the Iberville sector will experience an acceptable or low level of noise disturbance. The residences that will experience a moderate level of noise disturbance are located in the first row of houses east of the A-35 and north of the entrances/exits along Highway 133.

Table 5.11 Projected level of noise disturbance (2011 and 2021 – Saint-Alexandre sector).

Level of noise disturbance		In-service year (2011)		10 years later (2021)	
		Number of residences	Percentage (%)	Number of residences	Percentage (%)
Acceptable	L_{eq} (24 h) ≤ 55 dBA	22	100	22	100
Low	55 dBA < L_{eq} (24 h) ≤ 60 dBA	0	0	0	0
Moderate	60 dBA < L_{eq} (24 h) < 65 dBA	0	0	0	0
High	65 dBA ≤ L_{eq} (24 h)	0	0	0	0
Total		**22**	**100**	**194**	**100**

Source: Impact study (Génivar, 2005).

All residences in the Saint-Alexandre sector will experience an acceptable level of noise disturbance.

Table 5.12 Projected level of noise disturbance (2011 and 2021 – Saint-Sébastien sector).

Degree of noise disturbance		In-service year (2011)		10 years later (2021)	
		Number of residences	Percentage (%)		Number of residences
Acceptable	L_{eq} (24 h) ≤ 55 dBA	1	13	1	13
Low	55 dBA < L_{eq} (24 h) ≤ 60 dBA	7	87	7	87
Moderate	60 dBA < L_{eq} (24 h) < 65 dBA	0	0	0	0
High	65 dBA ≤ L_{eq} (24 h)	0	0	0	0
Total		**8**	**100**	**8**	**100**

Source: Impact study (Génivar, 2005).

All residences in the Saint-Sébastien sector will experience a low or acceptable level of noise disturbance.

Table 5.13 Projected level of noise disturbance (2011 and 2021 – Saint-Pierre-de-Véronne-à-Pike-River sector).

Level of noise disturbance		In-service year (2011)		10 years later (2021)	
		Number of residences	Percentage (%)		Number of residences
Acceptable	L_{eq} (24 h) ≤ 55 dBA	11	92	10	83
Low	55 dBA < L_{eq} (24 h) ≤ 60 dBA	1	8	2	17
Moderate	60 dBA < L_{eq} (24 h) < 65 dBA	0	0	0	0
High	65 dBA ≤ L_{eq} (24 h)	0	0	0	0
Total		**12**	**100**	**12**	**100**

Source: Impact study (Génivar, 2005).

All residences in the Saint-Pierre-de-Véronne-à-Pike-River sector will experience a low or acceptable level of noise disturbance.

It should be noted that three residences located within the boundaries of the A-35 right-of-way will be expropriated.

Table 5.14 Projected level of noise disturbance (2011 and 2021 – Saint-Armand sector).

Level of noise disturbance		In-service year (2011)		10 years later (2021)	
		Number of residences	Percentage (%)		Number of residences
Acceptable	L_{eq} (24 h) ≤ 55 dBA	111	84	111	84
Low	55 dBA < L_{eq} (24 h) ≤ 60 dBA	18	14	17	13
Moderate	60 dBA < L_{eq} (24 h) < 65 dBA	3	2	4	3
High	65 dBA ≤ L_{eq} (24 h)	0	0	0	0
Total		**132**	**100**	**132**	**100**

Source: Impact study (Génivar, 2005).

Most residences (97%) in the Saint-Armand sector will experience an acceptable or low level of noise disturbance. Two residences will experience a moderate level of noise disturbance: they are located in the first row of houses on either side of the A-35, south of Allen Street. Two other residences located near the U.S. border will also experience a moderate level of noise disturbance.

Noise impact during the operational phase

The term noise impact refers to the difference between the current noise level and the projected noise level. Noise impacts are evaluated using the evaluation grid provided in MTQ's *Traffic Noise Policy* (1998) (Annex B to Appendix 13 of the impact study (Génivar, 2005)). According to this grid, the greater the current noise level, the smaller the difference between that level and the projected noise level need be in order to generate a significant noise impact.

Each residence was considered on the basis of the noise impact it will experience (increased or decreased noise level) in the first year the A-35 extension is open (2011) and ten years later (2021), in

comparison to the situation that would exist in 2010, without the A-35 extension. A positive impact indicates that the residence in question will experience a reduction in noise levels, while a low, moderate or high impact indicates a commensurate increase in noise levels.

Tables 5.15 to 5.19 classify residences according to the increase in noise level (noise impact) they will experience, based on the MTQ grid.

Table 5.15 Noise impact for the Iberville sector.

Noise impact	In-service year (2011)		10 years later (2021)	
	Number of residences	Percentage (%)		Number of residences
Positive	47	24	41	21
Nil	124	64	7	4
Low	23	12	146	75
Moderate	0	0	0	0
High	0	0	0	0
Total	**194**	**100**	**194**	**100**

Source: Impact study (Génivar, 2005).

The results presented in Table 5.15 reveal the following with respect to the Iberville sector:

- 64% of residences will not experience any increase in noise levels when the new highway segment is operational;
- no residences will experience a moderate or high impact;
- the average increase in noise levels for residences that will experience a low impact is on the order of 1 dBA;
- the increase in traffic volume during the first 10 years of operation will cause an increase in the anticipated impacts. The increase in noise will be less than 2 dBA. During this period, 6 residences will move from the positive impact category to the nil category and 123 will move from nil to low.

Table 5.16 Noise impact for the Saint-Alexandre sector.

Noise impact	In-service year (2011)		10 years later (2021)	
	Number of residences	Percentage (%)		Number of residences
Positive	1	5	1	5
Nil	0	0	0	0
Low	21	95	21	95
Moderate	0	0	0	0
High	0	0	0	0
Total	**22**	**100**	**194**	**100**

Source: Impact study (Génivar, 2005).

The results presented in Table 5.16 reveal the following with respect to the Saint-Alexandre sector:

- 95% of residences will experience a low noise impact;
- no residence will experience a moderate or high impact;
- the increase in traffic volume during the first 10 years of operation will not cause an increase in the anticipated impacts. The noise increase will be less than 2 dBA.

Table 5.17 Noise impact for the Saint-Sébastien sector.

Noise impact	In-service year (2011)		10 years later (2021)	
	Number of residences	Percentage (%)		Number of residences
Positive	8	100	8	100
Nil	0	0	0	0
Low	0	0	0	0
Moderate	0	0	0	0
High	0	0	0	0
Total	**8**	**100**	**8**	**100**

Source: Impact study (Génivar, 2005).

The results presented in Table 5.17 reveal the following with respect to the Saint-Sébastien sector:

- all residences will experience a reduction in noise levels due to lower traffic volumes along Highway 133;
- the increase in traffic volume during the first 10 years of operation will not cause an increase in the anticipated impacts. The noise increase will be on the order of 1 dBA.

Table 5.18 Noise impact for the Saint-Pierre-de-Véronne-à-Pike-River sector.

Noise impact	In-service year (2011)		10 years later (2021)	
	Number of residences	Percentage (%)		Number of residences
Positive	0	0	0	0
Nil	0	0	0	0
Low	11	92	11	92
Moderate	1	8	1	8
High	0	0	0	0
Total	**12**	**100**	**12**	**100**

Source: Impact study (Génivar, 2005).

The results presented in Table 5.18 reveal the following with respect to the Saint-Pierre-de-Véronne-à-Pike-River sector:

- 92% of residences will experience a low noise impact;
- one residence will experience a moderate noise impact; this residence is located on Chemin du Bois and is closest to the new A-35 right-of-way;

- the increase in traffic volume during the first 10 years of operation will not cause an increase in the anticipated impacts. The increase will be on the order of 1 dBA.

Table 5.19 Noise impact for the Saint-Armand sector.

Noise impact	In-service year (2011)		10 years later (2021)	
	Number of residences	Percentage (%)		Number of residences
Positive	72	55	70	53
Nil	40	30	3	2
Low	20	15	59	45
Moderate	0	0	0	0
High	0	0	0	0
Total	**132**	**100**	**132**	**100**

Source: Impact study (Génivar, 2005).

The results presented in Table 5.19 reveal the following with respect to the Saint-Armand sector:

- more than half of all residences will experience a reduction in noise levels. These residences, which are located along Highway 133, north of Saint-Armand, will experience lower traffic volumes, as will residences on either side of the A-35 vis-à-vis Allen Street, since the highway will be lowered in this area;
- no residence will experience a moderate or high noise impact;
- the increase in traffic volume during the first 10 years of operation will cause an increase in the anticipated impacts. During this period, 2 residences will move from the positive impact category to the nil category and 39 will move from nil to low. The increase in noise will be on the order of 1 dBA.

In short, the new highway extension will bring about a significant reduction in traffic along Highway 133, improving the noise environment for residences located along that road, particularly in the municipalities of Saint-Armand, Saint-Pierre-de-Véronne-à-Pike-River, Saint-Sébastien, Henryville, Sabrevois and Iberville.

Mitigation measures

A toll-free telephone line will be made available to citizens in order to obtain their comments and answer any questions they might have about the project, particularly the noise aspect. Also, the MTQ Web site will contain a page providing the public with information on the Highway 35 project.

Local newspapers, as well as the MTQ Web site, will be used to disseminate information on the nature and duration of the project, as well as anticipated nuisances and mitigation measures; they will also provide telephone numbers the public can use to submit requests to MTQ.

A noise monitoring study will be carried out once the new highway is open, under the same conditions as the noise impact study, in order to measure actual noise levels associated with traffic along the A-35. These noise levels will then be compared with the projected levels, as well as with the community noise standards of the MDDEP. This monitoring study will be carried out over a two-year period, once the highway has been completed. It will provide a means of comparing simulated noise levels with real ones. If necessary, additional mitigation measures will be proposed.

A noise monitoring plan for the residence located on Chemin du Bois will be implement once the A-35 extension is open, in order to verify the accuracy of projected residual noise impacts for that particular

residence, as well as to evaluate the efficacy of the proposed mitigation measure, namely a noise barrier 2.4 metres high and 400 metres long. This monitoring plan is described in section 7.2. The results will be used to determine whether additional mitigation measures are needed.

Given that the level of noise disturbance has been evaluated as low or moderate, that some residences are likely to experience a reduction in noise levels, and that monitoring activities will be carried out in the operational phase to validate noise levels for existing residences located near the new highway, the residual impact on the noise environment has been categorized as not significant, its intensity low (worst-case increases of 1 dBA, which are imperceptible to the human ear), its scope local (vicinity of the highway) and its duration long (the entire life of the infrastructure).

5.1.7 Air quality

5.1.7.1 Description

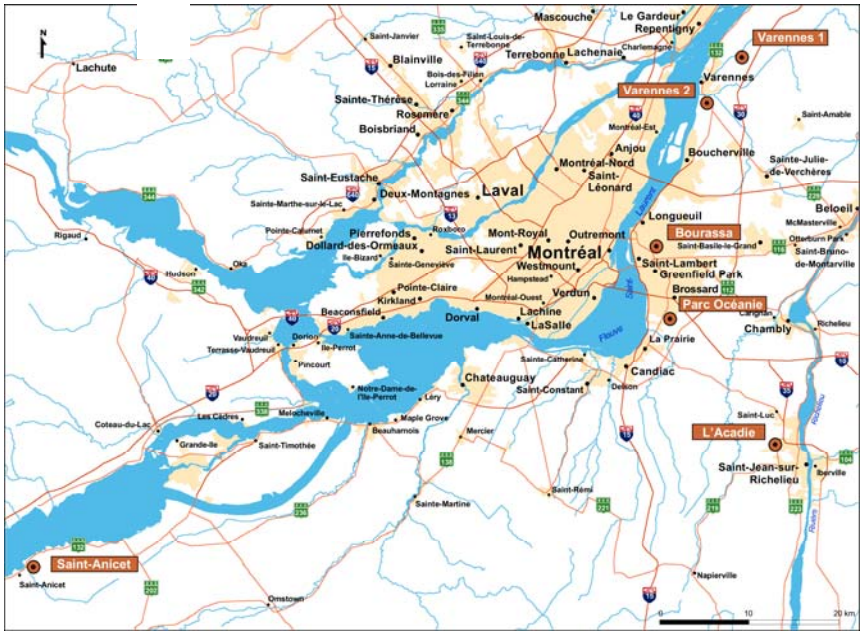
The evaluation of ambient air quality in the study area was based on data from measurement stations on the South Shore at Montreal. These stations are part of an air quality surveillance network operated jointly by MDDEP and Environment Canada (EC). The location of the stations is shown in Figure 5.1. The data were obtained from the environmental monitoring branch of the MDDEP.

Pollutants covered by the study

The air quality data obtained from MDDEP were analyzed and compared with the standards and guidelines in the current Quebec legislation (*Environment Quality Act* and *Regulation Respecting the Quality of the Atmosphere*). The main pollutants covered by the air quality assessment in the study area are the following:

- carbon monoxide (CO);
- nitric oxide (NO);
- nitrogen dioxide (NO_2);
- ozone (O_3);
- sulphur dioxide (SO_2);
- total suspended particulates (TSP);
- particulate matter of diameter less than 10 μm (PM_{10}).

Figure 5.1 Location of MDDEP and Environment Canada air quality monitoring stations in the study area.



Source: Impact study (Génivar, 2005).

Gaseous pollutants

The most complete data for the last seven years were acquired from MDDEP and analyzed for the periods where measurements were available. The Parc Océanie station at Brossard (1998-2002) and the Bourassa station at Saint-Hubert (1995-1998 and 1998-2004), located in a heavily urbanized area, present the most complete data series on the five gaseous pollutants. The Varennes 1 (1995-1998 and 1998-2004), Acadie (1999-2004) and Saint-Anicet (1994-2004, 1996-2004 and 1998-2003) stations are located at typically rural sites.

Suspended particulates

Data from the Parc Océanie (Brossard), Bourassa (Saint-Hubert) and Saint-Anicet stations relating to total suspended particulates (TSP) and particulate matter of diameter less than 10 μm (PM_{10}) are available for the years 1997-2001, 1988-2002 and 1988-2003, depending on the place and parameters considered. These data were used to estimate the health effects of particulate matter, as it is only very small particles that can cause health problems.

Characteristics of concentrations measured

Carbon monoxide (CO)

No exceedances of the standards were recorded at the Saint-Anicet and Varennes 1 stations during the measurement period considered. It is very likely that the CO standards would also be respected close to the major traffic arteries in the large urban centres, as well as in the zone considered.

Sulphur dioxide (SO_2)

Data on maximum concentrations are available for the Varennes 1 and Parc Océanie stations. The data show no exceedance of the SO_2 standard for the available measurement periods (30 ppm over 1 h and 13 ppm over 8 h).

Nitrogen oxides (NO_x)

Nitric oxide (NO) and nitrogen dioxide (NO_2) are the most relevant pollutants in terms of air quality in transportation studies. NO is the more significant in terms of volume at the time of emission, but it is quickly transformed by oxidation in the atmosphere to form NO_2. Most NO_x emissions in Quebec come from transportation activities (about 80%), particularly gas- and diesel-powered vehicles. Industrial combustion sources account for about 17%.

Nitric oxide (NO)

There is no mandatory air quality standards or guidelines for nitric oxide (NO), but it is still a toxic substance. However, it has no harmful effect in terms of air pollution, because it is quickly converted to nitrogen dioxide (NO2) in the presence of oxygen.

The heaviest maximum concentrations are recorded at Bourassa and Parc Océanie, which are located close to the urban centre of Longueuil.

Nitrogen dioxide (NO_2)

Maximum of NO_2 concentrations, based on hourly and daily observations at the Varennes 1, Parc Océanie, Bourassa, Saint-Anicet and Acadie stations, do not show any exceedance of the standards.

Ozone (O_3)

Ozone is known to be a highly reactive gas and a powerful oxidant that can cause health problems. Rising ozone concentrations are the result of chemical reactions between precursor pollutants emitted in large volumes in urban areas, in particular NO_x and volatile organic compounds (VOCs). However, observations reveal that ozone concentrations are lower in urban areas than in rural areas. The reason for this lies in the fact that when NO_2 begins the process of forming ozone, the NO accompanying the NO_2 reacts very quickly with the ozone as it forms. The presence of significant quantities of NO in urban air, generated by heavy automobile traffic, has the effect of momentarily reducing the ozone level.

The Acadie and Varennes 1 stations are representative of a rural area, while the Bourrassa Longueuil station is representative of an urban area. According to the results, between 1998 and 2003 there was relatively little exceedance of the one-hour standard, which is set at 80 ppb, especially at the Acadie Station, close to the study area. On the other hand, the CCME eight-hour standard, which is set at 65 ppb, was notably exceeded (in more than 1% of samples at the three stations) during 2001, and to a lesser extent during 1998.

Suspended particulates in the ambient air

With respect to suspended particulates in the ambient air, MDDEP statistics for 1997 show that transportation is responsible for around 12% of emissions in Quebec. Combustion in all its forms accounts for about 39%. There are different categories of suspended particles that can have severe consequences for health:

- total suspended particulates (TSP);
- particulate matter of diameter less than 10 μm (PM_{10})

Total suspended particulates (TSP)

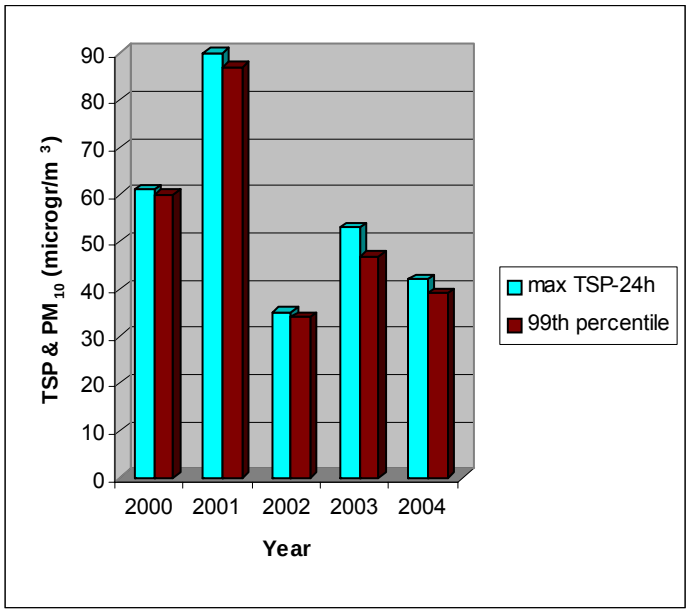
Suspended particulates with an aerodynamic diameter less than 40 μm come from various sources, both mobile and fixed. Their chemical and physical composition varies. They may be emitted directly into the atmosphere or they may form in the ambient air when gaseous pollutants react with fine suspended particles in the air. They can also become suspended in the air above roads, following the passage of vehicles of all kinds.

Figure 5.2 shows maximum TSP concentrations measured over 24 hours, and the 99th percentile recorded at the Acadie Station for the period 1998-2004. Table 5.26 shows maximum TSP concentrations over 24 hours at Parc Océanie and Bourassa (1998-2002), in urban areas, and Acadie (2000-2002), in a rural area.

Particulate matter of diameter less than 10 μm (PM_{10})

In general, suspended particulates with an aerodynamic diameter less than 10 μm (PM_{10}) are emitted by the passage of vehicles on unpaved roads, during the handling of construction materials, etc. The finest particles, with a diameter smaller than 2.5 μm ($PM_{2.5}$) can be inhaled and can reach the lungs. They come for the most part from motor vehicle combustion, the use of fossil fuels, and industrial and domestic activities.

Figure 5.2 Maximum TSP concentrations (μg/m^3) over 24 hours and 99th percentile (μg/m^3), measured at the Acadie Station between 1998 and 2004



Source: Impact study (Génivar, 2005).

Table 5.20 Maximum TSP concentrations (μg/m3) and number of exceedances observed over 1 hour at the Parc Océanie, Bourassa (1998-2002) and Acadie (2000-2002) stations

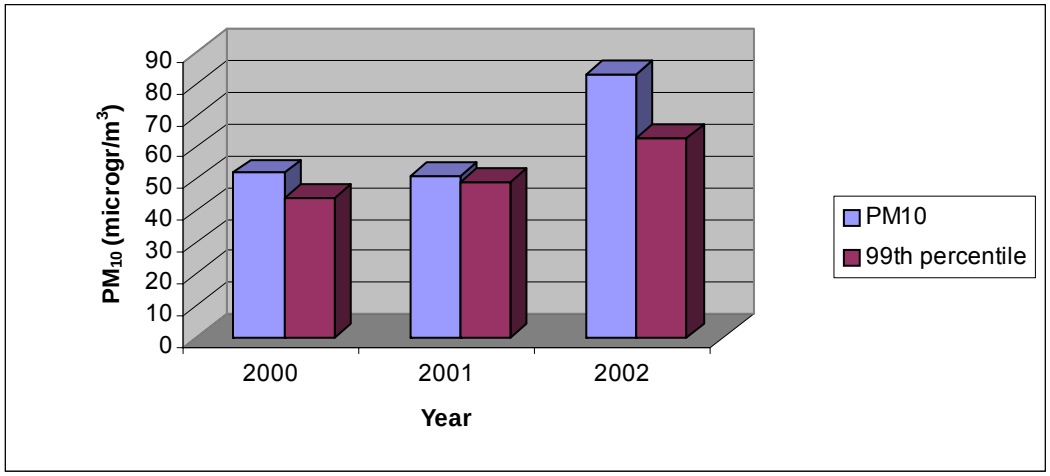
Measurement Station	Hourly maximum (μg/m^3)	Year	Exceedance of hourly standard (150 μg/m^3)
Parc Océanie	170	1998	1 (1998)
Bourassa	143	2001	1 (2003)
L'Acadie	90	2001	1 (2003)

Source: Impact study (Génivar, 2005).

Figure 5.3 shows the changes in maximum PM_{10} concentrations (μg/m^3) over 24 hours and the 99th percentile (μg/m^3) measured at Acadie over the period 2000-2002.

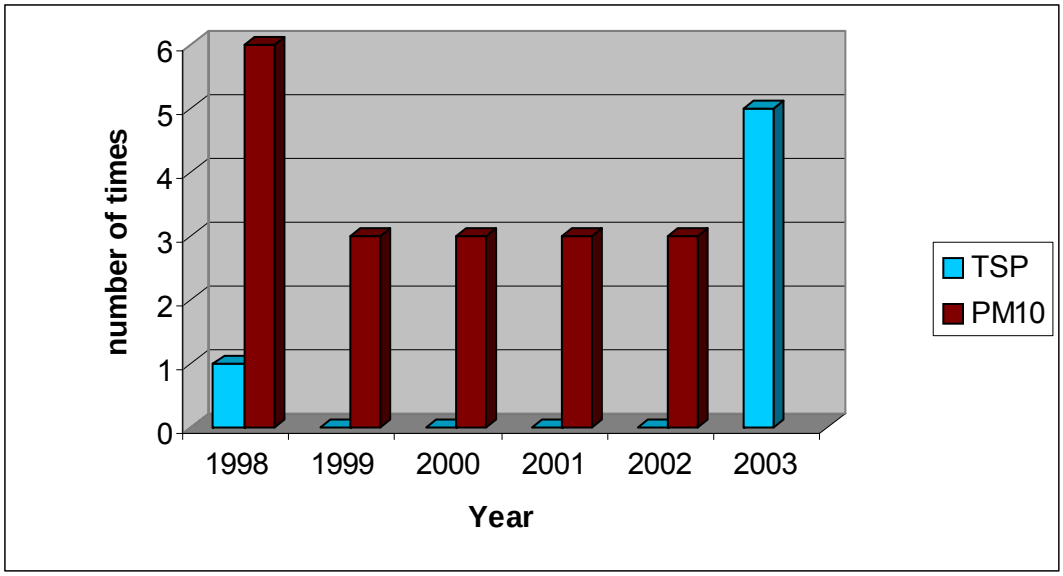
The maximum PM_{10} concentration over 24 hours measured between 1998 and 2003 is 138 μg/m^3, at the Parc Océanie station, and 83 μg/m^3, in 2002, at Acadie. Figure 5.4 shows the number of exceedances of the standards for TSP and for PM_{10} over 24 hours, recorded at the Parc Océanie station for the same period. The TSP standard is 150 μg/m^3, while the PM_{10} standard is 50 μg/m^3.

Figure 5.3 Maximum concentrations (μg/m^3) over 24 hours and 99th percentile (μg/m^3) measured at the Acadie Station between 2000 and 2002.



Source: Impact study (Génivar, 2005).

Figure 5.4 Exceedance of the maximum concentration standards for TSP and PM_{10} over 24 hours observed at the Parc Océanie station between 1998 and 2003



Source: Impact study (Génivar, 2005).

5.1.7.2 Mitigation measures during construction and significance of residual effects

During construction, the air quality effects will be localized and associated with the emissions from heavy machinery and equipment, as well as dust emission.

In addition to the mitigation measures included in the project, as presented in section 3.9.3, MTQ plans to adopt the following mitigation measures:

- MTQ will ask contractors to undertake regular maintenance of all diesel-powered equipment to keep it in proper working condition. Contractors will submit a preventive maintenance schedule at the outset of work. During its inspections, MTQ will make note of any situation deemed unsatisfactory and will promptly issue a correction order to the persons concerned, specifying the nature of the problem and the deadline for resolving it.
- In addition to the economic and technical guidelines, environmental criteria will be taken into consideration in the awarding of contracts. More precisely, aspects relating to pollutant emissions and noise will figure among the environmental criteria considered by MTQ. The use of energy-efficient vehicles will be encouraged.
- In addition to advising local residents of the hours during which the work is likely to generate particular nuisances (blasting, etc.) and taking all the necessary steps and precautions to protect persons and property, the worksite supervisor will monitor carbon monoxide (CO) concentrations during blasting operations near residences.

Given all the mitigation measures that are to be applied during construction work (section 4.8.4), the residual effect on air quality is considered not significant: it will be (1) of low intensity, involving only a small increase in atmospheric emissions; (2) localized in extent (near the construction sites); and (3) of short duration (the construction period).

Related activities

The operation of pits and quarries could have an impact on air quality. However, the following standards contained in the *Regulation Respecting Pits and Quarries* will be enforced, and they constitute special mitigation measures that have been proven effective in controlling the anticipated effects:

- Crushers, dryers, screens, conveyors, elevators and bins installed in a quarry and any feeding or dumping point for aggregate material removed from a quarry must not be employed in an activity or constitute circumstances resulting in the emissions into the atmosphere of dust visible more than 2 m from the source of emission.
- Where the sources of emission are linked to a collecting system for particulate matter, that matter must not be emitted in concentrations greater than 50 mg/m^3.
- Any equipment used or installed in a pit or quarry for the purpose of reducing or preventing the emission of pollutants into the environment shall at all times be in working condition and shall operate at optimum efficiency during the production hours of the plant, even if this equipment causes a reduction in the emission of pollutants that is well within the standards prescribed in this Regulation.
- Dust emissions from drilling operations carried out in a quarry must be controlled by the installation of a dust collecting apparatus linked to a dust collector system allowing not more than 50 mg/m^3 of particulate matter to be emitted into the atmosphere.
- Dust recuperated by dust collector systems must be handled and transported in such a way that there will be no loss of dust into the atmosphere visible more than 2 m from the source of emission. Where such dust is not recycled, it must be stored, deposited or disposed of on the ground, provided the required measures are taken to prevent any issuance of dust into the atmosphere visible more than 2 m from the source of emission.

The residual effect of quarry and pit operations on air quality during construction of the highway is considered not significant: it will be (1) of low intensity, as the standards have been established to avoid altering air quality; (2) localized in extent (the periphery of the extraction areas); and (3) of short duration, corresponding to just a portion of the highway construction schedule.

5.1.7.3 Mitigation measures during operation and significance of residual effects

The impact of the project on air quality were assessed for the sectors of Iberville (Saint-Jean-sur-Richelieu), Saint-Alexandre, Saint-Sébastien and Saint-Armand/Philipsburg, where interchanges are planned to serve the towns in the study area. The parameters selected for characterizing air-quality in the immediate neighbourhood of Highway 35 are carbon monoxide (CO) and nitrogen dioxide (NO_2).

MTQ estimates of Annual Average Daily Traffic (AADT) for the entire new highway segment, including access roads at the proposed interchanges, were taken into account in analyzing the impact of the project. The CO and NO_2 concentrations were calculated on the basis of hourly traffic during the peak morning period for the two base scenarios considered, i.e. the years 2011 and 2021. The year 2011 corresponds to the anticipated inauguration of the new highway, while the year 2021 represents its 10th year in service.

Table 5.21 presents the AADT estimates for each Highway 35 sector under study for the years 2011 and 2021.

Table 5.21 Estimated AADT by sector for the years 2011 and 2021

Scenario	Proposed interchanges							
	Iberville		Saint-Alexandre		Saint-Sébastien		Saint-Armand – Philipsburg	
	North	South	North	South	North	South	North	South
Year 2011	17,000	10,000	11,150	6,900	6,900	4,200	4,600	3,800
Year 2021	21,900	12,900	14,300	8,000	8,000	4,900	5,400	4,500

Source: Impact study (Génivar, 2005).

Estimated emission rates

Table 5.22 shows the emission rates (grams per mile) calculated using MOBILE6C[8] for the 2011 and 2021 summer and winter seasons. The calculations assume a constant and identical speed for all classes of vehicles considered. The vehicle pollutant emission rates are relatively higher in winter, as mixing in the lower atmospheric layers is sharply reduced because of relatively cold and stable air near the ground. It should also be noted that, with the gradual appearance of newer car models, emission rates are declining substantially as the years pass.

[8] Model developed by the U.S. Environmental Protection Agency, modified and adapted by EC to meet the needs of Canadian provinces.

Table 5.22 Estimated rates of CO, NO_x and HC emitted into the atmosphere for the years 2011 and 2021

Scenario	CO (g/m)		NO_x (g/m)		HC – VOC (g/m)	
	Winter	Summer	Winter	Summer	Winter	Summer
Year 2011	12.975	6.128	1.141	0.959	0.507	0.483
Year 2021	9.044	4.148	0.383	0.321	0.224	0.224

Source: Impact study (Génivar, 2005).

For all pollutants considered, the total mass that would be emitted by vehicles traveling in the study area was estimated using emission rates and AADT figures supplied by MTQ. Table 5.23 presents the annual balance sheet of atmospheric emissions in tonnes per year, for CO, NO_x and HC, under the two scenarios considered in the study.

Table 5.23 Estimated annual atmospheric emissions of CO, NO_x and HC for the years 2011 and 2021

Scenario	CO (t/yr)	NO_x (t/yr)	HC (t/yr)
Year 2011	1,830	161	71
Year 2021	1,566	66	39

Source: Impact study (Génivar, 2005).

Modelling and calculation of concentrations

The dispersion model used in the impact study is the CALINE4 model recommended by MDDEP, which can calculate concentrations near roadways for the main pollutants emitted by vehicles. It calculates pollutant concentrations under different weather conditions, particularly the most unfavourable ones that produce the highest concentrations on either side of the simulated roadway.

As noted above, the highest vehicle emission rates generally occur in winter. The simulations therefore assumed local weather conditions typical of the month of January.

The pollutants considered for each scenario are CO and NO_2. Between Saint-Jean-sur-Richelieu and the Saint-Armand/Philipsburg area, hourly CO and NO_2 concentrations were calculated for 406 potential receptors installed at a height of 1.5 m and at a distance of 200 to 300 m, depending on the area, and positioned on a notional grid extending along either side of the future highway.

The CO concentrations were calculated on the basis of an ambient air concentration of 2.8 ppm. This value is considered representative of ambient CO in the study area, as measured at the sampling stations on the South Shore at Montreal. For calculating NO_2 concentrations, an ambient atmospheric concentration of 75 ppb was assumed. Peak hourly traffic volume was estimated at 6.5% of AADT. Pollutant concentrations at the receptors were calculated on an hourly basis, and the maximum concentrations obtained were compared with the current standards and guidelines in Quebec: 20 ppm for CO and 220 ppb for NO_2.

Results

The concentrations calculated for each pollutant were analyzed separately for the years 2011 and 2021. The highest values were found in the immediate vicinity of the highway, and values declined gradually as distance from the road increased. The model predicts that the most critical concentrations will occur under unfavourable weather conditions, when the dispersion capacities of the pollutants are the lowest.

Tables 5.24 to 5.27 present maximum hourly concentrations of CO and NO_2, calculated for the years 2011 and 2021 in the four geographical locations selected from the study area. The independent variables X and Y are UTM coordinates, expressed in metres, for the points where the maximum concentrations of the various pollutants were found.

Table 5.24 Maximum CO and NO_2 concentrations calculated for 2011 and 2021 at Saint-Jean-sur-Richelieu

	CO (ppm)	X (m)	Y (m)	NO_2 (ppb)	X (m)	Y (m)
Hourly standard	20			220		
Scenario 2011	3	327188	5013895	73	330832	5011256
Scenario 2021	3	327188	5013895	71	330832	5011256

Source: Impact study (Génivar, 2005).

Table 5.25 Maximum CO and NO_2 concentrations calculated for 2011 and 2021 at Saint-Alexandre

	CO (ppm)	X (m)	Y (m)	NO_2 (ppb)	X (m)	Y (m)
Hourly standard	20			220		
Scenario 2011	3	3321171	5010502	63	332743	5010130
Scenario 2021	3	332171	5010502	61	332743	5010130

Source: Impact study (Génivar, 2005).

Table 5.26 Maximum CO and NO_2 concentrations calculated for 2011 and 2021 at Saint-Sébastien

	CO (ppm)	X (m)	Y (m)	NO_2 (ppb)	X (m)	Y (m)
Hourly standard	20			220		
Scenario 2011	3	334629	4997050	55	335759	4996227
Scenario 2021	3	334629	4997050	54	335759	4996227

Source: Impact study (Génivar, 2005).

Table 5.27 Maximum CO and NO_2 concentrations calculated for 2011 and 2021 at Saint Armand/Philipsburg

	CO (ppm)	X (m)	Y (m)	NO_2 (ppb)	X (m)	Y (m)
Hourly standard	20			220		
Scenario 2011	3	338535	4990788	59	337050	4994765
Scenario 2021	3	338535	4990788	58	337050	4994765

Source: Impact study (Génivar, 2005).

With an ambient concentration of 2.8 ppm, hourly CO concentrations calculated for the two scenarios are well below the hourly standard (20 ppm), and the MDDEP 8-hour standard (13 ppm). With respect to HC concentrations, calculations using the CALINE4 model show the same tendency as for carbon monoxide (CO). The ambient concentrations of HC can be expected therefore to show variation identical to that of CO, for both years considered (2011 and 2021). There is currently no standard for HC, and this parameter is not being measured at any of the sampling stations in the region under study.

With respect to NO_2, while the calculated concentrations remain well below the standards, the model is very conservative, as it does not imply any chemical reaction between the atmospheric components. This situation presupposes that all NO produced is automatically converted into NO_2, whereas in reality the quantity converted varies between 15 and 30%, depending on the situation. These estimates suggest, then, that the NO_2 concentrations measured along the future Highway 35 will always be below the official standards, in 2011 and in 2021.

As well, the anticipated increase in hourly traffic on the new Highway 35 at peak times will not lead to any increase in CO and HC concentrations, as the calculated emission rates show a net decline that will offset the future increase in traffic. NO_2 concentrations will also remain within the same orders of magnitude. Thus the overall decrease in direct emissions to the atmosphere should offset the traffic increase, especially during peak periods.

In conclusion, on the basis of data available for the region under study and the modelling of concentrations of the main pollutants associated with the passage of vehicles over the new highway during its operation, the residual effect on air quality of the Highway 35 completion project is deemed not significant: it will be (1) of low intensity (as estimated CO and NO_2 concentrations and several inhabited areas will not be altered and should even be improved); (2) localized in nature (near the roadway); and (3) of long duration (the entire service life of the highway).

5.2 Effects on the biophysical environment

The elements of the biophysical environment subject to assessment take into account the scope of the environmental assessment necessary to meet federal requirements regarding the project, and they concern more specifically terrestrial vegetation, wetlands and protected areas, species at risk and species of special status, as well as wildlife, in particular fish and migratory birds, and their habitats. There may also be socioeconomic effects associated with changes in any one of these components.

5.2.1 Terrestrial and riparian vegetation

5.2.1.1 Description

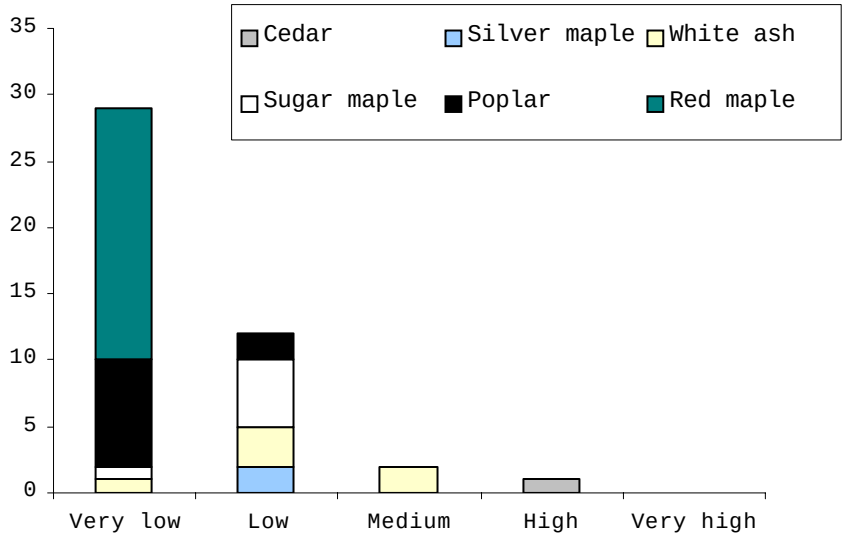
Ecological value of plant communities

This section presents a summary of the ecological value of the plant communities inventoried in 2003 along the proposed highway corridor. As noted in Annex 5.1 of the impact study (Génivar, 2005), the ecological value of a wooded area is determined by its species richness, the presence of species at risk, its age, its dynamic status and its regional and national distributions. The occurrences observed during the field inventories as well as those listed in the official databases (Annex 5.3 of the impact study, Génivar, 2005) have been integrated into the species-at-risk criterion as if they had all been observed in the field.

The ecological value of plant communities was considered to be representative of the environmental value of each community. Thus, to simplify the work of identifying and assessing effects, communities of similar ecological value were grouped and treated together. Ecological values were assigned as a

function of the vegetation characteristics of the communities, regardless of the particular type of stand to which they belong. To facilitate understanding of the five ecological value categories considered, the distribution of ecological values assigned as a function of the typical stands observed in the field is summarized below (Annex 5.5 (Génivar, 2005) and Figure 5.5).

Figure 5.5 Distribution frequency of woodlands inventoried along the planned corridor as a function of their ecological value



Source: Impact study (Génivar, 2005).

Woodland of high ecological value (20-25)

The cedar stand is the only woodland assigned a high ecological value for vegetation. This high value reflects primarily its rarity, age and relatively undisturbed structure. Its ecological value is further enhanced by the presence of four at-risk species, including wild leek, a species designated vulnerable.

Woodlands of medium ecological value (14-19)

The two woodlands of medium ecological value for vegetation are the white ash stands. These stands are characterized by an absence of disturbance, relatively high species richness, strong development of the sapling stratum with weak development of the seedling stratum, and a relatively significant presence of at-risk species, including wild leek.

Woodlands of low ecological value (8-13)

Of the 12 wooded areas assigned a low ecological value, two are popular stands, five are sugar maple stands, three are white ash stands, and two are silver maple stands. These stands are relatively undisturbed (< 10%), are located in the southern half of the study area, and the community dynamics indicates succession to climax species. These stands are generally relatively closed, intermediate to mature in age, and of variable species richness. Finally, half of these stands have species that are likely to be designated threatened or vulnerable.

Plant communities of very low ecological value (1-7)

Thirty-six plant communities have very low ecological value. They are highly variable in their characteristics and their composition. They include 3 wetlands, 1 pastureland, 1 shrubland, 2 clearcuts, 18 red maple stands, 2 grey birch stands, 1 white ash stand, and 8 poplar stands. These communities are located on flat land with few stones. In the woodlands of very low ecological value, the saplings and seedlings are declining. This may be attributable to their relatively young age and to the opening of the canopy as the stands mature. In general, the older the stand, the more severe the damage from ice storms. In addition, most of these stands are located in the northern half of the study area (survey map). The species richness of the older stands is low, while that of younger stands is high because they have been invaded by opportunistic species from fields and open areas. No species designated threatened or vulnerable occur in any of the plant communities. Two woodlands are home to one and two species likely to be designated, respectively. The pastureland contains three species likely to be designated, while one wetland (Streit Pond) contains six.

The ecological value of the wetlands (swamps, ponds and silver maple stands) has been estimated using the same criteria as for the other plant communities. Their value should however be revised upwards, because of the special status they are given under the *Federal Policy on Wetland Conservation*. The wetlands are presented in section 5.2.2.

The vegetation that grows along creeks and in agricultural ditches of the study area is presented in section 5.2.4, where the 20 streams that will be crossed by the highway are characterized. However, the residual effect of land clearing and construction activities on this component is presented in this section.

Conclusion

The qualitative survey of the 51 plant communities found along the proposed highway corridor reveals four types of environment: marshes and shrub swamps, clearcuts, pastureland, a shrubland dominated by hawthorne, and woodlands. Of these 51 communities, only one has high ecological value, two have medium ecological value, five have low ecological value, and 36 have very low ecological value. The successional status of regeneration is the main factor that contributes to reducing the ecological value of the communities. The number of at-risk plant species is the most important factor in raising the ecological value of woodlands that already reveal a healthy structure and a typical woodland vegetation composition. In general, the plant communities located to the southeast of the Rivière-aux-Brochets Ecological Reserve have characteristics that increase their value. By contrast, the communities located more to the north show weak structure and regeneration, primarily because of the 1998 ice storm.

5.2.1.2 Mitigation measures during construction and significance of residual effects

During construction, the activities involved in land clearing and leveling, grading, and digging ditches within the right-of-way will entail the permanent loss of about 80 ha of terrestrial plant communities and 0.7 ha of riparian vegetation. Activities at the construction sites, such as materials storage and machinery movements, could also produce losses.

All plant cover will have to be removed from the right-of-way in order to build the highway. The actual permanent loss of vegetation will be confined to the space occupied by the new roadway and its shoulders, and the entry and exit ramps. Beyond these sites, terrestrial vegetation cover will eventually return to the right-of-way. The lands immediately adjacent to the right-of-way will be seeded to promote rapid restoration of plant cover.

In this study, the only plant community of great environmental value is a cedar stand located north of Saint-Armand (at km 33). Plant communities of medium ecological value are the two ash stands located

on either side of the cedar forest (at km 33 and km 34). All the other terrestrial plant communities have low environmental value, primarily because their structure has been weakened by the 1998 ice storm.

During the construction period, no specific mitigation measures are considered necessary, beyond the general measures already presented in section 3.9.6.

The intensity of the anticipated effect on terrestrial plant communities of low ecological value is considered medium, because of the considerable clearing to which they will be subjected, especially in the northern half of the corridor (high degree of disturbance). However, the intensity of the effect on plant communities of medium and high ecological value is considered low, because these plant communities are located close to the existing Highway 133, and this stretch of road is already equivalent to a highway (low degree of disturbance). During the construction of Highway 35, only grading work will be required on this stretch of road, and little clearing will be necessary. In any case, the duration of the effect will be long (permanent loss of wooded areas) and the extent will be localized, limited to the right-of-way. The significance of the effects of the work is low for plant communities of low, medium and high ecological value.

In light of the stream bank restoration that will be done following the work, the intensity of disruptions attributable to construction will be low, as they will affect only a small portion of the riparian habitat and will not compromise its integrity; the extent will be local (riparian habitats within the right-of-way), and the duration will be short (temporary loss during construction, until vegetation cover is restored). The effect of construction work on riparian vegetation is thus considered not significant. Moreover, natural habitat losses are taken into consideration in the design of the compensation projects (see section 5.7.2).

The losses of terrestrial and riparian habitat during construction will have a potential effect on the availability of habitat and food, which could result in a decline in the wildlife species using this sector, with a consequent impact on hunting. In light of the planned restoration work on stream banks, however, the socioeconomic affect on hunting activities associated with this impact on the biological environment is considered not significant: it will be (1) of low intensity (there is little hunting in these areas), (2) localized in extent (certain portions of the highway right-of-way), and (3) of short duration (during construction).

The residual effects from loss of aquatic vegetation in wetlands, marshes, swamps and at stream crossings are presented in section 5.2.2.

5.2.1.3 Mitigation measures during operation and significance of residual effects

The anticipated effects during operation of the highway relate to the general degradation of vegetation areas bordering the right-of-way or changes to the species composition and structure of these plant communities. Species that are sensitive to trampling, soil compaction, changes in drainage patterns, and de-icing salt and, to a lesser extent, to winter desiccation will die back and will be replaced by more tolerant species.

As indicated in the provincial decree, MTQ is to transfer surplus forest lands (including the Saint-Alexandre woodland) to MDDEP for conservation purposes. Moreover, to reduce adverse environmental effects from loss of forest habitat, the cleared areas will be restored and the most severely degraded sites will be replanted.

The plant communities crossed by the future highway generally occupy small areas, and tend to be dominated by poplar, birch and sugar maple. The first two species are fairly tolerant of difficult conditions; whereas the sugar maple is sensitive to acidification, soil compaction and deterioration of air quality. The intensity of the effect is considered low, as the project will make no substantial change to the forest heritage of the region. The effect will be permanent (long) and localized, as the degradation will be felt beyond the right-of-way. Given the general mitigation measures planned, the residual effect is therefore considered not significant for all terrestrial and riparian plant communities in question.

5.2.2 Wetlands and protected areas

In order to describe the wetlands in terms of their vegetation and their potential as fish spawning and rearing habitat, a characterization was performed of five wetland areas affected by the highway completion project that were identified as having the potential for supporting fish species. For the location of the wetlands, see Figure 3.1, “Planned Corridor and Inventory of Natural and Human Environments”.

Ecological value of wetlands

According to the National Wetlands Working Group (NWWG, 1997), a wetland is a land which is saturated with water for a long enough period to promote such features as wet-altered soils and water-tolerant vegetation. Wetlands are characterized by poor soil drainage, and the presence of hydrophytes and various biological activities adapted to wet environments.

The wetlands were delimited through the use of photo interpretation. For the potential wetland of Barbotte Creek, the delimitation was done in the field using GPS.

The wetland types surveyed were classified using the Canadian Wetland Classification System (NWWG, 1997). For each wetland surveyed, a characterization field sheet was completed and accompanied by digital photographs. The wetland characterization is based on descriptors that can be used to attribute an ecological value to each wetland. The methodology and the design of the field sheet were adapted from Buteau et al. (1994) and based on the examples of Lacroix et al. (2006), Municonsult (2004) and Marineau and Couillard (2002).

The characterization criteria used were the following:

- wetland type
- surface area
- perimeter
- relative abundance of low-marsh herbaceous vegetation
- relative abundance of high-marsh herbaceous vegetation
- relative abundance of the shrub vegetation
- relative abundance of the tree vegetation
- number of vegetation strata comprising the wetland
- proportion of the area occupied by water where there is no vegetation (open water)
- proportion of the area occupied by water in vegetation (non-open water)
- proportion of the surface where there is water in the soil near the surface only
- number of connections to other wetlands
- type of connections to other wetlands
- identification of the adjacent environment
- presence of special-status species.

A wetland characterization field sheet was completed for each ecosystem visited. The field sheets and their associated photographs are described in the following document: Consortium Dessau-Aménatech. 2005. Fiches de caractérisation des milieux humides.

Wetland quality index

An indicative wetland quality index was calculated as a decision-making aid for each wetland visited. This index was prepared with the help of a weighting matrix that took account of the following biophysical factors: surface area, presence of open water, integrity of the adjacent environment, heterogeneity of the

environment, plants and animal species with special status, habitat fragmentation and hydroconnectivity.[9] The habitat quality index is based on the following weightings:

Surface area

To evaluate this criterion, the wetlands surveyed were subdivided into three size classes (< 2.5 ha, 0.5 to 2.5 ha, and > 0.5 ha) in order to distinguish their capacity to perform the following ecological functions: filtration capacity, water retention potential, capacity to recharge the water table, and capacity to support a diversity of plant and animal species.

Water

The presence of open water without vegetation, non-open water in vegetation, and water near the soil surface only are three indicators of a wetland's capacity to meet the various needs of wildlife, particularly in the spring during the breeding season (e.g. waterfowl broods). This criterion also serves to evaluate wetlands according to three different categories: the presence of open water without vegetation, the presence of non-open water in vegetation, and the presence of water in the soil near the surface.

Integrity

The integrity of the adjacent environment was weighted by determining whether it was a natural environment, a working agricultural environment, or a human environment (residential, commercial, industrial, transportation and other infrastructure), or a combination of these three types of environments. The wetlands were thus classified under one of the following seven categories: integrity of the adjacent environment, natural, natural-agricultural, natural-agricultural-human, natural-human, agricultural, agricultural-human, human.

Heterogeneity

The heterogeneity of the environment indicates a relatively high diversity of vegetation structure and consequently a relatively high capacity to support a diversity of wildlife. This criterion was evaluated as a function of the toposequence[10] of the physical structure of the vegetation present. With this approach, wetlands are classified into four categories, depending on the number of vegetation strata present. For a vegetation stratum to be considered in this assessment, its relative abundance must be 10% or more relative to the total plant cover.

Heterogeneity of the environment (vegetation structure):

- Presence of low-marsh[11] aquatic herbaceous species (cattails, rushes, etc.).
- Presence of high-marsh[12] palustrine herbaceous species (ferns, canary grass, etc.).
- Presence of a shrub stratum (willow, alder, etc.).

[9] The contribution of a wetland to the water system to which it belongs. This criterion is evaluated in light of the presence or absence of hydraulic connection between a wetland and one or more streams.

[10] Succession of related soils, attributable to variations in the relief.

[11] Plant communities that are flooded daily.

[12] Plant communities that are flooded occasionally.

- Presence of a tree stratum (silver maple, red maple, black ash, etc.).

Plant and animal species with special status

The wetlands were evaluated on the basis of the occurrence of plant and animal species with special status under federal or provincial legislation. They were classified according to the number of species present and their status. For a wetland plant or animal species to be associated with a specific site, it must be observed within a 100-m radius of that site.

The following databases were consulted: the Quebec Natural Heritage Information Centre (CDPNQ), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2006), MRNF (2006), MDDEP (2006), the Quebec atlas of amphibians and reptiles (AARQ) and Banque de données sur les oiseaux menacés du Québec (BDOMQ). In addition, all occurrences of species reported from field observations were considered in this evaluation.

Presence of plant or animal species with special status:

- Presence of at least one designated species.
- Presence of species likely to be designated

Fragmentation

Landscape fragmentation measures the connectivity between wetlands. “Interconnected” wetlands have greater ecological value because they allow the movement of species between them and contribute to greater genetic diversity. A wetland that is part of a system of wetlands will thus have a greater value than an isolated wetland.

Sites were evaluated as to whether there was connectivity with a natural terrestrial, wet or aquatic environment, or with several such environments. Any type of human infrastructure was treated as an element of fragmentation in this evaluation.

Hydroconnectivity

Hydroconnectivity measures the contribution of a wetland to the water system to which it belongs. This criterion is evaluated in light of the presence or absence of hydraulic connection between a wetland and one or more streams.

Determination of ecological value

The points awarded to each of the assessment criteria are totaled to determine a habitat quality index for each wetland surveyed in the study area, for a maximum of 100 points (Table 5.28).

Table 5.28 Classification of wetlands by the habitat quality index

Ecological value	Habitat quality index	Class
80 to 100	Very high	5
60 to 79	High	4
40 to 59	Medium	3
20 to 39	Low	2
0 to 19	Very low	1

Adapted from Lacroix *et al*. (2006).

The ecological value of the wetlands examined is presented in Table 5.29

Table 5.29 Weighting for each of the biophysical descriptors used to assess the ecological value of wetlands

Site	Area	Water	Integrity of adjacent environ-ment	Heterogeneity	Special-status fauna and flora	Fragmentation	Hydroconnectivity	**Class**	**Quality index**	**Ecological value**
Swamp WL-1	8	10	7	4	0	10	10	**3**	**Medium**	**49**
Silver maple stand WL-2	10	3	7	6	0	10	10	**3**	**Medium**	**46**
Silver maple stand WL-3	10	3	8	6	10	10	10	**3**	**Medium**	**57**
Banks of Barbotte Creek WL-4	--	--	--	--	--	--	--	**--**	**--**	**--**
Streit Pond WL-5	10	10	7	2	30	0	10	**4**	**High**	**69**

WL-1 (Swamp adjacent to Brochets River)

According to NWWG (1997), this wetland is a swamp. It has an area of 7.1 ha. The swamp lies west of the Brochets River. About 40% of the surface is open water. Two vegetation strata, the first being a low herbaceous stratum dominated by grasses, frog-bit and arrowhead, and the second a high herbaceous stratum dominated by cattails and reed canary grass. The swamp is relatively confined: a gravel road borders it to the north, east and west, while the Bellefroid-Archambault Creek lies to the south. There is direct hydroconnectivity between WL-1 and this creek. No special-status species were discovered during the survey. The weighting of each biophysical descriptor produces a medium habitat quality index for the swamp. However, this ecological value is revised upward because of its potential as fish and muskrat habitat. Thus, swamp WL-1 is considered to have high ecological value.

This swamp has very good potential for fish spawning, and in particular for pike. In scientific hoop-net fisheries conducted at the swamp's junction with Bellefroid-Archambault Creek, 10 fish species were surveyed, some of which, such as the golden shiner, were at spawning stage V. In light of the vegetation present, the swamp offers excellent spawning potential for pike, brown bullhead (or common catfish), golden shiner, yellow perch, and bowfin.

WL-2 (Silver maple stand south of WL-1)

This wet deciduous community is a swamp with silver maple, under the terms of NWWG (1997). It is located on the west bank of the Brochets River. It has an area of 38.7 ha. There is no open water in this wetland. Three stations were visited in the stand, and the herbaceous stratum was identified for each station (Table 5.30). Three vegetation strata are present. Generally, the size of the herbaceous stratum varies significantly within the stand. It seems to become denser at the stations nearer the river, however. The principal species found are: nettles (*Boehmeria cylindrica* and *Laportea canadensis*), sensitive fern, royal fern, spotted jewelweed, and several species of grass. In locations where the herbaceous stratum was less dense, it ranged in height from 10 to 30 cm, while at locations where it was denser (stations RB-2 and RB-3), the height varied from 20 to 100 cm. Finally, the field visit found a herbaceous clearing measuring about 30 m x 30 m at the edge of the river, as well as a cattail marsh located within the maple stand. The stand is bordered by agricultural land to the north and east, and there are a few private vacation cottages in one area. The stand is directly connected to the Brochets River, which floods the stand during the spring freshet. The entire stand is included within an ecological conservation area

The ecological value of the silver maple stand is rated medium. However, that value should be increased in light of the site's spawning potential for certain aquatic species: it has good spawning potential for brown bullhead and pike, among others, when the Brochets River crests and floods the herbaceous stratum. Moreover, its ecological value is in fact recognized by its protected status under current regulations.

Table 5.30 Composition of the herbaceous stratum (silver maple stand WL-2 near the Brochets River)

Station	Location	Coordinates	Dominant species (% cover)	Other species found (% cover)
BR-1	Silver maple stand near the road	45°05'16.5" N, 73°05'12.4" W	Sensitive fern (15%)	Silver maple (10%), nettles (5%), *Carex* sp. (1%)
BR-2	Silver maple stand near the river	45°05'19.9" N, 73°05'05.7" W	Nettles (80%)	Sensitive fern (10%), grasses (5%), royal fern (5%)
BR-3	Riverbank	45°05'19.5" N, 73°05'01.1" W	Nettles (80%)	Sensitive fern (10%), grasses (5%), royal fern (5%)

WL-3 (Silver maple stand east of the Brochets River)

This wetland is a silver maple swamp, under the terms of NWWG (1997). It is located east of the Brochets River. It has an area of 189 ha. It has no open water. Three vegetation strata are present: low herbaceous, shrub and tree. The integrity of the area surrounding this wet deciduous community is primarily intact, but there are some agricultural fields to the east. The wetland is directly connected to three watercourses—the Brochets River, Edwin Creek and Louis-Rocheleau Creek—as well as a major body of water, Missisquoi Bay (Lake Champlain). The southwest portion of WL-3 is protected by the Rivière-aux-Brochets Ecological Reserve, and the entire stand is included in an ecological conservation area. One herbaceous plant likely to be designated threatened or vulnerable was found in this wetland: *Eragrostis hypnoides*, a species associated with wet prairies and sandy river banks of the St. Lawrence Lowlands (Génivar, 2005).

The ecological value of the silver maple stand is rated medium. However, that value should be increased in light of the site's spawning potential for certain aquatic species: like WL-2, it has good spawning potential for brown bullhead and pike, among others, when the Brochets River is at high flow and floods the herbaceous stratum. Moreover, its ecological value is in fact recognized by its protected status under current regulations at different levels of government.

WL-4 (Banks of Barbotte Creek)

According to the Canadian Wetland Classification System (NWWG, 1997), the banks of Barbotte Creek are considered a dry zone (non-wetland).

There is some question about the high water line along the left bank of Barbotte Creek. The field visit sought to identify elements for delineating the high water line (traces of ice, wood debris, silt) and to characterize any wetlands next to the creek. The field visit covered a reach of approximately 800 m and revealed that the creek is deeply entrenched over this entire reach by relatively high, steeply sloping banks. Moreover, the higher portions of the banks show no indicators of wetland nor any indicators of the presence of the high water line. The only wetland observed along this reach is a small riparian marsh (approximately 875 m²), located near a former creek bed (45°16'39.5" N, 73°12'37.1" W) and composed almost exclusively of common reeds. The characterization of the left bank was done at several stations, the most representative of which is shown in the field sheet. For each station, the bank had a minimum height of 2.5 m.

As described in the characterization, however, Barbotte Creek offers good potential for fish as feeding, spawning, rearing and shelter habitat.

WL-5 (Streit Pond)

This wetland is a basin marsh (NWWG 1997). Streit Pond is composed primarily of tall herbaceous vegetation such as cattails and reed canary grass. The surrounding area is primarily in the natural state, although there is some farming in the vicinity, and Highway 133 runs nearby. The site is relatively isolated, and has only one outlet, to the east. Five special-status species are listed in the literature: least bittern, golden-winged warbler, cerulean warbler, western chorus frog, and pickerel frog (BDOMQ database; Morneau, 2003; CDPNQ-faune database; Génivar 2005).

Several stations in the adjacent wetlands were visited, and the forest composition noted for each station (Table 5.31). The woodlands are generally mature, with large trees and a wide diversity of deciduous species. Hemlock stands were noted in particular along the cliff bordering the pond to the east. Further to the interior, deciduous stands are dominant.

According to the biophysical analysis, Streit Pond has a high habitat quality index. However, the index should be raised to very high, given the recognition and protection accorded the site. The pond is provincially protected: it has the status of waterfowl gathering area, and is therefore protected under the Quebec *Act Respecting the Conservation and Development of Wildlife* and its *Regulation Respecting Wildlife Habitats*. At the federal level, the pond is part of the Migratory Bird Sanctuary protected under the 1994 *Migratory Birds Convention Act* and the *Migratory Bird Sanctuary Regulations*.

No information concerning fish species is available for this basin marsh. However, it is likely to contain several cyprinids.

Table 5.31 Composition of tree stands near Streit Pond

Station	Location	Coordinates	Dominant species	Other species found
SP-1	East side of Streit Pond, near the bank	45°01'42.5" N, 73°04'16.8" W	Eastern Hemlock	Sugar maple, ironwood, red oak, cedar, white birch
SP-2	East side of Streit Pond, within the tree stand	45°01'37.9" N, 73°04'19.8" W	Sugar maple	Black ash, red oak, burr oak, eastern hemlock, ironwood, cedar, shagbark hickory, white birch, basswood.
SP-3	West side of Streit Pond, between the road and the pond	45°01'44.2" N, 73°04'42.4" W	American elm	Red ash, pin cherry, hemlock, Manitoba maple
SP-4	North of the pond	45°01'47.4" N, 73°04'20.5" W	Sugar maple	American elm, black ash, oaks, shagbark hickory, black walnut, hemlock, white pine

Protected areas

The Philipsburg Migratory Bird Sanctuary, covering 525 ha, is located on the east shore of Missisquoi Bay in the municipality of Saint-Armand. Bird Protection Quebec owns close to 480 ha in the sanctuary, which comprises Streit Pond and the Saint-Armand hills. The sanctuary was created in 1955 by the Canadian government, under the *Migratory Birds Convention Act*, to protect numerous bird species during their breeding period. Some of those species, such as the redheaded woodpecker and cerulean warbler, are at risk. Footpaths and a cross-country ski trail have been built within the sanctuary, but hunting and fishing are prohibited. (Web site of the Canadian Wildlife Service, Quebec Region: www.qc.ec.gc.ca).

The area also has an ecological reserve (Rivière-aux-Brochets Ecological Reserve), three types of wildlife habitat (two waterfowl gathering areas, a muskrat habitat, and a white-tailed deer yard), the Missisquoi Bay Nature Refuge, and a former fish sanctuary, which today is classified as a "privately managed water body". These areas are located near Missisquoi Bay.

In addition, there is a spiny softshell turtle nesting area at the foot of the bridge at Saint-Pierre-de-Véronne-à-Pike-River, which has been protected since June 2003. The species is designated threatened under both federal and provincial law.

5.2.2.1 Mitigation measures during construction and significance of residual effects

Two silver maple stands located on either side of the Brochets River (km 36-37) will be affected by the project. As to marshes, the only natural elements of this type that will be affected by the work are Streit Pond (km 36-37) and two small marshes located east of Highway 133, and north of Saint-Armand (km 34-35). There is also a small marsh on the west bank of the Brochets River, near the future bridge crossing (km 28.5).

A total of 0.95 ha of silver maple stand will be lost as a result of the project, rather than the 1.17 ha initially anticipated, because MTQ has made improvements to the highway corridor. With the improvements, the marshland losses estimated in the preliminary proposal amount to 3.02 ha. A total loss of 1.98 ha (28.3% of the total surface area) is anticipated in the marshland located at km 34 (because of construction of the control post), while a loss of 37 m² (0.06% of its total area) is expected in a small marsh located at km 35. With respect to Streit Pond, located between km 36 and 37, habitat losses around its edge are estimated at only 429 m², or 0.1% of its total area.

During construction, no other specific mitigation measures are considered necessary, beyond the restoration of the affected banks to their natural state, and the general measures presented in section 3.9.6.

Apart from the silver maple stands and the marshes along Highway 133, for which a medium ecological value has been assigned, the intrinsic ecological value of the plant communities located along creeks and ditches may be rated low. However, given their functional roles (limiting bank erosion and protecting fish habitat) and the protected status they are accorded under the Quebec policy respecting the protection of banks, shores and floodplains, their intrinsic value is raised to medium.

The degree of disturbance of the silver maple stands, creeks and agricultural ditches is rated medium (medium intensity), as there will be little loss of surface area from construction of Highway 35. As to the marshes, their location with respect to Highway 133 and the work to be undertaken for its upgrade suggests little disruption (low intensity). The duration of the effect will be long (permanent loss) and the extent localized (certain areas within the right-of-way) for all these elements. The residual effects of the work will therefore be not significant for the silver maple stands and the plant communities located along the creeks, and not significant for marshes along Highway 133.

The impact of the project on wildlife habitat in the Philipsburg Migratory Bird Sanctuary are described in section 5.2.5, and are considered not significant. Considering the location of the other protected areas,

which are not under federal jurisdiction, the nature of the work and the mitigation measures to be applied, the residual effects on these sites are considered non-existent or not significant, during both the construction and operation of the highway.

In addition, the effect on marshes (Streit Pond and others), i.e. loss of wetland habitat, could have a potential impact on use by the public, as Streit Pond is considered to have recreational and tourism potential (site of choice for migratory bird watching). A mitigation measure has been included in the project design to limit work in the bird sanctuary as much as possible, and the small portion of the sanctuary that will be affected is a grassed embankment. The residual effect is therefore considered not significant: it will be (1) of low intensity, as the losses of area will not compromise the integrity of the environment; (2) localized in extent (limited to the wetlands within the right-of-way); and (3) of long duration (permanent loss).

5.2.2.2 Mitigation measures during operation and significance of residual effects

Because of their ecological importance, the marshes and swamps at the mouth of the Brochets River were subjected to a specific assessment. The presence and operation of the highway and bridge could have an impact on water quality in this sector, as a result of the use of de-icing salt. The presence of the bridge, piers and fill could also modify local drainage patterns and affect neighbouring plant communities.

Various mitigation measures will be implemented in respect of the wetland adjacent to the Brochets River to limit the potential adverse effects of road salt. These measures relate primarily to road salt management (section 3.8.1) in sensitive areas. Salinity, vegetation and wildlife in this area will be monitored to document any changes and, if necessary, measures will be taken to adapt salt management accordingly on this sector of the highway.

As a special measure, it is also planned to channel runoff from the roadway and the Brochets River bridge to points outside the floodplain. To this end, a surface ditch will be built at the top of the embankment, running to the boundary of the floodplain, together with a “constructed wetland” to filter runoff water before its discharge into the environment, so as to avoid the accumulation of chlorides in this habitat.

In light of its size, its general quality, its biological integrity and its mosaic of habitats, the ecological value of this sector is rated high. The degree of disruption, however, is considered low (low intensity), since there will be little change to the water regime or to water quality. Moreover, because water quality in the Brochets River is already seriously affected by agricultural discharges, the impact of the highway on water quality will be low. The residual effect is considered not significant: it will be (1) of medium intensity (because of the ecological importance of the affected environments); (2) localized in extent (confined to the right-of-way); and (3) of long duration (throughout the service life of the highway).

5.2.3 At-risk or special-status species

5.2.3.1 Description

Table 5.32 provides a listing of plant and animal species given special federal status under the *Species at Risk Act* (SARA). Schedule 1 of SARA was consulted on May 30, 2008.

Table 5.32 List of species with special status under the *Species at Risk Act* (SARA) potentially present in the study area

Mammals

Species	Latin name	SARA status
Woodland vole	*Microtus pinetorum*	Special concern

Birds

Species	Latin name	SARA status
Least bittern	*Ixobrychus exilis*	Threatened
Harlequin duck	*Histrionicus histrionicus*	Special concern
Barrow's goldeneye	*Bucephala islandica*	Special concern
Red-shouldered hawk	*Buteo lineatus*	Special concern
Barn owl	*Tyto alba*	Endangered
Short-eared owl	*Asio flammeus*	Special concern
Redheaded woodpecker	*Melanerpes erythrocephalus*	Special concern
Loggerhead shrike (migrans subspecies)	*Lanius ludovicianus*	Endangered
Cerulean warbler	*Dendroica cerulea*	Special concern
Louisiana water thrush	*Seiurus motacilla*	No status under SARA Last COSEWIC designation: Special concern
Golden-winged warbler	*Vermivora chrysoptera*	No status under SARA Last COSEWIC designation: Threatened
Rusty blackbird	*Euphagus carolinus*	No SARA status SARA Last COSEWIC designation: Special concern

Amphibians and reptiles

Species	Latin name	SARA status
Milksnake	*Lampropeltis triangulum*	Special concern
Wood turtle	*Clemmys insculpta*	Special concern
Northern map turtle	*Graptemys geographica*	Special concern
Spiny softshell turtle	*Apalone spinifera*	Threatened

Fish

Species	Latin name	SARA status
Bridle shiner	*Notropis bifrenatus*	Special concern

Vascular plants

Species	Latin name	SARA status
False hop sedge	*Carex lupuliformis*	Endangered
American ginseng	*Panax quinquefolius*	Endangered

Source: Species at Risk Public Registry–list of species) (Web site: http://www.registrelep.gc.ca/species/schedules_e.cfm?id=1

Mammals

The **woodland vole** is rare in Canada, where it has been observed in southwestern Ontario, north of Lake Erie and southernment Quebec. This vole inhabits dense hardwood and mixedwood forests. It prefers well-drained sites with a thick layer of humus (Desrosiers et al., 2002)

Birds

According to the database on threatened birds in Quebec (BDOMQ), there are five at-risk bird species that have established breeding grounds in the study area (BDOMQ, 2003): the least bittern, redheaded woodpecker, loggerhead shrike, golden-winged warbler and cerulean warbler (Table 5.33).

Table 5.33 List of bird species at risk and year last reported

Species	Latin name	Last reported
Least bittern	*Ixobrychus exilis*	2005
Redheaded woodpecker	*Melanerpes erythrocephalus*	1985
Loggerhead shrike	*Lanius ludovicianus*	1987
Cerulean warbler	*Dendroica cerulea*	2004
Golden-winged warbler	*Vermivora chrysoptera*	1999

Source: Impact study (Génivar, 2005).

The **least bittern** is designated as a threatened species by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and it is included on the Quebec list of species likely to be designated as a threatened or vulnerable species. It nested at Streit Pond between 1991 and 1996, but has since been seen only in 2003. This species breeds primarily in freshwater marshes containing cattails and ponds and along slow moving streams bordered by dense vegetation (bulrushes, sedge grass, reeds (Fragnier, 1995)). During visits to the study area in 2003, special attention was paid to Streit Pond. In early May, the species was heard in a bay on the west side of the pond, and on June 5 and 6 one individual was heard and seen at the northern end of the pond. The beginning of June is the earliest laying time for the species (Gauthier and Aubry, 1995). During the visit of July 3, the species was neither seen nor heard, despite the use of a call play-back. The site is located 300 m from the existing road, where an interchange is planned to connect with Chemin Saint-Armand.

The **loggerhead shrike** is considered endangered in Canada and is designated threatened in Quebec. It nested in 1987 on the west side of Highway 133, where it becomes a four-lane highway. The site was discovered in 1987 but has not been used since. In recent years, a portion of this habitat was cleared for farmland. In July 2003, clearing was under way in the rest of the habitat. No instance of breeding by this species has been reported in Quebec since 1996 (Laporte, 2002; Table 3.22). The species finds excellent breeding habitat in abandoned fields where there are hedges and thorny shrubs, such as hawthorn (*Craetegus* spp.) with perhaps some conifers and tall isolated trees that can serve as hunting perches (Laporte, 2002).

The **golden-winged warbler**, although it currently has no status under SARA, was listed as threatened in the most recent designation by COSEWIC (Committee on the Status of Endangered Wildlife in Canada) and is on the Quebec list of species likely to be designated threatened or vulnerable. It is a newcomer to Quebec, where it has been nesting for only the past 30 years or so. This northward expansion of its range was short-lived, and the species has been in constant decline since the 1990s (Bannon, 2002). In recent years (1997 to 2001), only 16 nesting sites were reported. In the study area, and more particularly in the Philipsburg Migratory Bird Sanctuary, the species (singing males) was observed at four sites in the 1990s, but none were found at these sites in 2000 or 2001 (BDOMQ, 2003). Two of these sites are located less than 600 m from Highway 133, before the customs station on the west side of the road and near the sanctuary parking lot (CDPNQ, 2003). The second site is on private land that is no longer accessible, and the parking lot has had to be relocated. During visits made to the first site in the spring

and summer of 2003, the species was not heard again. This warbler's preferred nesting habitats are clearings, forest edges, beaver ponds and old fields in forest areas where there are shrubs along the forest edge (Bannon, 1995).

The **cerulean warbler**, which COSEWIC (2006) considers a species of special concern in Canada and is likely to be designated threatened or vulnerable in Quebec (MRNF, 2006), nests in large mature deciduous forests, both flooded and well-drained, in which tall trees are present (24 to 30 m) (Morneau, 2002; Paquin, 2003). The Quebec database on threatened birds (BDOMQ) shows that six males (see protected area section x) and one female were present in the Philipsburg sanctuary in 1997 (Morneau, 2003). The population decline is attributable in part to the loss of breeding habitat, due largely to the expansion of farming, forestry activities and urbanization, all of which are occurring in the study area. Morneau (2002) mentions that the cerulean warbler is particularly sensitive to the fragmentation of forest habitats. In agricultural landscapes, its presence is believed to depend on the size of the residual pockets of forest. Pockets of between 10 and 1,600 ha have been identified as the minimum area for establishment of the species (Morneau, 2002). The 1998 ice storm was a natural event that had an adverse impact on reproduction of the species.

The **redheaded woodpecker** is listed as a species of special concern at the federal level (COSEWIC, 2006) and as a species likely to be designated as threatened or vulnerable at the provincial level (MRNF, 2006). It nests in mature forest stands containing dead trees, as well as in urban parks and in tree hedges bordering rivers and fields (David, 2002; Paquin, 2003). The Quebec population is estimated at less than five pairs, while there are thought to be between 2,000 and 15,000 pairs in Canada (David, 2002). The population decline in Quebec is attributable to the loss of habitat to agriculture, the cutting of mature trees and removal of snags, collisions with vehicles, the use of creosote on utility poles, and interspecies competition with the European starling (David, 2002).

Of these at-risk species, only the sites of the least bittern, loggerhead shrike and golden-winged warbler sites (two of four observation sites) are located in the vicinity of the proposed highway corridor (Table 5.40). All of these species were observed south of the corridor near Streit Pond and the Philipsburg Migratory Bird Sanctuary. The other observation points are more than 800 m from the corridor and are separated from it by wooded hills (Mousseau, 2003).

Table 5.34 Summary of data on at-risk bird species in the study area prior to 2003

Species	Site	Year			Status	
		Discovered	Last occupied	Last monitored	Quebec	COSEWIC
Least bittern	Streit Pond (Philipsburg Migratory Bird Sanctuary)	1991	1996	2001	Likely to be designated*	Threatened
Loggerhead shrike	Philipsburg	1987	1987	1997	Threatened	Endangered
Golden-winged warbler	Philipsburg Migratory Bird Sanctuary: 4 sites	1958	1999	2001	Susceptible	-

* Species likely to be designated threatened or vulnerable.

Sources: BDOMQ, 2003; COSEWIC, 2002; David, 2002; Bannon, 2002; Laporte, 2002; Létouneau, 2002.

Among the sites that were subsequently monitored because of the documented presence of at-risk species, only the least bittern nesting site at Streit Pond was still in use in 2003 and 2005: in 2005, five singing males were counted at Streit Pond during the breeding season by Pierre Fradette, as part of the Quebec program to inventory bird species at risk (SOS-POP) (J.-G. Papineau, pers. comm.). The former

observation site of the loggerhead shrike, at the current intersection of Highway 133 and Chemin Champlain (km 32.6), has not been occupied since 1987, and the habitat there has been completely disrupted for farming. Finally, the two observation sites of the golden-winged warbler located northeast of the customs station have not been used by that species since at least 2000 (Jean-Guy Papineau, pers. comm.).

Amphibians and reptiles

The **spiny softshell turtle** occurs in rivers, creeks and lakes, preferring those with sand or mud banks for egg-laying and sun-basking. It is likely one of the species most affected by water pollution. It is exclusively carnivorous and feeds on fish and invertebrates (Bider and Matte, 1994). Until very recently, only one population of spiny softshells was known in Quebec, in the Haut Richelieu sector along the Quebec-Vermont border. The monitoring program carried out in recent years by several agencies has found this species in several other regions. In fact, more than 15 observations have been reported for the six regions of western Quebec: Montérégie, Montréal, Laval, Laurentides, Outaouais and Lanaudière. However, these reported sightings have yet to be validated (Daigle et al., 2002).

In 1997 and 1998, studies were conducted on use of the Brochets River by spiny softshell turtles (Galois, 1998, 1999). The purpose of those studies was to identify critical habitat (nesting, feeding and hibernation). The sector covered extends from the river mouth to the first rapids, located 5.8 km upstream. In 2001, search efforts for breeding sites were carried out along the Brochets River as part of the Quebec spiny softshell turtle recovery plan (Daigle et al., 2002).

Using radio tracking and observations, these campaigns focused on the principal activities of the species (egg-laying, migration, summering grounds) on the Brochets River. Two nesting sites were identified, as well as two sites offering medium to high nesting potential, according to the established criteria: loose gravel and/or sand substrate, sufficiently above water level that the eggs will be dry at a depth of 15 cm, absence of vegetation, good exposure to the sun, and presence of signs of digging and/or predation.

A first nesting site was found downstream from the Notre-Dame-de-Stanbridge dam, on the east bank of a meander running northwest, consisting of a gently sloping band of gravel 2 to 5 m wide and 50 m long. A second site was located at the foot of the bridge at Saint-Pierre-de-Véronne-à-Pike River, where there is an accumulation of gravel around two bridge piers. These sites have also been used by snapping turtles (Galois, 1998, 1999; Daigle et al., 2002). This breeding site has been protected since June 2003, through an environmental initiative made possible by the Fondation Hydro-Québec pour l'environnement, together with Conservation Baie-Missisquoi and the Comité de rétablissement de la tortue-molle à épines and other partner agencies working to support the conservation plan for the spiny softshell turtle in Lake Champlain (L'Avenir & Des Rivières, July 12, 2003).

The first nesting site having good potential is a gravel island located 2.7 km upstream from the bridge at Saint-Pierre-de-Véronne-à-Pike River (near the village of Malmaison). Signs of turtle digging were observed, and a nest was found that had been destroyed by a predator. However, this was probably not a spiny softshell nest. The western shore of the Brochets River mouth also constitutes a potential nesting site (Galois, 1998, 1999).

Spiny softshells use the Brochets River for basking in the sun. The turtles bask along the shores very close to the water or on tree trunks in undisturbed sections of shoreline bordered by woods or fields. Two preferred basking sites were identified during the 1997 and 1998 field studies. The first was on a natural erosion bar 1 to 2 m wide, on a wooded island along the west bank of the river, upstream from Castor Creek. The second was on the east bank of the river, between Rocheleau and Edwin creeks (Galois, 1998, 1999).

The radio tracking of spiny softshells succeeded in locating three hibernation sites, all of them in Vermont. The turtles moved to these sites in late August and early September (Galois, 1998).

Spiny softshell turtles had been reported on the Richelieu River at Iberville. However, this observation dates back to 1930-1940 (Louis Mathieu, CDPNQ, pers. comm., February 2003).

The **northern map turtle** also has the status of a species likely to be designated as threatened or vulnerable in Quebec. It occurs in southwestern Quebec, which represents the northern limit of its range. It can be found in large lakes and rivers, where it frequents the shores only to lay eggs in the month of June (Bider and Matte, 1994). In the study area, the map turtle was found in the Brochets River, specifically at the mouth of the river, at the mouth of the Bellefroid-Dandurand Creek, and near the Rocheleau Creek (Louis Mathieu, CDPNQ, pers. comm., February 2003; Galois, 1998).

The **wood turtle** is also listed as a species likely to be designated threatened or vulnerable in Quebec. Its range is limited to northeastern North America, and approximately 10% of its range is in Quebec. It is found primarily in the Outaouais, Mauricie, Montérégie and Estrie regions. It generally occurs in meandering streams with gravel and sand substrate. It nests along the shores or on land without vegetation. It spends the summer in the forest or in the glades, generally less than 150 m from the river (Bider and Matte, 1994). The wood turtle has been observed near the study area, on the banks of the Brochets River, near Notre-Dame-de-Stanbridge, and in Venise Bay at Venise-en-Québec (Louis Mathieu, CDPNQ, pers. comm., February 2003).

Fish

The **bridle shiner** (*Notropis bifrenatus*) is a species of special concern at the federal level (COSEWIC, 2006). It is found only in eastern North America, in the Atlantic watershed from western Lake Ontario east to Maine and south to South Carolina. In Canada, it is found in the Bay of Quinte in Lake Ontario, to the east and north as far as Saint-Paul (near Trois-Rivières, Quebec) and south to Lake Memphremagog). It is found in low-lying areas, never far from the St. Lawrence River or the Richelieu River. Although it is abundant in some regions, its numbers are declining in certain parts of North America. In Canada, it has apparently declined in many watercourses where it was formerly abundant, particularly in rivers in Quebec. The bridle shiner occurs in calm areas of creeks, and sometimes in lakes. It is typically found in the presence of abundant aquatic vegetation, where it feeds and spawns. It can tolerate brackish water but not acidity, a factor that probably limits its penetration into the Canadian Shield, the waters of which are prone to acidity. It has been observed in moderately turbid waters, but is thought to prefer clear water. Increasing turbidity harms its capacity to find food and hinders the growth of submerged aquatic plants, which are essential to its diet, reproduction and shelter. Among other things, the draining of swamps and the extirpation of vegetation are reducing population sizes.

No bridle shiners were found in the various streams covered by the scientific fishing surveys carried out as part of this comprehensive study (see section 5.2.4). Because of their characteristics, those streams presented no habitat of apparent interest to the bridle shiner. However, according to the experimental fisheries carried out between 1941 and 1996 in some waters of the study area (Impact study, Génivar, 2005), the bridle shiner was present in the Brochets River.

Vascular plants

There are two vascular plant species listed as endangered under SARA. The first is a type of sedge that is associated with sandy stream banks subject to spring flooding and that has been observed on the banks of the Richelieu and St. Lawrence rivers in the Montreal region. This sedge grows in floodplain marshes and swamps in eastern North America. The second is American ginseng, associated with deciduous forests, such as maple.

In light of the nature and duration of the planned work, current agricultural use of the majority of the right-of-way of the new highway (land under cultivation), the results of experimental fisheries carried out in the creeks and in the Brochets River, and habitats favourable to species protected under the federal

legislation, it is only the bird species from the above list that have been identified as likely to be affected by the construction and operation of the new highway.

Finally, a review of the habitat stewardship programs for species at risk introduced in 2000 and described on Environment Canada's Web site revealed no specific habitat conservation projects in the study area for any of the species listed in Table 5.2.3.1.

5.2.3.2 Mitigation measures during construction and operation and significance of residual effects

The construction phase is expected to have a noise impact on the least bittern in Streit Pond during the breeding season.

The noise generated by machinery during construction could disrupt the breeding pattern of this species. The intensity of the noise effect on the least bittern is considered high, because the species is designated threatened in Canada and there are very few breeding pairs in Quebec (at most, perhaps 100 pairs; Letourneau, 2002). The extent of the effect is local, limited to Streit Pond, and the duration is short, limited to the construction period.

With the planned mitigation measure, prohibiting construction work in the Streit Pond sector (km 35.5 to 37.5) during the breeding season from mid-May to mid-August, the residual effect of construction work on at-risk or special-status species will not be significant.

No noise impacts are anticipated during the operating phase: the average noise level (Leq) over 24 hours at Streit Pond will be, as it is now, below 55 dBA. The same holds for other activities during this period, as they will be the same as those that now occur with the operation of Highway 133.

MTQ has undertaken to carry out specific follow-up for one bird species, the least bittern. The protocol prepared by the National Least Bittern Recovery Team (May 2006) will be used for environmental monitoring of this bird's use of Streit Pond. As discussed with Madeleine Papineau of Environment Canada, two inventories will be conducted instead of three, as called for in the protocol. Because the least bittern is more likely to appear at the beginning of the breeding season (late May to early June), the inventories will cover that period, and will be spaced at intervals of 7 to 10 days.

With respect to the bridle shiner and the spiny softshell turtle, MTQ will see that the stream bank restoration work is done in such a way as to re-create suitable habitats for these species and thereby avoid any adverse impact on their presence in the study area.

Given the approach to carrying out the project and the proposed mitigation measures, the project is not likely to affect any aquatic or migratory bird species listed in SARA Schedule 1 as endangered or threatened, nor any species of special concern, and it is therefore unlikely to contravene the general prohibitions of SARA. Moreover, no special-status fish species are likely to be affected by the work.

5.2.4 Fish and fish habitat

5.2.4.1 Description

Scientific fishing surveys were carried out in the spring of 2006 for the Brochets River and its adjacent wetland, as well as for seven streams to be crossed by the proposed Highway 35 (Consortium Dessau-Aménatech, 2006). Pierre Bilodeau of MRNF-Montérégie confirmed that no recent spring fish inventory

had been done at the Brochets River crossing, or in the streams crossed by Highway 35 (pers. comm., May 23, 2006).

A stream characterization was carried out at crossing sites between May 28 and June 8, 2006, and again between September 7 and 21, 2006. The spring characterization involved the following streams: Brochets River, and the Léo-Méthé, Bélanger and Rocheleau creeks. The characterizations conducted in late summer involved the Arcand, Barbotte, Chartier (upstream and downstream), Léandre-Beaudoin, Lalanne, Martel, Lacroix, Méthé-Fournier, Smith-Bonneville, Comeau-Lecompte (east and west), Phoenix-Campbell, Black, Tipping, Desranleau, Bellefroid-Archambault and Edwin streams.

The streams were characterized over the width of the Highway 35 right-of-way. The hydrographic network was characterized by segmenting the streams into homogeneous reaches. The homogeneity of the segments was based on the following parameters: streamflow facies, grain size of the streambed substrate and banks, width and depth of the stream, and dominant species of the riparian plant cover. Physical and chemical data were also measured using a multiparameter YSI probe (dissolved oxygen, temperature, conductivity and pH) during the scientific fishing surveys.

A descriptive fact sheet was completed for each homogeneous segment. The description of the stream is accompanied by photographs and a site map (Consortium Dessau-Aménatech, 2006b). Each fact sheet provides a schematic representation of habitat structure, dominant plant species, and wildlife present at the site. The fact sheets recorded the following information: pools, rapids, channels/other, current velocity, ordinary high water mark (OHWM), natural or artificial barriers, etc. The main parameters on each of the fact sheets are the following: name of segment, GPS coordinates, average width, length, average water depth, current velocity, type of substrate, nature of banks, riparian plant species, aquatic plant species, presence of barriers, wildlife species observed, and miscellaneous observations.

Streams offering good potential for fish habitat

Barbotte Creek

Barbotte Creek has a regular flow, and an estimated current velocity of 0.1 m/sec. It is a shallow permanent stream at the point crossed by Highway 35. Its average slope is varies from 0 to 5%. Aquatic vegetation is relatively undeveloped, and consists of patches of grass species. Grasses are the dominant plant species along the banks, while the shrub and tree strata are dominated by willows and Eastern cottonwood. There are also areas of erosion, covering 20% of the strip characterized. At least in the section characterized, the creek offers good potential for fish. It has a rich diversity of fish species, with 18 species, including chain pickerel, yellow walleye, smallmouth bass and yellow perch. The substrate consists primarily of gravel (5 to 40 mm). Shoreline vegetation consists essentially of grasses, which offer good spring spawning potential, particularly for pike.

Chartier Creek

Chartier Creek has a regular flow and offers a variety of habitats suitable for several fish species. The scientific survey identified 14 species in upstream and downstream reaches that will be crossed by the highway, including smallmouth bass and brown bullhead. During the fish inventory, a river otter was observed in the downstream section of the creek. The dominant vegetation strata in the two regions are different: in the upstream portion, the herbaceous stratum is dominant (75% of cover), whereas in the downstream portion, the tree stratum is dominant (70% of vegetation cover). The substrate also varies: sand is predominant downstream (100%), while the upstream substrate is a combination of sand and gravel (45% sand, 45% gravel, and 10% coarser material). The current at this point is 0.1 m/sec. With all these characteristics, Chartier Creek has good potential in terms of fish spawning, feeding and rearing habitat.

Brochets River

At the Highway 35 crossing, the Brochets River has an average width of 80 m. Its bed is composed of sand, silt and organic debris (mainly dead trees). Along the west bank, property owners have installed riprap at several locations. There is a silver maple stand on the east bank. The current is relatively slow, at about 0.02 m/sec (in June). The west bank offers less potential for pike spawning than does the east bank. This is attributable to human development. However, the real spawning potential in the sector to be crossed by the Highway is in the swamp located west of the houses along the Brochets River. This swamp offers very good fish spawning potential, particularly for pike. The scientific hoop-net fisheries at the swamp's confluence with Bellefoid-Archambault Creek found 10 fish species, some of which, such as the golden shiner, were in spawning stage V. With its vegetation, this swamp offers excellent pike spawning potential.

Apart from the northern pike, the other fish species likely to spawn in the floodplain of the Brochets River are: largemouth bass, brown bullhead, redfin pickerel, brook stickleback, banded killifish, muskellunge, silver minnow, mimic shiner, yellow perch, fathead minnow, chain pickerel, carp, bowfin, and golden shiner.

The potential of the spawning ground identified on the east bank of the wooded swamp is assessed as medium or high for the northern pike. This information was confirmed by Pierre Bilodeau of MRNF during the BAPE public hearings on the Highway 35 completion project in November 2005.

Streams with low to medium potential for fish habitat

Arcand Creek

Arcand Creek is a small intermittent stream with a weak current. The plant cover along the shores is 95% herbaceous. The substrate is composed primarily of silt and it is bordered by farm fields. These characteristics offer little potential for sport-fishing species. However, central mudminnows and certain other species that prefer these substrate and current conditions may be present.

Léandre-Beaudoin Creek

Léandre-Beaudoin Creek is an intermittent stream that has been straightened to drain farmland. It has an average width of 3.5 m and an average depth of 5 cm. There is almost no current. The substrate is composed of sand and silt. The vegetation consists 60% of herbaceous species and 40% of shrubs and trees. Stringy algae were observed. Such an environment offers limited potential for forage fish.

Lalanne Creek

Lalanne Creek is considered an agricultural ditch, with an intermittent flow. Its configuration is rectilinear. It is shallow and its current is very weak to non-existent. The substrate is composed of organic debris, silt and send. The mud of the stream bed is about 40 cm thick. The flow weaves its way through reeds and cattails as well as other plant species typical of swamps. During the fish survey, the ditch did not have enough water to use electric or any other fishing devices. It may be said with certainty that this stream offers little potential as fish habitat.

Martel Creek

Martel Creek has an intermittent flow, and its current was estimated at 0.04 m/s during the characterization. Its substrate is composed primarily of sand. Stringy algae covered about 60% of the streambed in September. Herbaceous plants dominate the edges of the creek (90%). This stream offers little potential for the sport fish species caught in the region. However, unfed and advanced fry were observed in the water. These were probably cyprinids and central mudminnows, like the species identified in the Lacroix, Louis-Rocheleau, Léo-Méthé and Bélanger creeks.

Lacroix Creek

Lacroix Creek is a permanent stream with a current of 0.1 m/s. It flows through cultivated farmland. During its characterization, its average width was 2 m and its average depth was 36 cm. The vegetation along the banks of the segment studied was composed 75% of trees and shrubs. The substrate is primarily gravel (90%). Problems with erosion and silting of sand were observed at certain points. While this stream has little potential for sport fish species, the scientific survey revealed the presence of cyprinids such as creek chub, common shiner, rosyface shiner, mimic shiner, blacknose shiner and blackchin shiner. Central mudminnows and johnny darters were also collected there.

Léo-Méthé Creek

Léo-Méthé Creek is considered an intermittent agricultural ditch. The course of the ditch was disrupted during its channelization and straightening for agricultural purposes. Its average width is 1 m. The segment characterized was straight and the banks were covered with herbaceous vegetation. The stream presents problems of erosion with significant amounts of fine matter, and it had a strong odour of manure (which is spread on neighbouring fields). Nevertheless, five fish species occur in this stream: creek chub, fathead minnow, brown bullhead, white sucker, rosyface shiner, and brook stickleback. This creek has few characteristics of interest to sport fish species.

Méthé-Fournier Creek

Méthé-Fournier Creek is also considered an intermittent agricultural ditch. It is very narrow and very shallow. Its course was disrupted by channelization and straightening for agricultural purposes. Its banks are covered by herbaceous vegetation to the extent of 60%, and trees and shrubs that offer midday shade (about 60%). The substrate is 90% silt, and the remainder is organic matter. The fish potential of Méthé-Fournier Creek is similar to that of Léo-Méthé Creek, i.e. low. It is very likely to have the same fish species.

Smith-Bonneville Creek

This creek has the characteristics of an intermittent agricultural ditch similar to the Léo-Méthé and Méthé-Fournier creeks, except that its substrate is 80% gravel in the segment characterized. Another unique feature is that duckweed grows there. Its potential is relatively low for sport species, but it is likely that creek chub and several other cyprinids, such as those found in the Lacroix, Léo-Méthé and Méthé-Fournier creeks, occur in this creek.

Comeau-Lecompte Creek

Comeau-Lecompte Creek is a stream that has been straightened over its entire length and is thus considered an agricultural ditch. It drains large expanses of farmland. It has a very weak current and shallow depth (3 cm). The substrate is composed entirely of silt, and the bed is colonized by common reed (phragmite). Its banks have herbaceous cover with scattered shrubs all along its course. It offers little potential as fish habitat, although the central mudminnow may be present.

Phoenix-Campbell Creek

This little intermittent creek runs through farmland over its entire length. It has been modified and straightened as far as Highway 133, where it discharges into a culvert. It is a tributary of Black Creek. It is an agricultural ditch. It is shallow and there is virtually no current. Its bed is composed of sand and organic debris. These sediments are covered by herbaceous plants and grasses. The banks are dominated by the herbaceous stratum. Problems of erosion and agricultural pollution were noted. It offers little potential as fish habitat. As with Comeau-Lecompte and Black creeks, the dominant fish species in this creek may be the central mudminnow.

Black Creek

Black Creek offers little potential for species prized by sport fishers, at least in the portion draining farmland. The scientific electric fishing surveys showed a dominance of central mudminnow (122 individuals caught). The substratum of the creek is largely silt, and the vegetation border is primarily herbaceous. The buffer strip is narrow, as the creek drains farm fields. At some places, its course has been modified to expand agricultural areas and drainage. The creek has minimal potential as fish habitat.

Bélanger Creek

Bélanger Creek is now considered a fairly degraded, intermittent agricultural ditch. Its bed is composed of silt and its banks are covered with herbaceous species. There is a small dam in the segment included in the highway right-of-way, and a culvert has been installed downstream. These two structures are barriers to the passage of fish. Erosion and agricultural pollution problems (caused by the application of manure application) were observed. The central mudminnow was the dominant species in the electric fishing survey. Only one other species was caught, a single pumpkinseed specimen. This agricultural ditch offers very little potential as fish habitat.

Tipping Creek

Tipping Creek drains farm land. In the sector characterized, its width is less than 1 m and its average depth is 10 cm. The sediment is composed primarily of sand. The banks are covered with herbaceous (50%) and tree and shrub (45%) species and riprap protection has been installed to stabilize the banks (5%). As with the other agricultural ditches described above, its flow is intermittent and its course has been modified by farming activities. Its potential as fish habitat is rated low.

Desranleau Creek

Desranleau Creek is a tributary of Tipping Creek. The creek bed is covered with approximately 25 cm of sediment, predominantly silt. The current in the segment characterized is nil. There is duckweed present. Forest debris was observed, as well as bank erosion problems. The habitat potential of the segment within the Highway 35 right-of-way is low.

Bellefroid-Archambault Creek

In the sector crossed by the planned Highway 35, this creek has been straightened and its flow is considered intermittent. It is approximately 2 m wide and averages 4 cm deep. The current is very weak. The sediment in the segment consists of silt and organic debris. Its banks are covered with herbaceous vegetation, with no shrub or tree strata. The main problem in this segment is sanding up. This portion of the creek offers little potential as fish habitat.

At its confluence with the Brochets River, however, the creek has been dredged and its flow is regular. The water level is therefore the same as that in the Brochets River. It is also directly connected with the swampland that will be affected by the bridge over the river. Génivar (2005) identified a spawning ground about 1 km upstream from its mouth. The fish sampling conducted in the swamp suggests that this sector of the creek offers good potential as fish habitat.

Edwin Stream

The Edwin Stream is a small, intermittent agricultural stream. It runs through farmland before flowing through a wet deciduous forest. It then discharges into the Brochets River. Its substrate is composed of silt and organic debris. Its bed has been colonized by grasses and bulrushes. Duckweed is also present. The banks are covered with herbaceous vegetation. The creek offers little potential as habitat for sport fish. However, like the nearby Louis-Rocheleau Creek, it could support yellow perch, sunfish and cyprinids.

Louis-Rocheleau Creek

Louis-Rocheleau Creek presents the same characteristics as Edwin Stream. It has minimal potential as sport fish habitat. However, scientific survey along two segments of 100 m² revealed the presence of the following species: creek chub, central mudminnow, white sucker, mimic shiner, banded killifish, yellow perch, and pumpkinseed. In the spring, the herbaceous bank cover could be used as spawning grounds for several species that require submerged vegetation for egg laying.

5.2.4.2 Mitigation measures during construction and significance of residual effects

The anticipated effects on fish species during the construction phase of Highway 35 will come essentially from encroachment on fish habitat and the introduction of suspended matter in the waters downstream from the work sites.

Construction work (land clearing, excavation and grading, movement of machinery etc.) near or in fish habitat areas could also degrade water and habitat quality through the resuspension of fine particulates in the water and their deposition downstream from the construction sites. Construction activities could also disturb fish species present during the work.

Fish in the Brochets River (km 28.8 to km 29.0) could be affected mainly by the construction and presence of the planned bridge over the river. The Barbotte Creek crossing (km 2.8), the building of the

highway at the edge of its floodplain (km 3.0) and the crossings of the numerous creeks surveyed in the Highway 35 corridor could also have an impact on fish in these waters.

The following table shows the size of the fish habitat areas that will be affected by the presence of the highway. In estimating the alteration, disruption and destruction of fish habitat, the following elements were taken into account:

- Encroachments caused by the installation of culverts or bridges below the ordinary high water mark (OHWM) of streams that have been defined as fish habitats.
- Riprap below the OHWM in the beds of streams defined as fish habitats.
- The channelization of streams that have been defined as fish habitats.
- The filling of streams, ponds, wetlands and floodplains that have been defined as fish habitats.
- Any other encroachment, draining or disruptions, temporary or permanent, in fish habitats.

The reconstruction of streams that have been filled or riprapped for purposes of re-creating fish habitat will be considered as a net gain of fish habitat, with the approval of DFO. The Barbotte and Chartier creeks and the Lacroix discharge will be reconstructed. The proposed improvements will have to be designed to achieve the following objectives:

- Ensure sufficient water flow above the substrate by minimizing interstitial flow (minimizing water loss through the substrate).
- Concentrate the flow during low flow periods (construction of a thalweg or minor bed).
- Make improvements that will promote heterogeneity of fish habitats (pools, sills, meanders, etc).
- Ensure free passage of fish by avoiding excessive gradients and impassable barriers.
- Limit protective riprapping of stream banks to the OHWM and provide with adequate vegetation cover. Beyond the OHWM, any stabilization must involve complete revegetation.

It should be noted that, in seeking authorization under the *Fisheries Act*, MTQ undertook to provide a detailed description of the stream redevelopment concept.

Table 5.35 Areas of harmful alteration, disruption or destruction (HADD) of fish habitat for streams in the study zone (except the Brochets River)

Stream	Length (m)	Average width (m)	Surface area (m^2)
Arcand Creek	120	2.1	252
Barbotte Creek	254	6.28	1,595
Chartier 1	146	4	584
Chartier 2	280	4	1,120
Lalanne	104	3.5	364
Léandre-Beaudoin	210	3.5	735
Lacroix	96	2	192
Léo-Méthé	860	1	860
Méthé-Fournier	174	0.7	122
Smith-Bonneville	434	0.8	347
Comeau-Lecompte	134	0.75	101
Black	90	1.8	162
Phoenix-Campbell	1,298	1.3	1,687
Tipping	116	0.8	93
Bélanger	106	1.75	186
Martel	144	2.5	360
Desranleau	94	1	94
Bellefroid-Archambault	116	1.94	225
Edwin	82	1.08	89
Louis-Rocheleau	76	3	228
		Total	**9,396**

The HADD of fish habitat listed in Table 5.35 is associated primarily with feeding and nursery habitat. It should be noted that fish habitat losses attributable to the work will be offset by adequate compensation projects to achieve “no net loss” of fish habitat, consistent with the *Policy for Management of Fish Habitat* of Fisheries and Oceans Canada (1986).

In response to the results of the scientific surveys conducted in the spring of 2006, and the characterization of streams in September 2006, MTQ has undertaken to ensure fish passage at the stream crossings over the Barbotte, Chartier, Lacroix, Bellefroid-Archambault, Edwin and Louis-Rocheleau watercourses. MTQ will also comply with the *Recommandations pour la conception des traversées de cours d’eau où le libre passage du poisson* (DFO, 2007). For the crossings of other creeks and agricultural ditches, culverts consistent with MTQ standards are planned. The design will involve burying the base, observing a maximum restriction of 20% of flow, and respecting the slope of the stream. Culvert construction will, to the extent possible, respect hydraulic conditions, typography and natural erosion forces.

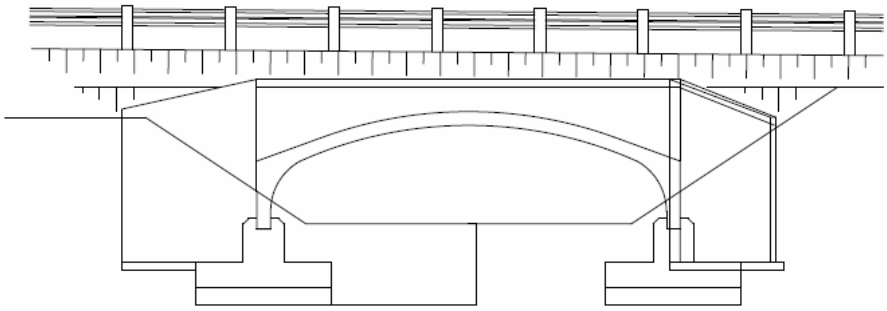
The culvert outlets (riprap size) will be properly designed with respect to flow rate and in keeping with DFO recommendations, in order to avoid erosion.

The routine mitigation measures included in departmental projects for erosion control and protection of the aquatic environment (Standards, Volume 4, Chapter 6), as presented in section 3.9.11 of the report, will be taken during culvert construction. The streambeds that must be stabilized will not cause a barrier to fish passage. Moreover, culvert inlets and outlets will be stabilized to reduce the risk of erosion. MTQ has undertaken to respect the additional mitigation measures proposed by DFO, as contained in the

environmental specifications, in order to mitigate the impact on fish habitat (for a listing, see section 3.9.11).

As a special mitigation measure to avoid altering the existing streambed characteristics in streams where fish passage must be maintained, MTQ plans to install arch culverts at their crossings. This measure will preserve the existing slope of the stream at the culvert site, and avoid any change in bed composition, hydraulic jumps and contraction of flow upstream.

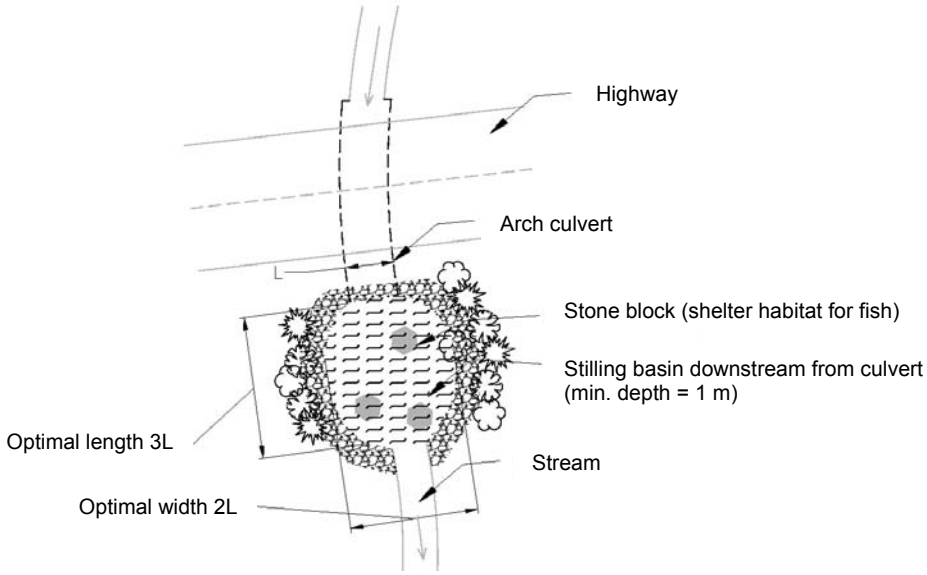
Figure 5.6 Standard arch culvert cross-section



MTQ has also undertaken to maintain uniform water drainage on either side of the highway in low- and high-flow flood zones, and to ensure free passage of fish during spring high flows. More specifically, the flow in the Edwin and Louis-Rocheleau streams will be maintained by arch culverts.

Stilling basins will also be constructed downstream from the Edwin and Louis-Rocheleau crossings (Figure 5.7) to dissipate energy, thus providing among other things resting habitat for fish.

Figure 5.7 Stilling basin



These structures (arches, stilling basins, culverts etc.) will be reviewed in greater detail during the advanced design work.

In addition, to mitigate the anticipated impact on fish habitat during construction, work in aquatic environments will be done outside the spawning period of the fish species likely to use the sites in question, i.e. early April to mid-August.

The redeveloped streams will be monitored. The developments will meet the recommendations and objectives set out in the DFO document on fish habitat restoration. Redevelopment of streams to recreate fish habitat upstream and downstream from crossings will be the subject of compensation for losses generated by riprap and channelization upstream and downstream.

Brochets River bridge

The initial design of the bridge consisted of three spans supported by piers and abutments, with complete riprap backfill of the highway in wetland WL-1. HADD of fish habitat was estimated at that time at 19,000 m² .

MTQ has examined four variants for the western approach to the Brochets River bridge, in order to limit encroachments on the river's floodplain (swamp).

These variants were compared primarily on the basis of estimated reductions in swamp encroachment.

*Variant **A**: an additional span of 52 m*

Encroachment reduction: **2,600 m²**

*Variant **B**: two additional spans of 52 m each*

Encroachment reduction: **5,200 m²**

*Variant **C**: box culvert at the boundary of the floodplain north side (chainage 39+350)*

Encroachment reduction: **200 m²**

*Variant **D**: box culvert (variant C) + walls on each side up to chainage 39+350 (floodplain limit)*

Encroachment reduction: **1,700 m²**

The encroachments for the bridge foundations are as follows:

- Encroachment for each abutment = 450 m², or 900 m² in total for the two abutments.
- Encroachment for each pier = 260 m², or 520 m² in total for the two piers.
- Total encroachment = 900 m² (abutments) +520 m² (piers) = 1,420 m².

Following discussions with the responsible federal authorities, MTQ is proposing a compromise to the concept of respect to an additional span for the Brochets River bridge that involves building a retaining wall, in line with variant "D" (Figure 5.8).

In order to make the structure biologically, economically and technically acceptable, MTQ has undertaken to respect the following criteria:

- Construct a riprap approach embankment in the floodplain to the boundary of wetland WL-1.
- Construct a retaining wall to the east, with an open structure (arch culvert) that could encroach into the WL-1 up to the abutment, to reduce encroachments in the floodplain.
- Construct an arch culvert in the retaining wall, with sufficient hydraulic capacity to ensure that future flood conditions upstream from the retaining wall (north side) will be the same as the current condition in terms of period, duration and water level. The arch culvert will also have to be properly positioned (low point) to allow fish to move downstream to the Brochets River when waters are receding.

The data and the calculations demonstrating observance of these design criteria will be transmitted to DFO for analysis and approval, in the context of the requested *Fisheries Act* authorizations.

MTQ intends to carry out this work from the infrastructure itself. If that is not possible, priority will have to be given to the use of temporary bridges on pilings for work in the Brochets River floodplain. Any temporary encroachment in the floodplain will be subject to site restoration approved by DFO. The site restoration will include restoration of the initial fish habitat potential and functions. MTQ will have to prepare a protection plan for the floodplain and have it approved by DFO.

It is possible that sheet piles could be used for the cofferdams during construction of the Brochets River bridge. In that case, 2 m would have to be left on each side of the bridge pier footings (6 m wide). The cofferdam would extend the full width of the bridge, i.e. 25 m, and would provide dry working conditions for installing (anchored into bedrock) and cementing the pier footings. For the construction of each pier, a river encroachment of 252 m² is required.

The total area of disruption and destruction of fish habitat for construction of the Brochets River bridge, with its new design, is estimated by MTQ at 0.7 ha, which represents a reduction of 0.4 ha compared to the original design. It should also be noted that the new bridge design will avoid disruption of the wetland to the northwest of the bridge, estimated at 0.8 ha.

The areas affected by bridge construction will lead to HADD of fish habitat in the spawning, rearing and feeding grounds of numerous fish species, including northern pike.

This work will of course be done outside the spawning season, which runs from April 1 to mid-August, and will be accompanied by all the mitigation measures required to minimize its impact.

Barbotte Creek crossing

The comparative analysis of variants carried out in the provincial impact study (Génivar, 2005) is based essentially on assessing the proposed alignments in light of the environmental issues they raise (zoning, agriculture potential, land use, the built environment, ecologically important areas, etc.) and their location, as well as the associated technical and economic considerations (respect for cadastral surveys, procurement of right-of-way, stream crossings and roads, and construction costs).

As specified in the document entitled “Réponses aux questions du MDDEP” (Génivar, 2005), optimization of the CB-1 alignment and acquisition of a strip of land of 7,500 m² between km 3.0 and 3.7, as proposed by the Department in its preliminary draft, will considerably reduce the land clearing initially provided for in the west riparian buffer of the Barbotte Creek. In fact, only a narrow strip of land, less than 100-m wide, located at km 13+700 of the corridor, will have to be cleared for the highway.

Field visits to the site by biologists confirmed that there is no wetland, but rather an area subject to spring flooding. The currently proposed geometry seeks to stay well away from the Barbotte Creek buffer strip. An additional right-of-way will therefore have to be acquired. This geometry cannot be modified because of the proximity of the interchange ramps at Chemin Grande-Ligne. The buffer strip is illustrated in the figure 5.9, which clearly shows the boundaries of the forest area. The buffer strip at the site considered (15-m wide relative to the ordinary high water mark) is not wooded. There will therefore be no clearing in the buffer strip. An area of 313 m² will however be modified for the installation of the ditch.

Conclusion

Although MTQ has reduced the impact with the design of the stream crossings, HADD of fish habitat is expected to amount to 9,396 m² in the feeding and nursery areas of several species that live in small streams. HADD of 7,000 m² of fish habitat is also observed in a spawning, rearing and feeding area used by several species of fish, including the northern pike.

The value of the affected component is considered medium, as no habitat of any special-status fish species is involved, and HADD of fish habitat in the swamp adjacent to the Brochets River has been reduced. Taking account of the routine and special design and mitigation measures proposed, the intensity of effects attributable to the work will be medium for the Brochets River sector, because of the scale of the planned work and the anticipated modifications, and low for other streams.

DFO is of the opinion that the HADD of fish habitat that would be caused by this project is such that it can be authorized and compensated but, consistent with the 1986 *Policy for the Management of Fish Habitat*, DFO gives priority to avoiding and mitigating HADD of fish habitat. At the planning and detail design? stage, DFO, in collaboration with MTQ, will examine options for reducing the effects on fish habitat. Consequently, the conclusion of this report in no way commits DFO to accept all the HADD mentioned, since the details of the project components will not be known until later.

Figure 5.8. Concept for the Brochets River bridge

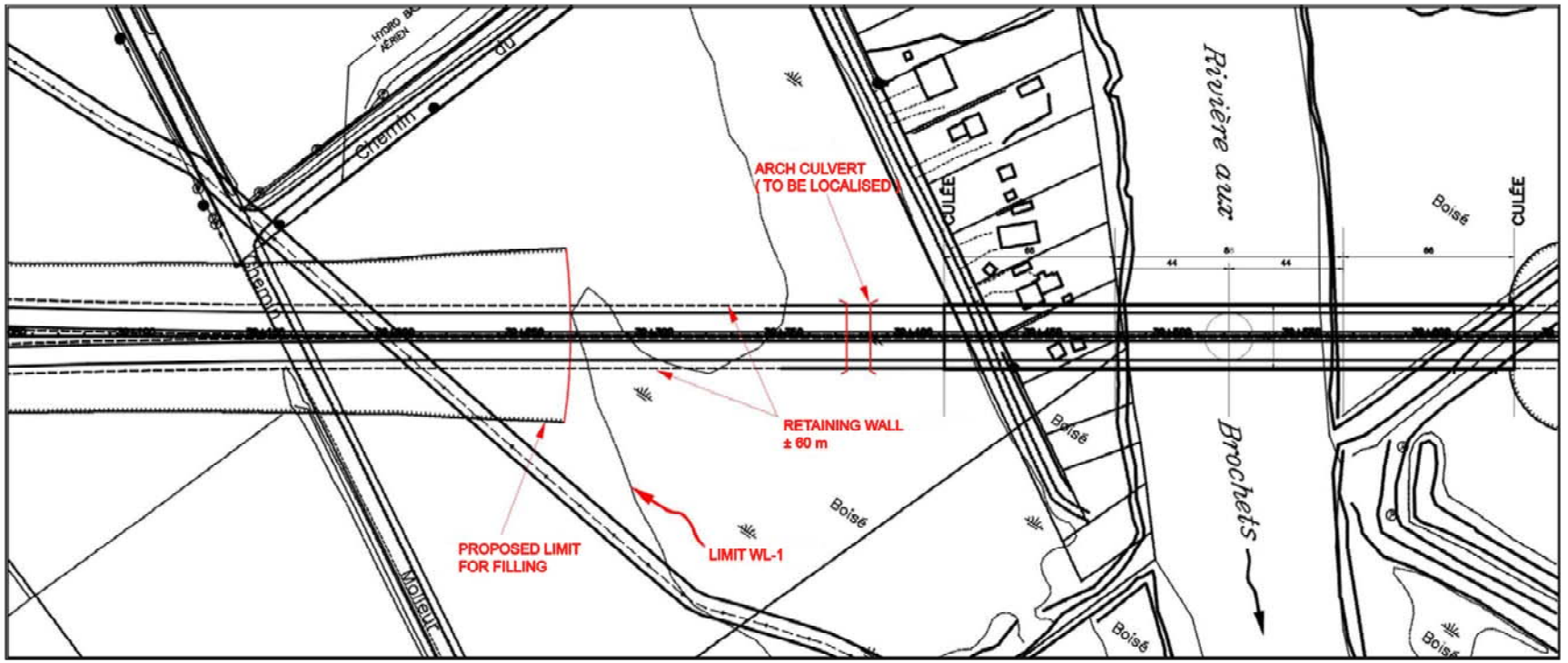


Figure 5.9 Localization of the buffer strip

5.2.4.3 Mitigation measures during operation and significance of residual effects

During operation of the highway, aquatic environment and fish habitat disruptions will primarily result from maintenance work on the new highway, especially during the winter, when abrasives and de-icing salt will be carried into streams near the highway through surface runoff from the right-of-way.

Over the entire length of the new highway, the Department will recommend ecological management of the vegetation (see section 3.8.2). With respect to the highway's drainage ditches, use of the "lower third" maintenance method will reduce the volume of sediment (suspended matter) that reaches streams, reduce contaminant loadings (including de-icing salt) to drainage water through better filtration, and reduce the rate of flow of water in ditches, thereby enhancing the buffer effect of the ditch system with respect to any downstream flooding.

Moreover, to prevent or mitigate washouts near stream crossings and to minimize loadings of suspended matter to receiving waters, the walls and bottom of the ditches will be protected with a geotextile membrane as well as with stable granular material, and drainage water will be diverted by a dike into areas of natural vegetation before they reach the receiving streams.

Prior to discharge into Martel Creek, along which Highway 35 will run for a distance of about 1 km, surface waters will be diverted into natural vegetation areas, in order to minimize the loadings of suspended matter and de-icing salt.

In the floodplain of the Brochets River (km 28 to 33), as a special design feature to protect the swamp forest, drainage water sedimentation basins will be constructed on either side of the stream between km 28 and km 33, to minimize the discharge of suspended matter and de-icing salt into this sensitive natural area.

These sedimentation basins, located upstream from the limits of the floodplain, will be designed with a riprap bottom into which aquatic plant species will be planted, offering a high capacity to retain contaminant loads.

Because of the heavy chloride concentrations expected at the Brochets River bridge, which could have a significant impact on the adjacent swamp, runoff waters from the roadway and the bridge will be channelled away from the floodplain. To this end, a surface ditch will be constructed above the embankment to the boundary of the floodplain, together with a "constructed wetland" to filter runoff water before it is discharged to the environment.

These sectors are assigned a medium environmental value. The intensity of the expected impacts will be low for all streams, primarily because of the sedimentation basins that will be built in the Brochets River sector, and the natural filtration of drainage waters by the roadside ditches (ecological ditch management); the scope will be local (confined to the stream crossings); and the duration will be long (throughout the service life of the highway). Consequently, the project's impact on fish life during operation is considered not significant.

5.2.5 Wildlife species of interest and migratory bird habitat

As described in section 5.2.2, the area includes the Philipsburg Migratory Bird Sanctuary, located on the east shore of Missisquoi Bay, including Streit Pond and the Saint-Armand hills in the municipality of Saint-Armand. The sanctuary was created to protect the breeding grounds of several bird species, some of which, including the redheaded woodpecker and cerulean warbler, are at risk (see section 5.2.3).

Although no inventory of migrating waterfowl was conducted during the impact study (Génivar, 2005), field visits and available data indicate that there are no migratory aquatic bird staging areas that would be crossed by the new highway.

5.2.5.1 Mitigation measures during construction and significance of residual effects

The anticipated effects on bird species in the study area, primarily migratory birds, are loss of forest habitat along the right-of-way in the migratory bird sanctuary, and noise disturbance.

Following optimization of the project by MTQ in the preliminary design phase, the habitat losses attributable to land clearing in the right-of-way are now estimated at 80.6 ha, rather than 140 ha (see Table 5.36).

The total area to be cleared in the Philipsburg Migratory Bird Sanctuary is estimated at 2.5 ha. The areas most affected will be those bordering the white ash stands (1.5 ha) and the old fields (0.8 ha). Widening work on the east side of the highway, in the Streit Pond sector, will affect at most about 10 m, and will affect primarily a small marsh of 0.04 ha. The exit ramp at Quinn Street will run primarily across fields and a narrow edge of trees, no more than 10 m wide. This ramp is located in the northern part of the bird sanctuary, 350 m from the northern boundary and 650 m from the site where the least bittern was observed in 2003.

Table 5.36 Type of environment and area affected by the highway right-of-way

	Affected area (ha)	
Type of environment	**Philipsburg Migratory Bird Sanctuary**	**Study area**
Birch stand	-	3.615
Cedar stand	-	0.944
Cutover area	-	1.124
Maple stand	0.135	31.882
Ash stand	1.460	4.046
Old field	0.848	7.666
Marsh	0.043	3.015
Swamp	-	1.168
Poplar stand	-	27.175
Total	**2.486**	**80.636**

The anticipated impact of the construction of the highway through the Philipsburg Migratory Bird Sanctuary will be negligible: it will be limited to the loss of habitat bordering the existing Highway 133, i.e. areas peripheral to these habitats (ecotones), and will represent only 0.5% of the total area of the sanctuary (525 ha) (one third of which is old field or grassed embankments). No habitat used by special-status species in recent years will be destroyed or modified by the project.

In order to comply with s. 6 of the Migratory Birds Regulations, which prohibits disturbing or destroying migratory bird nests, as well as s. 32 and 33 of *SARA*, tree felling and brush clearing will be avoided in all migratory bird nesting habitats during the breeding season. This applies to habitats that may be used by forest birds from May 1 to August 15, and habitats that may be used by waterfowl from the beginning of April to mid-June. At Streit Pond (km 35.5 to 37.5), construction work will be prohibited from mid-May to mid-August.

Section 10 of the Migratory Bird Sanctuary Regulations prohibits any activity in a sanctuary that would be harmful to migratory birds or their eggs, nests or habitat. The proponent must comply with this regulation.

MTQ will therefore work with the manager of the bird sanctuary to compensate for the anticipated habitat loss. It may contribute financially to specific initiatives, such as:

- Installation of nesting boxes to make up for the lack of cavities and vegetation for nesting waterfowl.
- Preservation and enhancement of dead trees and snags that offer suitable nesting and feeding conditions for passerine birds and woodpeckers.
- Inventory and relocation of nests likely to be affected by proposed forest clearing activities.
- Revegetation of areas disturbed by construction work.
- Preparation of a follow-up program for waterfowl.

In addition, grading work on the road near Streit Pond will not cause any significant changes in the pond's configuration, drainage or vegetation. Consequently the site should not be modified, and there should be no effect on aquatic birds during migration or breeding. The planned mitigation measures during the breeding season of the least bittern, a species at risk, will be quite sufficient to safeguard the breeding areas of the aquatic birds.

In light of the anticipated potential effect and the various mitigation measures proposed, the residual effect on migratory bird habitat is considered not significant due to its (1) low intensity (the integrity of the sanctuary will not be compromised), (2) localized nature (a small portion of the sanctuary), and (3) long-term duration (permanent loss of habitat).

5.2.5.2 Mitigation measures during operation and significance of residual effects

During operation of the highway, the principal anticipated effect will be the disturbance of migratory birds caused by noise from vehicles travelling on the highway. The anticipated effect is of the same nature and the same significance as that observed along any road corridor with similar daily traffic flows. With the first breeding season after the new stretch of highway is opened, a new balance will quickly be established between use of the area by birds and the noise environment in the vicinity of the new highway. The residual effect on bird species, primarily migratory birds, is considered not significant for the operating phase due to its (1) low intensity (birds will quickly adapt to this change); (2) localized nature (confined to the right-of-way), and (3) long-term duration (throughout the service life of the highway).

The impact on the biological environment, associated with the barrier to the movements of small animals (barrier effect) and the risk of collision with white-tailed deer during the operation of the highway (km 31 and km 38), has a potential effect on road safety, since the presence of the highway will result in an increased risk of collision with mammals, which could cause accidents.

The following mitigation measures will therefore be applied:

- Suitable signage will be installed in areas frequented by white-tailed deer to warn motorists of their presence.
- Fences will be installed along the MTQ right-of-way.
- Consideration will be given to creating passageways beneath the highway at places where high concentrations of small mammals have been observed.
- Drainage will be improved to limit the formation of saline pools.

The residual effect on road safety associated with the highway's impact on small forest wildlife species is considered not significant due to its (1) low intensity (wildlife will not be significantly affected), (2) localized nature (hazard zones) and (3) long-term duration (throughout the service life of the highway).

5.3 Human environment

Analysis of the effects on the human environment focused on the quality of life and public safety, the utilization of lands and resources by Aboriginal communities for traditional purposes, the visual environment, activities related to fishing and bird watching, and heritage, cultural, historic, archaeological and paleontological resources. Only archaeological resources and built heritage were considered in relation to the latter element, since the other elements outlined in the factors were neither present nor affected by the project.

The effects on navigation were dealt with previously in the section on hydrology (5.1.1), and constraints on the management of protected areas in the section examining the effects on the migratory bird sanctuary (5.2.3).

5.3.1 Quality of life and safety

5.3.1.1 Description

The project runs through areas used primarily for agriculture and inhabited sectors of low population density concentrated in the urban cores. Also present, especially at the approaches to Brochets River and Missisquoi Bay, are resort areas in which a number of residences are inhabited year round. This is a rural environment typical of southern Quebec with village cores often situated at the intersection of two roads. Finally, included in the study area is the town of Saint-Jean-sur-Richelieu on the shores of the Richelieu River.

5.3.1.2 Mitigation measures during construction and significance of residual effects

Quality of life of abutting residents

The overall work and activities associated with the construction of Highway 35 and its infrastructure may give rise to a decline in air quality and in the acoustic climate and may impact the quality of life of those abutting the proposed infrastructure.

For the most part, the sectors felt to be the most sensitive are located at:

- Saint-Jean-sur-Richelieu (northern sector), junction of Highway 133 and Highway 35 (km 1), the full length of Highway 133 (interchange and corrective work on Highway 133);
- intersection of Highway 133 and Chemin de la Grande-Ligne (km 2.2) (upgrade);
- intersection of chemin de la Grande-Ligne and 3^{e} Rang Sud (km 2.2), (interchange and upgrade of chemin de la Grande-Ligne);
- crossing of Highway 227, for residents abutting the old and new routes of Highway 227 to Chemin de la Grande-Ligne (km 10), and along Montée de la Station and la Montée Lacroix (Saint-Alexandre access and interchange);
- Highway 133 crossing at Saint-Sébastien (km 23.5), (interchange);
- Highway 202 crossing, (km 27.2), (Rang des Ducharme viaduct);
- Chemins Molleur and Archambault crossings (km 27.8), (Brochets River bridge);
- vicinity of junction with Highway 133 in Saint-Armand (km 32.6) north of Philipsburg (interchange and upgrade of accesses to Champlain and Fortin streets);
- at Saint-Armand, Philipsburg sector (km 35.2), (interchange and upgrade of accesses to rues Montgomery and Quinn);

- at Saint-Armand (southern sector) between Philipsburg municipality and the border sector (km 36 to 38).

The quality of life enjoyed by owners abutting the planned highway is rated high. The level of disturbance is felt to be low, in light of the mitigation measures included in the project and described in section 3.9.2. The expected repercussions are deemed of average intensity. Although the tranquility of the residents in the sector will come into play, the effects will be localized (to the most sensitive sectors only), and the disturbance will be of short duration (confined to the construction period). The residual effect on owners abutting Highway 35 is determined to be not significant.

Traffic and road safety

The road network lying in the proximity of the highway construction work, the access roads, service roads, bridges, viaducts and interchanges will be disturbed in varying degrees depending on the construction sites and periods (section 3.7, Completion Schedule).

Users of the regional road network such as car and truck drivers and bicyclists will be affected by congestion, closures and detours on parts of the roads. The safety of road users may be affected by the increased presence of heavy machinery/vehicles.

A number of measures are planned to minimize possible risks and inconveniences (section 3.9.2). In addition, a special strategy has been developed for Highway 35 to ensure continued traffic flow and management of traffic amidst the construction (section 3.6, Signage and Traffic Maintenance).

Considerable emphasis is placed on the continuation of traffic flow and the safety of road users. The level of disturbance from the viewpoint of safety and road traffic in general is expected to be medium, since the tranquility of the sector's residents will be affected. Since these effects will be confined to the construction period (short duration) and to a few sectors at any given time (localized effect), the residual effect on traffic and on the safety of the users of the road network is determined to be not significant.

Related activities

The activities involved in upgrading collector roads may diminish air quality and the acoustic environment, disturb local and regional traffic (congestion, detours, temporary closures, etc.) and jeopardize the safety of those using the road network.

In view of the development and implementation of a strategy to maintain and manage traffic (section 3.6), the importance of the residual effect of upgrading the collector roads on the quality of life and safety of abutting residents is determined to be not significant by reason of its medium intensity—the tranquility of the local residents will be affected, the scope is regional (confined to collector roads) and the duration is short (until the upgrades are completed).

The operation of quarries and pits can also affect traffic conditions and increase risks to road users. Accordingly, the following standards set out in the Regulations Respecting Pits and Quarries are applicable:

- The private access roads to a new pit or quarry must be located at a minimum distance of 25 metres from any structure or immovable contemplated [above];
- The operating site of a new pit or quarry must be located at a minimum distance of 70 metres from any public thoroughfare, or 35 metres in the case of a new pit.

The importance of the residual effect of operating quarries or pits during construction on the quality of life and safety of abutting residents is determined to be not significant by reason of its medium intensity—the

tranquility of local residents will be affected, the scope is local (in the vicinity of the extraction areas) and the duration is short (the borrow pits are used for a portion of the timetable).

5.3.1.3 Mitigation measures during construction and significance of residual effects

Aside from the effects on the noise environment and visual environment (see sections 5.1.6 and 5.3.3), the project will have no significant residual effects on residents' quality of life. The owners of agricultural lands and properties directly affected by the project will receive monetary compensation for the loss of their land. Moreover, an emergency plan will be put in place for rapid, effective response should major events occur on the highway or in the region served by it. Finally, the new highway infrastructure will help to improve the regional road network and provide rapid, safe access to health care services for the population living in the sector.

5.3.2 Utilization of lands and resources by Aboriginal communities for traditional purposes

5.3.2.1 Description

According to the impact study and the various public consultations, there are no Aboriginal communities in the study area. Since most of the activities are agricultural, with the exception of two natural areas, namely the sanctuary and the swamp forest, the territory cannot be set aside for hunting, trapping or the collecting of medicinal plants. Finally, during the many consultations held as part of the federal and provincial review processes, no member or members of an Aboriginal community came forth to express any concerns to the MTQ about the lands and resources affected by the project.

5.3.2.2 Mitigation measures during construction and operation phases and significance

The highway's construction, operation and presence are not expected to result in any loss of habitat or use of lands and resources for traditional Aboriginal purposes.

5.3.3 Visual environment

5.3.3.1 Description

The approach proposed in the landscape study conforms to the conventional visual analysis approaches outlined in environmental assessments of highway infrastructure projects, but it is adapted to the challenges arising from the study area and to the nature and scale of the project. While it is based on the concepts outlined in the MTQ Visual analysis method for the integration of transportation infrastructures (1994) and its 1998 revision, the study of the landscape attempts to encompass all of the challenges arising from the project to complete Highway 35 between the U.S. border and Saint-Jean-sur-Richelieu.

Three main stages are involved in studying the landscape: describing the components of the landscape and analyzing their sensitivity, determining the project's effects, and looking at suitable mitigation measures.

Regional landscape

A visual inventory is a tool used in collecting data of use in understanding the spatial organization of the landscape in a study area in order to determine the landscape units and the visual fields of abutting observers and road users. Landscape components are analyzed using the following parameters:

- regional context of the project and study area;
- the physical parameters, namely:
    - natural parameters (relief, hydrology, vegetation);
    - anthropogenic parameters (land use);
- types of observers and their visual field;
- particular elements (attraction, landmarks, unconformity, etc.);
- parameters relative to observer preferences (valuable and protected elements).

The inventory was conducted with the help of a reconnaissance visit in July 2003 and a photographic survey, completed by a review of the information available on the landscape in the study area.

The study area lies at the juncture of two localized regional landscapes close to the Canada-US border: the Monteregian Hills, part of the St. Lawrence Lowlands, and the Sutton Mountain Range, part of the Appalachian massif.

The landscapes are made up of a low plain dotted with wooded hills, the most visible of which are Mont Saint-Grégoire and the Sutton Mountains. Missisquoi Bay, north of Lake Champlain, is the only large body of water. The main rivers are the Richelieu and the Brochets, running from south to north. Most of the area is agricultural. The population is concentrated in small settlements scattered throughout the agricultural lands or along the rural roads. Most of the forests have been cut down; the remaining trees lie primarily on the hillsides or close to the bodies of water.

Description of landscape units

The analysis of the spatial organization of the landscape resulted in the identification of seven landscape units distinguished by relief, forest cover, land use and types of views. These units are:

- the riverside landscape of Iberville;
- the riverside landscape of Brochets River;
- the lacustrine landscape of Venise-en-Quebec;
- the lacustrine landscape of Philipsburg;
- the agricultural landscape of Saint-Athanase, Saint-Alexandre and Saint-Sébastien;
- the agri-forest landscape of Saint-Armand.

Riverside landcape of Iberville

The Richelieu River is the main component in the landscape of the unit and its main attraction. The largest population concentration in the study area, the Iberville sector of Saint-Jean-sur-Richelieu, lies on its shores. The municipality is served by two main roads, Highway 35 and Highway 133, called the "Chemin des Patriotes." The river cannot be seen from Highway 35, which is situated as one approaches the municipality. By contrast, the benefit of a river view can be enjoyed at all times from Highway 133 and from the residences located close to the riverbank. The municipality's built heritage, which is also one of the unit's major attractions, is visible primarily from Highway 133. For these reasons, the latter is regarded as a scenic route. The visual field along Highway 35 is quite ordinary, dominated as it is by an unattractive recently built landscape of residences, businesses and industries of various styles.

The riverside landscape of Brochets River

Brochets River, a long, meandering watercourse emptying into Missisquoi Bay, is the main component providing structure to the landscape of this unit. Although surrounded by an open agricultural landscape, the river can be seen only intermittently through the mature forest growing along its shores. Chemin des Rivières and rang des Duquette, which run parallel to each side of the river, are the main roads providing access to this riverside landscape and are a part of the MRC tourist route. Two municipalities, Saint-Pierre-de-Véronne-à-Pike River and Notre-Dame-de-Stanbridge, lie in the proximity of Brochets River.

The unit features two heritage complexes in addition to the river. The first lies at the intersection of the river and chemin Saint-Charles, where the covered bridge, the old schoolhouse, the Mal-Maison residence and the old mill are visible. The second lies at the intersection with the main highway (133) and comprises the Saint-Pierre-de-Véronne-à-Pike-River church, the presbytery and the old school. A rest stop overlooking Brochets River is found at the same location.

The mouth of Brochets River is another natural attraction. It has been designated an ecological reserve and is among the elements in the MRC with considerable recreational and touristic potential.

The lacustrine landscape of Venise-en-Québec

Missisquoi Bay, a part of Lake Champlain, dominates the landscape of the small municipality of Venise-en-Québec and represents the unit's primary attraction. Numerous private beaches encircle the Bay, which is recognized as a resort centre by the MRC. Other major attractions contributing to the unit's recreational and touristic vocation include campsites, a marina and the built heritage of Venise-en-Québec municipality itself. Highway 202 is the main access road to the bay and provides a rest stop overlooking it. However, the view of the Bay is at times obstructed by wooded areas and residential and commercial buildings on its shores. Finally, the piecemeal style of the commercial built landscape contributes little or nothing to the natural character of the landscape surrounding the bay.

The lacustrine landscape of Philipsburg

Missisquoi Bay also dominates the landscape of Philipsburg. The Bay is visible from chemin Champlain and from residences lying close to the shores or from the marine infrastructures. The municipality's distinctive built heritage, one of the oldest in the region, is another of the unit's significant attractions. For all these reasons, the MRC has included chemin Champlain on the "Tranquillité légendaire" touristic route. The lacustrine landscape of Philipsburg has a natural, harmonious character owing to the forest cover, the homogeneity of the built landscape and the absence of visual discord.

The agricultural landscape of Saint-Athanase, Saint-Alexandre and Saint-Sébastien

This unit comprises the largest land mass in the study area. The agricultural landscape, its main component, provides a broad view of the territory, interspersed with a few wooded areas. It has three population centres containing the main concentrations of abutting observers. The landscape is also accessible from a network of rural roads crisscrossing the territory, the main ones being highways 133 and 227. The Sutton and Saint-Grégoire mountains are visible from the broad agricultural landscape and, along with the churches in the three municipalities, serve as landmarks. Generally, the view of these summits and the rustic character of the small settlements seen across the fields lend a visual appeal. The crosses along the rural routes are also significant historic testimony and enrich the region's built heritage. Their very rarity lends distinctiveness to the occasional wooded areas interspersed through the agricultural lands, recalling the forest that once covered the territory.

The agricultural landscape of Stanbridge Station

Agricultural landscape is also the major component of this unit, which contains only one settlement, namely Stanbridge Station. This landscape also provides a panoramic view of the territory, limited by the forest cover along Brochets River and between the fields. The built heritage of Stanbridge Station, which includes an old railway station, and its rustic character are the main attractions of the landscape in the unit. Highway 202 to Stanbridge Station and the Saint-Henri and Marier roads are also part of the "Tranquillité légendaire" touristic route.

The agroforest landscape of Saint-Armand

The agroforest landscape of Saint-Armand differs from the other units in its rolling hills and denser forest cover, interspersed with agricultural lands known as the Saint-Armand Hills. Streit Pond, which lies among the hills, has a migratory bird sanctuary of significant ecological interest. The settlement of Saint-Armand, one of the oldest municipalities in the MRC, has the main concentration of abutting observers in the unit. Highway 133 and chemin Saint-Armand are the main roads from which the landscape in the unit may be viewed. On the other hand, the winding, hilly chemin Saint-Armand affords more diversified views of the agricultural and forest landscape of the Saint-Armand Hills. It is also a part of the "Tranquillité légendaire" touristic route.

Analysis of the sensitivity of landscape units

The sensitivity of the landscape in each unit was determined using the following evaluation criteria:

- absorption capacity, which is the intrinsic capacity of the landscape to visually overshadow the new infrastructure, and visibility, determined by the degree of openness of the visual fields, the type of views onto the new infrastructure and the number and type of observers concerned;
- visual interest, or the harmony of the landscape, its distinctiveness, visual attractions and discords;
- value assigned by the population in accordance with its preferences (existing and projected vocations) and the presence of specific settings and symbolic and historical elements.

The analysis of the sensitivity of landscape units suggests that only the abutting landscape of Iberville presents an average level of sensitivity. All the other units are highly sensitive in relation to the Highway 35 completion project, especially the lacustrine landscape units of Venise-en-Quebec and Philipsburg, which exhibit high degrees of accessibility, interest and expressed value, in spite of average visual

accessibility. Finally, the agricultural landscape units of Saint-Athanase, Saint-Alexandre, Saint-Sébastien and Stanbridge Station are also sensitive due to their high accessibility and expressed value, despite their average visual interest.

5.3.3.2 Mitigation measures during construction and significance of residual effects

During construction, the effects on the landscape are deemed not significant because of their low intensity (alteration of the landscape components will be not significant), because they are localized (limited to the intervention areas), and because they are of short duration (for the construction period only).

Generally, during the lifetime of the new highway, the main direct and indirect effects of the extension of Highway 35 between Saint-Jean-sur-Richelieu and the US border will pertain to:

- the composition of the landscape (forest, shoreline, lacustrine, agricultural, built);
- observer perception: fixed observers (residence, vacationers and tourists) and mobile observers (users of the new road infrastructure, existing roads, recreational paths).

The main landscape units affected by Highway 35 are:

- the Saint-Athanase, Saint-Alexandre and Saint-Sébastien agricultural landscape unit;
- the Brochets River landscape unit.

Saint-Athanase, Saint-Alexandre and Saint-Sébastien agricultural landscape unit

Changed perception of stationary and mobile observers

The main visual effects associated with the presence of the new Highway 35 will be felt by users of the secondary roads in the form of changes in the existing intersections and the creation of new ones. Most of these changes will consist of new art works, entrance and exit ramps and service roads.

The mitigation measures proposed to limit the visual effects caused by the new Highway 35 consist in harmonizing the earthworks for the full length of the new highway with the surrounding agricultural landscape and producing distinctive landscaping to serve as a reference and identification point for the residents of the nearby municipalities. The following intersections will be designed or redesigned with this in mind:

- intersection with Highway 133 near Saint-Jean-sur-Richelieu;
- intersection of Saint-Joachim with montée de la Station near the municipality of Saint-Alexandre;
- intersection with Highway 133 near Saint-Sébastien;
- intersection of Highway 133 with chemin du Moulin/Champlain near the municipality of Philipsburg.

All the other intersections will have to be designed or redesigned to harmonize them with the surrounding agricultural landscape. These mitigation measures will minimize alterations in the quality of the landscape and how it is seen by observers.

The environmental value of the Saint-Athanase, Saint-Alexandre and Saint-Sébastien landscape is considered average on account of the predominance of agricultural land and the panoramic views of the landscape. The degree of disturbance is felt to be average because of the large number of observers who will be able to see the new highway and the application of mitigation measures. The resultant intensity of effect is seen as average because the project results in a decline in the value of the landscape. The

importance of the effect is local because it covers a portion of the MRC, whereas the duration will be long, i.e. the full life span of the infrastructure. Accordingly, the residual effect is deemed not significant.

Brochets River riverside landscape unit

Modification of landscape composition

The Brochets River riverside landscape will be changed by the creation of a new bridge and the addition of a new intersection with Highway 202. This sector is part of a conservation area designated as an ecological reserve and is deemed by the MRC to have a high recreational and touristic potential.

Changed perception for stationary and mobile observers

The creation of a new bridge will affect primarily the view for of residents living in its proximity and of users frequenting the Brochets River ecological reserve. In addition, those using chemin Molleur will have a different view on account of the addition of a new intersection with Highway 35.

A restoration of the banks of Brochets River will be carried out after the construction of the new bridge in order to limit the effects on the landscape and on the visual field of observers. The banks will be reshaped and revegetated to give them a natural look in harmony with the existing landscape. The selected plants must be representative of the surrounding native flora. The earthworks and landscaping around the new intersection must also harmonize with the surrounding landscape. Application of these mitigation measures will limit disturbances of landscape quality and how it is seen by observers.

The environmental value of the Brochets River riverside landscape unit is deemed high on account of its value as an ecological reserve and recreational and touristic attraction of high quality even though its visibility is reduced by forest cover on the banks of the river. The degree of disturbance is nonetheless deemed low because of the low density of observers. The resultant intensity of effect is rated average. The importance of the effect is limited, since it is confined to the bridge and only one intersection, while the duration will be long, i.e. the lifetime of the infrastructure. Accordingly, the residual effect is deemed not significant.

Related activities

Restructuring of the collector roads will alter the way they are seen by mobile and stationary observers. With the application of the mitigation measures mentioned above, the residual effect on the visual environment associated with redevelopment of the collector roads is deemed not significant due to its medium intensity, its local importance and its long duration.

The operation of quarries and sand pits will alter the characteristics of the landscape. By way of mitigation measures to control these effects, the following standards set out in the Regulation Respecting Pits and Quarries are applied:

- Where the land on which a new quarry is located is covered with trees, the operator must preserve intact a strip of trees 50 metres in width between the operating site and the road allowance of any public thoroughfare and 35 metres in the case of a new pit. In the case of a new quarry, the operator must plant trees over a width of 35 metres between the operation area and the road allowance of any public thoroughfare, at a rate of 1,200 trees per hectare, if this strip of land is not already wooded in conformity with this standard of density and if the operation area is situated less than 100 metres from such public thoroughfare. These trees must be capable of growing to a height of 6 metres.

The residual effect on the visual environment associated with the operation of quarries is deemed not significant because: it is of low intensity; the project does not result in a significant decline in the value of the landscape; it is of local importance (confined to the extraction areas); it is of short duration (during the operation of the borrowing pits while the road is being built).

5.3.4 Activities related to fishing and bird watching

5.3.4.1 Description

The Brochets River is frequented by yellow walleye, a species for which a sport fishing sanctuary was created in 1980 to protect spawning fish. Today, this former sanctuary is subject to “special management” (“plan d’eau à gestion particulière”). The territory in question lies in the proximity of Missisquoi Bay, i.e. the west bank of Brochets River and its mouth at Notre-Dame-de-Standbridge. Boat speed in this sector must be reduced and fishing activities are restricted for some species during certain periods of the year. For example, bass, muskellunge and sturgeon fishing is prohibited before June 15 and fishing for all other species, before May 11.

Bertrand Dumas, who is responsible for issuing commercial fishing licenses for the MRNF, informed us on May 22, 2008, that about 50 licenses for bait fishing had been issued in Montérégie. Many of those who received licenses live close to lakes Champlain and Saint-Pierre and to the St. Lawrence River and probably do most of their fishing in that area.

People who have these licenses are allowed to fish anywhere in the region, however, including the Brochets River sector, or in the portion between the Notre-Dame-de-Standbridge dam and the mouth of the river at Missisquoi Bay. Bait fishing is allowed for a few months only, and is prohibited between January 1 and September 30.

Sport fishing is pursued primarily in the navigable section of Brochets River, from the docks found along its length and in some of the creeks, such as Black Creek, that empty into it.

Bird watching occurs primarily in the migratory bird sanctuary, a favorite site for this pursuit.

5.3.4.2 Mitigation measures during construction and significance of residual effects

The construction work such as building a new bridge across Brochets River using piles, abutments and dykes does not involve any work in the river, and the installation of the culverts required to cross the 20 watercourses along the alignment of the road will be achieved by applying proven mitigation measures to minimize effects on water quality and fish habitat. Accordingly, fishing activities will remain relatively undisturbed during the construction period in these sectors, which in any case will be relatively short. The work will be carried out during the spawning period between early April and mid-August. The roadway has been optimized to the satisfaction of MPO. Arched culverts will be used to cross certain watercourses. Sedimentation basins will be used to drain the right of way. For these reasons, the residual effect on fishing activities is deemed not significant and of low intensity. The disturbance will have little effect on these activities; it is of local importance (confined to be watercourse crossings); and is of short duration (while the construction is under way).

Streit Pond and other marshes: the loss of wetland habitats during the construction may affect visiting by the public, because Streit Pond, a special habitat for watching migratory birds, is regarded to have recreational-touristic potential. The installation of trails and other facilities for watching migratory birds will aid in reducing the effect. Intensity is low given that the affected portion of the marsh is quite small. Thus the work will not greatly impact the bird watching potential. The importance is local, being confined to the bogs, and its duration is short, with bird watching being curtailed during the construction period only. Thus the effect is deemed not significant.

5.3.4.3 Mitigation measures during operating phase and significance of residual effects

During the operating phase there may be an indirect effect on fishing activities caused by drainage water from the highway right-of-way and the use in winter of ice melters and abrasives that may introduce fine sediments and thus alter the quality of the aquatic habitat in the vicinity of the highway.

Since the modification is deemed not significant in the ROM (see 5.2.2), the project's effect on bird watching activities is also deemed not significant.

Mitigation measures are being used for winter maintenance of the highway (section 3.9.15). Sedimentation basins for drainage water on the right-of-ways are used at watercourse crossings, and compensation measures are being taken for the loss of fish habitat. Accordingly, residual effects on fishing activities arising from the expected alteration of the environment and the resource during the operating period are deemed not significant—the intensity is low (pursuit of the activity is not compromised), and the importance is local (confined to the waterway crossings). The duration is long, covering the lifetime of the infrastructure.

5.3.5 Archaeological resources and built heritage

5.3.5.1 Description

Known archaeological sites and archaeological potential

Archaeological exploration in Quebec is governed by the *Cultural Property Act* (CPA) (R.S.Q., c. B-4). This act gives legal protection to "recognized" and "classified" archaeological sites (ss. 15 and 24). "No person may alter, restore, repair, change in any manner or demolish all or part of any recognized cultural property" (s. 18) or of any "classified cultural property" (s. 31). The presence of such sites or properties on the grounds of an infrastructure development project can thus represent major impediments to its completion.

The CPA prescribes that an inventory of "known" archaeological sites must be kept and any archaeological site discovered fortuitously or by intentional search must be recorded in the inventory of Quebec archaeological sites (ISAQ) of the Quebec Department of Culture and Communications (MCCQ) (s. 52). "Known" archaeological sites may also be "classified" or "recognized" by virtue of the Act and may eventually benefit from the protections granted to these categories.

Section 40 of the Act states that whoever discovers an archaeological property or site must inform the Minister of it without delay. Sites discovered during construction work must also be protected without delay and the work must be interrupted pending a qualitative assessment of the site (s. 41). When the discovery of a site would have led to its being "classified" or "recognized," the work may be suspended, modified or definitively curtailed (s. 42). All archaeological research also requires a permit issued to persons competent in the field (s. 35). The permit requires its holder to submit to the Minister an annual report of its activities.

Finally, section 44 of the Act states that "Every alienation of lands in the domain of the State shall be subject to a reserve in full ownership in favour of the domain of the State, of archaeological property and sites found therein…" Archaeological sites found on a right-of-way belonging to the Department are subject to this section of the Act.

Consultation of the inventory of Quebec archaeological sites (ISAQ) for the region through which Highway 35 will be built shows the existence of two sites related to prehistoric Amerindian occupation of the territory. Most of the ground on these sites was excavated in two exploratory campaigns: one in 1997 in

the Haut-Richelieu MRC (St-Arnaud, 1998); and the other, between 1990 and 1994 in the Brome-Missisquoi MRC, with emphasis on the Brochets River valley (Chapdelaine et al, 1996).

Among the other archaeological inventories was the one carried out along the alignment of the gas pipeline between Saint-Sébastien and Philipsburgh (Arkéos, 1998). Seven of the excavated sites showed evidence of occupation during the Archaic period (between 6000 and 3000 BCE); but the Woodland period (3000 to 500 B.C.) is the best represented, with artefacts typical of this period present on 21 sites. An examination of the spatial distribution of these deposits revealed a clear association between settlement sites and river valleys: the sites are concentrated on the banks of the Richelieu River, the Yamaska River and especially Brochets River. However, a site from the archaic period was found well back of any watercourses, on a little mound overlooking the surrounding plain (site BgFg-17). No known prehistoric sites were found directly on the MTQ reference alignment. The closest prehistoric site lay a distance of 225 m away on the left bank of Brochets River (site BgFg-16).

The analysis of the archaeological potential of the study area for the prehistoric period is based primarily on a reconstitution of the regional paleo environments from the end of the most recent glacial era. Current data show that some sectors of the MTQ reference alignment had already emerged from the waters of the Champlain postglacial sea some 9,800 years ago, and the entire path was exposed and habitable 8,000 years ago. Moreover, an examination of the physical and ecological environment of the prehistoric sites already inventoried close to the study area reveals highly significant environmental factors in terms of the presence of ancient human settlements. In all, 18 potential areas related to the prehistoric era have been identified along the MTQ reference path: 16 coincide with the ancient shores of the Champlain Sea or Lake Lampsilis, and two are associated with the existing banks of Brochets River.

As for the historic period, only five terrestrial archaeological sites attesting to Euro-Quebec occupation have been inventoried in the region close to the MTQ reference alignment. In the Philipsburgh sector, these consist of old 19th century industrial facilities (a potash plant and a lime kiln), while northward, on the course of the Richelieu lies Fort Lennox, an important military installation on île aux Noix, and remains of an old inn on the right bank of the river facing the fort. The inventory of known archaeological sites also indicates the presence of a funeral vault on the side of Mount Saint-Grégoire.

An examination of the historic documentation concerning the area of the planned Highway 35 shows that settlement occurred earlier to the south, where the old Saint-Armand seigniory was located. The American Revolution of 1776-1783 gave rise to a flood of Loyalist immigrants to Canada, which was still under British control. The Philipsburg sector, which lay very close to the border, received many American nationals of British and Dutch descent as early as 1784. In the Brome-Missisquoi region, Philipsburg was thus the first nucleus of population, and owed its relative prosperity between 1790 and 1850 not to agriculture, but to trade with the United States. Further to the northwest, although the Richelieu was a key avenue of communication from the early 17th century, the hinterland east of the river was populated on a permanent basis only at the very end of the 18th century; colonization was a slow process. Later, during the first half of the 19th century, the three seigniories of Bleury, Sabrevois and Noyan were gradually occupied, first by the Loyalists and then by French-Canadians and Canadian and American immigrants.

The analysis of the archaeological potential for the historic period rests primarily on the detailed examination of cartographic documents dated between 1815 and 1939. This examination made it possible to trace the spatial evolution of the habitat in the study area and to identify seven potential areas coinciding most often with channels of communication or centres of agricultural population. The relatively low number of archaeologically sensitive areas arises from the fact that the MTQ reference alignment often uses cadastral “boundary” areas that lie back from densely populated spaces.

Built heritage

Built heritage includes monuments and heritage sites recognized under the CPA. In the study area, only the Saint-Pierre-de-Véronne-à-Pike-River institutional core has heritage status. Established in 1993 on the heritage site by the municipality, the institutional core, which lies at the intersection of highways 133

and 202, is composed of the church, the old presbytery and the old school (MCC, 2003). Today the presbytery contains a tourist information office; the school houses city hall offices.

In addition to the Saint-Pierre-de-Véronne-à-Pike-River heritage core, heritage complexes without legal protection status are found within the boundaries of the municipalities of Saint-Armand, Notre-Dame-de-Stanbridge, Saint-Sébastien and Saint-Jean-sur-Richelieu, Iberville sector.

The Philipsburg sector of Saint-Armand municipality, on the edge of Missisquoi Bay, has three heritage complexes (Brome-Missisquoi MRC, 2000). The first is a shoreline strip between the dock and rue James, its heritage status arising from the archaeological potential of the 1780-1796 historical period. The second series, which lies along rue Montgomery, is a residential core consisting of large villas and two churches. The latter complex lies east of Highway 133 in the same direction as rue Montgomery and consists of a Palladian style church, buildings and a few residences.

The Saint-Armand village nucleus, which lies along chemin Saint-Armand, has two heritage complexes consisting of a group of commercial buildings at the intersection of chemin Saint-Armand and chemin Bradley and an institutional complex along rue de l'Église comprising the church and an old train station converted into a city hall.

In Notre-Dame-de-Stanbridge, interesting heritage elements consisting of a covered bridge, a residence with Georgian architecture, an old school and an old mill are found close to Brochets River, chemin Duquette and rang Saint-Charles.

The Saint-Sébastien village core has two heritage complexes, one of them institutional and including, among other things, the church and the presbytery, and the other, made up of buildings combining residential and commercial uses. Both are located on the edge of Highway 133.

Finally, the heritage complex of the former municipality of Iberville consists of a large quadrangle bounded on the west by the Richelieu River. Old Iberville contains old residential sites, commercial buildings along the traffic routes and institutional complexes.

5.3.5.2 Mitigation measures in the construction and operating phases and significance of residual effects

The construction of a new transportation infrastructure such as Highway 35 can have an adverse effect on archaeological remains. Archaeological sites are geographical areas formerly occupied and modified by humans. The ground on these sites contains many indications of cultural activities in the form of objects, structures, signs of alteration, et cetera. Together these elements form a coherent, structured, decipherable archaeological context, but any alteration of the ground by modern human activities can destroy or irreversibly diminish the message they convey.

Archaeological resources

No "classified" or "recognized" archaeological sites are currently located in the boundaries of the study area for the extension of Highway 35 between Saint-Jean-sur-Richelieu and the American border. Accordingly, no "known," "classified," or "recognized" archaeological items or sites can be affected by the execution of the work.

However, only a very small part of the region, including the right of way for the Highway 35 extension, has been the subject of archaeological explorations. Accordingly, there is no information at present to confirm or deny the archaeological potential of the land that will be required to carry out the project. Thus there may be some archaeological remains along the right of way. The construction project may therefore create adverse effects on archaeological remains as yet undiscovered but potentially present in the study area.

As a preventive mitigation measure, areas with archaeological potential identified within the Highway 35 extension area between Saint-Jean-sur-Richelieu and the US border will be the subject of an exhaustive archaeological inventory. These areas, along with those within the boundaries of possible detour roads, surfaces required for contractor sites and, if necessary, sources of materials for disposal areas will be systematically evaluated by visual inspections and exploratory archaeological surveys in order to determine whether archaeological sites are present in the project areas. The research will be conducted exclusively within the right of ways owned by or under the responsibility of MTQ.

Should archaeological excavations be appropriate, they will be subject to the legal procedure for obtaining a permit under such circumstances. All archaeological research will be conducted by archaeologists under the auspices of MTQ before any construction work begins. Regardless of the results of the archaeological inventories, those responsible for the site must be notified of the obligation to indicate to the main contractor any fortuitous discoveries, in which case work will be interrupted at the site of the discovery pending a comprehensive assessment by archaeological experts.

The use of inventorying methods and archaeological excavations where appropriate can considerably reduce the possibility of archaeological sites being destroyed. Nevertheless, archaeological sites may still be discovered by chance, since the measures focus on only a sample of the surfaces required to carry out a project. Should this happen, the discovery must be dealt with in accordance with the law (R.S.Q. c. B-4, ss. 41 and 42), by temporary protection measures, by an assessment of the discovery, and, where applicable, by an archaeological excavation. With the application of these measures in view, no difficulties are anticipated in so far as the archaeological heritage is concerned.

Built heritage

The highway infrastructures planned as part of the project will not affect the various heritage clusters identified in the inventories. Nor will any heritage buildings outside these clusters be affected.

However, the highway will run close to the heritage cluster located east of Highway 133, in Philipsburg, along the axis of rue Montgomery. The rue Montgomery viaduct, which will cross Highway 35 from east to west, will provide a new access to these historic buildings. Thus this component of the human environment is expected to remain unaffected by the project.

5.4 Accidents and malfunctions

All necessary precautions will be taken to avoid accidents and malfunctions during all phases of the project, and to minimize their potential impact on the environment. The accidents that pose the greatest threat of environmental impact include:

- Spills of oil or other hazardous materials.
- Failure of measures to control erosion and sedimentation.
- Washout of a bridge or culvert.
- Fires.
- Disturbance of archaeological and heritage resources.

It is difficult to predict the exact nature and severity of such events. However, there is little probability of serious accidents or events that would cause significant adverse environmental effects, because of the emergency response plans that will be in place. To this end, in 2003 MTQ developed a safety plan (operational process, emergency measures) that calls for prompt, concerted and effective action by all internal and external stakeholders in the event of an emergency.

5.4.1 Spills of oil and other hazardous materials

Spills of petroleum products such as gasoline, oils or lubricants can occur during construction or during machinery refuelling, or as the result of a hydraulic line rupturing. These spills are usually highly localized and can easily be cleaned up by on-site teams using normally available equipment. In the unlikely event of a major spill, there could be contamination of the soil, groundwater and surface water. This in turn could have adverse effects on groundwater quality, on fish and fish habitat, and on wetland habitats, and wildlife could then ingest or absorb contaminants. Depending on the nature of the spill, it can also have an impact on residential, commercial, agricultural and other land uses.

For this reason, emergency measures plans include procedures to minimize the probability of a spill. The storage and handling of oil and other hazardous materials will comply with applicable regulations and procedures. Construction equipment will be inspected regularly to detect any possible leakage from hydraulic and fuelling systems. Any leak thus identified will be immediately repaired. Fuelling and maintenance of machinery will be done at designated places, well removed from residential properties or sites of recognized cultural or heritage value. Such activities must not be conducted within 30 m of wetlands or watercourses.

In the unlikely event of a major spill, local and provincial response procedures will be followed to minimize possible environmental effects. Emergency plans are recognized as effective ways of limiting the severity of environmental effects.

5.4.2 Failure of erosion and sedimentation control measures

There is a risk of failure of works designed to combat erosion and sedimentation following precipitation. This could cause the discharge of large volumes of sediment-laden effluents into streams, and could have potentially harmful effects on fish and fish habitat. Erosion and sedimentation control measures will be implemented in accordance with the environmental specifications. These measures will be subject to oversight by an environmental inspector, especially after heavy precipitation or during snowmelt when there is visible surface runoff. Corrective measures will be taken as needed.

5.4.3 Washout of a bridge or culvert

A bridge or culvert could be washed out after heavy rainfall or storms of much greater intensity than those allowed for in the design of these structures, or if a culvert is blocked by ice or debris. Current design standards are based on 50-year floods for culverts and 100-year floods for bridges(MTQ, 2008). Mitigation measures will include prohibiting access by road traffic to such structures during events of this scope, inspection and periodic maintenance of structures (e.g. removal of debris blocking culverts). Corrective measures will be taken as needed.

5.4.4 Fire

Fires can lead to loss of habitat, sensory problems and mortality for wildlife, and destruction and disturbance of archaeological and heritage resources. Management of fuels and other hazardous materials as well as procedures for storage, handling and transport will reduce the likelihood and the extent of accidental fires related to the project. In the unlikely event of a fire, local emergency response and firefighting capabilities will help reduce the severity and extent of damage. A fire emergency plan and fire prevention procedures are included in the MTQ manual *Processus opérationnel, mesures d'urgence*.

5.5 Environmental effects on the project

5.5.1 Description

The effects of the environment on the project were examined for both the construction and the operating phases. Table 5.37 lists the measures to be taken in the case of extreme events (heavy downpours, ice storms etc.).

Table 5.37. Extreme events, impacts and preventive measures

Type of event	Impact	Preventive Measure
Highway construction		
Torrential rains	Washing of sediment from the road and work site to streams. Storm sewer back-ups and flooding of the highway right-of-way.	Provide for the design of sediment basins. Keep the work site clean. Carry out partial or complete closure of the highway when conditions compromise user safety, and provide for temporary detour roads.
High waters	Loss of material.	Store material outside the flood zone. Use cofferdams and geomembranes where required. Keep the work site clean.
Operation		
Torrential rains	Difficult road conditions due to loss of contact with the road surface (aquaplaning), and reduced visibility due to heavy rains. Storm sewer back-ups and flooding of the highway right-of-way.	Consider the possibility of installing rumble strips along the shoulder of the highway to alert drivers when visibility may be impaired by weather conditions and to prevent them from leaving the road; regularly clean drainage systems (ditches, catch basins, etc.); inform the public of road conditions. Information on road conditions will be made available to users via variable message signs, where necessary, MTQ's emergency hotline, the Inforoutiere.qc.ca Web site, and various media outlets. Carry out partial or complete closure of the highway when the conditions compromise user safety, and provide for temporary detour roads.
Strong winds	Difficult road conditions due to vehicle instability. Increased risk of downed trees, breakage of light standards and signs, which can constitute hazardous obstacles in the roadway. Increased risk of highway light and sign outages, which can reduce visibility, particularly at highway entrances and exits.	Consider the possibility of planting windbreaks composed of shrubs and ornamental grasses at locations where high winds are a possibility; regularly verify the solidity of the structures (light standards and sign boards); inform the public of road conditions. Information on road conditions will be made available to users via variable message signs, where necessary, MTQ's emergency hotline, the Inforoutiere.qc.ca Web site and various media outlets.
Snow, hail or ice storm	Difficult road conditions due to vehicle instability, reduced visibility and loss of contact with the pavement. Increased risk of downed trees, breakage of light standards and signs, which can constitute hazardous obstacles in the roadway.	Carry out snow removal in accordance with a preventive deployment plan to ensure the best possible road conditions. Remove any snow accumulated on the shoulder and along guardrails. If necessary, remove ice from under overpasses and clean off signs; use deicing agents and abrasives when required. Give priority to the anti-icing technique (preventive application on dry roads); consider the possibility of installing rumble strips on the shoulder of the highway to alert drivers when visibility is impaired by weather conditions.

Type of event	Impact	Preventive Measure
		Consider the possibility of planting windbreaks composed of shrubs and ornamental grasses at locations where high winds are a possibility, to reduce blowing snow and prevent the formation of snow drifts across the roadway; inform the public of road conditions. Information on road conditions will be made available to users via variable message signs, where necessary, MTQ's emergency hotline, the Inforoutiere.qc.ca Web site, and various media outlets. Carry out partial or complete closure of the highway when conditions compromise user safety, and provide for temporary detour roads.
Earthquake, landslide	Increased risk of downed trees, breakage of light standards and signs, which can constitute hazardous obstacles in the roadway. Increased risk of highway light and signal outages, which can reduce visibility, particularly at highway entrances and exits.	Map sectors that could be affected by landslides; regularly verify the solidity of structures (light standards and signs); inform the public of road conditions. Information on road conditions will be made available to users via variable message signs, where necessary, MTQ's emergency hotline, the Inforoutiere.qc.ca Web site, and various media outlets. Carry out partial or complete closure of the highway when conditions compromise user safety, and provide for temporary detour roads.

5.5.1.1 Mitigation measures during construction and operation and significance of residual effects

The measures listed in Table 5.37 for preventing or mitigating environmental consequences in the case of extreme events during construction and operation of the new highway are such that the residual effect is considered not significant: it will be (1) of low to medium intensity (recognizing that the damage caused by such weather events may be of varying degrees short of completely compromising the integrity of the environmental components in question); (2) of local extent (extreme weather events are normally restricted to specific areas); and (3) of short duration (rapid response to stabilize the situation).

5.6 Cumulative effects

The cumulative effects of the completion of Highway 35 between the U.S. border and Saint-Jean-sur-Richelieu have been assessed in accordance with the *Canadian Environmental Assessment Act* (R.S.C., c. 37) and the *Environment Quality Act* (R.S.Q., c Q-2). The assessment was carried out in keeping with the Canadian Environmental Assessment Agency's "Practitioners Guide" (CEAA; Hegmann et al., 1999), and bearing in mind the scope of the federal environmental assessment supplied to the project proponent.

As presented in the Guide, the notion of cumulative effects refers to the possibility that the permanent residual effects of a project will combine with those of other projects, events or actions, past, present or future, in the same area or nearby, to produce effects of greater amplitude on the receptor environment. The assessment of cumulative effects is a means of dealing with a project's effects in a broader context than that of the conventional environmental assessment.

This section summarizes the analysis of cumulative effects (MTQ, 2008).

5.6.1 Issues and components assessed

The main issues identified from the environmental impact study of the project for completing Highway 35 between the U.S. border and Saint-Jean-sur-Richelieu (Génivar, 2005) are the following (residual effects after mitigation measures have been taken):

- vegetation;
- wetlands;
- special-status species;
- fish habitat;
- noise environment.

Each issue comprises a number of valued ecosystem components (VEC) and valued social components (VSC). These are defined as any part or aspect of the environment that is considered important by the proponent, the public, scientists, government or any other administrative entity involved in the assessment process (Hegmann et al., 1999). For the Highway 35 completion project, the VECs examined are forest environments, riparian environments, wetlands, special-status plant species, and fish communities.

A single VSC—noise – was identified in the environmental impact study (Génivar, 2005), during the BAPE public hearings, and by Health Canada.

5.6.2 Study area

The cumulative effects assessment study area includes the Richelieu and Brochets watersheds. It does not cover the entire Richelieu River watershed, because two-thirds of this watershed lies in the U.S. and it includes the entire watershed of Lake Champlain (21,325 km²). Given the size of the U.S. portion and the difficulty of obtaining information for it, the study area is limited to the portion located in Quebec.

5.6.3 Results of the cumulative effects assessment

Table 5.38 presents the summary of cumulative effects on VECs and VSCs produced by the projects and actions identified as likely to exert a cumulative adverse impact in the course of completing Highway 35 between the U.S. border and Saint-Jean-sur-Richelieu.

Table 5.38 Summary of residual cumulative effects of actions and projects on VEC and VSC

Projects and actions	VEC					VSC
	Forest environment	Riparian habitat	Silver maple, marshes and swamps	Special-status flora	Fish	Noise
Introduction of exotic and competing species	--	--	--	--	√	--
Tree felling	√	√	--	√	√	--
Plant resource use	--	--	--	√	--	--
Stocking with salmonids	--	--	--	--	√	--
Power line construction and maintenance	√	√	--	--	√	--
Roads	√	√	√	√	√	√
Winter maintenance of roads	√	√	--	√	√	--
Dam building	--	√	--	--	√	--
Rail transport	√	--	--	--	--	--
Outdoor activities (ATVs and sport fishing)	√	--	--	--	√	--
Residential development	√	√	√	√	--	--
Commercial and industrial development	--	--	--	--	--	√
Shoreline development	√	√	--	--	√	--
Agriculture and irrigation facilities	√	√	√	√	√	--
1998 ice storm	√	--	--	--	--	--
Flooding in the 1970s	--	--	√	--	--	--
Wind farms	√	--	--	--	--	--
Completion of Highway 35	**Not significant**	**Not significant**	**Not significant**	**Not significant**	**Not significant**	**Not significant**

The completion of Highway 35 between the U.S. border and Saint-Jean-sur-Richelieu will have cumulative effects on the valued ecosystem components and valued social components included in the assessment. While the project's overall contribution to cumulative effects is considered not significant, the natural environment will be gradually modified by the project in combination with the effects generated by other projects and actions that have occurred or are occurring in the watersheds of the Richelieu and Brochets Rivers.

Cumulative effects are expected on the forest environment, as a result of further fragmentation and loss of residual habitats. Mitigation measures are unlikely to have significant effects on this component. In the past, forest cover has been lost and the forest environment fragmented by various activities, including logging, urban development, building on shorelines, road construction and maintenance, the railway system, ATV trails, power line construction, farming, and the 1998 ice storm.

Considering the planned mitigation measures that are part of the project, the cumulative effect will not be significant on the riparian habitats of the Brochets River, Barbotte Creek, and the small streams crossed by the proposed highway routing. Bank stabilization and monitoring of bank erosion will serve to mitigate the project's effects. If monitoring with respect to the reference state shows that the project is having an effect on the stability of banks, they will be restored and stabilized. For this reason, the cumulative effect is considered not significant.

Relatively small areas of wetland will be affected, and their ecological value is not particularly high. Moreover, mitigation measures will reduce the anticipated effects, rendering them not significant. Past activities that have affected and continue to affect these environments are the roads, residential development, farming and irrigation, and the great floods of the 1970s.

The cumulative effect on special-status plants might have been significant because of the number of species and the anticipated instances of disturbance or destruction. Tree felling and plant resource use, the presence and maintenance of roads, loss of habitat to residential development and farming are also affecting and will continue to affect this VEC. However, this important feature of Québec's biodiversity will be preserved by collecting at-risk plant species and growing them for seed in greenhouses, and the effect on special-status plants can therefore be considered not significant.

The project will contribute to the decline of the aquatic habitat, already degraded by other projects and activities, past or present. Consequently, the project's contribution to the cumulative effects on fish life in the region's streams would be considered significant if no measures were proposed to control them. However, the planned mitigation measures and compensation project will help reduce this effect, which will therefore not be significant.

The cumulative noise effect is more difficult to assess, as there is little information on noise levels in the study area. The only analysis available at the time the cumulative effects were assessed was the one contained in the project impact study. It was shown, however, that the commercial and industrial development potential of the Highway 35 corridor, when added to existing roads, will be such that the impact on local noise levels will not be significant (affecting a few isolated homes and residential areas).

5.7 Overall environmental impact of the project

5.7.1 Renewable resources

Given the assessment of the project's effects on physical and biological components, and the various mitigation measures that MTQ has undertaken to implement, including compensation for loss of fish habitat, wetlands and the like, it can be concluded that the area's renewable resources will continue to be able to meet the needs of present and future generations.

5.7.2 Mitigation and compensation measures

A number of mitigation measures are planned to control the anticipated effects, and several of them have already been tested. Some of these measures were incorporated into the project's design, while others will be applied during construction of the highway or during its service life. In addition to impact reduction measures, compensation measures will be applied to offset losses of wetland and fish habitat.

In order to observe the “no net loss” principle set out in DFO’s *Policy for the Management of Fish Habitat* (DFO, 1986), MTQ is planning a compensation project. The purpose of the project is to compensate for the harmful alteration, disruption or destruction of fish habitat, estimated at 1.64 ha, including 0.70 ha affected by the installation of permanent structures on the Brochets River and 0.94 ha affected by other stream crossings. The compensation project will offset the loss of fish spawning, feeding and nursery habitat. The actual balance in terms of making up for the harmful alteration, disruption or destruction of fish habitat will be assessed when the new compensation project is submitted.

The potential HADD of fish habitat could be in part offset by post-construction river restoration work. That will not be enough, however, to guarantee a “no net loss” outcome. A compensation project will therefore be needed

Fish habitat losses could be compensated by the proposal to develop certain parcels of land located along the MTQ right-of-way near the Brochets River floodplain.

The proposed compensation project would create spawning and nursery habitats for the northern pike, and nursery and feeding habitats for other fish species present in the area. The proposed site for the project is immediately next to the treed swamp by the Brochets River, west of the Highway 35 right-of-way. This area is almost entirely located below the 2-year flood line of the river.

The compensation project will modify the site's topography to maximize the effect of high water in the river, while planting vegetation suitable to the region and to the fish habitat objectives.

The area in which the proposed site is located has already been recognized as offering good potential as spawning habitat for northern pike, though the present vegetation is unsuitable for spawning because of systematic land clearing for agricultural purposes. The proposed improvements are designed to increase the flooded area and the water column through excavation of the banks, and to maximize the duration of flooding during the spring. The type of vegetation proposed should produce optimal cover for pike spawning, and will also consolidate the treed swamp next to the site. A dense carpet of aquatic and semi-aquatic plants is proposed for the floodplain, comprising a mixture of *Carex lacustris*, *Calamagristis canadensis*, *Agrostis abla*, and *Scirpus acutus* and *Elocharis* sp. Plantings of shrubs (*Cornus stolonifera*, *Salix interior* and *Salix candida*) and trees (*Acer rubrum*, *Fraxinus nigra* and *Ulmus americana*) are also suggested.

The improved area will offer between 21,000 m² and 32,000 m² of breeding and nursery habitat for northern pike, and nursery and feeding habitat for other fish species in the area. The banks will need to be stable and well planted with a sufficient buffer strip, and water depth will have to be suitable for northern pike. The water linkage between the improvements and Edwin Creek will have to be designed to allow the fish to pass freely and to avoid fish mortality within the site during low-water periods.

The plans and specifications for the compensation project will have to be prepared for DFO approval before work begins. The project will be monitored, and three reports will be submitted to DFO over a period of five years: an initial report one year after project completion, a second report three years after completion, and a final report five years after completion. A report on the work performed will also be submitted to DFO.

5.7.3 Residual effects

Figure 5.10 summarizes the project's effects on the factors covered by the scope of the environmental assessment. The summary takes into account all the mitigation measures and compensation projects that will be carried out in the course of the project.

Table 5.38 presents the overall action plan for implementing the project, including residual effects, mitigation measures, oversight, follow-up, and the proposed schedule.The analysis of residual effects, which was conducted in accordance with the methodological approach of the federal assessment process, demonstrates that the project will cause no significant modifications to the components examined.

Figure 5.10 Table of the residual effects

			Construction	Operation
Biophysical components	Hydrology	Navigation		
		Streambed substrate		
	Groundwater			
	Surface waters			
	Soils and sediments			
	Geology, geomorphology and type of soil			
	Noise environment			
	Air quality			
Biological components	Terrestrial vegetation			
	Wetlands and protected areas			
	At-risk and special-status species			
	Wildlife species and habitat	Fishes		
		Migratory birds		
Human components	Quality of life and safety			
	Utilization of lands and resources by Aboriginal communities for traditional purposes			
	Visual environment			
	Activities related to fishing and bird watching			
	Archaeological resources and built heritage			
Environmental effects on the project				

Legend:

No or insignificant effect
Important effect
Unimportant effect

Table 5.39. Overall Action Plan for Project Implementation

Effect Indicators: Intensity: Low (**L**), Medium (**M**), High (**H**); **Scope**: Site specific (**S**), Local (**L**), Regional (**R**); **Duration**: Short-term (**S**), Medium-term (**M**), Long-term (**L**)

Project Activity	Component Affected	Description of Effects	Mitigation Measure	Monitoring and Specific Environmental Follow-up	Indicators			Significance of Residual Effect	Federal Permit Required
					Intensity	Scope	Duration		
CONSTRUCTION									
Transport and traffic	Surface water and groundwater	Soil and water quality can be affected by the presence and operation of the equipment or methods used, e.g.: • soil compaction; • increase in suspended matter in the hydrographic network; • accidental spill of contaminants in the environment.	1. Have an emergency plan in case of an accidental spill of contaminants. Post a sign within view of workers that describes emergency structures and lists the names and telephone numbers of those in charge. The EC (1-866-283-2333) or MDDEP (1-866-694-5454) environmental emergencies network should be advised promptly.	---	**L**	**L**	**S**	**Not significant**	---
	Soils and sediments		2. Have emergency kits on hand at work sites at all times (absorbent tubes and cotton, impermeable containers, sumps, etc.) as well as the personnel to immediately contain any accidental spill of contaminants. 3. Carry out general maintenance and refuelling, as well as handling and storage of oil, at a distance of more than 30 m from the OHWM, and make sure that the risk of contaminating aquatic fauna remains negligible. 4. Have site supervisor approve location of areas set aside for activities that may adversely affect environmental quality (storage of oil or other hazardous materials, cleaning and maintenance of equipment, recovery of hazardous waste, etc.). 5. See that machinery is in good condition, clean and free of leakages of oil or other contaminants. 6. Restrict vehicles to proposed and clearly identified routes. 7. Outside the right-of-way, avoid letting machinery move within 20 m of the OHWM. 8. Prohibit fording of water courses by machinery. 9. Build temporary roads and access points in the right-of-way of the future highway. 10. Recover stripped materials that have been set aside during construction of access roads off the right-of-way so as to permit their re-use when the access roads are redeveloped.	---	**L**	**S**	**S**	**Not significant**	---
	Sound environment, quality of life	Noise attributable to the construction work and traffic may adversely affect the quality of the acoustic environment and, consequently, potentially impact the quality of life of residents abutting the proposed infrastructure, particularly for the most sensitive sectors.	11. Respect noise thresholds for the nearest noise-sensitive buildings pursuant to the MTQ specifications, i.e. 75 dBA or the ambient noise without construction work plus 5 dBA (take the higher of the two) during the day (7:00 am to 7:00 pm) and the ambient noise without construction work plus 5 dBA at night (7:00 pm to 7:00 am). 12. Pay particular attention to the Hamel school and ensure that L_{eq} levels inside the classrooms do not exceed 35 dBA, i.e. an outdoor L_{10} noise level of 58 dBA; send the school a copy of the work schedule for this sector before the work begins. 13. Reduce the speed of traffic in the vicinity of the construction site. 14. Build by-pass roads to divert traffic along the current A-35 to facilitate construction at the terminus of the current highway. 15. Disseminate information about the project (nature, schedule and duration of the work, etc.) through local newspapers and the MTQ Web site.	Once the equipment and schedules have been determined by the contractor, a noise monitoring program will be implemented in areas where there are homes located less than 150 m from the construction zone.	**L**	**L**	**S**	**Not significant**	---

Project Activity	Component Affected	Description of Effects	Mitigation Measure	Monitoring and Specific Environmental Follow-up	Indicators			Significance of Residual Effect	Federal Permit Required
					Intensity	Scope	Duration		
Transport and traffic	Air quality, Quality of life	Emissions from heavy machinery and equipment as well as dust emissions may affect air quality during the construction period and, consequently, potentially affect the quality of life of residents abutting the proposed infrastructure.	16. Use dust suppressants as needed to prevent the dispersal of fine particles in the ambient air. The suppressants must comply with Quebec standard NQ 2410-0300 *Abat-poussière pour routes non pavées et autres surfaces similaires* [dust suppressants for unpaved roads and other similar surfaces], or must be approved by the MDDEP. 17. See that all pollution control systems in vehicles and equipment are operational and comply with provincial air quality regulations; encourage the use of energy-efficient vehicles. 18. Avoid idling when trucks are waiting in order to limit exhaust gases. 19. Use a route away from residential areas for transporting excavated and fill material and the like, in order to limit dust, exhaust and noise. 20. Cover truckloads of loose material with securely anchored tarpaulins during transportation. 21. Prohibit burning of waste at construction sites. 22. Ask contractors to undertake regular maintenance of all diesel-powered equipment to keep it in proper working condition. 23. During inspections, make note of any situation deemed unsatisfactory and promptly issue a correction order to the persons concerned. 24. Notify abutting residents of timetables for any work that may cause damage such as blasting. 25. Take all precautions needed to protect people and property.	If any blasting must be carried out near residences, the worksite supervisor will monitor carbon monoxide (CO) concentrations.	**L**	**L**	**S**	**Not significant**	---
	Safety	The road network in the area near the highway construction work, the access roads, service roads, bridges, viaducts and interchanges will be disrupted to varying degrees depending on the construction sites and periods. Users of the regional road network such as car and truck drivers and cyclists will be affected by congestion, closures and detours on parts of the roads. The safety of road users may be affected by the increased presence of heavy machinery/vehicles on the roads, and noise and dust will cause nuisances that may adversely affect the safety of road users.	26. Maintain a traffic lane (existing or to be constructed) in each direction at all times. 27. Provide information to the local news media on changes to the road network as well as the location, dates and schedules of the construction sites. 28. Install adequate signage to ensure the safety of road users at all times. 29. Evaluate the functionality of abutting roads and maintain their accessibility during work on the junction with the highway that is being constructed or relocated. 30. Clean up the highways used by machinery and transport vehicles in order to remove any accumulated debris for the entire duration of the work.	---	**M**	**L**	**S**	**Not significant**	---

Project Activity	Component Affected	Description of Effects	Mitigation Measure	Monitoring and Specific Environmental Follow-up	Indicators			Significance of Residual Effect	Federal Permit Required
					Intensity	Scope	Duration		
Land clearing	Terrestrial and riparian plant communities Surface water	The activities involved in land clearing and levelling, grading and digging ditches within the right-of-way will entail the permanent loss of about 80 ha of terrestrial plant communities and 0.7 ha of riparian vegetation (streambanks and agricultural ditches). Activities at the construction sites, such as storage of materials and movements of machinery, could also result in losses. The actual permanent loss of vegetation will be confined to the space occupied by the new roadway and its shoulders, and the on and off ramps. The land clearing work will expose the soil, thus promoting runoff and the input of suspended matter into water courses which may alter their quality	31. Signpost areas where trees are to be felled with proper visual markers and show the boundaries of these areas on the construction plans 32. Keep tree felling to a minimum, especially near lakes and streams, and preserve a 20-m strip along water courses and lakes when possible. 33. Protect trees located outside these boundaries. If necessary, install tree protectors and protect the root systems of trees and shrubs. 34. Fell trees in a manner that does not damage the forest edge and avoid letting trees fall outside the boundaries of the tree felling area or into a water course. If necessary, the contractor responsible for tree felling shall be required to clean up the water course and remove tree felling waste to a location outside the riparian strip. 35. Carry out selective cutting in the 3-metre transitional strip along the edge of the right-of-way so as to remove dead or diseased trees and avoid a situation where mature trees will fall. 36. Manually cut trees within 20 m of the OHWM. 37. Strip topsoil in erosion-prone locations immediately before grading in order to avoid lengthy exposure of the soil to erosive forces. 38. Leave stumps, branches and other vegetation, including shrubs, in place until one week before work starts within 20 m of the OHWM. 39. Plan soil protection measures (e.g. sediment barriers) when sediment may come in direct contact with a ditch or water course. Set aside the surface layer of topsoil, the stumps and the roots and pile them up at a distance of more than 20 m from a water course for future use (e.g., replanting on fill work or on abandoned stretches of the existing highway). 40. Take unusable materials or debris from tree felling work to an MDDEP authorized disposal site. 41. Recover trees of merchantable size before work begins. 42. No machinery is to be operated within 20 m of the OHWM unless unavoidable for the purpose of fording. 43. Restrict the fording of streams; the contractor responsible for tree felling must use existing bridges and culverts, wherever possible; if fording is unavoidable, the ford must be constructed on a gravel bed or on the rocky outcrops of the stream, in a shallow area, and be of sufficient thickness to protect the stream while allowing free flow of water above the riprap. 44. Pay special attention to preserving soil integrity. 45. As work proceeds, divert any ruts within 20 m of water courses. 46. Restore (e.g., revegetate) the most degraded cleared areas in order to reduce the adverse environmental impacts caused by loss of forest habitats. 47. Transfer (MTQ) to the Minister of MDDEP surplus forest areas (e.g., Saint-Alexandre forest) for conservation purposes.	---	**L – M** **L**	**S** **L**	**L-S** **S**	**Not significant** **Not significant**	--- ---

Project Activity	Component Affected	Description of Effects	Mitigation Measure	Monitoring and Specific Environmental Follow-up	Indicators			Significance of Residual Effect	Federal Permit Required
					Intensity	Scope	Duration		
	Protected area, bird species at risk	The total area of the migratory bird sanctuary that will be affected is estimated at 2.5 ha and is likely to contribute to the loss of nesting habitat. The anticipated impact of the construction of the highway through the migratory bird sanctuary will be negligible: it will be limited to the loss of habitat bordering the existing Highway 133, i.e. areas peripheral to these habitats (ecotones), and will represent only 0.5% of the total area of the sanctuary (525 ha) (one third of which is old field or grassed embankments). No habitat used by species at risk in recent years will be destroyed or modified by the project.	48. Limit to the extent possible activities in the Migratory Bird Sanctuary (mitigation measure integrated into the project design). 49. Avoid tree felling and brush clearing in all migratory bird nesting habitats during the breeding season, both in habitats that may be used by forest birds from May 1 to August 15 and in habitats that may be used by waterfowl from early April to mid-June.	---	**L**	**S**	**L**	**Not significant**	---
Infrastructure and collector road construction	Hydrology	During highway construction, the effects on navigation and streambed substrate will be insignificant because the piers for the bridge over the Brochets River are not in the water.	50. Comply with the conditions of vertical clearance above the high water mark set out in the permit issued under the *Navigable Waters Protection Act.*	---	**L**	**S**	**S**	**Not significant**	---
	Surface water	Generally speaking, construction activities can temporarily affect streams located downstream from the work by bringing fine sediments into suspension, thereby increasing water turbidity. The exact nature of changes to water quality will vary according to the site, as a function of such factors as the type of surficial deposits, the type of materials used, meteorological conditions, the season in which the work is performed and the type of machinery used.	51. Limit tree felling, soil stripping, excavation and grading of work areas to what is strictly necessary. 52. Do not carry out grading or excavation work near water courses during high water periods or heavy rains. 53. No quarry, pit, dump or storage site should be located within 20 m of the OHWM of any water course. 54. Prohibit installation of utility poles below the OHWM of stream. This also applies to streams that will be relocated or will dry up in the course of the project. 55. Take all necessary precautions to prevent transport of fine particulates into the aquatic environment beyond the immediate area of construction work. 56. Stabilize all locations that have been altered, in particular slopes of embankments, as the work progresses. If a delay is necessary for permanent stabilization, erosion control measures must remain in place to prevent erosion and capture any eroded material. 57. As a temporary erosion control measure, hay bales or geotextile barriers will be secured to the embankments to capture fine sediment in runoff, or filter berms and sediment traps will be placed in the ditches upstream from the streams. See that all measures are taken to limit erosion when construction sites are temporarily closed.	---	**L**	**L**	**S**	**Not significant**	Permit for construction of the bridge over the Brochets River obtained under the *Navigable Waters Protection Act*.

Project Activity	Component Affected	Description of Effects	Mitigation Measure	Monitoring and Specific Environmental Follow-up	Indicators			Significance of Residual Effect	Federal Permit Required
					Intensity	Scope	Duration		
			58. Strict surveillance of the most sensitive areas, particularly during the spring and fall high-water periods or in the case of exceptional meteorological events. 59. Divert drainage ditches toward stable, planted areas more than 20 m from the OHWM. If diversion is not possible, potential sediment arriving from structures must be controlled through an appropriate and effective system that can prevent leaching. 60. Install containment structures, filter berms, sedimentation basins or sediment traps in sufficient quantity in work areas to prevent transport of sediment into the water. However, such structures must not be built outside the work area in fish habitats. 61. Maintain in good condition all existing works designed to protect the environment. 62. Do not dump any debris, concrete waste or wet mortar into the aquatic environment. Any debris accidentally entering the aquatic environment must be removed as quickly as possible. 63. Dispose of excavated materials at a site designated for this purpose. 64. Install ditches to capture runoff water along temporary roads in order to prevent erosion and transport of fine sediment.					
	Special-status species	The noise generated by machinery during construction could disrupt nesting of the least bittern, which is found in the Streit Pond sector. Highway construction-related work could disrupt the habitats of the bridle shiner and of the spiny softshell turtle.	65. Prohibit construction work in the Streit Pond sector during the breeding season from mid-May to mid-August. 66. Restore streambanks and water courses in such a way as to re-create suitable habitats for these species and thereby avoid any adverse impact on their presence in the study area.	The MTQ has undertaken to carry out specific environmental monitoring for the least bittern in accordance with the protocol prepared by the National Least Bittern Recovery Team. Since the least bittern is more likely to be present at the beginning of the breeding season, i.e. at the start of egg-laying (late May-early June), the inventories will cover that period and will be spaced at intervals of 7 to 10 days between visits to Streit Pond.	**H**	**S**	**S**	**Not significant**	---
	Quality of life and safety	The activities involved in upgrading collector roads may diminish air quality and the acoustic climate, disrupt local and regional traffic (congestion, detours, temporary closures, etc.) and jeopardize the safety of users of the road network.		---	**M**	**R**	**S**	**Not significant**	---

Project Activity	Component Affected	Description of Effects	Mitigation Measure	Monitoring and Specific Environmental Follow-up	Indicators			Significance of Residual Effect	Federal Permit Required
					Intensity	Scope	Duration		
	Visual environment	The various types of construction work may modify the landscape.	67. Plan regrading work in such a way that the profile of the new road is in harmony with the natural forms of the surrounding landscape: embankments should have shallow slopes and the route should follow the relief. 68. Plan laying of topsoil and seeding on all ground that has been disturbed. 69. Plant trees on embankments extending more than 12 m from the roadway, taking care to vary the edge of the treed area in order to achieve visual integration. 70. Replant with species of trees and shrubs that have a stabilizing effect, match the mix of existing species at the location, are suited to the soil type and moisture content, and are resistant to salt spray. 71. Grade banks and shores, with shallow embankment slopes that are rounded off at the point where they connect with natural banks and shores. 72. Restore stabilized embankments to a natural state by seeding banks and shores and planting shrubs above the high water mark in a varied arrangement so that they are visually integrated, taking care to select species that will stabilize the banks/shores and will match the mix of existing species at the location. 73. Within the right-of-way of the old road, do grading work in harmony with the major relief features, with due attention to conditions necessary to allow plant growth to resume. 74. Make slopes shallow and see that they are properly connected to their surroundings. 75. Cover ground with sufficient topsoil to enable plant growth to resume; depending on how much topsoil is available, give priority to the ends of stretches of the old road in order to foster growth of trees that will create a screen. Where no topsoil is being applied, use a suitable mix of grasses. 76. Create visual screens consisting of hillocks and large plants at the intersection of the new roadway with stretches of the old road, as well as on visually exposed hillsides.	---	**L**	**S**	**S**	**Not significant**	---
	Archaeological heritage	The construction work may destroy archaeological remains.	77. Conduct an exhaustive archaeological inventory before work begins in areas of archaeological potential identified within the right-of-way as well as areas within the boundaries of any temporary detour roads, surfaces required for contractor sites and, if necessary, sources of materials or disposal sites. 78. Regardless of the results of the archaeological inventories, inform construction site managers of their obligation to report any fortuitous discoveries to the prime contractor. 79. If necessary, interrupt the work at the location of the discovery until a thorough assessment can be completed by archaeologists.	---	**No anticipated effects**				Should archaeological excavations be appropriate, they will be subject to the legal procedure (R.S.Q., c. B-4, sections 41 and 42) for obtaining a research permit under such circumstances.

Project Activity	Component Affected	Description of Effects	Mitigation Measure	Monitoring and Specific Environmental Follow-up	Indicators			Significance of Residual Effect	Federal Permit Required
					Intensity	Scope	Duration		
Work in aquatic environments	Surface water Fish and fish habitat, fishing-related activities	Construction work (land clearing, excavation and grading, movement of machinery, etc.) near or in fish habitat areas could degrade water and habitat quality through the resuspension of fine particulates in the water and their deposition downstream from the construction sites. Construction activities could also disturb fish species present during the work. The anticipated effect on fish species during the construction phase will be due mainly to encroachment on fish habitat and the introduction of suspended matter in the waters downstream from the work sites. The structures constructed for stream crossings, temporary or permanent, may impede fish passage (Brochets River bridge and culverts). The diversion or straightening of certain streams may modify fish habitat. A temporary deterioration[1] and permanent losses[2] of fish habitat are expected. The loss of fish habitat could also result in a decrease in the fish population in the area and thus have an impact on fishing success, with a resulting decrease in use of the area by fishermen. [1] Redevelopment of streams to recreate fish habitat upstream and downstream from crossings will be designed to compensate for losses caused by riprap or channelization upstream and downstream.	80. To prevent or mitigate washouts near stream crossings and to minimize inputs of suspended matter into receiving waters, the walls and bottom of the ditches will be protected with a geotextile membrane as well as with stable granular material, and drainage water will be diverted by a dike into areas of natural vegetation before it reaches the receiving streams. 81. Comply with the *Recommandations pour la conception des traversées de cours d'eau où le libre passage du poisson doit être assuré* [Recommendations for the design of water course crossings where the free passage of fish must be ensured] (Fisheries and Oceans Canada, 2007). 82. Notify DFO as soon as possible of any change in the project (plan, timetable, etc.) or any unexpected impact on fish habitat. 83. Ensure that water can flow freely at all times and that there is sufficient water for the various habitat functions (feeding, spawning, nursery) downstream from the construction area. Take necessary measures to avoid negative impacts (e.g.: flooding, dewatering, suspended matter and erosion) both upstream and downstream from the work area. 84. Maintain uniform water drainage on either side of the highway in low- and high-flow flood zones, and ensure the free passage of fish during spring high flows. More specifically, the flow in the Edwin and Louis-Rocheleau creeks will be maintained by arch culverts. 85. Ensure fish passage at the stream crossings over the Barbotte, Chartier, Décharge Lacroix, Bellefroid-Archambault, Edwin and Louis-Rocheleau creeks. 86. To avoid altering the specific streambed characteristics in streams where fish passage must be maintained, install arch culverts at their crossings, i.e. preserve the existing slope of the stream at the culvert site and avoid any change in bed composition, hydraulic jumps and contraction of flow upstream. 87. For the crossings of other creeks and agricultural ditches, install culverts consistent with MTQ standards. 88. Design culverts so as to bury the base and respect the slope of the stream and, insofar as possible, culvert construction should respect hydraulic conditions, topography and natural erosion forces. 89. Stabilize culvert inlets and outlets to reduce the risk of erosion. 90. Culvert outlets (riprap size) must be properly designed with respect to flow rates and in keeping with DFO recommendations, in order to prevent erosion. 91. Construct stilling basins downstream from the Edwin and Louis-Rocheleau crossings in order, among other things, to provide resting habitat for fish. 92. Carry out the work outside the spawning period of the fish species likely to use the sites in question, i.e. early April to mid-August. 93. Conduct site restoration following any temporary encroachment in the floodplain in order to restore initial fish habitat potential and functions. 94. Unless otherwise specified, fish must be able to move freely through diversion canals at all times.	The redeveloped streams will be monitored and will meet the recommendations and objectives of the DFO document on fish habitat restoration.	**L** **L-M**	**L** **S**	**S** **S**	**Not significant** **Not significant**	Blasting work must comply with the Guidelines for the Use of Explosives in or near Canadian Fisheries Waters. Proponents unable to meet the guideline values must apply for authorization under section 32 of the *Fisheries Act.* In seeking authorization under the *Fisheries Act*, MTQ undertakes to provide a detailed description of the stream redevelopment concept.

Project Activity	Component Affected	Description of Effects	Mitigation Measure	Monitoring and Specific Environmental Follow-up	Indicators			Significance of Residual Effect	Federal Permit Required
					Intensity	Scope	Duration		
		[2] Fish habitat losses attributable to the work will be offset by adequate compensation projects to achieve “no net loss” of fish habitat, consistent with the DFO *Policy for the Management of Fish Habitat* (1986).	**Temporary diversion of water courses:** 95. The bed and banks of the diversion canal must be stabilized with non-erodible riprap and a geomembrane or impermeable membrane at all times. 96. Use clean granular material (free of fine particles) for cofferdams. Preferably use a membrane or other non-granular material to achieve impermeability. 97. Design temporary works to withstand floodwaters that may occur during the construction period. 98. Temporary works must be protected against erosion through stabilization, for example a geomembrane or riprap. <u>Machinery:</u> 99. Install an absorbent floating boom for oil in water courses, downstream from the work area, in a location with a slow current, and in lakes (for work along the shore), for the entire duration of the work. 100. Take machinery away from water courses when it is no longer in use. <u>Site restoration:</u> 101. Restore stream banks and beds to their original state (sediment grain size, streambed profile, etc.) after temporary structures have been dismantled. 102. Restore ditches damaged by machinery (damage to gradient, shoulders of embankments, etc.). 103. Restore banks using recognized stabilization techniques using vegetation, taking into account stability, susceptibility to erosion, slope and height of embankment. Replanting must be done as soon as possible after grading work is complete, with preference given to indigenous species. 104. Restore diversion canal to its original state after backfilling. 105. Limit riprip on stream banks to the ordinary high water mark and replant starting at the edge of the riprip, which shall be composed of clean stones free of fine materials. **Stream reconstruction:** 106. Ensure sufficient flow above the substrate by minimizing interstitial flow (minimize water loss through the substrate). 107. Concentrate flow during low flow periods (construction of a thalweg or minor bed). 108. Make improvements that will promote heterogeneity of fish habitat (pools, sills, meanders, etc). 109. Ensure free passage of fish by avoiding excessive gradients and impassable barriers.					

Project Activity	Component Affected	Description of Effects	Mitigation Measure	Monitoring and Specific Environmental Follow-up	Indicators			Significance of Residual Effect	Federal Permit Required
					Intensity	Scope	Duration		
			110. Limit protective riprapping of stream banks to the OHWM and provide with adequate vegetation cover. Beyond the OHWM, any stabilization must involve complete revegetation.						
	Wetland, marshes and swamps Actives related to bird watching	The total area of wetland loss[2] attributable to the work is 0.95 ha in the silver maple forests, 0.04 ha in Streit Pond, 1.98 ha in the marsh located at km 34 and 0.004 ha in the small marsh located at km 35. The impact on marshes (Streit Pond and other) could have a potential effect on use by the public since Streit Pond is considered to have recreational and tourism potential (site of choice for migratory bird watching). [2]Losses of natural habitat are taken into consideration in the compensation project.	111. Renaturalize affected shorelines. 112. Create developments to allow migratory bird watching (e.g., interpretive trails).	--- ---	**L-M** **L**	**S** **S**	**L** **S**	**Not significant** **Not significant**	For possible blasting activities, comply with the *Guidelines for the Use of Explosives in or Near Canadian Waters*. If the proponent is unable to meet the guidelines, it will have to seek authorization under s. 32 of the *Fisheries Act*. In seeking authorization under the *Fisheries Act*, MTQ undertakes to provide a detailed description of the stream redevelopment concept.
Operation of quarries and sand pits	Groundwater	The removal of material below the level of the water table may lower the water table and alter groundwater quality.	Comply with the following standards of the *Regulation Respecting Pits and Quarries* (R.Q., 1981, c. Q-2, r. 2): 113. Determine the piezometric level before operations begin. 114. Limit the depth that can be worked.	---	**L**	**L**	**S**	**Not significant**	---

Project Activity	Component Affected	Description of Effects	Mitigation Measure	Monitoring and Specific Environmental Follow-up	Indicators			Significance of Residual Effect	Federal Permit Required
					Intensity	Scope	Duration		
	Surface water	The operation of quarries or sand pits could alter the surface water quality by increasing loadings of suspended matter to nearby streams via runoff water.	115. Locate the operating site of any new pit or quarry at a minimum horizontal distance of 75 m from any stream, river, lake, ocean, swamp or sandbank. 116. Locate every new pit or quarry at a minimum distance of 1 km from any well, water, source or other water intake used to supply a municipal waterworks or a waterworks network, unless the operator submits a hydrological study in support of his request and the operation of the new pit or quarry is not likely to affect the yield of the well which supplies such waterworks network. 117. Comply with the following concentrations for water discharged to the environment: • oil, grease, tar of a mineral origin: 15 mg/l; • suspended matter: 25 mg/l; • pH: between 5.5 and 9.5.	--	**L**	**L**	**S**	**Not significant**	---
	Soils and sediments	Blasting during quarry operations is likely to alter soil stability by generating seismic waves.	118. Do not emit into the environment impulsive or discontinuous seismic waves whose ground speed, measured at less than 30 m from any structure or immovable or from any artesian well, is greater than 4 cm/s.	--	**L**	**L**	**S**	**Not significant**	---
	Noise environment	The excavation, loading and transport of materials are likely to increase noise levels.	119. It is prohibited to establish a new pit or quarry whose operating site is located in a territory zoned by municipal authorities for residential, commercial or mixed purposes. 120. It is prohibited to establish a new quarry less than 600 m from such territory or to establish a new pit less than 150 m from such territory, including any school or other educational institution, place of worship, campground or any institution within the meaning of the *Act Respecting Health Services and Social Services* (R.S.Q., c. S-5). 121. Locate the operating site of a new quarry at a minimum distance of 600 m from any dwellings; in the case of sandpits, the minimum distance required is 150 m. A new pit or quarry may nevertheless be established at a distance that is under the distances prescribed if the operator submits in support of his request an estimate of the maximum noise level that will be emitted into the environment by the operation of the new pit or quarry, and if the noise measured at the boundary of any residential, commercial or mixed zone and any structure or immoveable (school or other educational institution, place of worship, campground, or any institution within the meaning of the *Act Respecting Health Services and Social Services*) does not exceed 40 dBA between 6:00 p.m. and 6:00 a.m. and 45 dBA between 6:00 a.m. and 6:00 p.m. 122. Blasting is prohibited between 7:00 p.m. and 7:00 a.m. in a quarry situated less than 600 m from a structure or immoveable mentioned above, even if such quarry was already in operation on August 17, 1977.	---	**M**	**L**	**S**	**Not significant**	---

Project Activity	Component Affected	Description of Effects	Mitigation Measure	Monitoring and Specific Environmental Follow-up	Indicators			Significance of Residual Effect	Federal Permit Required
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	Air quality	Dust generated during quarry operations is likely to affect air quality.	123. Crushers, dryers, screens, conveyors, elevators and bins installed in a quarry and any feeding or dumping point for aggregate material removed from a quarry must not be employed in an activity or constitute circumstances resulting in the emissions into the atmosphere of dust visible more than 2 m from the source of emission. 124. Where the sources of emission are linked to a collecting system for particulate matter, that matter must not be emitted in concentrations greater than 50 mg/m^3. 125. Any equipment used or installed in a pit or quarry for the purpose of reducing or preventing the emission of contaminants into the environment shall at all times be in working condition and shall operate at optimum efficiency during the production hours of the plant, even if this equipment causes a reduction in the emission of contaminants that is well within the standards prescribed in this Regulation. 126. Install dust collector connected to a dust collector system allowing not more than 50 mg/m^3 of particulate matter to be emitted into the atmosphere to control dust emissions from drilling operations carried out in a quarry. 127. Handle and store dust recovered by dust collector systems in such a way that there will be no loss of dust into the atmosphere visible more than 2 m from the source of emission. 128. Store, deposit or dispose of any dust that is not recycled on the ground, provided the required measures are taken to prevent any issuance of dust into the atmosphere visible more than 2 m from the source of emission.	---	**L**	**S**	**S**	**Not significant**	---
	Safety	The presence of operating quarries and sand pits is likely to alter traffic conditions and to increase risks relating to user safety.	129. Locate the private access roads to any new quarry or sand pit a minimum distance of 25 m from any construction or building. 130. Locate the operating area of any new quarry or sand pit a minimum distance of 70 m and 35 m, respectively, from any public thoroughfare.	---	**M**	**L**	**S**	**Not significant**	---
	Visual environment	The opening of a new quarry or sand pit is likely to alter landscape features.	131. Where the land on which a new quarry is located is covered with trees, preserve intact a strip of trees 50 m in width between the operating site and the road allowance of any public thoroughfare and 35 m in the case of a new pit. 132. In the case of a new quarry, plant trees over a width of 35 m between the operation area and the road allowance of any public thoroughfare, at a rate of 1,200 trees per hectare, if this strip of land is not already wooded in conformity with this standard of density and if the operation area is situated less than 100 m from such public thoroughfare. These trees must be capable of growing to a height of 6 m.	---	**L**	**S**	**S**	**Not significant**	---

Project Activity	Component Affected	Description of Effects	Mitigation Measure	Monitoring and Specific Environmental Follow-up	Indicators			Significance of Residual Effect	Federal Permit Required
					Intensity	Scope	Duration		
Presence of the infrastructure	Hydrology	The presence of the highway in a floodplain will have a minor effect on the flow section and level of the river upstream from the future bridge. The increases are estimated at 2 cm, 3 cm and 5 cm under 2-, 20- and 100-year flood conditions. These increases will be insignificant and barely perceptible in the flood zones. However, the presence of the highway in the low-flow floodplain (100-year flood) will result in slight changes to the boundaries of flood-prone areas, despite the presence of culverts that are designed to allow water to run from one side of the future highway to the other. The presence of the highway and the bridge over the Brochets River will not increase the risk of ice jams. The presence of the bridge over the Brochets River, which is considered a navigable waterway, is likely to pose an obstacle to the passage of a pleasure boat.	133. Meet the conditions respecting vertical clearance above the high water line set out in the permits issued under the *Navigable Waters Protection Act.*	Although the presence of the A-35 and bridge over the Brochets River is unlikely to increase the risk of ice jam formation, it is recommended that flow conditions be observed at least once as the ice cover on the Brochets River melts and breaks up.	**L**	**S**	**M**	**Not significant**	---
	Surface water, fish habitat	The presence of the highway in a floodplain is likely to alter the surface water drainage pattern. The increase in drainage water flows from the right-of-way into the hydrographic network could promote the development of pockets of erosion likely to affect the stability of embankments and stream banks, thereby contributing to the transport and suspension of fine sediments in streams and therefore to the degradation of the quality of the aquatic environment.	134. Install culverts to allow water to flow from one side of the future highway to the other. 135. Construct one or more sediment basins in the floodplain of the Brochets River, between km 28 and km 33, to reduce sediment loadings to the surface hydrographic network. 136. Install sediment pits to capture fine sediment along the entire length of drainage ditches in order to avoid impacts on fish habitat. The sediment basins must be functional at all times. 137. Limit maintenance of drainage ditches to excavation of their lower third in order to maintain stability of replanted slopes.	---	**L**	**L**	**L**	**Not significant**	---
	Soils and sediments	Spills of contaminants into the environment are likely to have an effect on soil and sediment quality.	138. Manage potential effects in accordance with the management and maintenance procedures and response measures included in the emergency plan for dealing with contaminant spills to the environment.	---	**L**	**S**	**S**	**Not significant**	---

Project Activity	Component Affected	Description of Effects	Mitigation Measure	Monitoring and Specific Environmental Follow-up	Indicators			Significance of Residual Effect	Federal Permit Required
					Intensity	Scope	Duration		
	Visual environment	The presence of the infrastructure is likely to alter the landscape composition and perception of fixed and mobile observers. The construction of the bridge and addition of a new intersection with Highway 202 are likely to alter the riparian landscape of the Brochets River and the perception of nearby residents and users of the Brochets River ecological reserve.	139. Harmonize the highway earthwork with the surrounding agricultural landscape over the entire length of the new highway. 140. Carry out distinctive landscaping to serve as a reference and identification point for the residents of the nearby municipalities. 141. Restore the banks of Brochets River following construction of the new bridge in order to restore a natural appearance that blends in with the existing landscape. 142. Harmonize the earthworks and landscaping around the new intersection with the surrounding landscape.	---	**M-L**	**L-S**	**L**	**Not significant**	---
Traffic (estimated flows for 2011 and 2021)	Noise environment	The estimated traffic flows are likely to increase noise levels, particularly in the sector of Saint-Pierre-de-Véronne-à-Pike-River.	143. Construct a noise barrier 2.4 m high and 400 m long.	A noise monitoring study similar to that conducted at the time of the provincial impact study will be carried out to measure actual noise levels associated with traffic on the A-35, particularly for the home located on Chemin du Bois, which is the closest to the right-of-way of the stretch of A-35. The monitoring will be carried out over a 2-year period following construction of the highway.	**L**	**L**	**L**	**Not significant**	---
	Air quality	The anticipated increase in traffic flows is likely to result in increased emissions of certain pollutants (CO and HC concentrations) and in a decline in air quality. The estimated CO and NO_2 concentrations in several inhabited sectors will not be altered and should even improve.		---	**L**	**L**	**L**	**Not significant**	---

Project Activity	Component Affected	Description of Effects	Mitigation Measure	Monitoring and Specific Environmental Follow-up	Indicators			Significance of Residual Effect	Federal Permit Required
					Intensity	Scope	Duration		
	Bird species	The principal anticipated effect is the disturbance of migratory birds caused by noise from vehicles travelling on the highway. The anticipated effect is of the same nature and significance as that observed along any road corridor with similar daily traffic flows. With the first breeding season after the new stretch of highway is opened, a new balance will quickly be established between use of the area by birds and the noise environment in the vicinity of the new highway.		---	**L**	**S**	**L**	**Not significant**	---
	Road safety	The impact on the biological environment, associated with the barrier to the movements of small animals (barrier effect) and the risk of collision with white-tailed deer during the operation of the highway, has a potential effect on road safety, since the presence of the highway will result in an increased risk of collision with mammals, which could cause accidents.	144. Install suitable signage in areas frequented by white-tailed deer to warn motorists of their presence. 145. Install fences along the MTQ right-of-way. 146. Consider the possibility of creating passageways beneath the highway at sites where high concentrations of small mammals have been observed. 147. Optimize drainage to limit the formation of saline pools.	---	**L**	**S**	**L**	**Not significant**	---

Project Activity	Component Affected	Description of Effects	Mitigation Measure	Monitoring and Specific Environmental Follow-up	Indicators			Significance of Residual Effect	Federal Permit Required
					Intensity	Scope	Duration		
Maintenance, snow removal and use of ieicing agents	Surface water and groundwater, vegetation Fish habitat, activities related to fishing.	Winter road maintenance is likely to alter surface water and groundwater quality in the vicinity of the future highway through suspension, during periods of snowmelt, and accumulation of fine particulates (deicing salts and abrasives) in streams via drainage water from the right-of-way. These loadings of salts and abrasives are likely to disrupt and alter fish habitat and the vegetation on the periphery of the right-of-way. An indirect effect on fishing activities is possible.	148. Meet the standards set out in the *Code of Practice for the Environmental Management of Road Salts*: • remove snow contaminated by road salts; • use technologies that further optimize the use of road salts; • apply the right amount of salt to the right areas at the right time (use the most recent advancements in the application of winter maintenance anti-icing and de-icing materials); • avoid use of salt solutions near sensitive areas (wetlands, streams, etc.); • use environmentally, technically and economically feasible alternatives to road salts; • locate patrol yards and snow disposal sites outside of vulnerable areas; • cover salt piles and blended sand-salt piles; • use handling practices that prevent uncontrolled releases; • collect and treat wash water; • train personnel and monitor the effectiveness of road salt application techniques; • develop intervention procedures that can be applied in case of salt runoff that could have a negative impact on the environment. 149. Use an ecological approach to vegetation management (lower third technique) to reduce pollutant loads by naturally filtering drainage waters via the highway ditches; streams identified as fish habitat and fish habitat that will be restored shall not be maintained and any nearby vegetation shall be maintained. 150. Prior to their discharge into Martel Creek, along which Highway 35 will run for a distance of about 1 km, surface waters will be diverted to natural vegetation areas, in order to reduce loadings of suspended matter and de-icing salt. 151. Promote drainage to ditches and the drainage network to avoid the accumulation of salt and thus the formation of saline ponds in poorly drained areas. 152. Where necessary install one or more basins to capture fine sediment (sands) in ditches downstream from the drainage network before the natural hydrological system is affected, to avoid disturbing fish habitat and, more specifically, to avoid silting up spawning grounds. 153. Regularly empty the basins when they are 50% full and ensure they are accessible at all times.	MTQ will implement a program for monitoring potable water wells located along the highway that are considered at risk. This monitoring will continue for at least two years and will be repeated if a contamination problem is found to persist beyond that time. If necessary, a permanent solution to the problem will be implemented.	**L** **L**	**L** **S**	**L** **L**	**Not significant** **Not significant**	--- ---

Project Activity	Component Affected	Description of Effects	Mitigation Measure	Monitoring and Specific Environmental Follow-up	Indicators			Significance of Residual Effect	Federal Permit Required
					Intensity	Scope	Duration		
	Marshes and swamps	The presence and operation of the highway and bridge could have an impact on water quality in this sector due to loadings of de-icing salt via runoff waters from the right-of-way at the mouth of the Brochets River. The presence of the bridge, piers and fill could also modify local drainage patterns and affect nearby plant communities	154. Channel runoff from the roadway and the Brochets River bridge to points outside the floodplain by means of a surface ditch built at the top of the embankment running to the boundary of the floodplain. 155. Build a constructed wetland to filter runoff waters before they are released to the environment to avoid the accumulation of chlorides in this habitat. 156. Protect the swamp forest by installing drainage water sedimentation basins on either side of the stream between km 28 and km 33, to minimize loadings of de-icing salt to this sensitive natural area. 157. Design these sedimentation basins located upstream from the floodplain boundaries with a riprap bottom into which aquatic plant species with a high capacity to retain pollutants will be planted. 158. Channel runoff water from the roadway and the Brochets River bridge to areas outside the floodplain to protect the adjacent swamp.	Monitoring of salinity, vegetation and wildlife in this area could be conducted to document any changes and, if necessary, to take corrective measures with respect to salt management in this sector of A-35.	**M**	**L**	**L**	**Not significant**	---

Impact indicators: Intensity: Low (**L**), Medium (**M**), High (**H**); **Scope**: Site specific (**S**), Local (**L**), Regional (**R**); **Duration**: Short-term (**S**), Medium-term (**M**), Long-term (**L**)

6 EMERGENCY MEASUREMENT PLAN

The MTQ's 2003 guide *Processus opérationnel, mesures d'urgence* applies the precautionary principle, which in turn draws on the principles of adaptive management. Applying this principle means quick, concerned and effective action by all internal and external stakeholders in the event of an emergency. The guide complements the MTQ's emergency preparedness plan for Quebec, which was also written in 2003.

As a result the MTQ branch in the area in question (Est-de-la-Montérégie) has an emergency measures plan covering a range of measures for action in the event of specific events. The plan is updated regularly.

Table 5.37 in the section entitled "Environmental effects on the project" sets out the measures that will be taken in the event of each of the listed extreme events (heavy rainfall, ice storm, etc).

7 OVERSIGHT AND MONITORING PROGRAMS

In order to provide proper communication on progress and difficulties encountered when implementing mitigation measures, Transport Quebec will produce a monthly activity report that will be sent to the responsible authorities (RAs) electronically. This monthly report will give an account of mitigation measure implementation and effectiveness, and corrective measures taken where necessary. Additional reports will be produced on specific events.

Table 5.39 presents an overall of project progress by the different components reviewed by the environmental assessment. For each of the identified effects, if applicable, the related environmental monitoring and/or follow-up programs are listed along with the person responsible for applying mitigation measures and issuing the required permits, if applicable.

7.1 Environmental monitoring program

The Transport Quebec engineer in charge of the project or, if applicable, the engineer of the firm hired to complete the project will be responsible for worksite monitoring. Transport Quebec will delegate the task of environmental monitoring to a qualified professional who will ensure that the contractor and its sub-contractors fully implement and adhere to all the mitigation measures included in this comprehensive study report, the federal authorization and permit conditions, the mitigation measures that stem from adaptive management, the environmental clauses included in the contract (specifications) and all Transport Quebec's general specifications pertaining to the environment.

7.2 Environmental follow-up program

Identifying sources of impact consists of determining which project activities are likely to modify physical, biological and human environments. Such information comes from the technical description of the project, previous studies and knowledge of the location. Construction and operational impacts are discussed, and other sources of impacts during the project's lifespan could be identified. For example, recovery of work carried of by flooding, modifications to work as a result of unforeseen site conditions and changes to the route may lead to impacts that the environmental assessment did not predict and that may require a revision of the comprehensive study in order to include any new mitigation measures as required. It is important for Transport Quebec to notify the RAs of these specific situations in a timely manner to comply with the adaptive management advocated in current practice.

Adaptive management measures:

- include the development or modification of mitigation measures during the life of a project in order to deal with unforeseen environmental effects; and
- facilitate the adoption of better mitigation measures (e.g. resulting from technological progress) during the life of the project.

In other words, adaptive management measures are activities undertaken in light of new information resulting from monitoring activities in a follow-up program in order to prevent, mitigate or offset an environmental effect of a completed project or one in progress.

Adaptive management may include actual testing of new impact scenarios or new mitigation measures that could be accompanied by new follow-up activities to check the accuracy of forecasts and/or effectiveness of new measures.

A follow-up program will be developed in collaboration with the relevant RAs and federal experts. This program will deal with the following components:

- vegetation (disturbed areas, areas devoid of vegetation, watercourse banks, wetlands);
- special status flora;
- herpetofauna egg-laying and burrowing areas;
- the ditch adjacent to the Rivière-aux-Brochets bridge (swamp, spawning and ichthyological fauna area);
- culverts (free movement of fish);
- fish habitat at the intersection with highway, including restoration and rehabilitation programs;
- least bittern (Streit pond);
- saltwater pools;
- chlorine and sodium (from spreading road salt);
- vehicle-whitetail deer collision statistics;
- tree and shrub planting (landscaping);
- acoustic climate.

The follow-up program permitting the verification of the effectiveness of the mitigation measures and the effectiveness of the compensation project will be specified with Fisheries and Oceans Canada (DFO) at the time of the request for authorization made under the Fisheries Act.

An action plan for the protection of the fish habitat, prepared by the proponent and the contractor, will be also presented to the representatives of DFO before the beginning of works. This action plan will include suggested measures, in particular to avoid the introduction of sediments in the watercourses or the neighbouring lakes during construction. This protection plan will be subject to a follow-up.
Also, follow-up activities that may occur within a 5-year period are:

• Follow-up of the watercourse restoration projects
• Follow-up of the compensation projects
• Follow-up of the unrestricted passage of fish for structures where this objective is targeted.

The schedule for sending follow-up reports will be established with the RAs at the start of each study, and an electronic copy and a hard copy will be sent to the environmental assessment coordinator. A month after the on-site work for each follow-up, a follow-up report will be provided to the RAs. Other follow-up reports will be provided based on the needs established during follow-up program development with the RAs.

Acoustic climate follow-up

A noise impact follow-up study will be conducted when Highway 35 is in use under the same conditions as those when the first noise impact study was performed to check actual noise levels associated with Highway 35 traffic. These noise levels can be compared to the forecast levels and to the Quebec department of sustainable development, the environment and parks (MDDEP) community noise standard. The follow-up will be conducted over a two-year period after highway construction and will provide a comparison of simulated and actual noise levels. Additional mitigation measures will be proposed as needed.

The Chemin du Bois residence noise follow-up plan, to be implemented when the Highway 35 extension is in use, will help verify the accuracy of the forecasted residual noise impact at that residence and to validate the effectiveness of the proposed mitigation measure. That follow-up plan will include the following three aspects:

- measurement of actual noise level at the residence before project completion;
- measurement of noise level at the residence one year and five years after highway extension and the proposed noise-abatement wall erected along the route; and
- if applicable, recommendation of additional mitigation measures should the noise-abatement wall prove insufficient to offset the residual noise impact. The impact should not be deemed “average” or “high” on the noise impact assessment scale of Transport Quebec’s road noise Policy.

The follow-up report shall include the following components:

- location of noise measurement;
- type of equipment used for noise measurements;
- noise measurement methodology;
- noise measurement results;
- noise impact assessment based on measurement results;
- implemented or modified mitigation measures;
- acoustic effectiveness of implemented measures;
- mitigation measure photographs and fact sheets; and
- recommendations for additional mitigation measures if necessary.

8 PEOPLE CONSULTED

Bertrand Dumas, ministère des Ressources naturelles et de la Faune, Montérégie.
Chantal D'Auteuil, Corporation Bassin Versant Baie Missisquoi.
Louis Mathieu, CDPNQ.
Lyne Boivin, municipality of Saint-Pierre-de-Véronne-à-Pike-River.
Madeleine Papineau, Environment Canada.
Pierre Bilodeau, ministère des Ressources naturelles et de la Faune, Montérégie.

9 PRELIMINARY CONCLUSIONS PURSUANT TO THE *CANADIAN ENVIRONMENTAL ASSESSMENT ACT*

In the course of this CEAA comprehensive study, the responsible authorities consulted federal authorities having special knowledge as well as the public and other interested parties. In the light of the information in this report, and in view of the mitigation measures that will be implemented, the responsible authorities find that the project does not risk having significant adverse effects on the environment.

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APPENDIX A

Federal Responses to the public issues raised
in the third federal public consultation in 2008

Transports Canada / Transport Canada

Ottawa, Feburary 29, 2008

Subject: Highway 35 completion project between St Jean sur Richelieu and the US border CEAA # 05-03-12245

Dear Ms. Coderre and Mr. Denicourt,

Thank you for participating in the consultation on preliminary results of the comprehensive study required by the *Canadian Environmental Assessment Act*, currently underway on the Highway 35 completion project.

The main purpose of the ongoing environmental assessment is to minimize or avoid significant adverse environmental effects caused by the project as much as possible.

The federal authorities are paying close attention to the protection of forest canopy in the context of the Highway 35 project, especially in the sector near the Philipsburg Migratory Bird Sanctuary. However, as initially stated in the provincial impact analysis, the project's completion resulted in the permanent loss of nearly 80.6 hectares of forest land. The project modifications proposed by the Quebec Department of Transportation (MTQ, November, 2006), particularly in the area of the St. Alexander interchange and the rest area, have reduced the size of the affected area and limited a lot encroachment on the Sanctuary. No deforestation will be permitted during the birds' breeding season.

At this stage, the federal government is still conducting the comprehensive study. It has therefore not made a decision on the significance of the adverse environmental effects outlined in the scope of the environmental assessment. However, the MTQ (the project's proponent) has suggested some mitigation measures. These measures will likely be accepted by the federal authorities.

In order to reduce the adverse environmental effects resulting from the loss of forest habitat, restoration of deforested zones, including revegetation of the most degraded sites, will be required. In addition, recovery of commercially valuable trees will be carried out before the works begin. Moreover, as stated in the provincial Order in Council, the MTQ must transfer surplus forestlands (such as the St. Alexandre woodlot) to the Quebec Minister of Sustainable Development, Environment, and Parks to ensure environmental conservation. In addition, the preservation of Highway 227's current corridor, and the addition of a diamond interchange at St. Alexandre, will reduce the amount of affected forestland and avoid the loss of rare plants[13].

Transport Canada cannot respond to your questions concerning expropriated lands, since this is not its area of responsibility. We suggest you contact the MTQ for more information on this matter by calling Bernard McCann at 450-698-3400, extension 308.

I also invite you to consult the Canadian Environmental Assessment Registry on a regular basis for the latest updates on the project. You can access the Registry Web site at http://www.ceaa-acee.gc.ca/050/index_e.cfm (enter the keyword "highway 35" in the search window). A final public consultation on the comprehensive study report is planned for the fall of 2008, at which time you will have an opportunity to make further comments on the federal environmental assessment and the recommended mitigation measures.

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[13] For more information, please consult the Order in Council from the province at: http://www.menv.gouv.qc.ca/evaluations/decret/2007/599-2007.htm

Transports Canada | Transport Canada

If you have any questions, you can reach me by email at auto35@tc.gc.ca or by telephone at 418-648-4437.

Yours sincerely,

_____

Claire Michaud
Project Manager, Environmental Assessment of Highway Projects
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Quebec, Quebec G1K 4K1

c.c. Keith Grady, Infrastructure Canada
Maryse Lemire, Fisheries and Oceans Canada
Richard Jones, Transport Canada
Bernard McCann, Transport Quebec

Transports Canada | Transport Canada

Ottawa, February 29, 2008

Subject: Highway 35 completion project between St Jean sur Richelieu and the US border CEAA # 05-03-12245

Dear Ms. Campbell and Mr. Asnong,

Thank you for participating in the consultation on preliminary results of the comprehensive study required by the *Canadian Environmental Assessment Act*, currently underway on the Highway 35 completion project.

First of all, the highway system in Quebec is administered by the Quebec government. As the project's proponent, the Quebec Ministry of Transportation (MTQ) has jurisdiction over Highway 35 and determines the project's parameters. As you know, Transport Canada and Infrastructure Canada intend to make financial contributions to the project, and Transport Canada is likely to issue a permit pursuant to the *Navigable Waters Protection Act* (NWPA). These federal organizations play a specific role in assuring the project undergoes an environmental assessment (pursuant to the *Canadian Environmental Assessment Act)* prior to issuing a permit (pursuant to the NWPA) and before funding is approved. Fisheries and Oceans Canada is yet another federal department involved in the project's environmental assessment, because of its role as administrator of the *Fisheries Act*. As responsible authorities, Transport Canada, Infrastructure Canada and Fisheries and Oceans Canada must therefore ensure that mitigation measures are proposed as part of the current comprehensive study, and that these measures are implemented during construction to ensure the environmental impact is insignificant within the meaning of the Act.

Below are responses from federal departments to your concerns:

- Modifications to, relocation or removal of existing structures

Your comment:

We have never been invited to a meeting, nor have we received any information or proposal regarding drainage systems' mitigation measures and modifications, or proposed watercourse displacement.

Response:

Under the federal environmental assessment process, the responsible authorities have carried out two public consultations to date. At the first consultation, the public was invited to comment on the scope of the environmental assessment for the Highway 35 extension project. This hearing took place between August 31 and September 21, 2005. At the second hearing, which just recently concluded, the public was invited to comment on the ongoing comprehensive study's preliminary results.

In addition, in the context of the provincial environmental assessment process, Quebec's environmental public hearings office (BAPE) held information and public consultation sessions from September to December 2005. The purpose of the information sessions (in which the proponent, MTQ, participated), was to inform citizens on the project, and on the environmental

assessment process. MTQ will redevelop watercourses in the highway's right of way to allow the drainage of farmland. These watercourses will also restore fish habitats. To obtain a copy of the Departmental Position Statement issued following the BAPE report, please contact Mr. Bernard McCann at 450-698-3400, extension 308.

- snow removal and use of abrasives and de-icing salt

Your comment:

We request a detailed comprehensive study, such as exists in the US, on the potential for short-term and long-term direct soil contamination by abrasives and de-icing salt.

Response:

The responsible authorities have asked that the project management plan observe Environment Canada's "Code of practice for Environmental Management of Road Salts" (http://www.ec.gc.ca/nopp/roadsalt/cop/en/rs_main.htm).

The document entitled "Public Consultation on Federal Issues" (available on the *Canadian Environmental Assessment Registry*) states:

"With regard to road salt management, the proponent undertakes to abide by the "Road Salts Code of Practice" published by Environment Canada (2004). The federal authorities are of the opinion that it is important for the MTQ to implement adequate measures to limit the addition of salt into sensitive aquatic environments and wetlands, using a prevention-based approach to limiting impairment of the natural environment without, however, compromising highway safety.

- Actual total cost of the completion of Highway 35 between St-Jean-sur-Richelieu and the US border

Your comment:

We believe that the Highway 35 construction project will only be partially completed, i.e. from Saint-Jean-sur-Richelieu to Highway 133 in Saint-Sébastien, which will increase traffic on Highway 133 between our two farms in Saint-Pierre de Véronne, and prevent us from crossing Highway 133 to work our land on the south side of the highway.

Response:

The comprehensive study covers the total proposed alignment. In addition, the provincial Order in Council also covers the total alignment. You can obtain a copy of the provincial Order in Council by visiting http://www.menv.gouv.qc.ca/evaluations/lisprode.htm.

It should be mentioned that project costs are not a part of the federal environmental assessment. The federal process is limited to the scope of the environmental assessment posted in August 2005.

Conclusion:

We hereby request, for reasons stated above, that a much more comprehensive federal environmental assessment be carried out, and that public hearings be held if necessary.

Transports Canada | Transport Canada

Response:

The federal environmental assessment is a comprehensive study pursuant to the Comprehensive Study List Regulations. The environment is a shared responsibility. Construction projects often require environmental assessments by the governments of Canada and Quebec, two jurisdictions with different but often complementary legislative requirements and areas of expertise. Both governments contribute to the process. By working together, the two levels of government avoid duplicating environmental assessment-related efforts. In carrying out its comprehensive study, the federal government will address issues that fall under its jurisdiction, in accordance with the definition of environmental effects within the meaning of the Act. Details relating to these issues can be found in the document entitled "Extension of Highway 35 Proposed Scope of Environmental Assessment," and primarily concern the protection of fish habitat, navigation (socio-economic impact), species at risk, areas protected by federal regulations (Philipsburg Sanctuary), etc.

For more information, please refer to the "Federal Environmental Assessment Scoping Document" at
http://www.ceaa-acee.gc.ca/050/DocHTMLContainer_e.cfm?DocumentID=10267

In addition, in the "Extension of Highway 35 Proposed Scope of Environmental Assessment," the federal responsible authorities state that the assessment must examine alternate means of carrying out the project that are technically and economically feasible, and the environmental effects of any such alternative means. Consequently, under the federal process, all environmental effects associated with the suggested alignment alternatives proposed by MTQ will be studied.

I invite you to consult the Canadian Environmental Assessment Registry on a regular basis for the latest updates on the project. You can access the Registry at http://www.ceaa-acee.gc.ca/050/index_e.cfm (enter the keyword "highway 35" in the search window). A final public consultation on the comprehensive study report is planned for the fall of 2008, at which time you will have the opportunity to make further comments on the federal environmental assessment.

If you have any questions, you can reach me by email at auto35@tc.gc.ca or by telephone at 416-648-4437.

Yours sincerely,

_____

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Richard Jones, Transport Canada
Bernard McCann, Transport Quebec

Transports Canada | Transport Canada

Ottawa, March 14, 2008

SUBJECT: Highway 35 construction project between St Jean sur Richelieu and the US border CEAA # 05-03-12245

Dear Mr. Benoit,

Thank you for participating in the consultation on preliminary results of the comprehensive study required by the *Canadian Environmental Assessment Act*, currently underway on the Highway 35 construction project.

First of all, the highway system in Quebec is administered by the Quebec government. The Quebec Department of Transportation (MTQ) therefore has jurisdiction over Highway 35 and determines the project's parameters. Through the Canada Strategic Infrastructure Fund and the Border Infrastructure Fund (administered by Infrastructure Canada and Transport Canada), the federal government makes financial contributions to projects in sectors that help support economic growth in order to improve the quality of life of all Canadians[14]. There are a number of factors supporting the Highway 35 project in regard to funding criteria:

- the project will result in substantial safety improvements;
- since Highway 35 is the second busiest point of entry to the US (after Highway 15), the project will rectify current infrastructure deficiencies on Highway 133;
- a reduction of traffic on Highway 133 will improve safety and reduce noise levels for nearby residents.
- Upon completion, Highway 35 will strengthen the job markets and economies of the Montérégie region and Quebec, which are New England's major business partners.

In addition, following public hearings conducted by the Bureau d'audiences publiques sur l'environnement (Quebec environmental public hearings office) and after receiving the report of the Commission de protection du territoire agricole du Québec (Commission on the protection of Quebec farmland) in 2007, the MTQ submitted changes to the project, including the following mitigation and compensation measures:

- preservation of the current right-of-way (approximately 75 metres) excluding the two service roads (minimum encroachment on the Philipsburg Migratory Bird Sanctuary);
- modification of the configuration of two interchanges (Saint-Alexandre and Saint-Sébastien), narrowing of the lanes and reduction of the right-of-way (75 metres) to mitigate encroachment on floodplain farmland.
- construction of an agricultural viaduct to allow access to a cut-off area of 78 hectares that is currently farmed in the Brochets River floodplain.
- possible purchase of cut-off areas and creation of new agricultural units in the floodplain.

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[14] For more information on project selection criteria, please consult the following Web sites:

http://www.infrastructure.gc.ca/ip-pi/csif-fcis/index_e.shtml

http://www.infrastructure.gc.ca/ip-pi/bif-fsif/investmentcriteria_e.shtml

With regards to the Brochets River, which empties into the Missisquoi Bay at St.Armand, the bridge and construction of structures for crossing this river will require permits pursuant to the *Navigable Waters Protection Act* and the *Fisheries Act* for the loss of fish habitat resulting from this bridge. Once they are issued, the conditions specific to these permits will be published in official journals.

Chlorine and sodium discharges into the Brochets River and Barbotte Creek will be monitored for two years. To prevent the accumulation of chorine and sodium in wetlands, particularly the Brochets River floodplain, federal authorities will ensure that the drainage waters are, to the extent possible, routed outside these habitats, which are very valuable from a biodiversity perspective.

Bearing in mind the potential for quality habitats in these waters and after a review of the available data, including a field visit, Fisheries and Oceans Canada (DFO) is of the opinion that the MTQ must ensure the free circulation of water and free passage of fish in the watercourses and the floodplains with weak and strong currents which are spawning areas, particularly at the locations where the highway crosses Barbotte Creek and the Brochets River.

Destruction, deterioration or disturbances of fish habitat (DDDH) caused in part by filling, rocks placed on the banks or construction of temporary structures, must be added to the assessment. DFO will also require a review of the revegetation method intended to ensure that sensitive areas, such as the embankments at the bridge, the banks of the watercourses and the wetlands, are restored so as to limit erosion, maintain a good water quality and redevelop fish habitats.

In addition to the current mitigation measures to maintain good water quality over the construction period, the MTQ proposes carrying out the work outside the breeding period of fish likely to use the sites in question, i.e., early April to mid-August. Moreover, discussions are ongoing with the MTQ in order to avoid and mitigate the impact on fish habitat in the Brochets River floodplain.

If you have any further questions, please contact me by email at: auto35@tc.gc.ca or by phone at 418-648-4437.

Yours sincerely,

_____

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Figure 3.1 Legend (see at the end of the document)

Territorial limit

- Study area
- Municipal limit
- Municipality
- International border
- Permanent agricultural zone

Infrastructure and equipment

- Selected corridor
- Highway
- Main road
- Secondary road
- Trail
- Railway
- Gaz Pipeline
- Power Line (120 kv)
- Hydro-Quebec Distribution Station
- Wastewater Treatment
- Dry Waste Disposal
- Abandoned Residual Waste Disposal
- Extraction Areas (pits, quarries, sand pits and mines)
- Selected Interchange

Utilization of soil Built landscape

- Residential core
- Industrial zone
- Agricultural area
- Planting

Tourist equipment

- Biking path
- Local snowmobile trail
- Regional snowmobile trail
- Trans-Quebec snowmobile trail
- Camping ground
- Marina
- Pedestrian trail
- Cross-country ski trail

Territory of ecological interest

- Rivière-aux-Brochets Ecological Reserve
- Missisquoi Bay Nature Refuge
- Philipsburg Migratory Bird Sanctuary
- Rivière-aux-Brochets fish sanctuary
- Ecological conservation zone
- Identified ecological zone

Heritage and archeology

- Site or building of cultural or historical interest
- Historic archeological site
- Prehistoric archeological site
- Prehistoric archeological Potential zone
- Historic archeological potential zone

Special-status species

- Herpetofauna
- Avifauna
- Turtles nesting area

Wildlife habitat

- Waterfowl gathering area
- White-tailed deer yard
- Muskrat habitat
- Spawning potential for pike
- Spawning site

Type of vegetation

- Grey Birch Stand
- Cedar Stand
- Sugar Maple Stand
- Red Maple Stand
- Shrub Swamps
- Terrestrial Plant Community
- Mixed Plant Community
- Evergreen Community
- Poplar Stand

Special-status flora

- Trees (susceptible)
- Shrubs (susceptible)
- Herbaceous vegetation (susceptible)
- Herbaceous vegetation (designated)

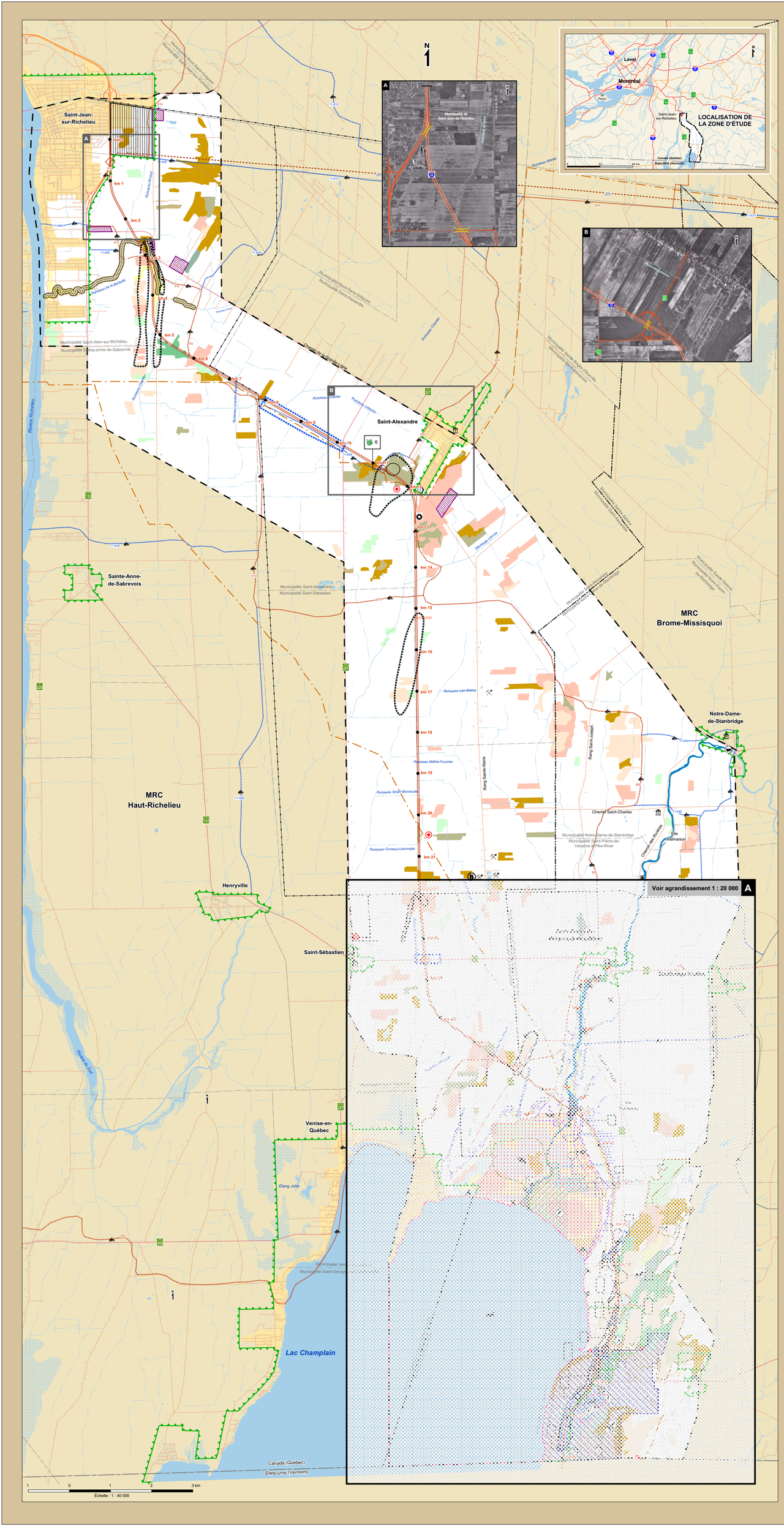
Limitation zone

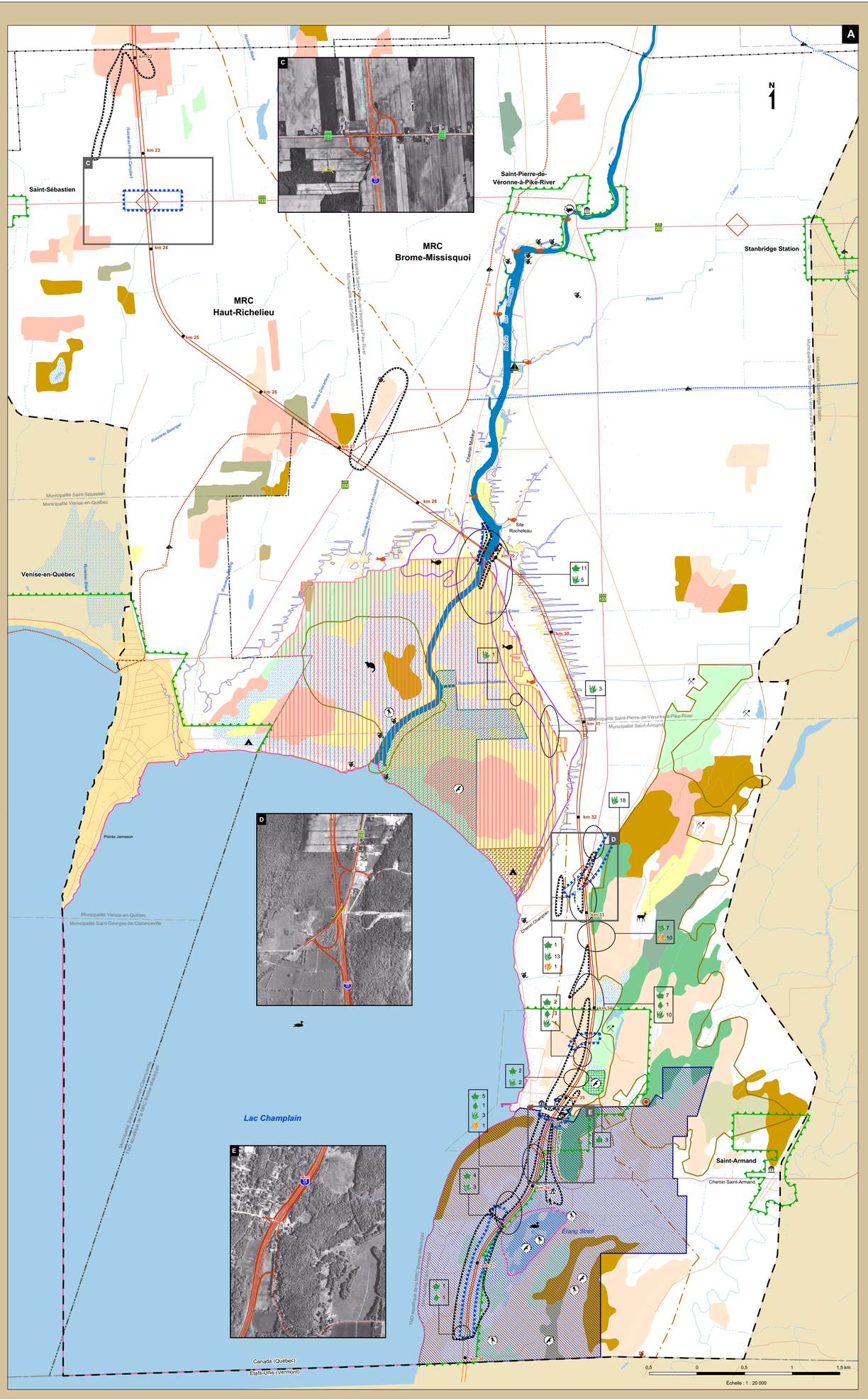
- Erosion site
- Limit of 20-year flood
- Limit of 100-year flood

Others

- Wetland
- Watercourse
- Intermittent stream

Figure 3.1 Inventaire des milieux physique et humain de la zone d'étude





Limite territoriale
- Zone d'étude
- Limite municipale
- Municipalité régionale de comté (MRC)
- Frontière internationale
- Zone agricole permanente

Infrastructure et équipement
- Tracé retenu
- Autoroute
- Route principale
- Route secondaire
- Chemin non carossable
- Chemin de fer
- Gazoduc
- Ligne de transport d'énergie (120 kV)
- Poste de distribution d'Hydro-Québec
- Traitement des eaux usées
- Lieu d'élimination des matériaux secs
- Ancien lieu d'élimination des matières résiduelles
- Aire d'extraction (gravière, carrière, sablière et mine)
- Échangeur retenu

Utilisation du sol
- Espace bâti
- Zone de consolidation résidentielle
- Espace industriel
- Espace agricole
- Plantation

Équipement récréotouristique
- Réseau cyclable
- Piste de motoneige locale
- Piste de motoneige régionale
- Piste de motoneige Trans-Québec
- Terrain de camping
- Marina
- Sentier pédestre
- Piste de ski de fond

Territoire d'intérêt écologique
- Réserve écologique de la rivière aux Brochets
- Refuge naturel Baie-Missisquoi
- Refuge d'oiseaux migrateurs de Philipsburg
- Sanctuaire de la rivière aux Brochets
- Zone écologique de conservation
- Zone écologique identifiée (MRC)

Patrimoine et archéologie
- Site ou bâtiment d'intérêt culturel ou historique
- Site archéologique historique
- Site archéologique préhistorique
- Zone de potentiel archéologique préhistorique
- Zone de potentiel archéologique historique

Faune à statut précaire
- Herpétofaune
- Avifaune
- Aire de ponte de tortues

Habitat faunique
- Aire de concentration d'oiseaux aquatiques
- Aire de confinement du cerf de Virginie
- Habitat du rat musqué
- Aire de fraie potentielle du grand brochet
- Frayère

Type de végétation
- Bétulaie
- Cédrière
- Érablière à sucre
- Érablière rouge
- Peuplement feuillu humide
- Peuplement feuillu terrestre
- Peuplement mixte
- Peuplement résineux
- Peupleraie

Flore à statut précaire

Nombre d'occurences
- 5 Arbre (susceptible)
- 1 Arbuste ou arbrisseau (susceptible)
- 3 Plante herbacée (susceptible)
- 1 Plante herbacée (désignée)

Zone de contrainte
- Zone d'érosion
- Limite de la crue de 20 ans
- Limite de la crue de 100 ans

Autres
- Milieu humide
- Cours d'eau
- Cours d'eau intermittent

Sources :

Base : BDTQ, 1 : 20 000
Archéologie : MTQ
Sentiers de motoneiges : Fédération des clubs de motoneigistes du Québec (2004)
Cartes écoforestières : MRNFP (2001)
Faune à statut précaire : Société d'histoire naturelle de la vallée du Saint-Laurent, Centre de données sur le patrimoine naturel du Québec (CDPNQ), Banque de données sur les oiseaux menacés du Québec (BDOMQ), GENIVAR Groupe Conseil inc., Beaulieu et Huot (1992), COSEPAC
Flore à statut précaire : GENIVAR Groupe Conseil inc., Consultants S.M. (2003), Centre de données sur le patrimoine naturel du Québec (CDPNQ)
Habitats fauniques : Ministère du Loisir, de la Chasse et de la Pêche (1991), Société de la faune et des parcs (2002)
Inventaires : GENIVAR Groupe Conseil inc., Étude des population d'oiseaux du Québec (EPOQ), Papineau (2003)

Source: Réponses au MDDEP (Génivar, 2005).