Publics Services and Procurement Canada

Timiskaming Dam-Bridge of Quebec Replacement Project (Quebec)

Environmental Impact Statement
PART D – Baseline Conditions and Impact Assessment
Chapter 11 Physical Environment

TETRA TECH

Project number : 715-32760TT
February 2023

PUBLIC SERVICES AND PROCUREMENT CANADA

Environmental Impact Statement
Timiskaming Dam-Bridge of Quebec Replacement Project (Quebec)

Our Reference: 32760TT (60ET)

Tetra Tech QI inc.
7275, Sherbrooke Street East
Office 600
Montréal (Québec) H1N 1E9
☎ 514-257-0707

Verified by:

[redacted]

Jacqueline Roy, M.Sc., biologist, PMP
Project manager

February 2023
Revision 03

TETRA TECH

REVISIONS

Revision nº	Description	Date	By
00	Preliminary Report - Version for comments	March 2022	JR
01	Final Draft – Version for comments	June 2022	JR
02	EIS – Version for the Impact Assessment Agency Review	September 2022	JR
03	EIS – Second Version for the Impact Assessment Agency Review	February 2023	JR

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF MAPS

LIST OF PHOTOS

LIST OF APPENDIXES

PART D – BASELINE CONDITIONS AND IMPACT ASSESSMENT

11 PHYSICAL ENVIRONMENT

11.1 BASELINE CONDITIONS

11.1.1 Concerns and Comments on the Physical Environment

During consultations with Indigenous communities (see Chapters 8 and 13), the main concerns raised about the physical environment were related to water and sediment quality and water management (hydrology of the river), contaminant levels and cumulative effects of the Project in conjunction with water level fluctuations in the ORW. Actual nuisances such as air quality, soundscape and contamination were also mentioned.

11.1.2 Regional Environment

The Project is located on the Quebec-Ontario border of the ORW in a wooded area where several lakes and watercourses are found. Since the 17th century, the Ottawa River has been the gateway to the Hudson Bay region.

The Timiskaming Dam Complex crosses the Ottawa River,[1] one of the St. Lawrence River's main tributaries, which flows in a north-south direction. Its watershed area is approximately 146,300 km^2 and the main source of the river is Lake Timiskaming, approximately 300 km upstream of the mouth of the Ottawa River (Map 11.1). More than 1,000 dams have been referenced by the Department of the Environment and the Fight against Climate Change (Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC)) in the Ottawa River's watershed.[2] If the Chaudière dam and the Hull power plant are treated as a single dam, there are eight dams downstream of the Timiskaming Dam Complex (Map 11.1).

Directly upstream of the Timiskaming Dam Complex is Lake Timiskaming[3] which retains water in a 304 km^2 area. The lake is 35 meters deep on average, 9 km wide (maximum) and 108 km long.

Downstream of the Project, the river flows in a more linear way up to the St. Lawrence River. It crosses the city of Ottawa 300 km from the Project. Gordon creek flows into the Ottawa River just downstream of the Project.

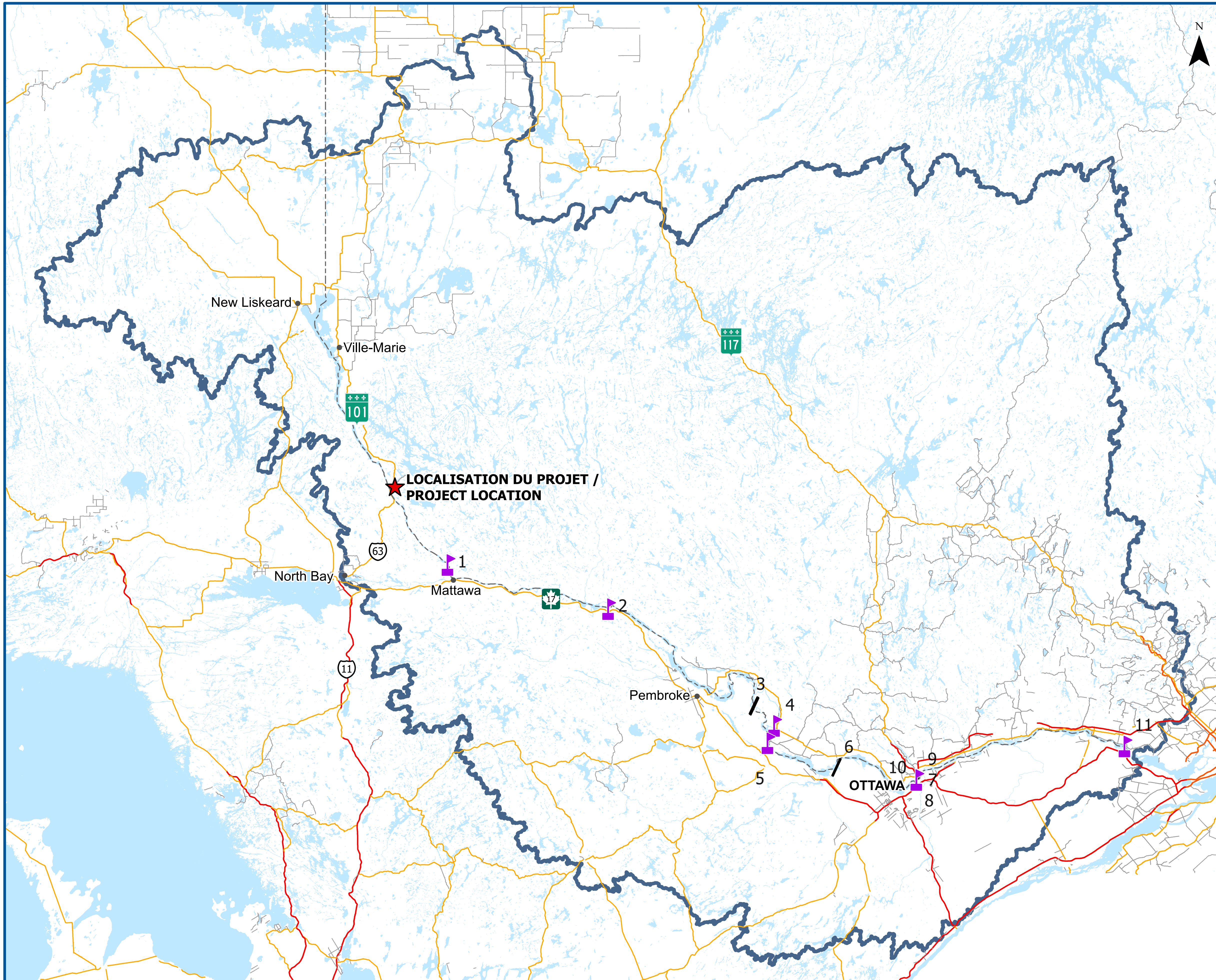
11.1.3 Climate

The weather station closest to the Project is located on Long Sault Island.[4] However, data from the North Bay station[5] must be used to obtain the historic averages for the region.

Between 1971 and 2000, the average daily temperature was 4.2°C, the maximum average temperature in July was 18.9°C and the minimum temperature in January was -12.5°C. The highest temperature ever recorded is 35.8°C in July 1988, and the lowest is -40.0°C in January 1942 (ECCC, 2017).

On average, 802.8 mm of rain falls per year. July and September are generally the wettest months, whereas January and February are the driest months. On average, 299.6 cm of snow falls annually. December is the month with the most snowfalls, with 77 cm of snow, on average (ECCC, 2017).

[1] https://thecanadianencyclopedia.ca/en/article/ottawa-river
[2] http://www.cehq.gouv.qc.ca/barrages/ListeBarrages.asp?Tri=No
[3] http://www.encyclopediecanadienne.ca/fr/article/lac-temiscamingue/
[4] Numéro d'identification climat de la station : 7080468 – source Environnement Canada
[5] Numéro d'identification climat de la station : 6085700 – source Environnement Canada



LÉGENDE / LEGEND

- Centrale / Generating Station
- Barrage / Dam
- Hydrographie / Hydrography
- Bassin versant de la Rivière des Outaouais / Ottawa River Watershed
- Limite provinciale / Provincial border

Routes / Roads:

- Autoroute / Highway
- Route nationale / National road
- Route secondaire / Secondary road

Centrales et barrages / Generating stations and Dams:

1. Centrale Otto Holden / Otto Holden Generating Station, OPG
2. Centrale de Des Joachims /Des Joachims Generating Station, OPG
3. Barrage Rocher-Fendu/ Rocher Fendu Dam, HQ
4. Centrale de Bryson et barrage/Bryson Generation Station and Dam, HQ
5. Centrale Chenaux/Chenaux Generating Station, OPG
6. Barrage de la Chute-des-Chats/Chats Fall Dam, OPG / HQ
7. Centrale de Gatineau 1 (Chaudière) / Gatineau 1 (Chaudière Generating Station, Energy Ottawa, OPG
8. Barrage Chaudière/Chaudière Dam, OPG
9. Centrale de Hull 2/Hull 2 Generating Station, HQ
10. Centrale de Hull /Hull Generating Station, HQ
11. Cenrale de Carillon/Carillon Generating Station, HQ

TETRA TECH

Services publics et Approvisionnement Canada

Public Services and Procurement Canada

Projet de remplacement du barrage Témiscamingue du côté du Québec / Timiskaming Quebec Dam Replacement Project

Carte/Map 11.1: Localisation des centrales et barrages en aval du barrage Témiscamingue / Generating stations and dams location downstream of the Timiskaming dam

CARTOGRAPHIE/CARTOGRAPHY	DATE
E. NAULT	2021-11-01
NO. PROJET/PROJECT NO.	FICHIER/FILE
32760TT	32760TT_Etude d'impact_

ÉCHELLE/SCALE 0 50 100 200 km

As for wind, the record average wind in one day is 72 km/hour, recorded on March 8, 1956 (ECCC, 2017).

The climate change projections by Ouranos[6] indicate that, under a high emissions scenario (worst-case scenario), the annual average temperature, which was 4.3 C in 1981–2010, will increase to 7.5 C ± 3.2 C during the 2041–2070 period and then to 10.0 C ± 5.7 C during the 2071–2100 period. Annual precipitation, which totaled 941 mm in 1981–2010, will increase to 1,012 mm ± 69 mm during the 2041–2070 period and then to 1,057 mm ± 116 mm during the 2071–2100 period, again under a high emissions scenario. Snow accounted for 222 mm of the total precipitation in 1981–2010, 189 mm ± 34 mm in 2041–2070 and 160 mm ± 61 mm in 2071–2100. This means that precipitation in the form of snow will gradually decrease as precipitation in the form of rain increases. Climate change has been taken into account in the design of the dam, particularly with regard to the flood levels and gate design, which will allow the gates to open more quickly to better respond to events.

11.1.4 Air Quality

The region of Témiscaming is part of the East Central airshed as defined by the Canadian Council of Ministers of the Environment (CCME). The East Central covers Southern Québec, Southern Ontario, and the east part of Northeast Ontario. Several major agglomerations are located within this airshed, including Toronto and Montreal. There is a much greater density of industrial and transport-related emission sources in those area than in the Temiscaming area where Rayonier is the only large industry.

Air quality in Quebec is monitored based on the MELCC's air quality index. This index is used on regional and local scales (regional index and local index respectively).

The air quality monitoring station nearest to the Project is located in the city of Témiscaming (MELCC station #08401) (Map 11.2). This is an urban-type station that monitors ozone (O_3), fine particles (particulate matter or $PM_{2.5}$) and sulfur dioxide (SO_2). The air quality index (AQI) reflects the concentrations of fine particles and ozone measured at this station. The Environment and Climate Change Canada (ECCC) stations are located a very long distance away from the Project (Rouyn-Noranda, North Bay, Petawawa) and are thought to be less representative of episodic conditions in the Témiscaming area.

The Figures 11.1 to 11.3 show the concentrations of fine particulate matter ($PM_{2.5}$), sulphur dioxide (SO_2) and ozone measured at the Témiscaming station over the years (source: Quebec Air Quality Monitoring Network (gouv.qc.ca) [French only]). The Canadian Ambiant Air Quality Standards and the Quebec Air Quality Standards and Criteria are also included for comparison purposes. It is to be noted that the Quebec regulations do not have an annual standard for $PM_{2.5}$, the value showed on Figure 11.1 is the daily average standard.

Concentrations of fine particulate matter vary considerably depending on the year and may come from the Rayonier plant, road traffic, fireplaces, or natural sources. Concentrations of sulfur dioxide have been declining steadily, likely because of the improved processes implemented at the Rayonier plant to reduce sources of emissions. Ozone concentrations have remained at around 26–27 ppb and below the Canadian and Quebec standards for the past several years.

[6] https://www.ouranos.ca/portraits-climatiques/#/regions/1

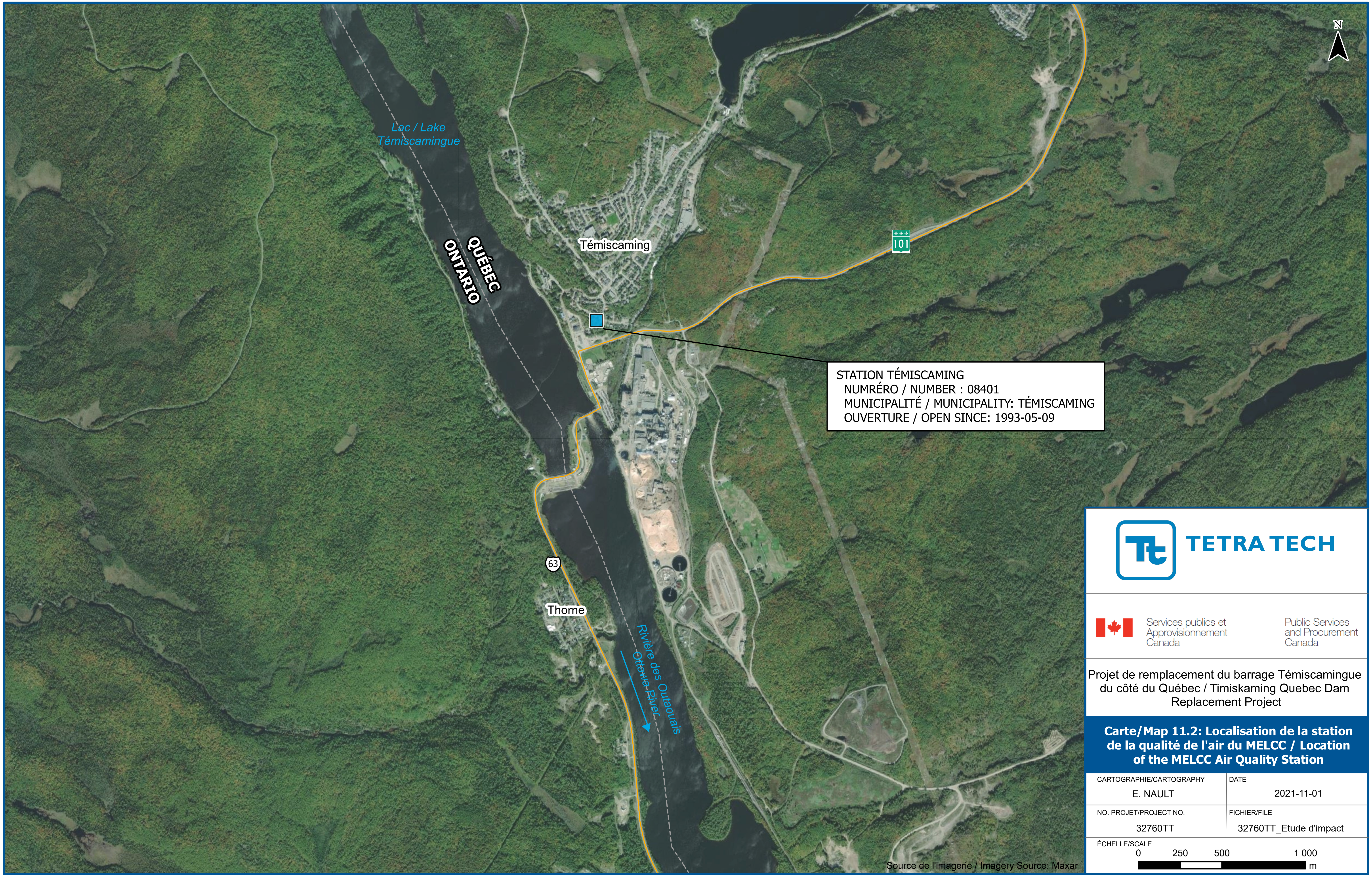

Lac / Lake Témiscamingue
QUÉBEC
ONTARIO
Témiscaming
101
63
Thorne
Rivière des Outaouais
Ottawa River
STATION TÉMISCAMING
NUMRÉRO / NUMBER : 08401
MUNICIPALITÉ / MUNICIPALITY: TÉMISCAMING
OUVERTURE / OPEN SINCE: 1993-05-09
N
Source de l'imagerie / Imagery Source: Maxar
TETRA TECH
Services publics et Approvisionnement Canada
Public Services and Procurement Canada
Projet de remplacement du barrage Témiscamingue du côté du Québec / Timiskaming Quebec Dam Replacement Project
Carte/Map 11.2: Localisation de la station de la qualité de l'air du MELCC / Location of the MELCC Air Quality Station
CARTOGRAPHIE/CARTOGRAPHY
E. NAULT
DATE
2021-11-01
NO. PROJET/PROJECT NO.
32760TT
FICHIER/FILE
32760TT_Etude d'impact
ÉCHELLE/SCALE
0 250 500 1 000
m

Figure 11-1 Annual Average Concentration of Fine Particulate Matter ($PM_{2.5}$) at the MELCC Témiscaming Station

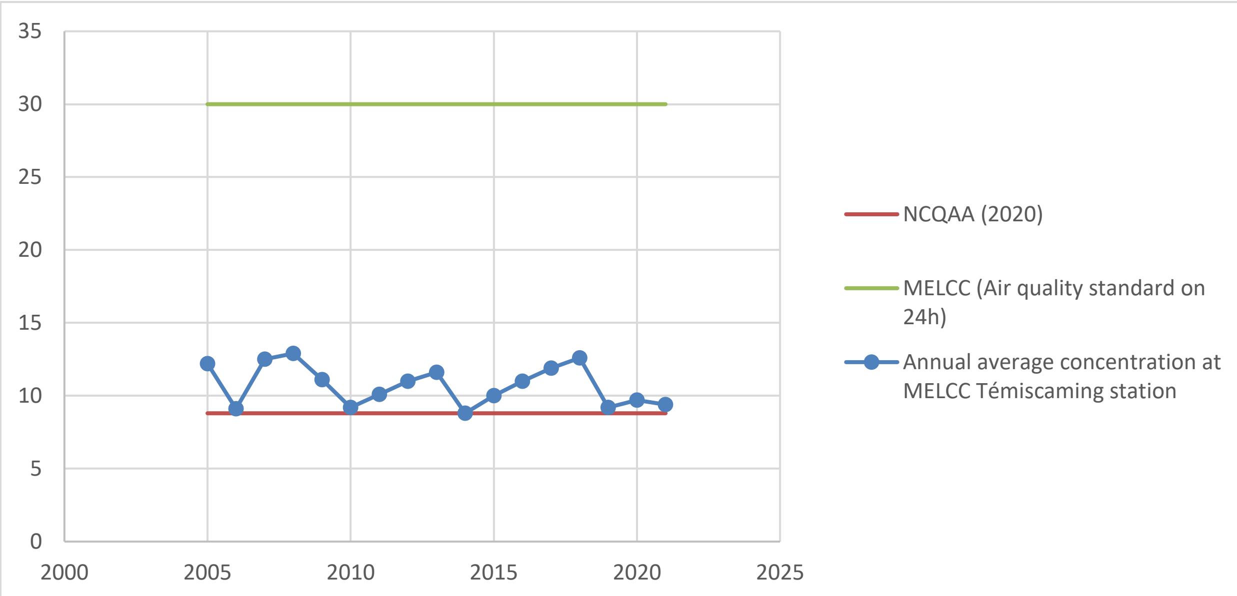


Figure 11-2 Annual Average Concentration of Sulphur Dioxide (SO_2) at the MELCC Témiscaming Station

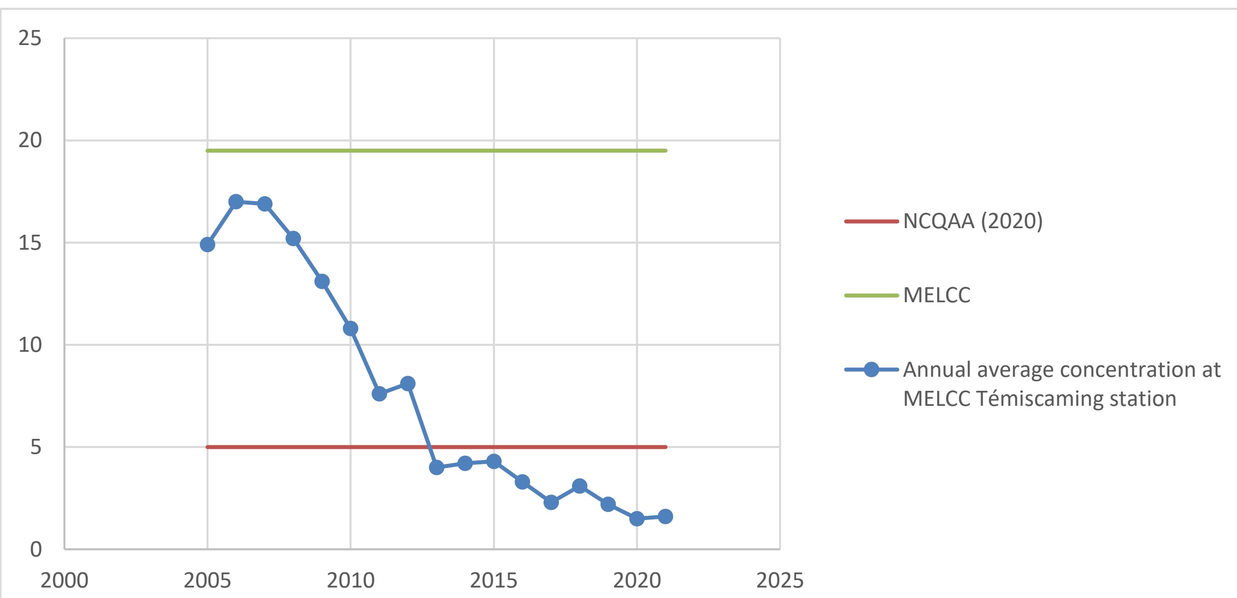
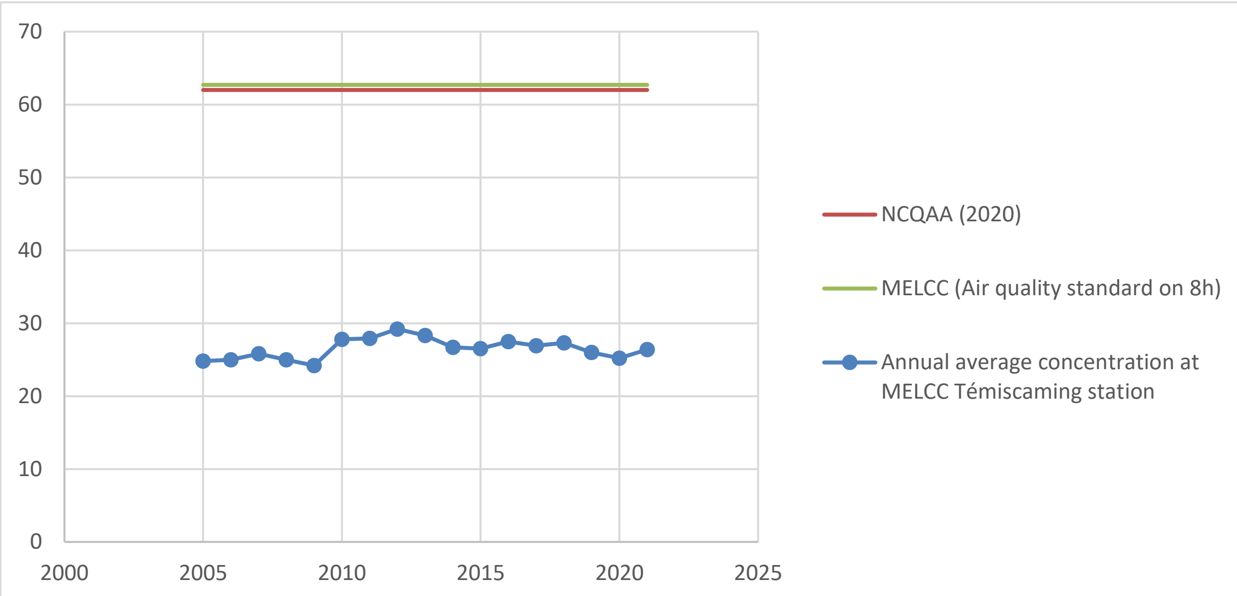


Figure 11-3 Annual Average Concentration of Ozone (O_3) at the MELCC Témiscaming Station



MELCC calculates an AQI based on the data collected at its stations. This index is calculated every hour, individually at first for each of the contaminants that are measured at a station (e.g. at the Témiscaming station, ozone, fine particulate matter and sulphur dioxide are measured). The value obtained is then compared with the reference value using a formula described on the MELCC website.[7] The highest value represents the AQI. The index is an information and educational tool that is used to inform the public about local air quality. Within the study area, industrial sources are the main factors affecting air quality (SO_2 and $PM_{2.5}$).

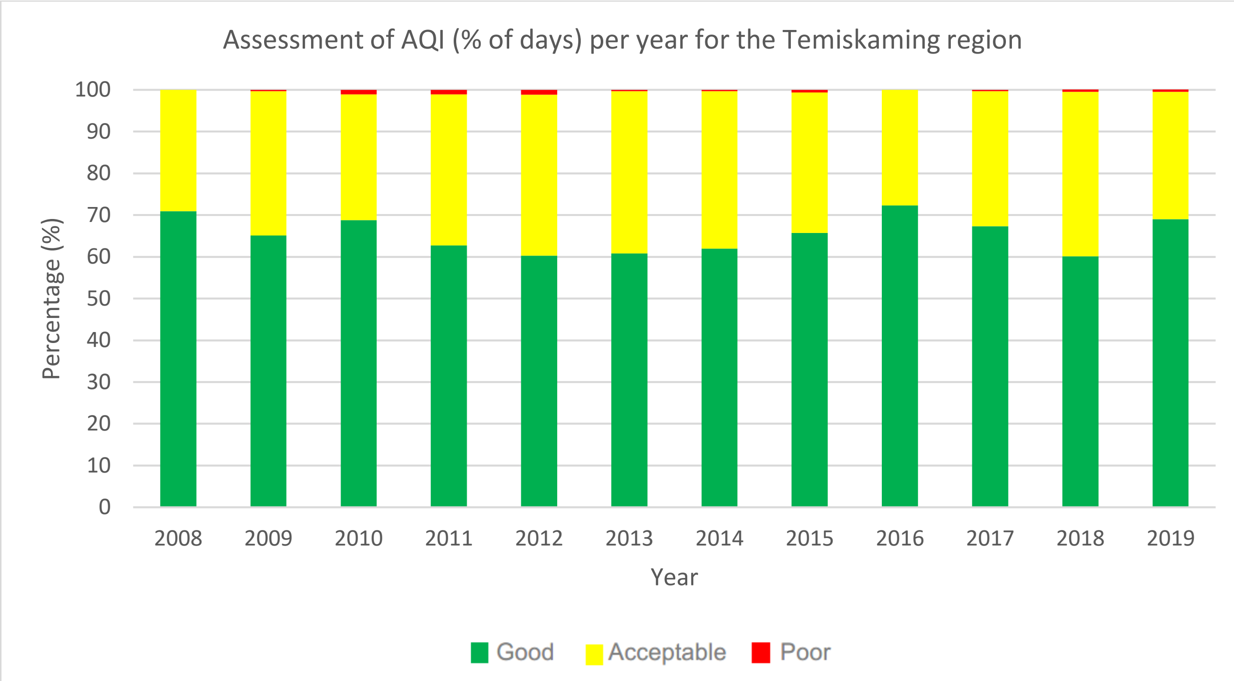
At the regional level, in recent years (2008–2019) the air quality has been good between 60% and 72% of the time and poor less than 1% of the time (Figure 11.4). At the local level (Figure 11.5), air quality is poorer in the Project area. Based on available data for the 2008 to 2019 period, air quality is good from 26% to 38% of the time and poor from 17% to 41% of the time.

According to MELCC,[8] the pollutants that have the greatest impact on air quality on a local scale are industrial, i.e. fine particles and SO_2. The industrial facility located nearest to the Project and which is likely to emit these contaminants into the air is Rayonier.

Rayonier is the only industrial facility in the Témiscaming region that reports its atmospheric emissions under ECCC's National Pollutant Release Inventory (NPRI) program. Rayonier's 2021 NPRI report included 1,031 metric tons of carbon monoxide (CO), 103 metric tons of SO_2, 607 metric tons of nitrous oxides (NO_X), 430 metric tons of particulate matter, 87 metric tons of PM_{10}, 70 metric tons of $PM_{2.5}$, as well as other substances such as metals and volatile organic compounds (VOCs).[9]

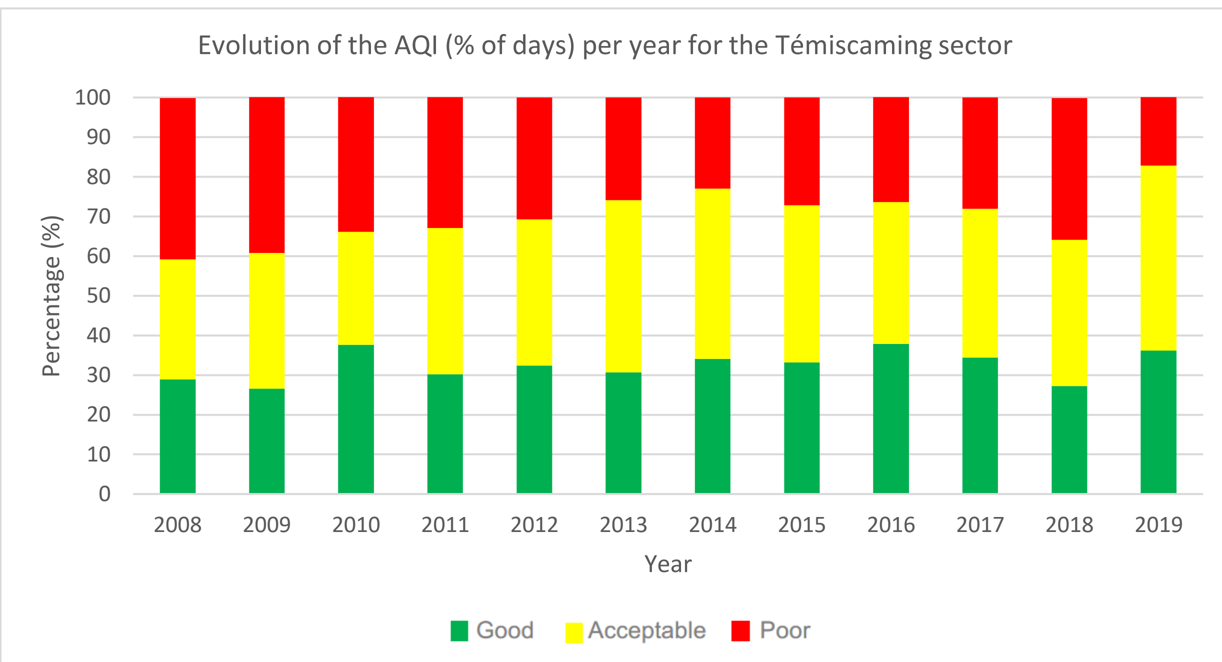
[7] Indice de la qualité de l'air (gouv.qc.ca)
[8] http://www.mddelcc.gouv.qc.ca/air/iqa/statistiques/influence.htm
[9] https://pollution-dechets.canada.ca/inventaire-national-rejets/2021/2948

Figure 11-4 Air Quality in the Témiscaming Region (Regional Scale)



Source: MELCC [10]

Figure 11-5 Air Quality in the Témiscaming Area (Local Scale)



Source: MELCC[11]

The Rayonier plant is the main source of GHG emissions in the study area. Because it is listed as a large emitter (over 10,000 tonnes of CO_2 equivalent [tCO_2eq]), the company must report its emissions every year under the *Regulation respecting mandatory reporting of certain emissions of contaminants into the*

[10] http://www.mddelcc.gouv.qc.ca/air/iqa/statistiques/index.htm (consulté le 18 mai 2021)
[11] http://www.mddelcc.gouv.qc.ca/air/iqa/statistiques/index.htm (consulté le 18 mai 2021)

atmosphere (RMRCECA). In 2021, GHG emissions were estimated at 183,033 tCO_2eq, excluding CO_2 emissions from biomass[12].

No other significant source of GHG emissions is in the study area.

11.1.5 Night-time Light

Current sources of light in the area are the Rayonier plant on the left bank of the river; streetlights along the road that runs across the dams and Long Sault Island; adjacent residential areas on both the Témiscaming and Thorne sides; and a few buildings on the Island. No measurements of light levels were taken. These light conditions do not change with the seasons or weather conditions since they are regulated under MTQ and MTO lighting standards as well as the safety standards that govern the Rayonier industrial site and dam operations.

11.1.6 Soundscape

The main sources of noise in the study area are road traffic, the Rayonier plant, and the dam itself. These sources of ambient noise are unlikely to vary significantly throughout the year. Apart from these sources, natural sources of noise are mostly related to river flows and the wind.

A study of sound quality in the study area carried out by Soft dB (Soft dB, 2020) measured existing noise levels near the Project. In accordance with the approach recommended by Health Canada, the indicators used in this assessment are the noise level in dBA and percent highly annoyed (%HA).

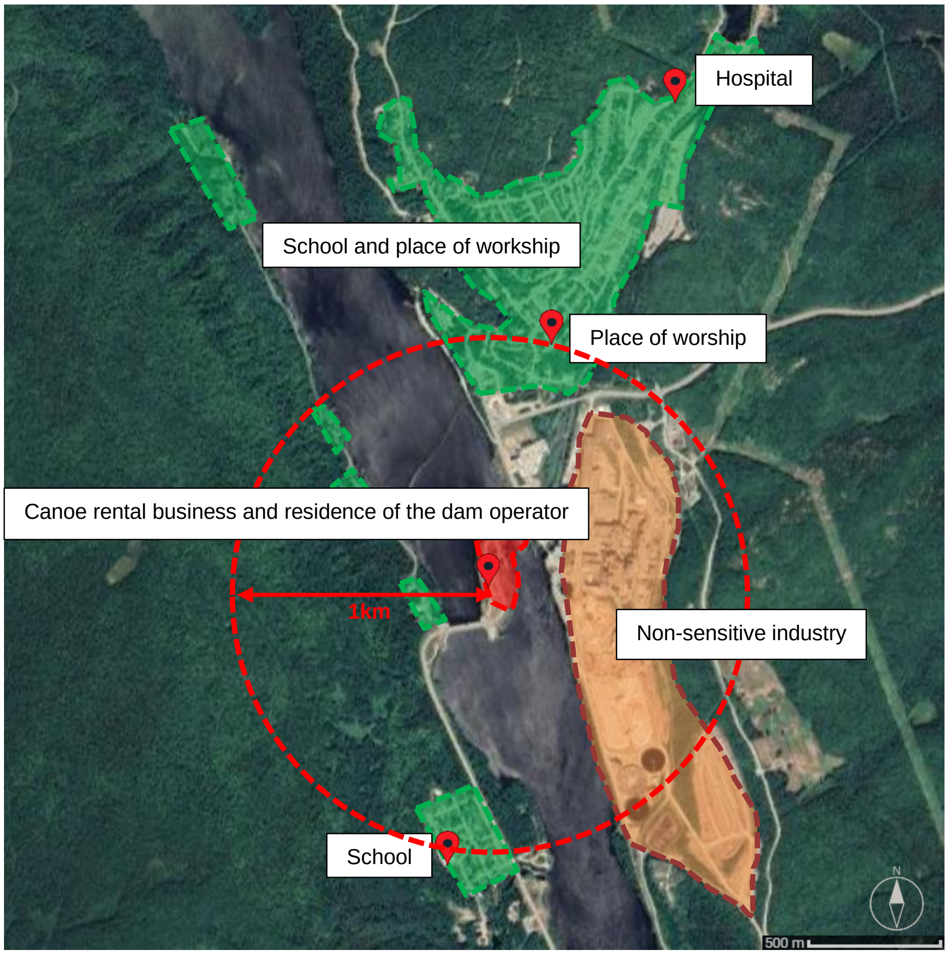
Health Canada (2016) recommends using sensitive receptors where users are present on a permanent or long-term basis. This includes receptors such as schools; hospitals; daycare centers; entertainment establishments (theatres); places of worship and cemeteries; commercial premises; seniors' residences; permanent and seasonal residences (cottages, campgrounds); and parks and outdoor grounds used for hunting or fishing, including locations where Indigenous Peoples' hunt, fish or gather country foods. Temporary use sites, such as boat launches, are not considered sensitive receptors because they are used for a very short period of time by the public (e.g. boat launches are used briefly to launch boats). An analysis

[12] https://www.environnement.gouv.qc.ca/changements/ges/registre/index.htm [French only]

of the zoning and uses of the study area, in addition to a site visit, allowed nearby sensitive receptors to be identified. In general, the sensitive use class receptor located closest to the Project was chosen for the analysis (the rationale being that if this receptor were not affected, the other receptors farther away would not be either).

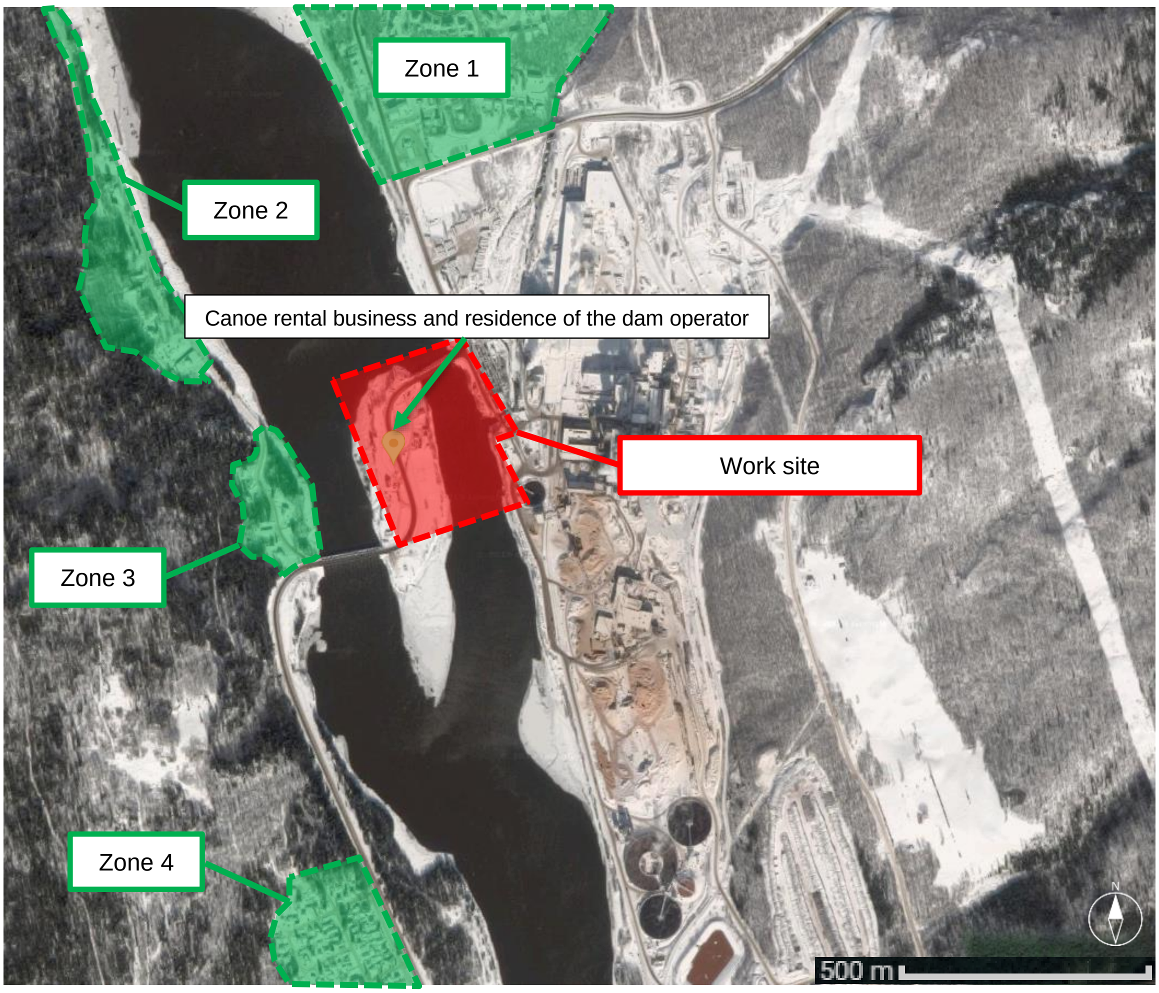
Figure 11.6 shows the sensitive areas and receptors located within a 1 km radius of the work site (red). The green and orange areas represent sensitive residences and the Rayonier plant located near the construction Project, respectively. The points of reference on the figure show other sensitive receptors, such as hospitals, schools, places of worship and any other places where noise may have a significant impact on health or the smooth running of operations. The business and the residence of the dam operator were also identified as sensitive due to their immediate proximity to the work site. A receptor location has also been identified within the 1 km radius, north of Thorne and north of the Ontario road, east of Zone 2, 3, and 4. This was identified to represent conditions necessary for Métis harvesting activities and practices.

Figure 11-6 Location of Work Site (Red) and Sensitive Areas and Receptors (Green) in the Study Area Within a 1 km Radius of the Work Site



Receptors identified as sensitive are located in the towns (Témiscaming and Thorne) and will not be directly exposed to construction noise, since they are at least 1 km away from the construction area and the future dam. Only the canoe leasing business and the residence of the dam operator are directly exposed to noise, since they are located on the island next to the existing dam and are therefore inside the work area. According to the information provided by Indigenous communities, the Project area will not be used on a permanent basis; although fishing, hunting and plant or berry harvesting activities will take place around the dam site, these activities do not make the site a sensitive receptor (as defined above) since they occur periodically.

Figure 11-7 Location of Work Site (Red) and Sensitive Areas Under Study (Green)



Five sensitive areas were identified (Figure 11.8):

- Zone 1: Residences on “Rue Byrne” (street) and “Avenue Murer”, in Témiscaming;
- Zone 2: Residences on Wyse Road in Ontario;
- Zone 3: Residences at the intersection of Kipawa Road and Wyse Road in Ontario;
- Zone 4: Residences on Oak Street and Pine Avenue in Thorne, in Ontario;
- Construction zone: The canoe leasing business and the residence of the dam operator.

Within these areas, five measurement points were chosen for estimating baseline noise levels (Figure 11.8). Because these points are located nearest to the work areas, they are considered representative of the noise level in each of the sensitive areas. The receptors’ positions make it possible to assess annoyance at the most critical locations.

Noise levels were measured on July 8 and 9, 2019 at Points 1–4. Noise levels at Point 5 were estimated using the Health Canada (2016) approach, which is based on qualitative descriptions of community characteristics and average population density.

Figure 11-8 Location of the Sensitive Areas and Sound Monitoring Stations

The results of the study were compared with applicable recommendations from Health Canada. Based on these recommendations, in order not to interfere with the understanding of speech, the latter must be at least 15 dB louder than ambient noise. Therefore, it is recommended that outdoor noise not exceed 60 dBA.

To assess noise levels during construction, two additional criteria were taken into consideration, namely the percentage of people highly affected by the noise (%HA), which was not to exceed 6.5%, and the normalized noise level associated solely with the Project (day-night rating level or LRdn) which was not to exceed 75 dBA (Table 11.1).

Table 11.1 Summary of Health Canada Recommendations Applicable for Construction and Operation

Metric	Ld(7:00-22:00) Speech Understanding (Day Noise Level Between 7:00 and 22:00)	LRdn (Normalized Noise Level over a Period of 24 hours)	Increase of the Percentage of People Highly Affected by the Noise Level %HA
Recommended Target	<60 dBA	<75 dBA	<6.5%

The noise levels monitored are indicated in the table below. Location P5 is in Thorne (Figure 11.8) and the noise level is an estimate, in accordance with the Health Canada recommendations.

Table 11.2 Noise Levels Before Construction (current ambient sound levels)

Location	Day Noise Levels ($Ld_{(7h-22h)}$ in dBA)	Night Noise Levels ($Ln_{(22h-7h)}$ in dBA)	Noise Levels for a 24-hour Period (Ldn in dBA)	Main Sources of Noise in Descending Order
P1	52.7	53.4	53.0	The industrial facility next to the dam/bridge Roadway traffic noise River flow
P2	**62.9**	**63.2**	**63.0**	The industrial facility next to the dam River flow and flow through the dam/bridge Roadway traffic noise
P3	59.2	59.7	59.4	River flow The industrial facility next to the dam/bridge Roadway traffic noise
P4	53.8	52.9	53.5	River flow The industrial facility next to the dam
P5	-	-	Estimate: 53*	Roadway traffic noise River flow

* Reference noise level estimate based on qualitative descriptions and typical population densities from Health Canada recommendations.

Results show that for location P2 (the commercial facility and the residence of the dam operator on Long Sault Island), the noise levels exceed the levels recommended to understand speech (60 dBA) and that the noise levels at location P3 (residences on the Ontario bank of the river and facing the dam) nearly reach the limit recommended by Health Canada.

11.1.7 Soil and Geology

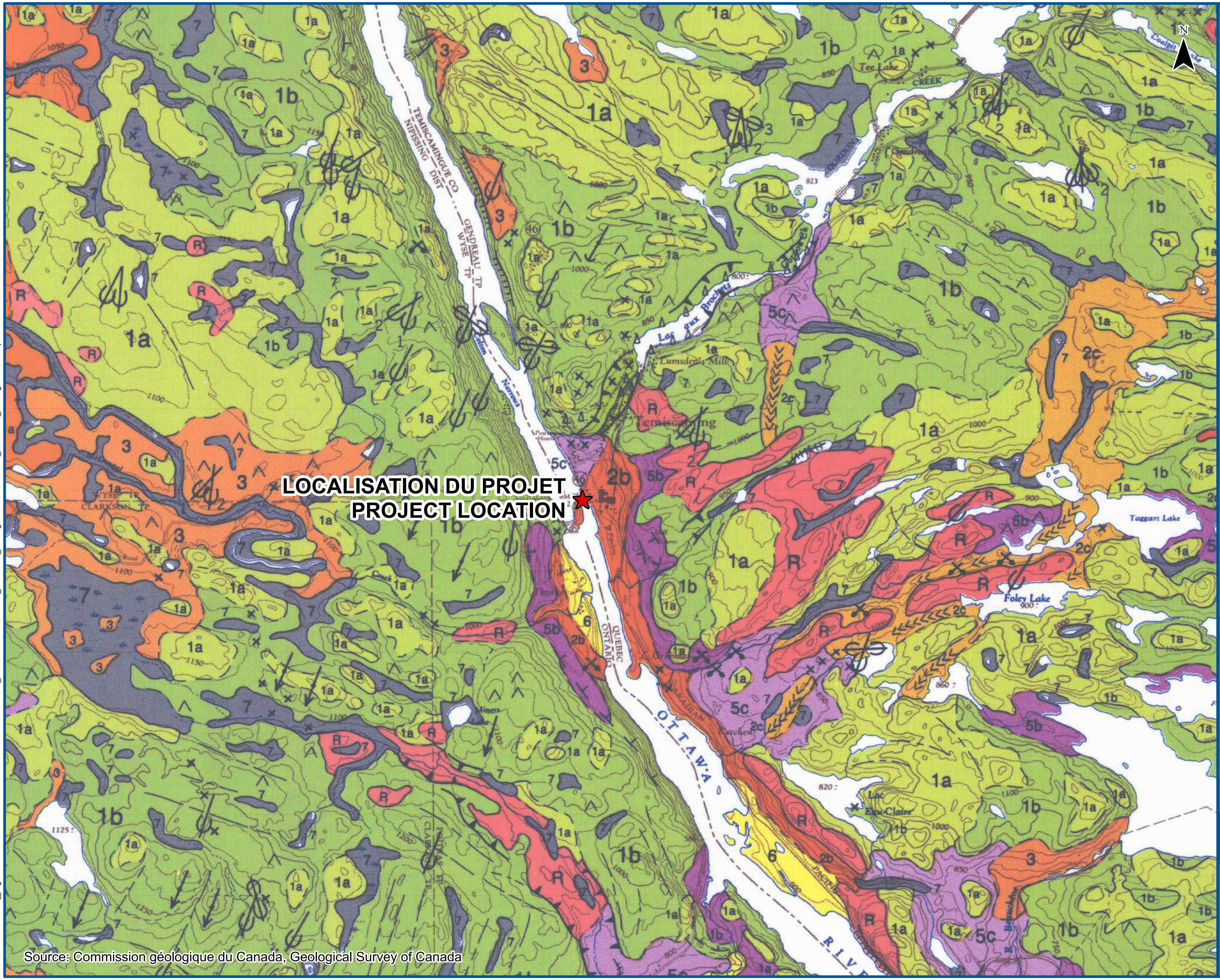
The study area is inside the geological province of Grenville, Precambrian era (Paleoproterozoic). The bedrock consists of orthogneiss (granitoids), commonly characterized by quartzofeldspathic gneiss and grey biotite gneiss (Rive, 1973). Specifically, the formation of Ogascanan gneiss is prominent in the eastern section of the Project area (SIGEOM, 2019).

The Ogascanan gneiss formation consists mostly of an assembly of tonalitic gneiss, diorite gneiss, granite gneiss, quartzofeldspathic biotite gneiss, with or without muscovite, biotite gneiss and alternating quartzofeldspathic biotite gneiss and quartzofeldspathic biotite gneiss containing hornblende.

The Ogascanan gneiss formation consists mostly of an assembly of tonalitic gneiss, diorite gneiss, granite gneiss, quartzofeldspathic biotite gneiss, with or without muscovite, biotite gneiss and alternating quartzofeldspathic biotite gneiss and quartzofeldspathic biotite gneiss containing hornblende.

In the western part of the site, in Ontario, Precambrian rock (Mesoproterozoic) similar in nature to that which is found in Quebec has been observed. The bedrock is characterized by paragneisses, pelitic gneisses, marble and iron formations.

Based on the map in *Surficial Geology, Lake Kipawa* (Veillette and Daigneault,1987), the surficial deposits consist of glaciofluvial deposits 5 to 20 meters thick, including sand, gravel, blocks and moraines. Also present in the study area is the Lake McDonnell Moraine, on the other side of the Ottawa River (Veillette, 1996). In the immediate vicinity of the Project, till with rock outcrops is also characteristic. Figure 11.8a shows the surficial deposits in the Regional Study Area.



LÉGENDE / LEGEND

QUATERNAIRE / QUATERNARY

POST-GLACIAIRE / POST-LAST GLACIATION

- 7 — Dépôts organiques / Organic deposits
- 6 — Dépôts alluviaux / Alluvial deposits

DERNIÈRE GLACIATION / LAST GLACIATION

DÉPÔTS GLACIOLACUSTRES / GLACIOLACUSTRINE DEPOSITS

- 5c — Sédiments deltaïques / Deltaic sediments
- 5b — Sédiments sub-littoraux et de plage / Nearshore and beach sediments
- 5a — Sédiments d'eau profonde / Deep water sediments

DÉPÔTS FLUVIOGLACIAIRES / FLUVIOGLACIAL DEPOSITS

- 3 — Sédiments proglaciaires: sable et gravier / Proglacial sediments: sand and gravel
- 2c — Sable et gravier / Sand and gravel
- 2b — Sable, gravier et blocs / Sand, gravel and boulders
- 2a — Sable et gravier d'origine non déterminée / Sand and gravel of undetermined origin

DÉPÔTS GLACIAIRES / GLACIAL DEPOSITS

- 1b — Couverture généralement continue / Generally continuous cover
- 1a — Couverture discontinue parsemé d'affleurement rocheux / Discontinuous veneer interspersed with rock outcrop

PRÉ-QUATERNAIRE / PRE-QUATERNARY

- R — Roches sédimentaires d'âge paléozoïque / Paleozoic sedimentary rocks
- R — Roches ignées, métamorphiques et volcaniques d'âge précambrien / Precambrian igneous, metamorhpic, and volcanic rocks

TETRA TECH

Services publics et Approvisionnement Canada | Public Services and Procurement Canada

Projet de remplacement du barrage Témiscamingue du côté du Québec / Timiskaming Quebec Dam Replacement Project

Figure 11.8a: Dépôts de surface dans la zone d'étude régionale / Surficial deposits in the Regional Study Area

CARTOGRAPHIE/CARTOGRAPHY	DATE
E. NAULT	2022-12-16
NO. PROJET/PROJECT NO.	FICHIER/FILE
32760TT	32760TT_20221213_Geologie surface

ÉCHELLE/SCALE: 0 — 1,25 — 2,5 — 5 km

Path: \\TTS349FS3\Prj_reg\32760TT\DOC-PROJ\60\60CRO\ArcGIS\ArcGIS Pro\02_TRAITEMENT\32760TT_20221213_Geologie surface\32760TT_20221213_Geologie surface.aprx

Generally speaking, the surficial deposits date back to the last Quarternary glaciation and subsequent lacustrine and marine periods. Toward the end of glaciation, the continental glacier split in two and left a layer of till of varying depth directly on the rock. When the till was thick enough (more than 4-6 meters), it flowed and formed long flared ridges. Rivers and their tributaries made their beds in the surficial deposits as land emerged.

Although the river banks in the study area consist of backfill and surficial granular deposits showing signs of erosion, the embankments are currently stable and protected against erosion by riprap up to elevation 179.7 mASL[13] at least, that is 2 m above the maximum downstream water level (177.78 mASL). Section 12.1.6.5.1.2 provides a detailed description of the banks downstream of the dam.

In the Lake Timiskaming area, the risk of erosion is limited to the northeast section of the lake, where the banks are not very high, relatively flat and consisting of unconsolidated surficial sediment deposits, such as lacustrine clay, fluvial silt and glaciofluvial sand (Marche & Hardy, 1996; Ouellet, 1997) The banks of the southern half of the lake consist of coarser material and bedrock. Therefore, they are not very sensitive to erosion (Acres International, 1993).

Based on the technical and historical information available and identified, significant geological hazards are not expected in the context of the Project. In addition, the Project is not located in a sector known for landslides, as indicated in the interactive map of areas potentially exposed to landslides, updated by the Government of Quebec.[14]

The study area is located in one of the most seismically active regions in Quebec (Figure 11.9).

The Project is located in the Western Quebec seismic zone (NRCAN, 2019; Earthquake zones in Eastern Canada (nrcan.gc.ca); Figure 11.10), which encompasses a vast territory that includes the Ottawa Valley from Montreal to Témiscaming, in addition to the Laurentians and Eastern Ontario. The urban regions of Montreal, Ottawa-Hull and Cornwall are also located within this zone.

Three significant earthquakes occurred in the past in Quebec's west seismic zone: in 1732, 1935 (magnitude of 6.2 on the Richter scale) and 1944, when an earthquake with a magnitude of 5.6 between Cornwall (Ontario) and Massena, N.Y., caused damages estimated at $2M (in 1944 dollars).

In 1990, an earthquake with a magnitude of 5 occurred near Mont-Laurier (Quebec). In 1996 and 1997, two earthquakes with magnitudes of 4.4 and 4.3 respectively occurred near Sainte-Agathe-des-Monts (Quebec).

Based on the information in the National Earthquake Database (NEDB), only one earthquake with a low magnitude (2.7 on the Richter scale) has been recorded 17 km northeast of Témiscaming since 1990. The general fracturing presents two prevalent orthogonals, in a northeast-southwest direction and in a northwest-southeast direction, with subvertical dips. Lakes currently occupy large structural lows of glacial origin, characterized with a hilly relief.

The post-glacial isostatic uplift caused the Tyrrell Sea to retreat gradually. Land first emerged at an accelerated rate, approximately 9 meters every century. The process then slowed down considerably in the last four millennia. The current uplift rate is approximately 0.5 cm/year.

13 mASL: meters above sea level.
14 https://www.donneesquebec.ca/recherche/fr/dataset/zone-potentiellement-exposee-aux-glissements-de-terrain-zpegt

Figure 11-9 Seismic Hazard in Quebec

Natural Resources Canada   Ressources naturelles Canada

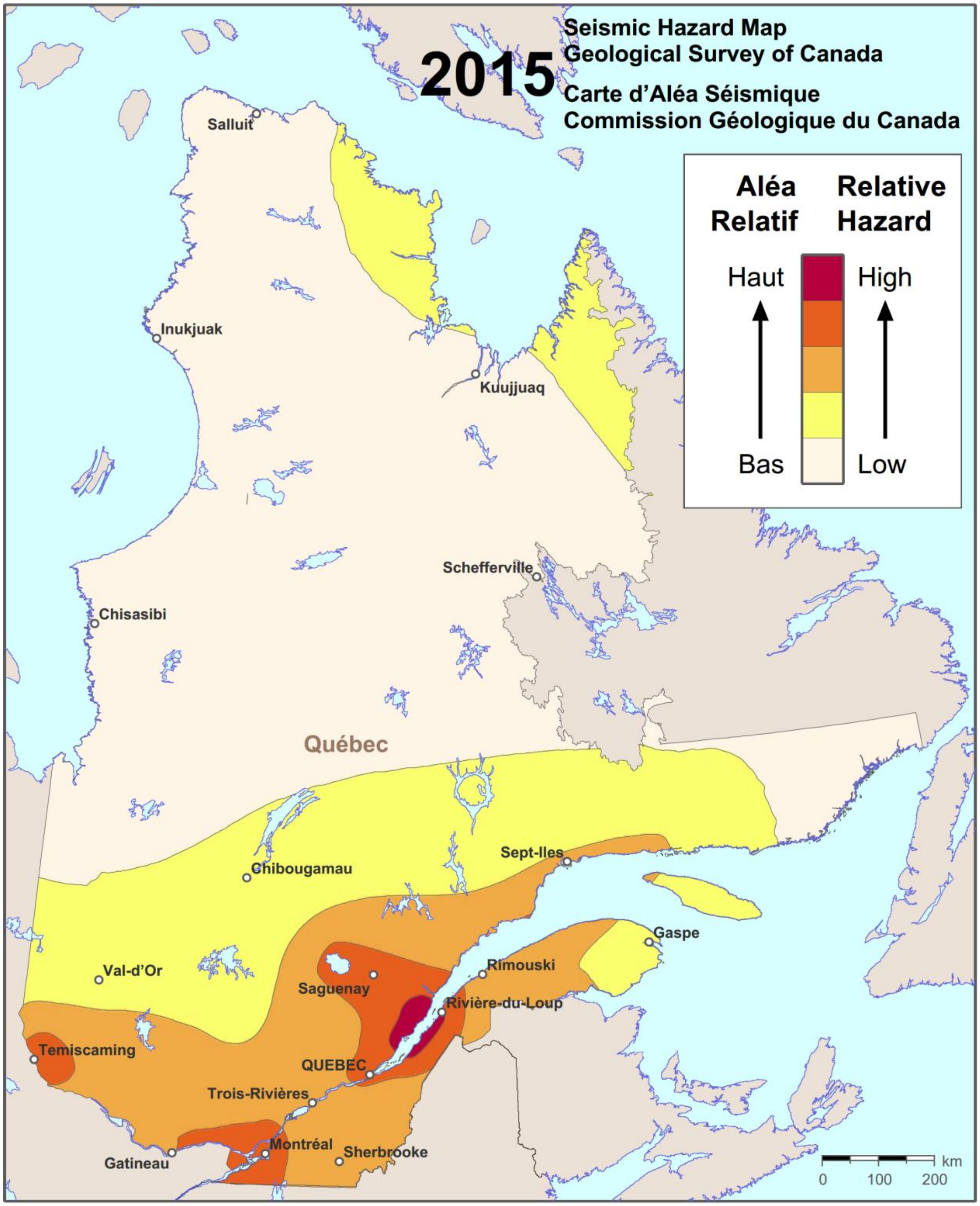
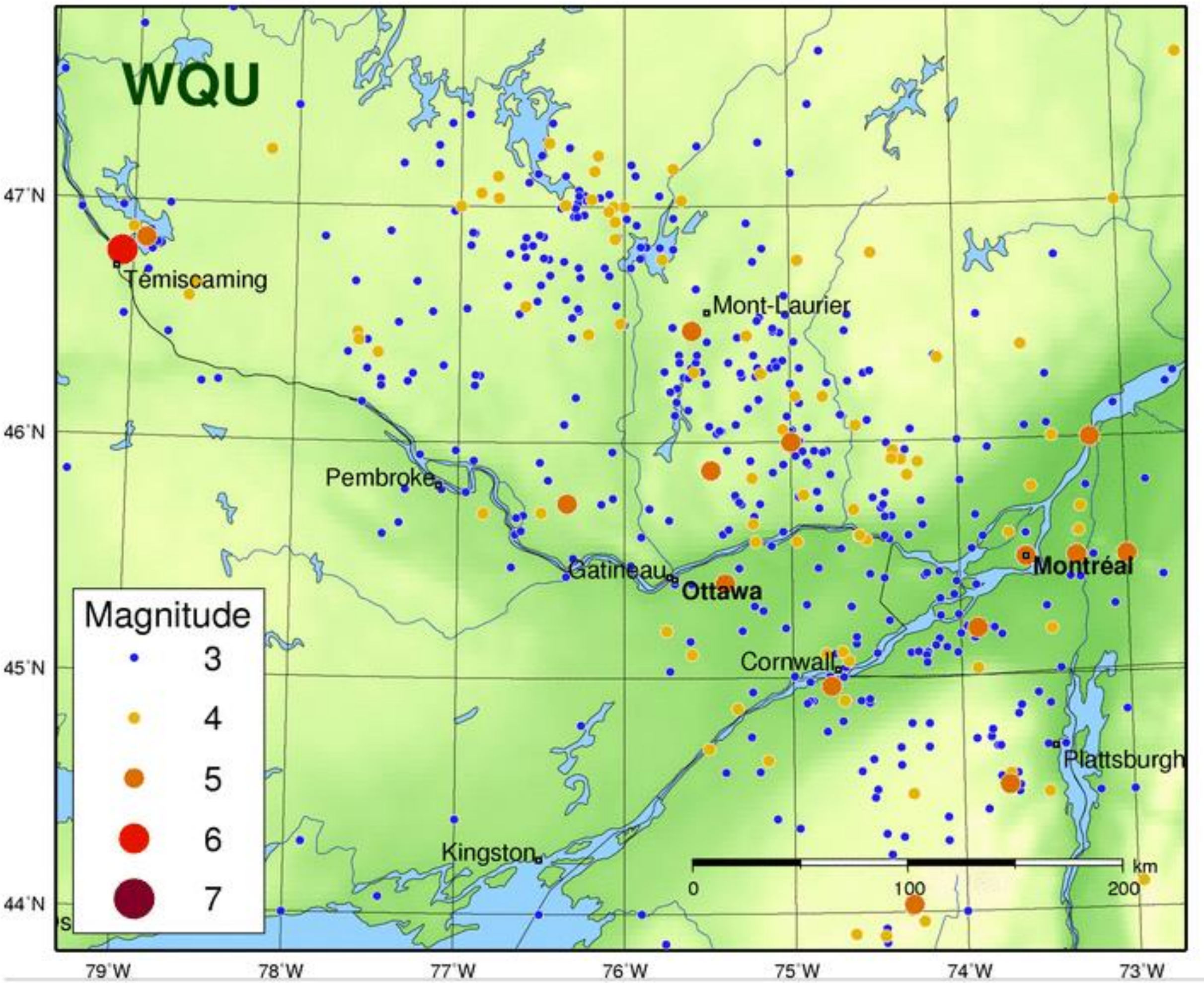


Figure 11-10 Earthquakes Recorded in Quebec Since the Beginning of the Century



Some mineral occurrences (iron (Fe), copper (Cu), kyanite (Ky), zinc (Zn)) have been observed northeast and southeast of the Project, but none have been noted in the immediate vicinity of the Project site (MER, 1990). The various mapped facies correspond to paragneiss formations delineated locally in terms of gabbros, diabases and pegmatites. Several signs of mineralization (pyrite, chalcopyrite and nickeliferous pyrrhotite) were found in this region. Some industrial minerals, notably disthene, have also been reported. Some sectors, particularly east, in the Lake Kipawa area, can show signs of radioactive minerals updated and associated with uranium prospection and mining. Local variations of the metal content indicated above, without limitations, could therefore potentially suggest abnormal concentrations in the soil. Such concentrations, if present, could also reflect natural variations in the soil. Based on the document titled *Exploration géochimique au Témiscamingue* (Beaumier, 1995), the geochemical anomalies as mapped by the Ministry may be deemed essentially local.

Boreholes were drilled around the dam in 2017 (GHD, 2017). The locations of the boreholes are shown on Map 11.3. Table 11.3 presents the stratigraphy recorded. In general, beneath the vegetative cover and/or backfill, the stratigraphy consists of layers of sand and/or gravel containing varying proportions of silt, pebbles and boulders.

LÉGENDE / LEGEND

Forage / Borehole (GHD, 2017)

Limite provinciale / Provincial border

Coordonnées géodésiques / Geodetic Coordinates (MTM 10 NAD83) (m)			
Forage / Borehole	X	Y	Z
F-A	335 256,8	5 174 623,6	180,91
F-B	335 291,1	5 174 691,0	181,06
F-1	335 299,4	5 174 708,8	180,59
F-2	335 317,6	5 174 718,5	178,77
F-3	335 386,4	5 174 756,2	178,80
F-4	335 397,5	5 174 761,9	180,71

Source de l'imagerie / Imagery Source: MFFP, Gouvernement du Québec/Quebec gouvernment, 2021

TETRA TECH

Services publics et Approvisionnement Canada

Public Services and Procurement Canada

Projet de remplacement du barrage Témiscamingue du côté du Québec / Timiskaming Quebec Dam Replacement Project

Carte / Map 11.3:
Localisation des forages de GHD (2017) / GHD Borehole Location, 2017

CARTOGRAPHIE/CARTOGRAPHY	DATE
E. NAULT	2021-11-01
NO. PROJET/PROJECT NO.	FICHIER/FILE
32760TT	32760TT_Forages

ÉCHELLE/SCALE
0 12,5 25 50 m

Table 11.3 Stratigraphic Summary – Depth (Elevation)

Boreholes	Type of layer of material					
	Vegetative cover (mm)	Concrete slab (mm)	Backfill (m)	Sand (m)	Sand and gravel (m)	Gravel (m)
F-1 (180.59)	50	-	0.05 to 3.95 (180.54 to 176.64)	3.95 to 5.64 (176.64 to 174.95) 7.62 to 18.59 (172.97 to 162.00) 23.70 to 23.93 (1) (156.89 to 156.66)	-	5.64 to 7.62 (174.95 to 172.97) 18.59 to 23.70 (162.00 to 156.89)
F-2 (178.77)	-	1,290	-	9.15 to 13.99 (169.62 to 164.78) 22.23 to 22.33 (1) (156.54 to 156.44)	-	8.00 to 9.15 (170.77 to 169.62) 13.99 to 22.23 (164.78 to 156.54)
F-3 (178.80)	-	1,090	-	-	7.80 to 22.87 (1) (171.00 to 155.93)	-
F-4 (180.71)	-	-	0.00 to 3.81 (180.71 to 176.90)	-	3.81 to 22.87 (1) (176.90 to 157.84)	
F-A (180.91)	180	-	0.18 to 1.50 (1) (180.73 to 179.41)	-	-	-
F-B (181.06)	60	-	0.06 to 1.97 (1) (181.00 to 179.09)			

(1) : Borehole end depth

\- : The material layer was not encountered in the borehole

11.1.8 Topography and Bathymetry

The river is located in a shallow valley (Figure 11.11a). The variations in water levels in the river's flood plain during high water periods are moderate. The elevation of the Ottawa River's banks ranges between 190 and 240 mASL (meter above sea level). The island, at 180 mASL, slopes slightly toward the south (Figures 11.11 and 11.12).

The channel beds of the Quebec and Ontario dams meet about 800 m downstream of the dams, forming the river's main channel. Downstream of the Quebec dam, the channel bed elevation ranges from 167 mASL immediately downstream of the dam to 173 mASL about 100 m from the dam. Given that the average water level downstream of the dam is maintained at an elevation of around 177 m, a pool approximately 10 m in depth is present downstream of the spillway slab. It is likely that this pool continues to exist at this location because of the increase in flow velocities immediately downstream of the dam, which causes scouring of the riverbed.

The shoal (observable at an elevation of about 173 mASL) corresponds to the remains of the former dam complex (1909–1934), and several large, meter-size concrete blocks along with various types of metal debris are still present on the river bottom in this area (Mistras, 2016) (Figure 11.13).

Figure 11-11 Elevations in the Study Area

LÉGENDE / LEGEND

350 Courbe de niveau maîtresse / Contour index

Courbe de niveau intermédiaire / Contour intermediate

Valeur des courbes de niveau: mètres
Contour values: meters

Hydrographie / Hydrography

TETRA TECH

Services publics et Approvisionnement Canada / Public Services and Procurement Canada

Projet de remplacement du barrage Témiscamingue du côté du Québec / Timiskaming Quebec Dam Replacement Project

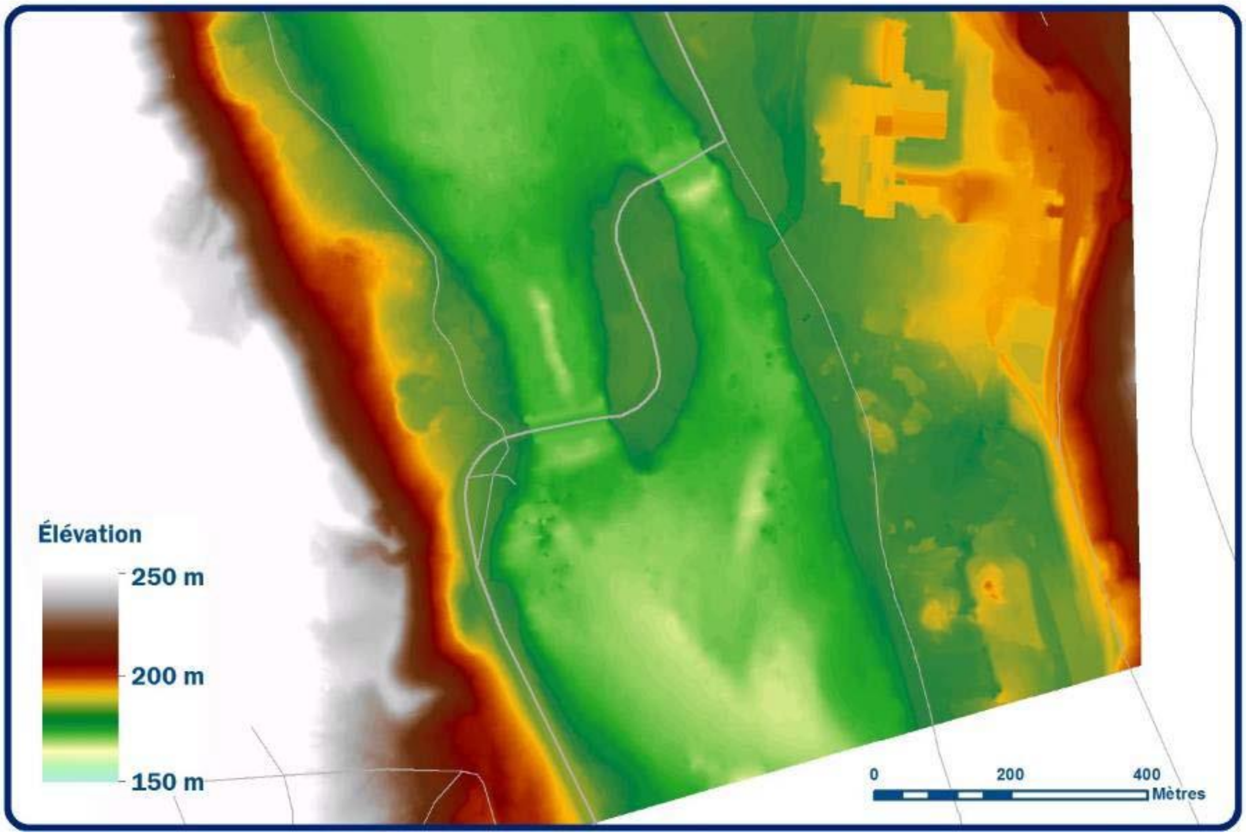
Figure 11.11a: Topographie dans la zone d'étude régionale / Topography in the Regional Study Area

CARTOGRAPHIE/CARTOGRAPHY	DATE
E. NAULT	2022-12-16
NO. PROJET/PROJECT NO.	FICHIER/FILE
32760TT	32760TT_20221212_Topo

ÉCHELLE/SCALE 0 1,25 2,5 5 km

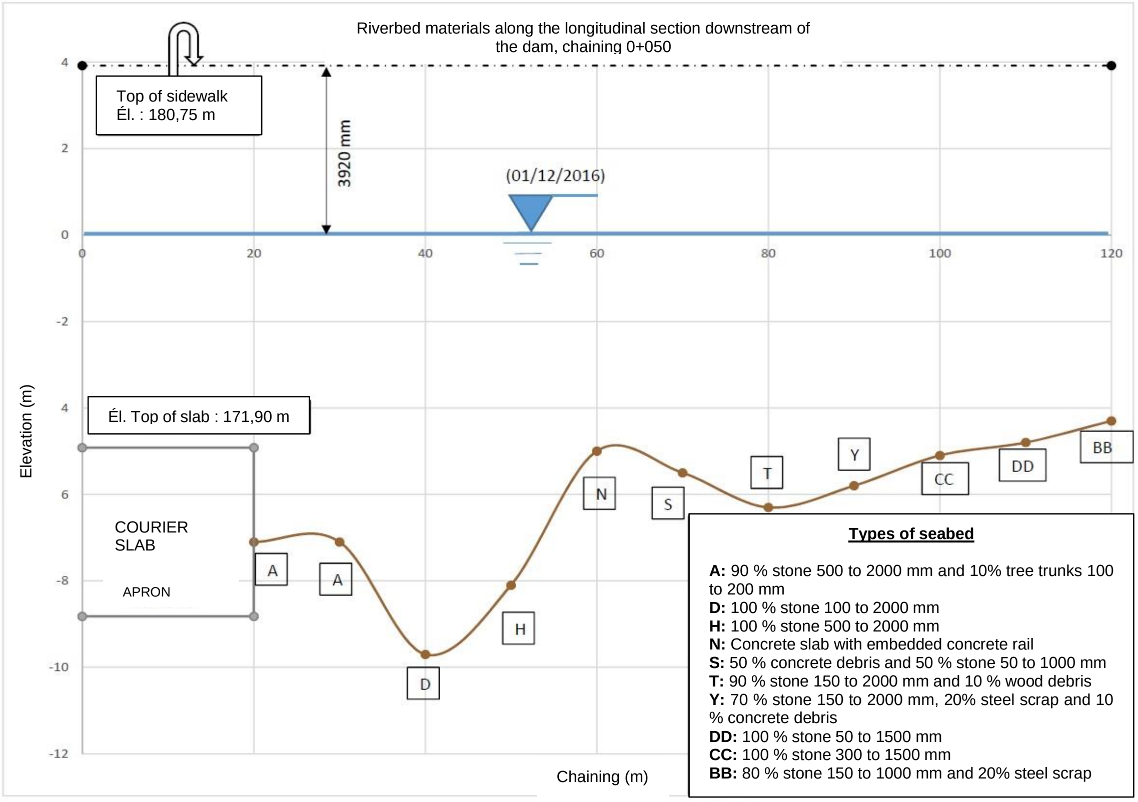
Path: \\TTS349FS3\Prj_reg\32760TT\DOC-PROJ\60\60CRO\ArcGIS\ArcGIS Pro\02_TRAITEMENT\32760TT_20221212_Topo\32760TT_20221212_Topo.aprx

Figure 11-12 Study Area Topography and bathymetry



Note: Elevations are given in meters above sea level (mASL).

Figure 11-13 Bathymetric Profile of the Channel Downstream of the Quebec Dam



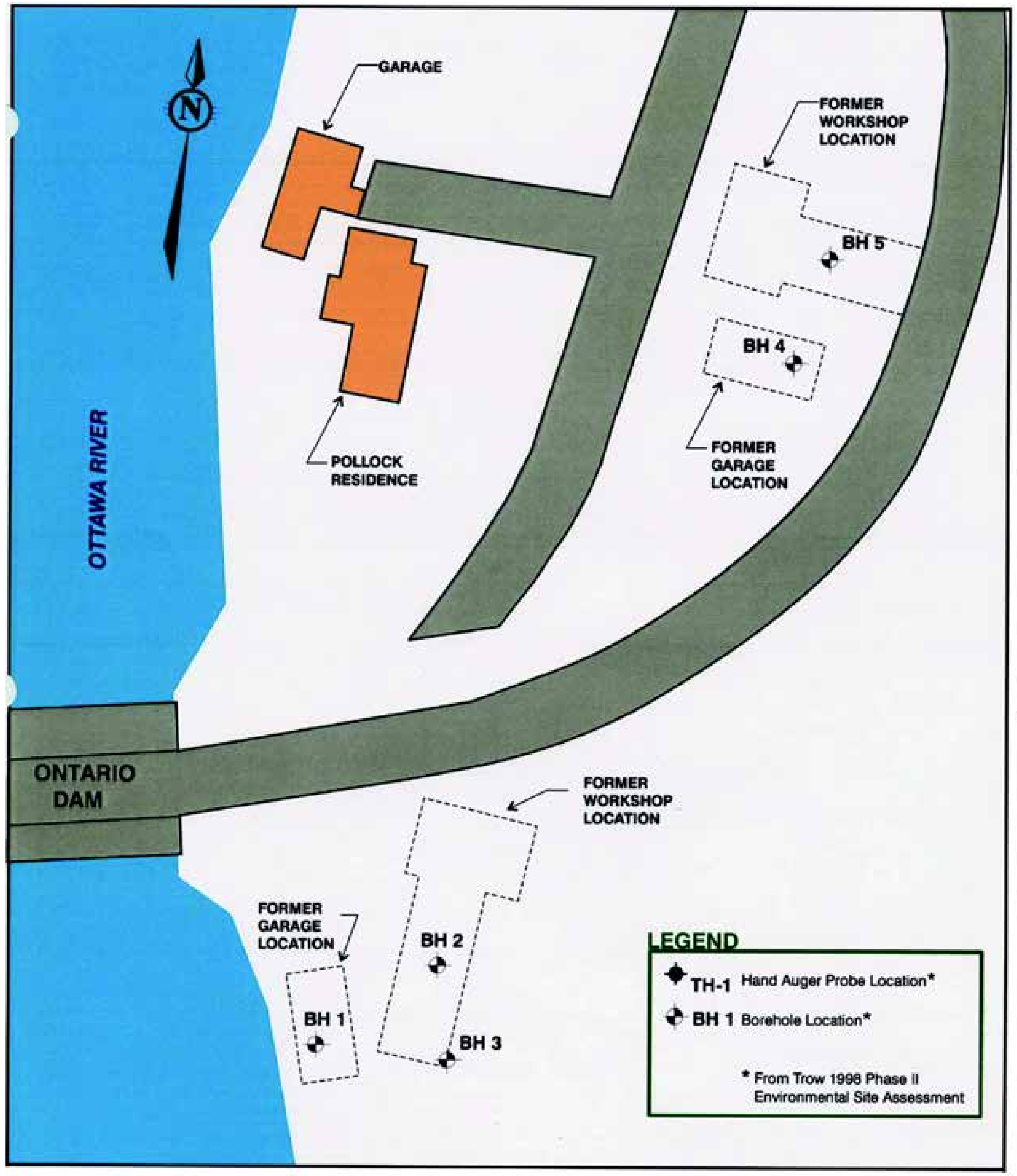
Source : Mistras, 2016

11.1.9 Potential Contamination

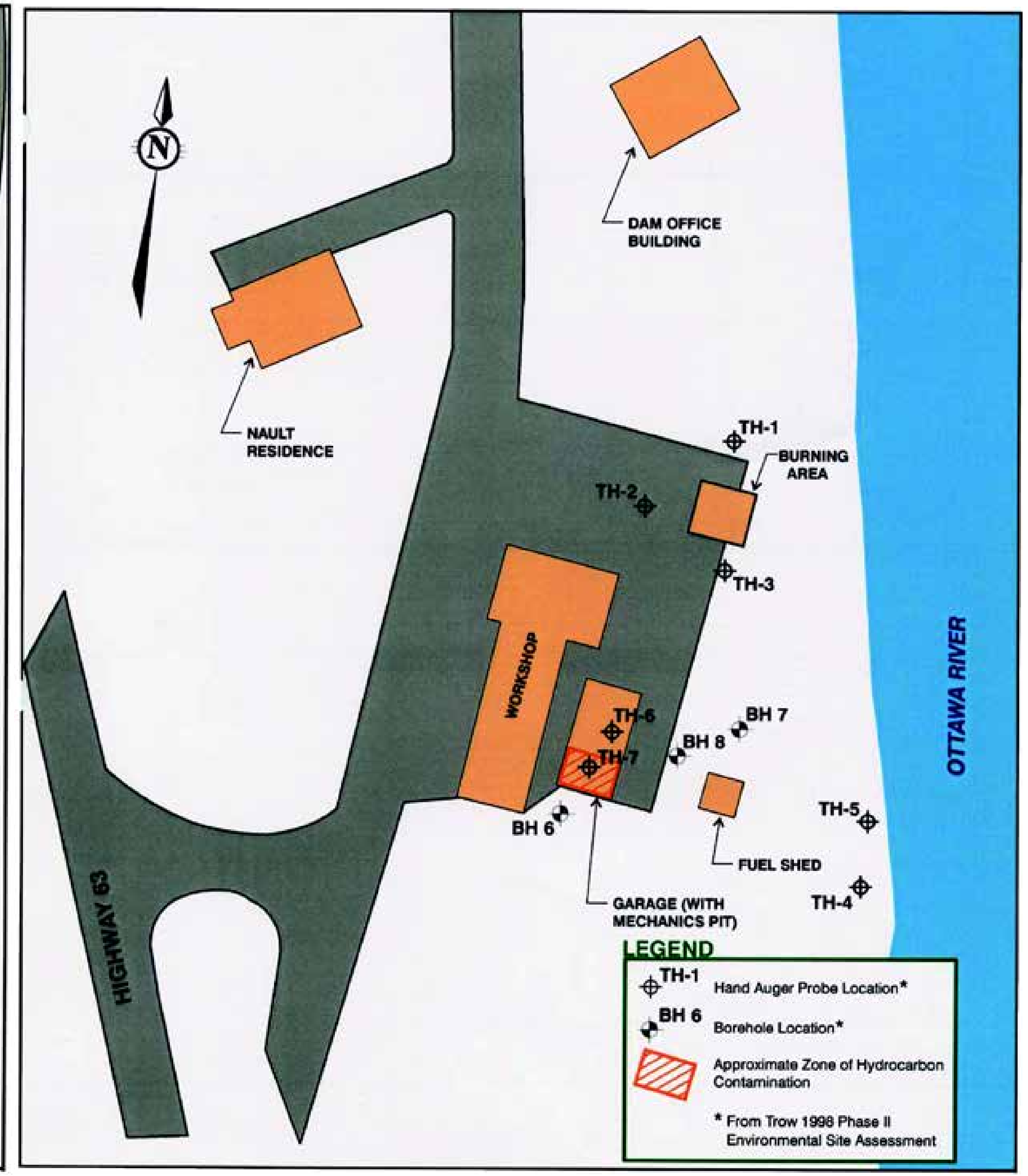
11.1.9.1 Soils

In 1996, a phase 1 Environmental Site Assessment (ESA) (Adamas environnement, 1996) reported the presence of two potential areas of contamination on Long Sault Island, one in the working area of the garage, and the other in a waste burning area of said garage. The report also mentions the presence of an underground tank at the south pier. A phase 2 ESA (Trow Consulting Engineers Ltd., 1998) confirmed the presence of hydrocarbons in concentrations that exceeded acceptable criteria for the maintenance pit. Decontamination was not recommended, unless the garage had to be demolished and relocated. A phase 3 ESA (Trow Consulting Engineers Ltd., 2002) stated that this was a Class N contamination (action not necessarily recommended) based on the National Classification System for Contaminated Sites (Map 11.4).

In 2004, a phase 1 ESA (Golder Associates Ltd., 2004) reported two potential contaminated areas along the east bank of the river, on Crown Land used by Rayonier. A Phase 2 ESA (Trow Associates Inc., 2006) mentions that there was no contamination that exceeded the criteria listed in applicable regulations (Map 11.5).



Portion sud de la propriété / Southern portion of the property *



Portion nord de la propriété / Northern portion of the property *

Figures tirées du rapport / Figures taken from report : *Phase III Environmental Site Assessment Temiscamigue Dam, Flood Control Land Sault Island, Ontario*

LÉGENDE / LEGEND

- TH-1 Tarière manuelle / Hand Auger Probe
- BH 6 Forage / Borehole
- Zone approximative de contamination aux hydrocarbures / Approximate Zone of Hydrocarbon Contamination

TETRA TECH

Services publics et Approvisionnement Canada | Public Services and Procurement Canada

Projet de remplacement du barrage Témiscamingue du côté du Québec / Timiskaming Quebec Dam Replacement Project

Carte / Map 11.4: Localisation des forages réalisés en 2002 / 2002 Boreholes Location,Trow Consulting Engineers

CARTOGRAPHIE/CARTOGRAPHY	DATE
E. NAULT	2021-11-01
NO. PROJET/PROJECT NO. 32760TT	FICHIER/FILE 32760TT_Forages
ÉCHELLE/SCALE Sans échelle / No scale	

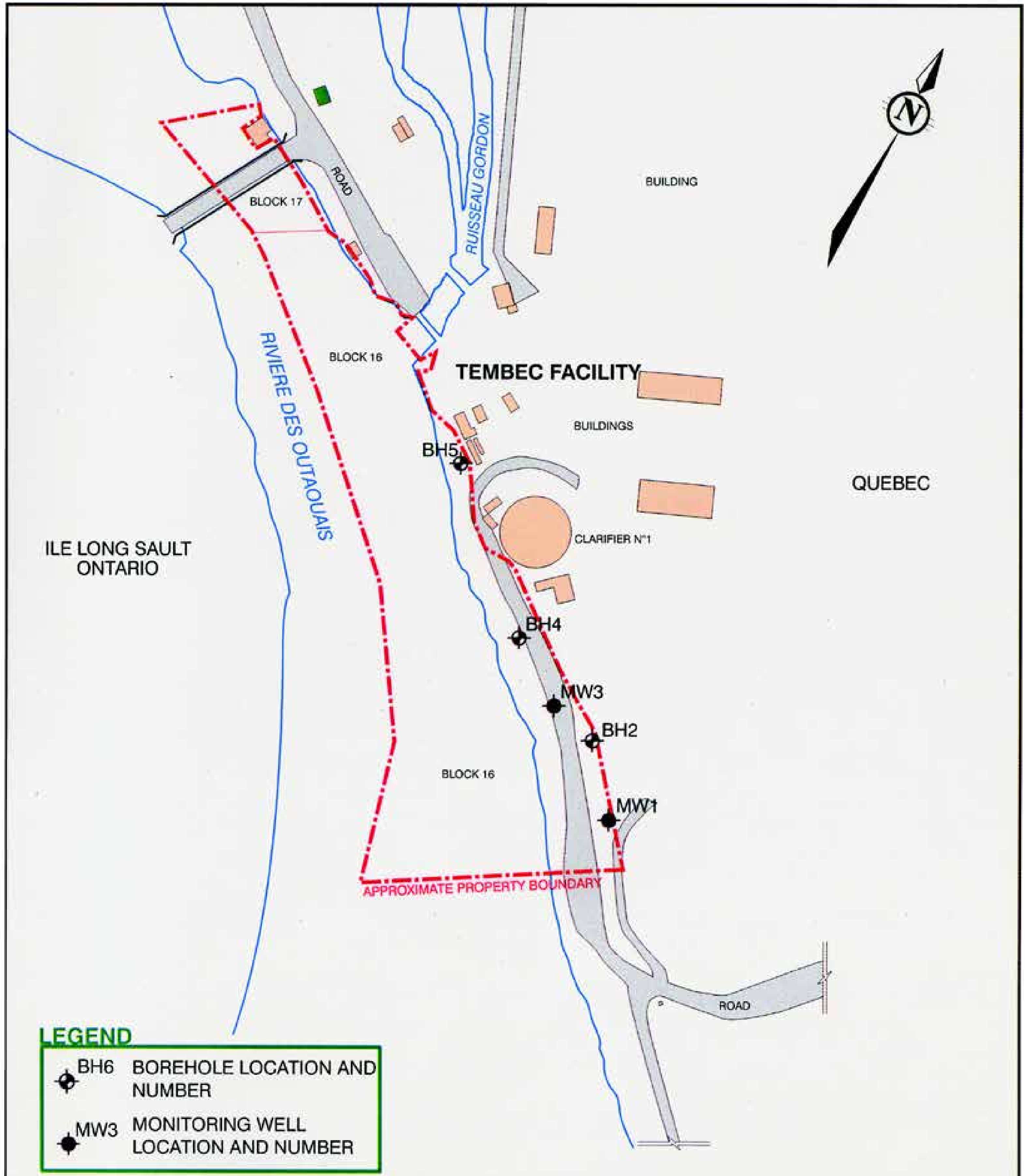


Figure tirée du rapport / Figure taken from report : *Phase II Environmental Site Assessment Temiscamigue Land, Temiscamingue, Quebec*

LÉGENDE / LEGEND

BH 6 Forage / Borehole

MW 3 Puits / Monitoring Well

TETRA TECH

Services publics et Approvisionnement Canada / Public Services and Procurement Canada

Projet de remplacement du barrage Témiscamingue du côté du Québec / Timiskaming Quebec Dam Replacement Project

Carte / Map 11.5:
Localisation des forages réalisés en 2006 / 2006 Boreholes Location,Trow Associates Inc.

CARTOGRAPHIE/CARTOGRAPHY	DATE
E. NAULT	2021-11-01
NO. PROJET/PROJECT NO.	FICHIER/FILE
32760TT	32760TT_Forages
ÉCHELLE/SCALE	
Sans échelle / No scale	

At the preparatory stage of the Project, a geotechnical study was carried out (GHD, 2017) and the chemical analysis results showed that one sample (F-A, on the island, see Map 11.3) contained a significant concentration of manganese (1,100 mg/kg). Neither the Canadian Council of Ministers of Environment (CCME), nor the Ontario Government imposed directives regarding manganese. For comparative purposes, the MELCC's *Guide d'intervention protection des sols et réhabilitation des terrains contaminés* (intervention guide for soil protection and the rehabilitation of contaminated sites) states that such a concentration (B-C range; A and B threshold are 1 000 mg/kg and C is 2200 mg/kg) is compatible with the proposed use of the site (road bed). Should these soils be excavated, they will have to be managed in accordance with the applicable regulations and based on their final disposal site.

11.1.9.2 List of Contaminated Sites in Quebec

As of November 2020, the MELCC's *Répertoire des terrains contaminés* (list of contaminated sites in Quebec) identifies four contaminated sites in the city of Témiscaming (Table 11.4). They are all far enough from the Project to eliminate any risk of contamination migration toward the study area.

11.1.9.3 Federal Contaminated Sites Inventory

The Federal Contaminated Sites Inventory, consulted on November 16, 2020, indicates the presence of petroleum hydrocarbons and polycyclic aromatic hydrocarbons (PAH) contamination (30 m^3) on Long Sault Island. The data sheet for this event is in Appendix 11.1. This is the contamination identified in the phase 3 ESA (Trow Associates Inc., 2002). The risk that this contamination would migrate toward the right of way used for construction is low. At this stage, additional action is not recommended. Environmental monitoring during construction will identify any new contamination and the actions to take at the appropriate time.

11.1.9.4 Kitchi Sibi Technical Team 2021 Study

The Kitchi Sibi Technical team also conducted a soil plot sampling during the summer 2021 (see Appendix 12.3 for the full report). Ten places upstream and downstream on the Quebec side of the Ottawa River and at the Timiskaming Dam Complex including Long Sault Island were identified, and in each soil sampling site, two samples were collected. 28 different heavy metals were investigated. The following soil sampling sites were located within the project area: S1, S2, S4 and S10 (see Map 2 of the report in Appendix 12.3 for the site locations). Based on the laboratory results provided in Appendix B of the Kitchi Sibi report, a table summarizing the results at the sampling sites within the project area (S1, S2, S4 and S10) was prepared and included in Appendix 12.4. The results were compared with the Quebec criteria and the Canadian Council of Minister of the Environment (CCME) criteria.

Compared with the Quebec criteria, the results are generally lower than criteria A (background criteria - unrestricted reuse) except for S1-A and S1-B samples (which are on the east bank of the river, close to Rayonier) for arsenic, chromium, lead, molybdenum and tin. For S2-A sample (also on the east bank), only chromium exceed criteria A. For these samples, the results present contamination in the range A-B of the criteria (soils in this range can be reused, for example: on the site or on the site of the source of the contamination and as cover material for landfill sites [15]). As for the CCME criteria, they are exceeded only for arsenic in samples S1-A and S1-B (the criteria are the same for all land use).

[15] In all cases, the temporary storage of A-B soils must be done in such a way as not to introduce new contamination to the land (water-soil-air). In particular, soils must be stored on a waterproof surface. Measures must also be put in place to prevent the dispersion of contaminants in the environment (dust, runoff, etc.). Source: Guide d'intervention - Protection des sols et réhabilitation des terrains contaminés (gouv.qc.ca)

11.1.9.5 Sediments

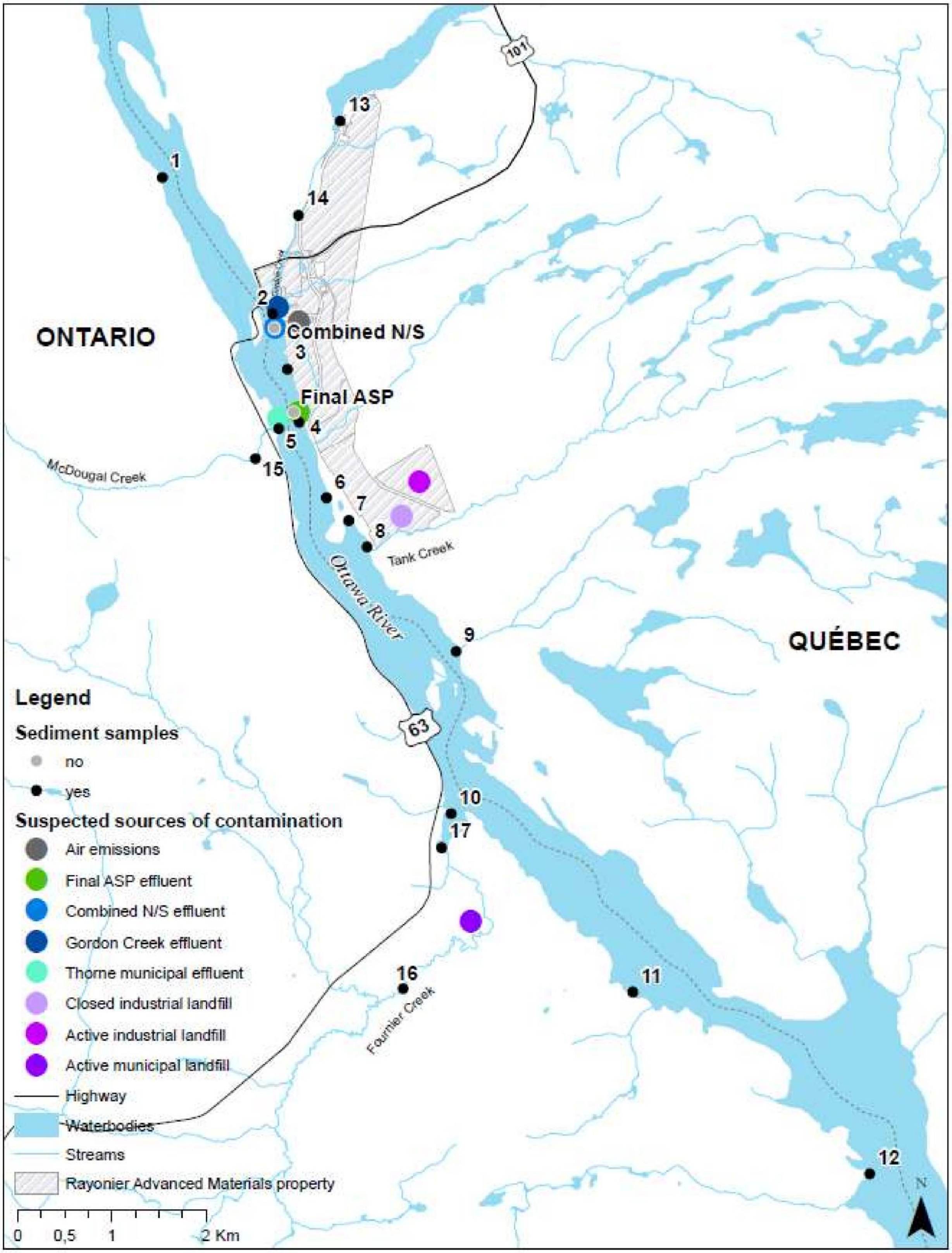
No data are available on the level of contamination of Ottawa river bottom sediments in the portion of the study area that is likely to be directly impacted by the work. Boreholes were drilled in the terrestrial environment near the dam in 2017 (GHD, 2017). Two of these boreholes (F-2 and F-3, Map 11.3) were located on the shore (in the terrestrial part, not in riverbed sediments). However, no chemical analysis was conducted, given that the boreholes were located on the slab of the dam. Boreholes F-1 and F-4, which were located on the banks but in the terrestrial part, revealed concentrations below Criterion A of the response guide for hydrocarbons C_{10}-C_{50}, BTEX and metals. There is nothing to suggest that the sediments are contaminated, given that there are few sources of contamination upstream and that the downstream area of the dam is not an area of sediment deposition or accumulation because of the very high velocities of the river flow there. However, according to SART, they suggest that contamination from the previous log boom storage upstream of the dam should be studied also downstream of Gordon Creek approximately 20 m at the Rayonier outfall piping.

A study conducted as part of a master's degree project by Camilla Arbour (2020) provided some data on sediment quality in areas impacted by human activities, including those occurring at Rayonier. In the study, sediment samples were collected in 2017 in Gordon Creek and the Ottawa River, in the area affected by effluents from Rayonier. A control sample was also collected about 2 km upstream of the dam, in Lake Timiskaming. Figure 11.14, taken from the report, shows the location of the sampling stations and potential sources of contamination.

Table 11.4 List of Contaminated Land as of November 16, 2020

Name	Location	Regional County Municipality	Nature of the contamination		Rehabilitation Status (R) and Residual Soil Quality After Rehabilitation (Q)	Date of Creation or Update
			Groundwater	Soil		
CP Railway Right of Way Angliers/Ville-Marie / Témiscaming		Témiscamingue		Benzene, copper (Cu), polycyclic aromatic hydrocarbons*, nickel (Ni), petroleum products*, total sulfur (S), xylenes (o,m,p)	R: Completed in 2000 Q: B-C range	2005-09-07
Lumsden Dam	46,7281254817 -79,090331662	Témiscamingue		Cadmium (Cd), total chrome (Cr), cobalt (Co), copper (Cu), polycyclic aromatic hydrocarbons*, nickel (Ni), lead (Pb), zinc (Zn)	R: Completed in 2005 Q: B-C range	2006-07-19
Opémican Site Pointe Opimica	46,8321679834 -79,1913002562	Témiscamingue		Polycyclic aromatic hydrocarbons*, petroleum hydrocarbons C10 to C50, lead (Pb), zinc (Zn)	R: Not completed	2015-05-05
Esso Canada Service Station	527, chemin Kipawa Témiscaming	Témiscamingue	Benzene, ethylbenzene, petroleum hydrocarbons C10 to C50, toluene, xylenes (o,m,p)	Benzene, ethylbenzene, petroleum hydrocarbons C10 to C50, toluene, xylenes (o,m,p)	R: Completed in 1993 Q: B-C range	2014-10-30

Figure 11-14 Location of Potential Sources of Contamination and Sediment and Surface Water Sampling Stations



Source: Arbour, 2020; Figure 2.4.

For the purposes of this description of the environment, Station 2 (in the Ottawa River, about 150 m downstream of the dam and 170 m downstream of Rayonier's cooling water effluent, which is discharged into Gordon Creek), Station 3 (in the Ottawa River, about 460 m from Rayonier's combined effluent) and Station 1 (the control) are the most relevant. Table 11.5 presents the data obtained and the sediment quality criteria.

According to the analysis provided in the report, Station 1 had higher lead and zinc levels than Station 2 downstream, but the difference was not statistically significant. However, this could be related to the former presence of an old wharf made of treated wood, which could have occasionally leached metals (given that these structures were treated with preservatives containing metals). Some parameters at Station 2 were significantly higher than the levels at Stations 1 and 3, i.e. aluminum, calcium, cobalt, chromium, potassium, manganese, sodium, nickel and vanadium. High levels of copper, iron and strontium were also found at Station 2, which had the highest concentrations of fine particulate matter (clay and silt) among the three stations. Because metals and several other parameters tend to adsorb to fine particulate matter, this outcome is to be expected.

Amongst all sampling locations in their study area (17 sites), Stations 1, 2 and 3 had the lowest levels of total nitrogen, organic matter and sulphur; they also are consistently (among the 17 sites) with the lowest concentrations of aluminum, barium, beryllium, calcium, cobalt, copper, iron, mercury, manganese, vanadium, nitrites and silicon. At those 3 stations (1, 2, 3), mercury was the only parameter that exceeds the CEO (Occasional effect level) sediment quality guidelines criteria for the protection of aquatic life. All other stations downstream of station 3 had higher mercury concentrations.

According to the report, the observations and analyses indicate that the contamination in the upstream portion (Station 1) - especially from the mining and pulp and paper industries in the upper part of the watershed - does not appear to be adversely affecting the environment. Although the levels found at Stations 2 and 3 generally do not exceed the guidelines, they do show the past and current effects of releases from Rayonier, including those of lead and mercury accumulated in sediments.

Table 11.5 Sediment Analysis Results at Stations 1, 2 and 3

	Guidelines for the protection of aquatic life					Station		
	ISQG (CCME)*	LEL (ON)*	CER (QC)*	CSE (QC)*	CEO (QC)*	1	2	3
Grain size distribution								
Clay (%)						21.85	29.39	26.03
Silt (%)						21.85	31.18	26.03
Sand (%)						56.30	39.43	47.94
Texture						Sandy clay loam	Clay loam	Sandy clay loam
Chemical parameters (metals)								
Arsenic (mg/kg)	5.9	6	4.1	5.9	7.6	1.03	0.92	0.90
Cadmium (mg/kg)	0.60	0.60	0.33	0.60	1.7	0.13	0.13	0.13
Cobalt (mg/kg)			-	-	-	4.43	3.79	3.73
Copper (mg/kg)	35.70	16.00	22	36	63	6.64	5.22	4.41
Chromium (mg/kg)	37.30	26.00	25	37	57	19.54	18.54	17.71
Iron (mg/kg)			-	-	-	9,255.59	7,873.21	7,823.05

	Guidelines for the protection of aquatic life					Station		
	ISQG (CCME)*	LEL (ON)*	CER (QC)*	CSE (QC)*	CEO (QC)*	1	2	3
Chemical parameters (metals)								
Mercury (mg/kg)			0.094	0.17	0.25	3.57	3.21	3.02
Manganese (mg/kg)	460	1,100	-	-	-	125.5	102.30	100.66
Nickel (mg/kg)	16	16	ND	ND	47	11.81	9.35	8.24
Lead (mg/kg)	35.00	31.00	25	35	52	3.39	2.58	2.35
Titanium (mg/kg)			-	-	-	341.71	311.12	307.03
Vanadium (mg/kg)			-	-	-	13.33	12.94	12.49
Zinc (mg/kg)	123.00	120.00	80	120	170	21.88	19.27	17.51
Chemical parameters (nutrients and organic matter)								
Organic matter (%)			-	-	-	2.60	1.38	0.83
NO_3 (mg/kg)			-	-	-	1.77	1.74	1.70
N_{tot} (mg/kg)			-	-	-	0.04	0.03	0.02
PO_4 (mg/kg)			-	-	-	23.38	19.94	17.11
P_{tot} (mg/kg)		600	-	-	-	242.65	211.45	201.70
Chemical parameters (other)								
Aluminum (mg/kg)			-	-	-	5,316.71	4,906.52	4,758.12
Barium (mg/kg)			-	-	-	26.05	23.97	23.37
Beryllium (mg/kg)			-	-	-	0.12	0.12	0.11
Calcium (mg/kg)			-	-	-	2,504.81	2,350.89	2,199.21
Potassium (mg/kg)			-	-	-	739.64	538.08	504.42
Magnesium (mg/kg)			-	-	-	3,373.89	2,695.66	2,625.75
Molybdenum (mg/kg)			-	-	-	1.00	1.00	1.00
Sodium (mg/kg)			-	-	-	105.68	91.78	91.50
Sulphur (mg/kg)			-	-	-	171.68	92.02	78.00
Selenium (mg/kg)			-	-	-	1.00	1.00	1.00
Silicon (mg/kg)			-	-	-	65.00	60.87	43.39
Strontium (mg/kg)			-	-	-	16.87	15.38	14.40

*ISQG : Interim sediment quality guidelines (CCME)
*LEL: Lowest effect level (ON)
*CER: Rare effect level (QC) – CER: concentration d'effets rares
*CSE: Effect threshold level (QC) – CSE: Concentration seuil produisant un effet
*CEO: Occasional effect level (QC) – CEO: Concentration d'effets occasionnels
ND: Values not determined
Source : Arbour, 2020. Tables 3.9 et 3.10 et
https://www.planstlaurent.qc.ca/fileadmin/publications/diverses/Qualite_criteres_sediments_f.pdf

On June 30, 2022, the SART team observed some soil sloughing from the Rayonier traffic bridge over the Gordon Creek including soil build-up on the steel structural bridge from traffic. There is some soil possibly contaminated from the road traffic and maintenance entering the creek.

11.1.9.6 Groundwater

There is very little data on groundwater quality in the terrestrial study area.

In 2002, Trow Consulting Engineers Ltd. conducted a Phase III environmental site assessment on PSPC properties on Long Sault Island (Map 11.4). One area (near the mechanical maintenance pit in the garage) was found to be contaminated by hydrocarbons (20-30 m^3), but it was determined that the groundwater was not affected by the hydrocarbons. This was after the Phase II assessment (Trow Consulting Engineers Ltd., 1998), in which the soil contamination was identified; however, the water table was not encountered in the boreholes/surveys. LVM-Fondatec Inc. (1999) determined that there did not seem to be significant migration towards sensitive receptors (Ottawa River) and that the risk was considered negligible.

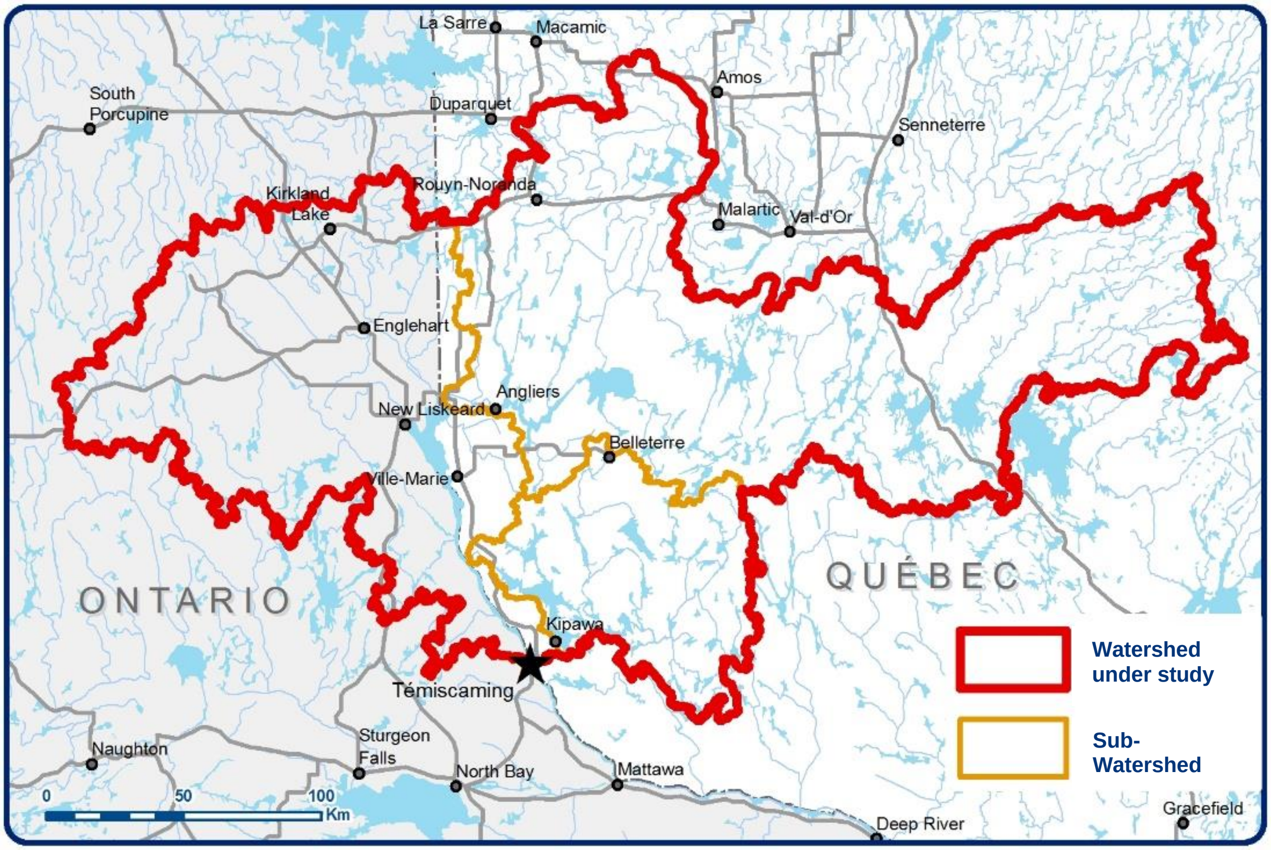
In 2006, Trow Associates Inc. conducted a Phase II environmental site assessment (Trow Associates Inc., 2006) of the lands on the left bank of the river, bordering the Rayonier property (Map 11.5). Two observation wells (BH1 and BH3) were installed to analyze the groundwater: petroleum hydrocarbons, volatile organic compounds (VOC), phenols, PCBs, metals and inorganic parameters. According to the results of the analyses of samples collected in March 2006, all the concentrations meet the applicable criteria (Soil Protection and Contaminated Sites Rehabilitation Policy, seepage into surface water or infiltration into sewers criteria).

11.1.10 Hydrology

11.1.10.1 Ottawa River Watershed

The watershed includes nearly 20,000 lakes and bodies of water. Most of the significant bodies of water (> 100 km^2) are regulated by dams, such as the Dozois and Decelles reservoirs, as well as “Lac Simard”, “Lac des Quinze”, Lake Kipawa and Lake Timiskaming (Figure 11.15). More than half the dams (55%) are high-capacity dams mostly dedicated to hydropower generation and wildlife conservation. Hydro-Québec owns approximately a fourth of the dams in the watershed “Organisme du bassin versant du Témiscamingue” (OBVT) (organization for the management of the Témiscaming watershed), 2013).

Figure 11-15 Watershed and Sub-Watersheds



In the south section of the watershed, where the Timiskaming Dam Complex is located, the lakes are deeper, oblong and with clearer water. Lake Timiskaming, for example, is 35 meters deep on average, with a maximum depth of 209 m in the south area of the lake, some 12 km south of the Kipawa River's mouth (OBVT, 2013).

The watershed groups the water bodies of the Upper Ottawa region, at the head of the Ottawa River which is the St. Lawrence River's main tributary. The source of the Ottawa River is "Lac Capimitchigama" and the river flows over a distance of approximately 1,271 km up to the mouth of the St. Lawrence River. Its watershed covers a 146,334 km² area, of which 92,203 km² (65%) is in the province of Quebec and 54,131 km² (35%) is in Ontario. At the Timiskaming Dam Complex, the Ottawa River drains a 45,740 km² watershed.

On the left bank immediately downstream of the dam is Gordon Creek, a major tributary of the Project study area. Its watershed covers an area of 93 km², and the tributary is influenced by the Kipawa Dam.

11.1.10.2 Water Levels

The Ottawa River is one of the most regulated rivers in Quebec. Forty-three dams manage high water levels from Témiscaming up to the mouth of the Ottawa River, including its effluents (OBVT, 2013).

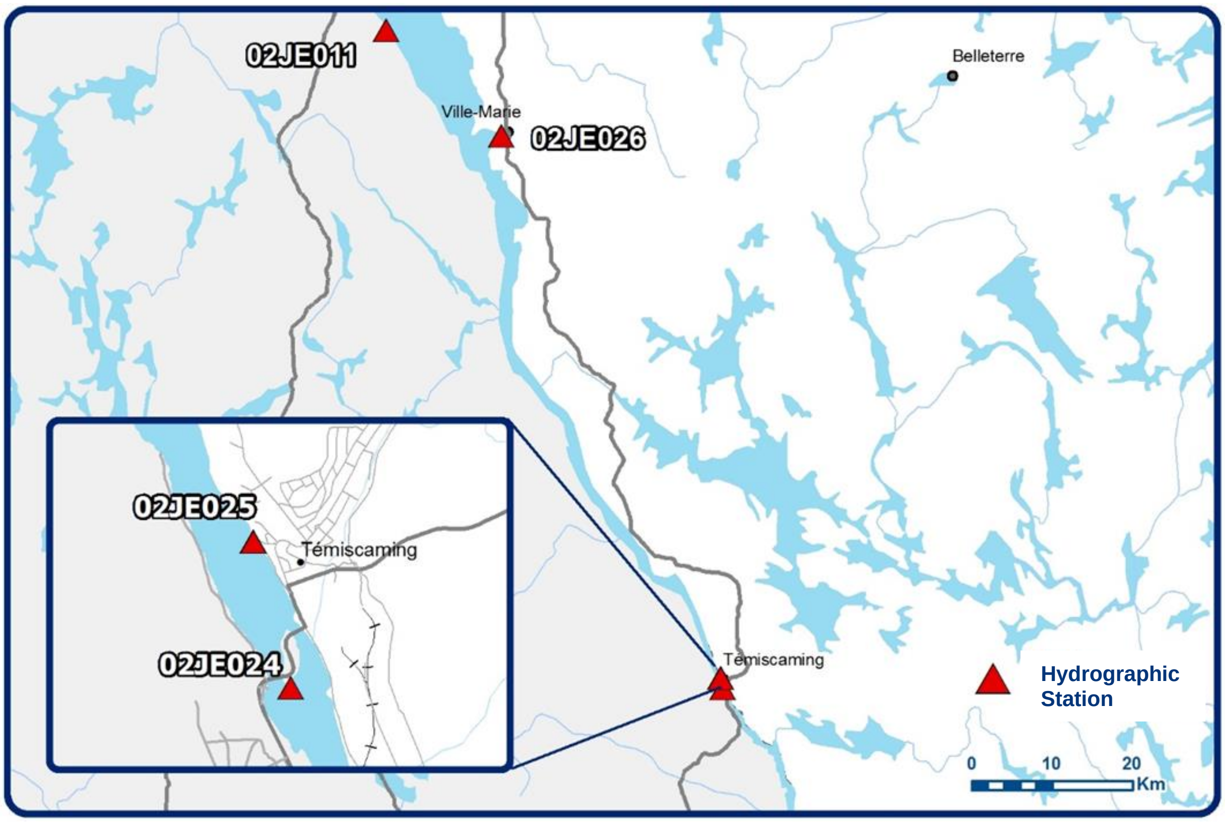
Water levels in the Ottawa River and the Timiskaming reservoir are measured at stations operated by the Water Survey of Canada. Currently, reservoir levels are measured at three stations:

- Station 02JE011 near the municipality of Haileybury (1908–2016);
- Station 02JE025 upstream of the Timiskaming Dam (1987–2016);

- Station 02JE026 near the municipality of Ville-Marie (1987–2016).

Water levels downstream of the dam are measured at station 02JE024, which is located on the southern tip of Long Sault Island, between the Ontario and Quebec dams. Figure 11.16 shows the location of the hydrometric stations used for the hydraulic study.

Figure 11-16 Location of Hydrographic Stations Used



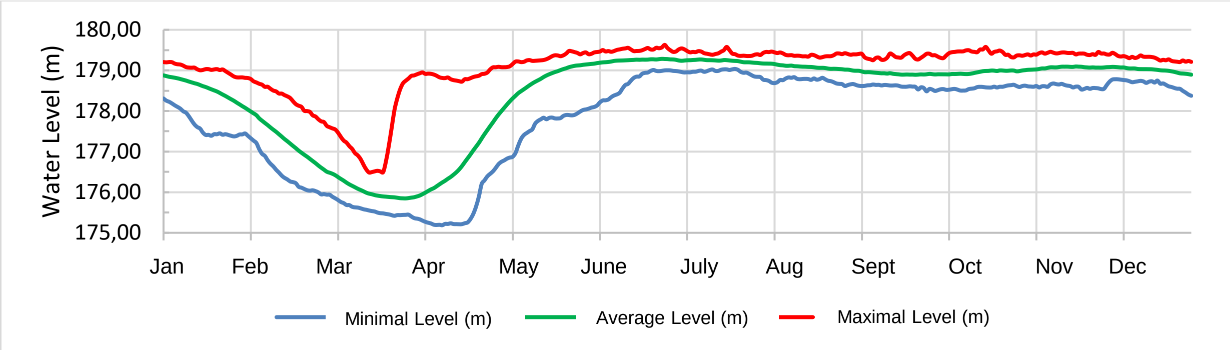
Daily mean water levels recorded at these stations are available for the 1987–2016 period. Figures 11.17 and 11.18 present the mean, maximum and minimum daily levels in the Timiskaming reservoir and downstream of the dam, based on the data recorded at stations 02JE025 and 02JE24.

In summer, the maximum operational level for the Timiskaming reservoir is at 179.56 mASL to protect shoreline residents against flooding. This level is 1.2 m under the maximum level reached in 1909 before the construction of the dams (Ogden Beeman & Associates, 1997). The maximum area of influence of the Timiskaming Dam Complex extends to Notre-Dame-du-Nord and thus includes Lake Timiskaming.

The minimum level required for navigation is at 178.65 mASL. This level is maintained in summer, from mid-May to mid-October, to ensure navigability. Generally speaking, the level of the reservoir is maintained at approximately 179.35 mASL and is lowered only during low flow periods, when flows from various tributaries are low, to maintain the desired minimum outflow rate of 300 m³/s (Ogden Beeman & Associates, 1997).

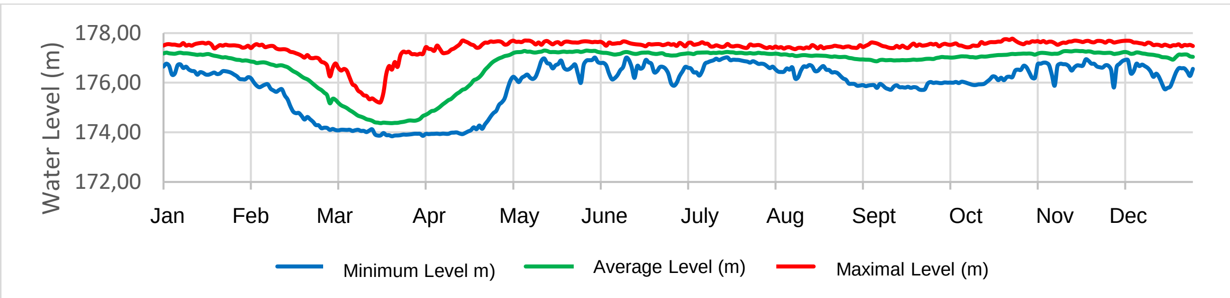
From January, the bays of the Quebec and Ontario dam are opened gradually to lower the water level in the reservoir to 175.50 mASL. When the water level reaches 177.70 mASL and the spring freshet has begun, the bays are closed to regain hydraulic control and prepare for the storage of the spring freshet. As water retention begins in mid-April, the operation of the dams aims to lower the water level of the Timiskaming reservoir as much as possible to ensure the availability of the maximum storage volume for the spring freshet. This storage lowers the peak flow in the center and south sections of the Ottawa River’s watershed.

Figure 11-17 Average Annual Levels in the Timiskaming Reservoir



Source: Tetra Tech, 2017a

Figure 11-18 Average Annual Water Levels Downstream of the Timiskaming Dam Complex



Source: Tetra Tech, 2017a

For reference purposes, Table 11.6 presents the maximum water levels in the Timiskaming reservoir, which were measured at station 02JE011 in Haileybury. These data are available from 1908 to the present. Although the station is located farther from the study area than the other stations available, it covers the most extensive period—in total, 106 years of available data. Data from this station were therefore used to evaluate historical water levels in the reservoir.

Table 11.6 Historical Reservoir Levels, in Decreasing Order

Rank	Year	Reservoir Level (m)
1	1960	181.044
2	1947	180.755
3	1928	180.700
4	1909	180.496
5	1966	180.249
57	2014	179.487
91	2015	179.368

11.1.10.3 Flow

The inflow to the Temiskaming reservoir is affected by the management of the “Barrage des Quinze” in Angliers, as well as by the Kipawa Dam in Laniel and the Lower Notch and Matabitchuan dams (see Map 11.1). PSPC estimates the inflows to the Timiskaming reservoir by calculating a theoretical balance based on the flows calculated at the Otto Holden Dam and provided by Ontario Power Generation (OPG) and on the variation of the water level in the reservoir. The inflows are available from the year 1997 up to 2019, a sample containing more than 20 years of data.

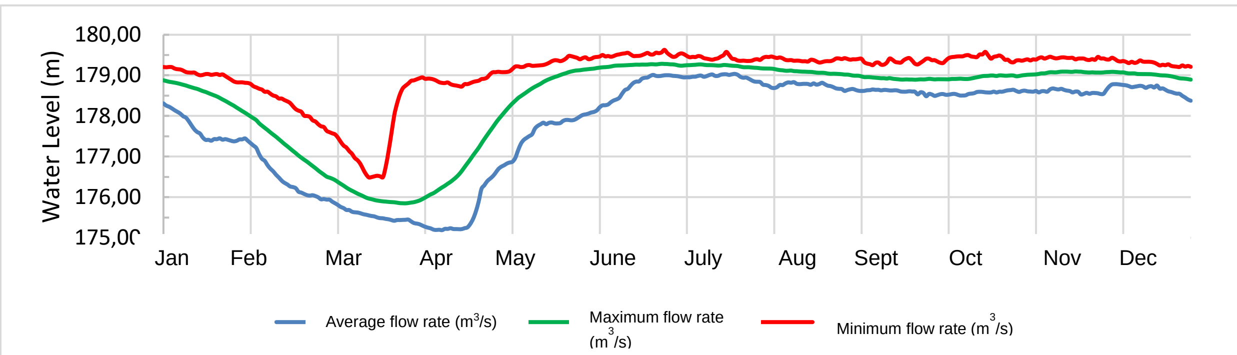
There are no flow monitoring stations at the Timiskaming Dam Complex. The flow through the two dams has also been estimated based on flows calculated at the Otto Holden Dam. This structure is located approximately 50 km downstream of the study area. To obtain the flows at the Timiskaming Dam Complex, PSPC subtracts the flows of the tributaries to the Ottawa River between the Otto Holden dam and the Timiskaming Dam Complex from the flows calculated at the Otto Holden Dam. These flows are estimated based on PSPC hydrological models and are not monitored in the field.

The daily outflows from the Timiskaming Dam Complex are available from April 1911 up to 2019. However, no data are available for the period between October 1, 1960, and October 1, 1966. The flows are calculated based on water levels monitored at the Otto Holden Dam at midnight and are not representative of average day flows. However, due to the vast area of the Ottawa River's watershed and the long response time, the data available is deemed acceptable for the purpose of daily statistics analysis Figure 11.19 presents the mean monthly outflows calculated for the Timiskaming dams based on daily averages.

Tetra Tech conducted a statistic analysis of the flows in Lake Timiskaming calculated based on the data recorded at the Otto Holden Dam using the HYFRAN software to determine the flows for return periods ranging between 2 years and 1,000 years (Table 11.7). The flow rate of 6,532.5 m^3/s, corresponding to the 1,000-year flood + 1/3 Probable Maximum Precipitation (PMP), was used to design the dam. The Weibull distribution was used for the analysis because it represents the data available most accurately, as shown in Figure 11.20. The flows were analyzed based on 99 years of available data. The mean flow discharge of the complex was estimated at 758 m^3/s, with a maximum flow that reached 3,664 m^3/s in 1960.

For information, the mean minimum flow rate is about 200 m^3/s near the dam (Timiskaming complex), and the historical minimum is 97 m^3/s.

Figure 11-19 Average Outflow from the Timiskaming Dam Complex



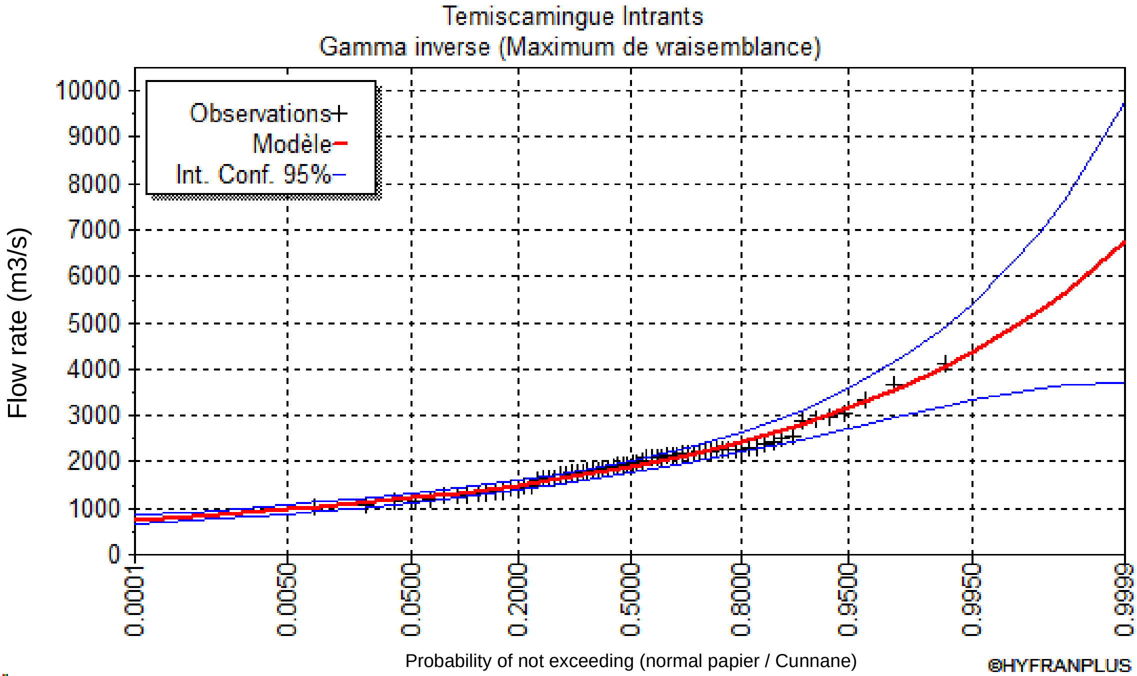
Source: Tetra Tech, 2017a

Table 11.7 Return Periods of the Inflows to the Timiskaming Reservoir and Safety Check Flood

Return Period	Flow rate (m^3/s)
2 years	1 885.3
10 years	2 793.5
100 years	3 995.4
1000 years	5 281.8
1000 years + 1/3 of the Probable Maximum Precipitation (PMP)*	6 532.5

*Design flood for the dam

Figure 11-20 Weibull Distribution of the Inflows to the Timiskaming Reservoir



Source: Tetra Tech, 2020

Gordon Creek is a tributary of Lake Kipawa, and its flow is managed by the Lumsden Dam (owned by Hydro-Québec and managed by Rayonier). The Lumsden Dam holds back the water in the Réservoir aux Brochets; inflows to this reservoir are managed by the Tee Dam (X0002991). Note that these structures are part of the Kipawa dam complex (X0002992) and that outflows are managed at all times.

To assess the impact of flood outflows from Gordon Creek, a statistical analysis of flows measured at hydrometric station 48603 was conducted by the Centre d'Expertise Hydrique du Québec (CEHQ). The data available from this station cover the 1988–2016 period (29 years). Table 11.8 presents the flood flows calculated for Gordon Creek.

Table 11.8 Gordon Creek Flood Outflows (Mean Daily Flows)

Return Period	Flow Rate (m^3/s)
2 years	17
10 years	21
100 years	25

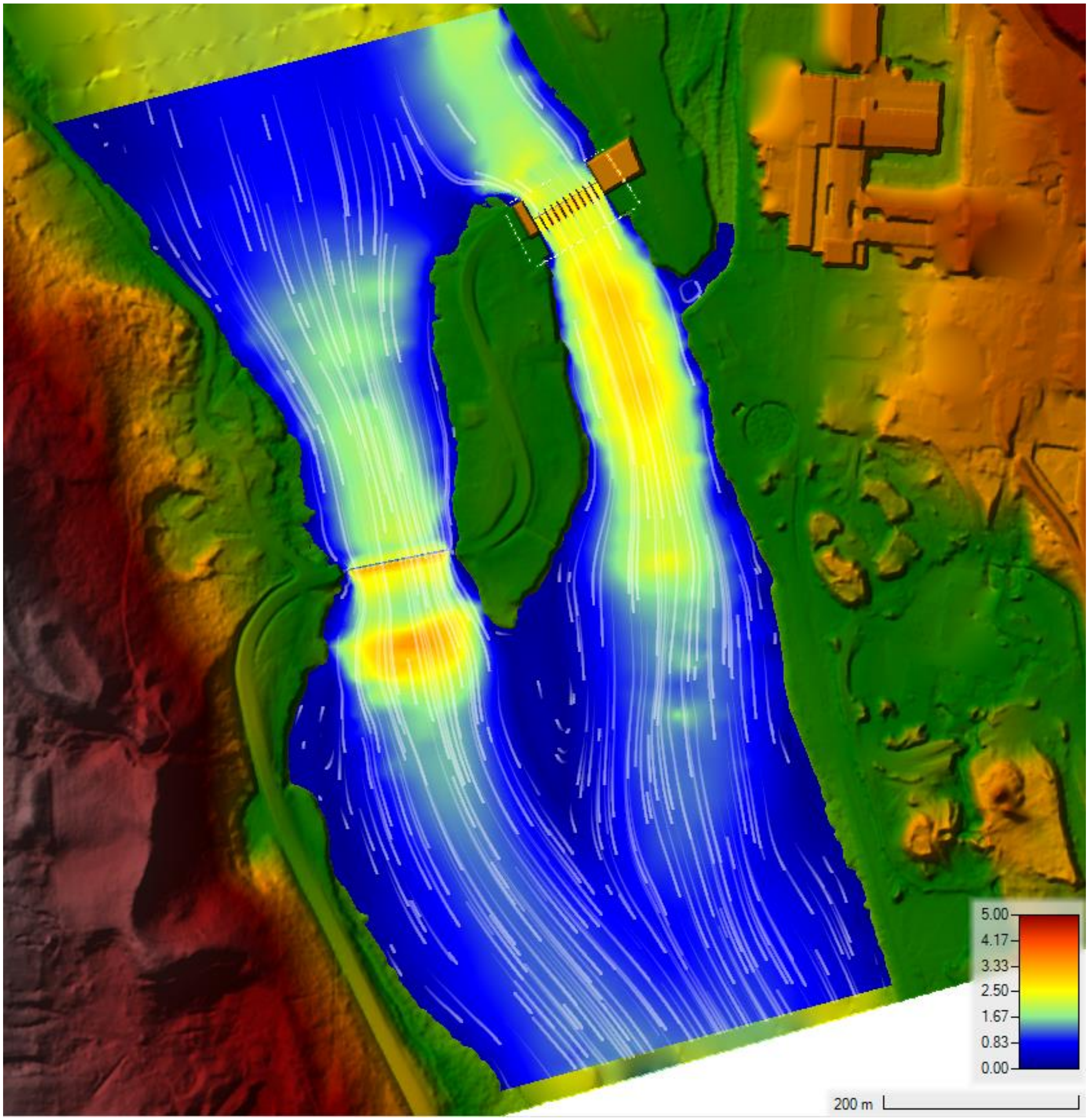
11.1.10.4 Hydrodynamics

The 2D modeling module of the HECRAS software, version 5.0.3, was used to model the section of the Ottawa River under study. The use of a 2D model ensures a better reproduction of the river's flow patterns upstream and downstream of Long Sault Island. A 2D model also characterizes the impacts of the management of one dam versus the other better, as well as the flow rates conveyed by each structure.

The 2D hydraulic model is a meshing of 15,222 cells up to 200 m upstream and 800 m downstream of the Quebec dam. The meshing covers both sides of Long Sault Island, with an average resolution of 10 m. A denser meshing is used at the Quebec and Ontario dams, where the resolution of the cells is 1 m. The meshing is associated with the digital terrain model (DTM) built from topographic and bathymetric surveys.

Figure 11.21 presents the results of the hydrodynamic simulations for a flood flow of 2,447 m^3/s, which is equivalent to a flood slightly less than the 10-year flood. Considering that all the sluice gates of both dams are open, the figure shows the distribution of flows on both sides of the island. At a distance of about 200 m upstream of the dams, flow velocities are less than 1 m/s, increasing to around 2.5 to 3.5 m/s near the dams. It should be noted that these velocities represent the average over the entire water column. Velocities gradually decrease downstream of the dam, reaching 1 m/s again just downstream of the island.

Figure 11-21 2D Hydraulic Modeling of the Flow When All the Dam Bays are Open



11.1.11 Ice Regime

According to the operators of the Timiskaming Dam Complex, ice does not form in the river section directly upstream and downstream of the dam under normal operation and flow conditions (Photos 11.1 to 11.4). In fact, from January to March, the sluice gates are opened to reduce the water level of Lake Timiskaming in anticipation of the spring flood. Specifically, it appears that the limits of the ice cover are located in the Wyse sector, 1.6 km upstream and in the Eldee sector, nearly 6 km downstream. The operators added that ice cover forms at the dam only when it is closed for repairs or maintenance. No issues with frazil ice (ice fragments or crystals) have been reported by operators.

Photo 11.1 Upstream View (January 2011)

Photo 11.2 Downstream View (January 2011)

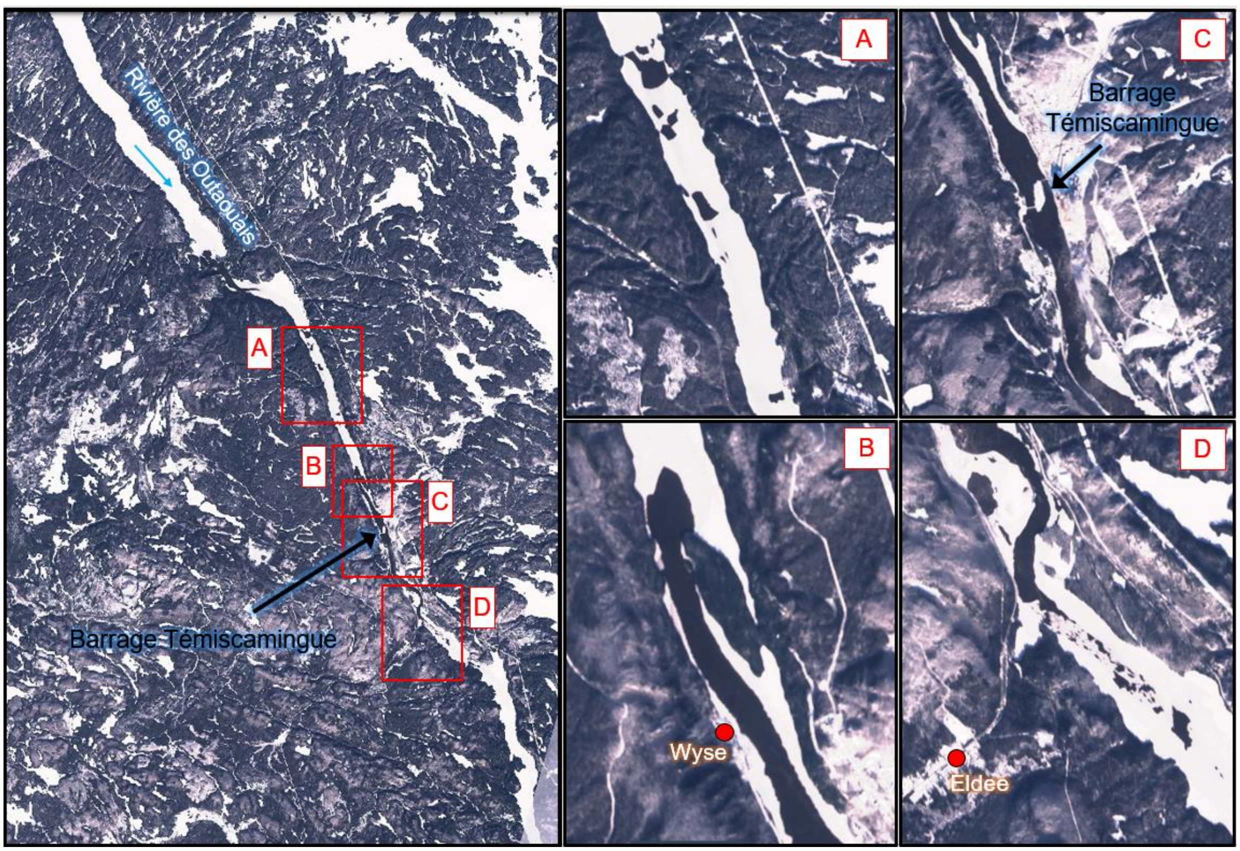
Photo 11.3 Upstream View (January 2019)

Photo 11.4 Downstream View (February 2019)

To confirm these observations, an analysis of the Sentinel satellite images was conducted. The year 2018–2019 was considered a representative year and is presented as a baseline for the ice regime over an approximately 22 km section of the Ottawa River. In addition to the Sentinel satellite images, weather data from Environment Canada station 7080468 (located directly at the Timiskaming Dam site) were also analyzed. Figure 11.22 shows the maximum ice cover during the winter of 2018-2019, i.e., on January 20, 2019. The analysis of the satellite images available confirmed that at any other time in the winter, the area of water free of ice in the section under study was greater than that of January 20th. The river sections directly upstream and downstream of the dam (insert C, Figure 11.22) remained entirely free of ice, with the exception of limited areas occupied by embankment ice where the flow rate was low.

Based on the data collected at the weather station, air temperature on January 20th reached a minimum of -30.6°C, with a daily average temperature of -25.9°C. For three days before that date, minimum temperatures ranged between -26.1°C and -29.6°C, with daily average temperatures ranging between -17.4°C and -26.4°C. The graph of the Freezing Degree Days (FDDs) in Figure 11.18 indicates that the second half of January 2019 was the coldest period of the winter and also that the most FDDs occurred during this period. However, January 20th was not the date when the maximum number of FDDs was reached. The maximum was reached between March 15th and April 1st. This suggests that the Ottawa River's thermal budget in the section under study, combined with the flow rate, does not allow the formation of a complete ice cover that thickens as winter progresses.

Figure 11-22 Status of the Ice Cover on the Ottawa River in the Timiskaming Dam Complex Area on January 20, 2019 (Satellite Images: Sentinel Hub)



Upstream, a series of lakes discharge into the Ottawa River. These relatively warm (between 1°C and 4°C typically) lacustrine effluents in winter add to the river's thermal budget. In addition, although water temperatures monitored in winter are not available, warmer temperatures from Lake Timiskaming water may be observed in the dam area approximately 70 km from the structure. Consequently, the surface flow rate must be slow enough to allow an efficient thermal exchange that would form ice. This occurs very rarely in the long river section upstream of the dam. Figure 11.23 shows the narrowing of the flow section 12 km upstream of the structure, where a complete ice cover rarely forms due to the acceleration of the flow. The same phenomenon is observed upstream of Wyse (insert B, Figure 11.22) where the peninsula restricts the flow and causes the flow speed to increase, preventing the formation of an ice cover.

The analysis also included the area downstream of the dam, where Gordon Creek discharges and brings relatively warm water from the reservoir located merely 2 km upstream. This source of heat, combined with the other discharges along the river and the flow rate in the narrow section downstream of the structure up to Eldee (insert D, Figure 11.22), renders the formation of a complete ice cover from shore to shore very difficult.

As for ice jam issues, the history of ice jams recorded by the “Ministère de la Sécurité publique" or MSP (the Quebec government authority on public safety) was consulted. No ice jams on the Ottawa River in the Timiskaming Dam Complex area have been reported to MSP.

Figure 11-23 FDDs in the Winter of 2019 at the Timiskaming Dam Complex (Environment Canada Station #7080468)

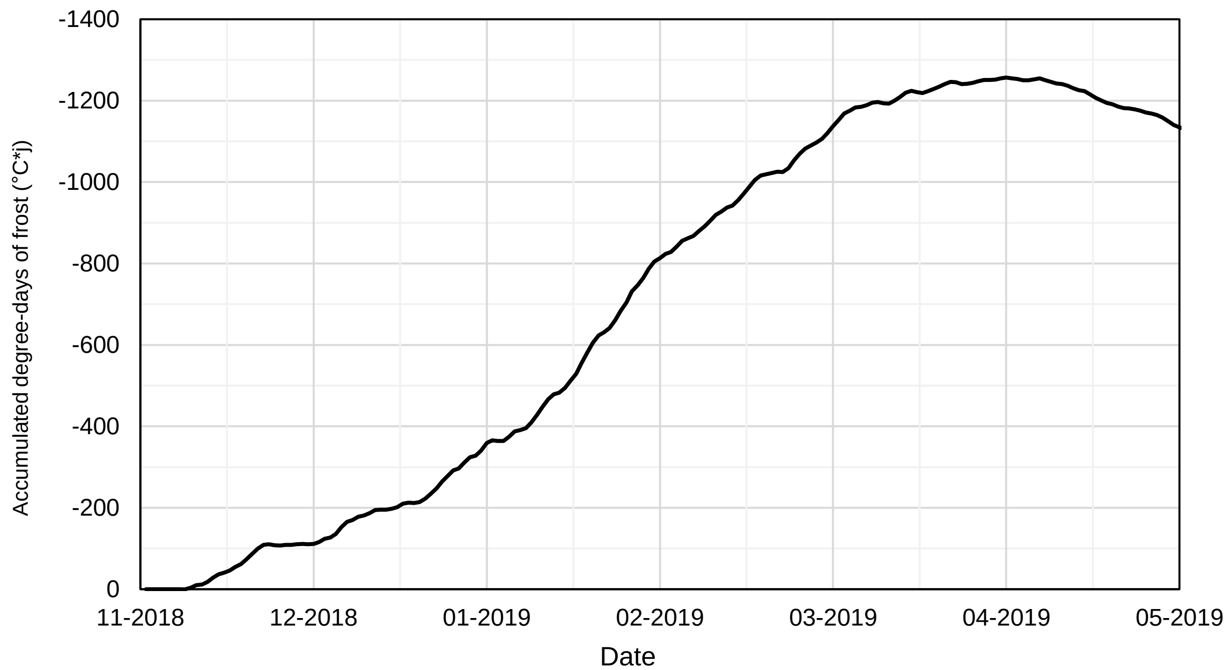
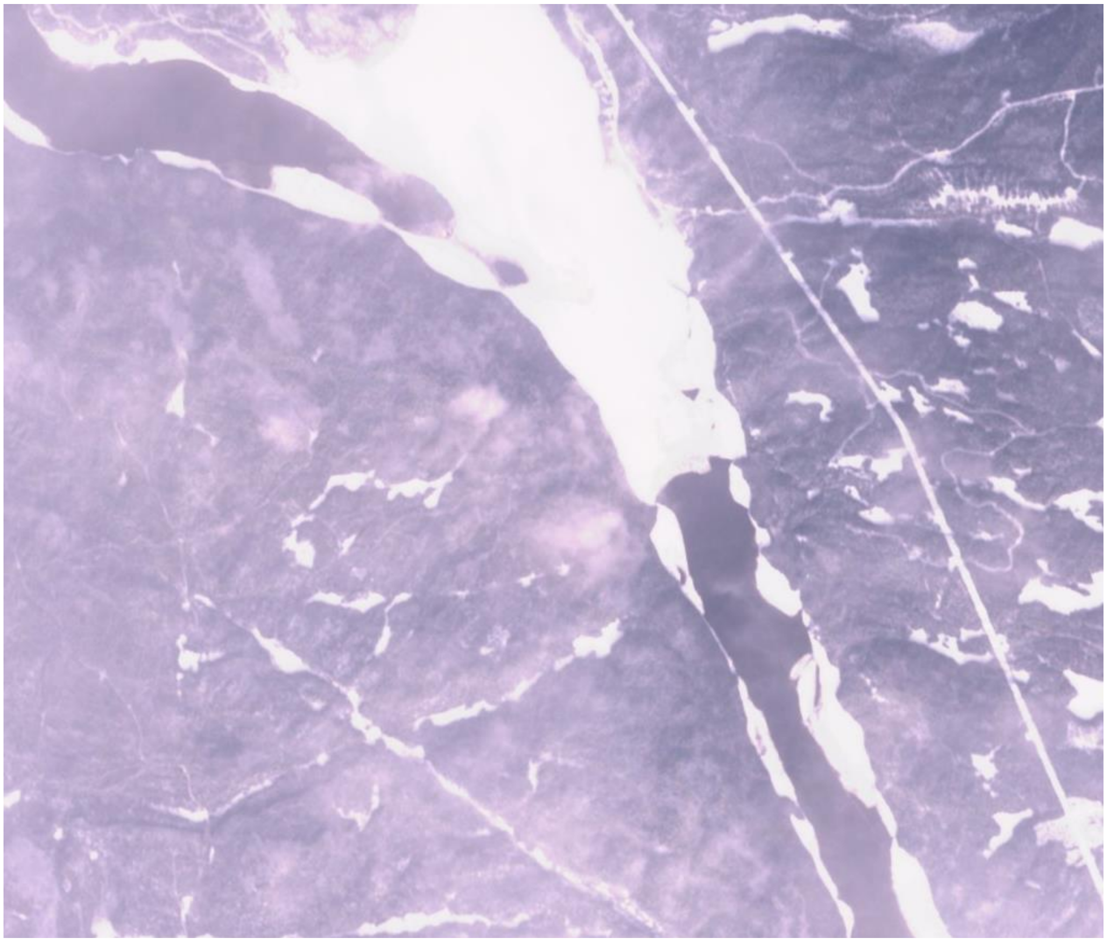


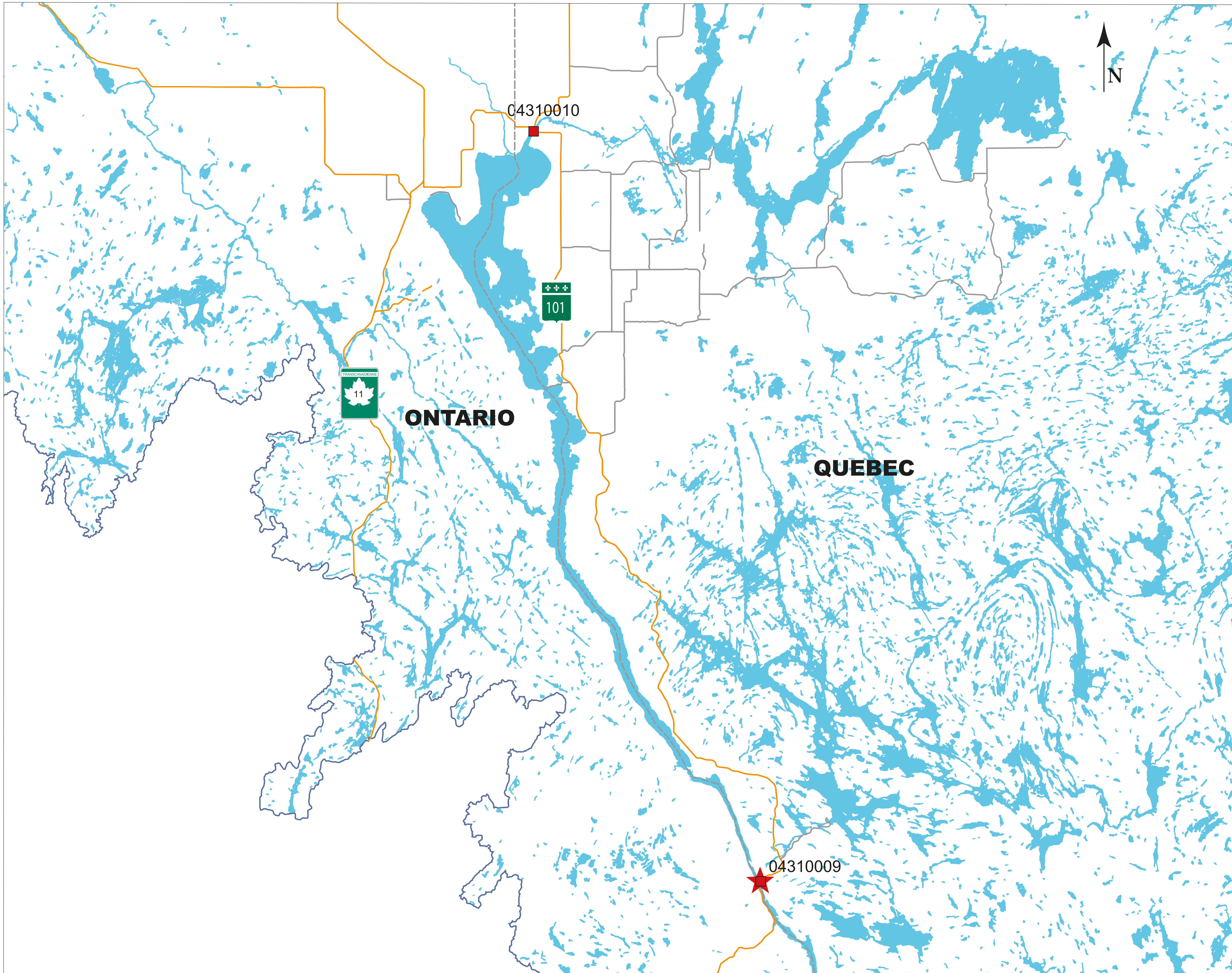
Figure 11-24 Ice Cover on January 25, 2019, at 12 km upstream of the Timiskaming Dam Complex (Satellite Image: Sentinel Hub)



11.1.12 Sediment Dynamics

Lake Timiskaming is known for its strong north to south turbidity gradient due to the geological and pedological characteristics of the lake's shores, combined with the sedimentation process between the north and south areas of the lake. In the north section of the lake, rivers cut through deposits of lacustrine sediments and contain high concentrations of suspended sediments which can reach 20 Nephelometric Turbidity Units (NTU). In the south area of the lake, rivers drain coarse morainic areas. Therefore, the concentration of suspended sediments is lower (5 to 10 NTU).

The water of the Ottawa River downstream of Lake Timiskaming is not greatly loaded with sediments. Very little information is available on the exact concentrations of suspended sediments and on the region's sediment dynamics. However, one of the monitoring stations of the MELCC's "Banque de données sur la qualité du milieu aquatique" or BQMA (database on the quality of the aquatic environment) (MDDELCC, 2017) is located on the Ottawa River next to the Timiskaming Dam Complex (Map 11.6). Tables 11.9 and 11.10 summarizes the data on the water quality recorded at this monitoring station between April 15, 2013 and November 11, 2017. According to the data from this station, the turbidity ranges from 1.2 to 15 NTU, with an average of about 5 NTU. In general, turbidity was very low throughout the year (2 NTU), with the exception of the spring flood period when it reached 10 to 15 NTU. Turbidity at the upstream station, at Notre-Dame-du-Nord (Map 11.6, station no. 04310010) was higher, with an average of 7.2 NTU and varying between 3 and 35 NTU during high water periods (Table 11.11), indicating that sediment deposition likely occurs in the calmer areas of Lake Timiskaming.



LÉGENDE/LEGEND

- Projet/Project
- Station de mesure de la qualité de l'eau du MELCC/ MELCC water quality measuring station
- Réseau hydrographique/ Hydrographic network
- Bassin versant de la rivière des Outaouais/ Ottawa river watershed
- Limite provinciale

Routes / Roads

- Autoroute / Highway
- Route nationale / National road
- Route secondaire / Secondary road

N° STATION	DESCRIPTION	LATITUDE	LONGITUDE
04310009	DES OUTAOUAIS AU PONT-ROUTE 101 À TÉMISCAMINGUE/ FROM OUTAOUAIS TO PONT-ROUTE101 BRIDGE IN TEMISCAMINGUE	46.7115510	-79.1004940

N° STATION	DESCRIPTION	LATITUDE	LONGITUDE
04310010	DES OUTAOUAIS AU PONT-ROUTE 101 À NOTRE-DAME-DU-NORD/ FROM OUTAOUAIS TO PONT-ROUTE 101 BRIDGE IN NOTRE-DAME-DU-NORD	47.5891930	-79.4842220

TETRA TECH

Services publics et Approvisionnement Canada | Public Services and Procurement Canada

Projet de remplacement du barrage Témiscamingue du côté du Québec / Timiskaming Quebec Dam Replacement Project

Carte /Map 11.6: Localisation des stations de qualité de l'eau/Localization of water quality stations

CARTOGRAPHIE/CARTOGRAPHY	DATE
C.HOULE	2021-06-04
NO. PROJET/PROJECT NO.	FICHIER/FILE
32760TT	32760TT_Etude d'impact
ÉCHELLE/SCALE	
1:500 000	

Table 11.9 Physicochemical Statistics of the Ottawa River's Surface Water (2013-2015) (Timiskaming Dam Station)

Parameter	Unit	#	Criteria	Average	Difference	Min	Median	Maximum
Ammoniacal nitrogen (filtered or not)	mg/l	24	1	0.01	0.01	0.01	0.01	0.06
Total nitrogen (filtered or not)	mg/l	24	3	0.36	0.06	0.21	0.37	0.44
Dissolved organic carbon	mg/l	24	-	7.4	0.9	5.4	7.5	9.2
Active chlorophyll *a*	µg/l	18	-	1.09	0.89	0.02	0.94	3.18
Total chlorophyll *a*	µg/l	18	4.75	1.56	1.13	0.04	1.48	3.88
Fecal coliforms	UFC/100 ml	22	100	2	2	1	1	7
Conductivity	µS/cm	24	-	61.5	12.6	44.0	62.5	100.0
Nitrates and nitrites (filtered or not)	mg/l	24	3	0.17	0.04	0.08	0.18	0.23
pH	pH	24	6.5 à 9	7.3	-	7.1	7.4	7.5
Total phosphorus	mg/l	24	0.03	0.011	0.004	0.004	0.012	0.020
Suspended solids	mg/l	24	13	1.9	1.5	0.5	2.0	8.0
Temperature	°C	24		10.9	5.7	2.0	10.5	20.0
Turbidity	NTU	24	5.2	4.7	2.4	1.2	4.5	10.0

Source: MDDELCC, 2017a

Table 11.10 Physicochemical Statistics of the Ottawa River's Surface Water (2017-2019) (Timiskaming dam station)

Parameter	Unit	#	Criteria	Average	Difference	Min	Median	Maximum
Ammoniacal nitrogen (filtered or not)	mg/l	23	1	0.01	0.01	0.01	0.01	0.04
Total nitrogen (filtered or not)	mg/l	23	3	0.39	0.06	0.30	0.38	0.51
Dissolved organic carbon	mg/l	23	-	8.0	1.7	6.6	7.7	15.4
Active chlorophyll *a*	µg/l	17	-	0.99	0.63	0.11	0.94	2.51
Total chlorophyll *a*	µg/l	12	4.75	1.52	0.80	0.28	1.38	3.04
Fecal coliforms	UFC/100 ml	21	100	1	2	1	1	8
Conductivity	µS/cm	23	-	58.2	7.3	43.0	59.0	72.0
Nitrates and nitrites (filtered or not)	mg/l	23	3	0.19	0.03	0.14	0.19	0.25
pH	pH	23	6.5 à 9	7.3		6.8	7.4	7.4
Total phosphorus	mg/l	23	0.03	0.012	0.005	0.006	0.011	0.034
Suspended solids	mg/l	23	13	1.7	0.9	1.0	2.0	5.0
Temperature	°C	23	-	11.2	6.5	0.0	12.0	20.0
Turbidity	NTU	23	5.2	5.2	3.3	2.1	4.0	15.0

Source: MELCC, 2021

Table 11.11 Physicochemical Statistics of the Ottawa River's Surface Water (2017-2019) (station upstream of Timiskaming Lake, in Notre-Dame-du-Nord)

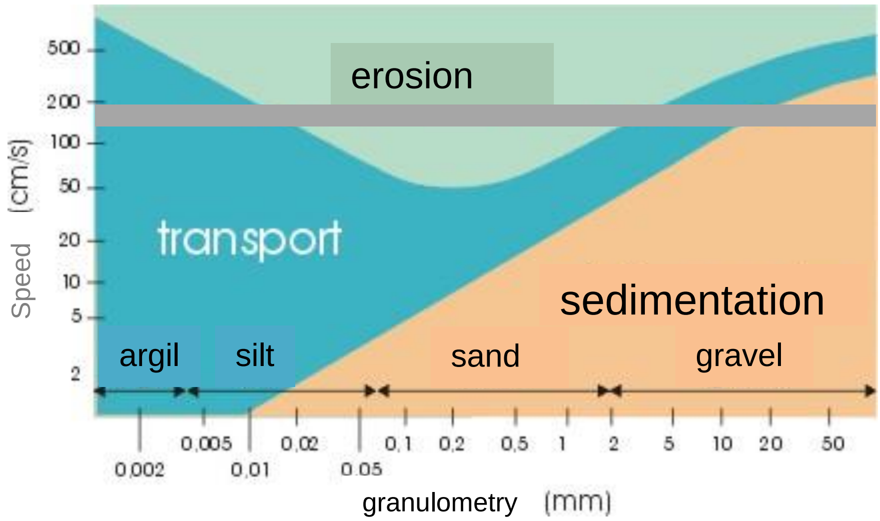
Parameter	Unit	#	Criteria	Average	Difference	Min	Median	Maximum
Ammoniacal nitrogen (filtered or not)	mg/l	35	1	0.02	0.01	0.01	0.01	0.05
Total nitrogen (filtered or not)	mg/l	35	3	0.34	0.07	0.22	0.32	0.54
Dissolved organic carbon	mg/l	35	-	8.6	1.2	7.0	8.4	11.8
Active chlorophyll *a*	µg/l	17	-	1.31	0.43	0.49	1.42	2.28
Total chlorophyll *a*	µg/l	11	4.75	1.93	0.51	0.98	2.10	2.71
Fecal coliforms	UFC/100 ml	34	100	3	4	1	2	16
Conductivity	µS/cm	35	-	36.1	7.5	24.0	37.0	54.0
Nitrates and nitrites (filtered or not)	mg/l	35	3	0.13	0.04	0.08	0.12	0.23
pH	pH	35	6.5 à 9	6.7	-	6.4	6.8	7.8
Total phosphorus	mg/l	35	0.03	0.015	0.01	0.008	0.014	0.069
Suspended solids	mg/l	34	13	5.9	15.3	1	2.5	90
Temperature	°C	33	-	7.7	8.1	0	4.0	23.5
Turbidity	NTU	35	5.2	7.2	5.8	3.0	5.4	35.0

Source : MELCC, 2021

However, sedimentation is very limited in the study area, as evidenced by the small extent of the fine sediment veneer observed in the riverbed during underwater inspections. Similarly, shoreline armouring (concrete or riprap revetments) along the Ottawa River upstream of the dam substantially limit erosive processes and sediment input to the study area.

Near the dam, velocities of approximately 1.5 to 2 m/s were observed. At these velocities, clay and silt are transported by the current without sedimentation. Such velocities also contribute to erosion and the transport of larger particles (Figure 11.25 – the grey band illustrates the velocity range of 1.5 to 2 m/s). It is not surprising then, that larger particles (course gravel, boulders, pebbles) that can withstand these velocities are found downstream of the dam, rather than fine particles.

Figure 11-25 Relationship between particle size and current velocity (Hjulström diagram)



Source : http://www.geolsed.ulg.ac.be/processus/processus.htm#ECOULEMENTS DE FLUIDES

11.1.12.1 Gordon Creek

Although data on the sediment dynamics in the watercourse is not available, the presence of numerous regulating structures along its path, as well as the riprapping of its banks (concrete or riprap revetments), limit the supply of sediments in the Ottawa River, as confirmed by the absence of deltaic deposits at the river's mouth observed in underwater surveys. Its contribution to the local sediments is deemed negligible.
Surface Water Quality

Based on data collected between 2011 and 2013, the overall quality of the water in the Ottawa River's main channel is good in terms of both physico-chemical and bacteriological parameters. This reflects the beneficial impacts of the urban water treatment interventions of the last 35 years on the watershed, as well as the limited contributions of diffuse sources of pollution from agricultural activity (MDDELCC, 2015, 2017b).

In the watershed where the Timiskaming Dam Complex is located, the Timiskaming water management plan (OBVT, 2013) has identified three main factors affecting water quality: effluents from municipal outfalls, effluents from metal mining facilities and effluents from pulp and paper mills.

- Wastewater from only three municipalities, population of approximately 800, does not receive treatment. However, the high risks associated with the effluents from the sewer network of the Kebaowek First Nation community were reduced with the construction of a new water treatment plant in 2017 (https://www.ledevoir.com/politique/canada/595671/kebaowek-se-serre-la-ceinture [French only]);

- Mining facilities are not present in the watershed's south area. However, several open-pit mining projects could become a reality in the next few years, including the Zeus (Matamec Exploration) rare earth elements project east of Kipawa;

- The Rayonier mill is located in the study area. There have been no recent nonconformities regarding the effluents from this facility (OBVT, 2013).

11.1.13 Surface Water Quality

11.1.13.1 Ottawa River

One of the MELCC's BQMA monitoring stations (2017) is located on the Ottawa River at the Timiskaming Dam Complex (station 04310009, Map 11.6). Table 11.9 summarizes the data collected at this river water quality monitoring station between April 15, 2013 and November 10, 2015. Turbidity is the only criteria that was exceeded during the characterization period. Out of 24 samples, nine (38%) exceeded the 5.2 NTU criterion (a value intended as a guideline) by 1.4 NTU on average. In addition, the data collected between 2007 and 2015 is sufficient to calculate the station's median bacteriological and physicochemical water quality index based on six parameters ("indice de qualité bactériologique et physico-chimique, 6 paramètres" or IQBP6) which allows the assessment of the general quality of a watercourse's water. The median IQBP6 obtained for this period shows that the water quality at that station is good (MDDELCC, 2017; OBVT, 2013) and allows all uses, including swimming. The portrait for this station is similar in every aspect from 2017 to 2019 (Table 11.10).

Another MELCC monitoring station is located upstream, in the upper portion of Lake Timiskaming at the Route 101 bridge in Notre-Dame-du-Nord (station 04310010), and allows the water quality in the lake to be assessed. The water quality is fairly similar to that at the station at the dam; exceedances were mainly due to turbidity and suspended solids (SS) during spring floods (Table 11.11). However, turbidity and SS values were higher than the concentrations recorded at the station by the dam. This suggests that some sedimentation occurs in the calmer areas of the lake. The threshold for total phosphorus was exceeded somewhat. The IQBP6 at this station also indicates that the water quality is good.

Wastewater from the city of Témiscaming and the Rayonier mill is treated by the latter's wastewater treatment system (activated sludge) (personal communications from Ms. Lise Leblanc, City of Témiscaming, February 22, 2017; Ms. Nancy Bendwell, Rayonier, February 23, 2017). The presence of Rayonier's outfalls, one approximately 500 m (north-south outfall, cooling water) and 1,000 m downstream of the Timiskaming Dam Complex (TDE outfall, which also discharges municipal wastewater) is likely to affect the quality of local water (Map 11.7). The latter was documented in 2007 in the context of mining and metallurgy effluent monitoring studies for Rayonier to assess the impacts on the aquatic environment (Alliance Environnement, 2007). Conductivity, pH, total organic carbon (TOC), and phosphorus, nitrogen and dissolved oxygen concentrations were monitored approximately 2 km and 10 km downstream and upstream of the dam. None of the criteria exceeded the requirements. Parameter values were similar in the three sampling areas, with the exception of total nitrogen which was slightly higher 2 km downstream of the dam.

Three other known effluents can affect water quality in the aquatic study area. The City of Témiskaming's stormwater network has two overflow sites discharging in the Ottawa River, one south of the city and the other at the marina. The Municipality of Thorne's outfall, on the Ontario side of the river, is located approximately 1,200 m downstream of the Quebec dam (Map 11.7).

Water for the fire protection of the Rayonier plant is supplied by a pumping station on the Ottawa River, at the junction between Kipawa Road and the Timiskaming Dam Complex (Map 11.7; personal communication from Ms. Nancy Bendwell, Rayonier, February 10, 2017). With regard to the drinking water supply to buildings on the island, including the Algonquin Canoe Company, water is supplied through a water intake installed on the Ontario side of Long Sault Island, upstream of the island (i.e. in Lake Timiskaming). The water is transported to a vertical well on the island, where there is a small building that houses the pumping station and the different treatment systems.

The pumping station equipment includes a:

- Horizontal water intake leading to a vertical well;
- Submersible pump inside the well casing;
- Filter;
- Water softener;
- UV treatment device;
- Pressurized tank with an automated switch.

There is no other municipal water intake in the Ottawa River in the local and regional study areas. More information about the water intakes is provided in Section 14.2.6.2.

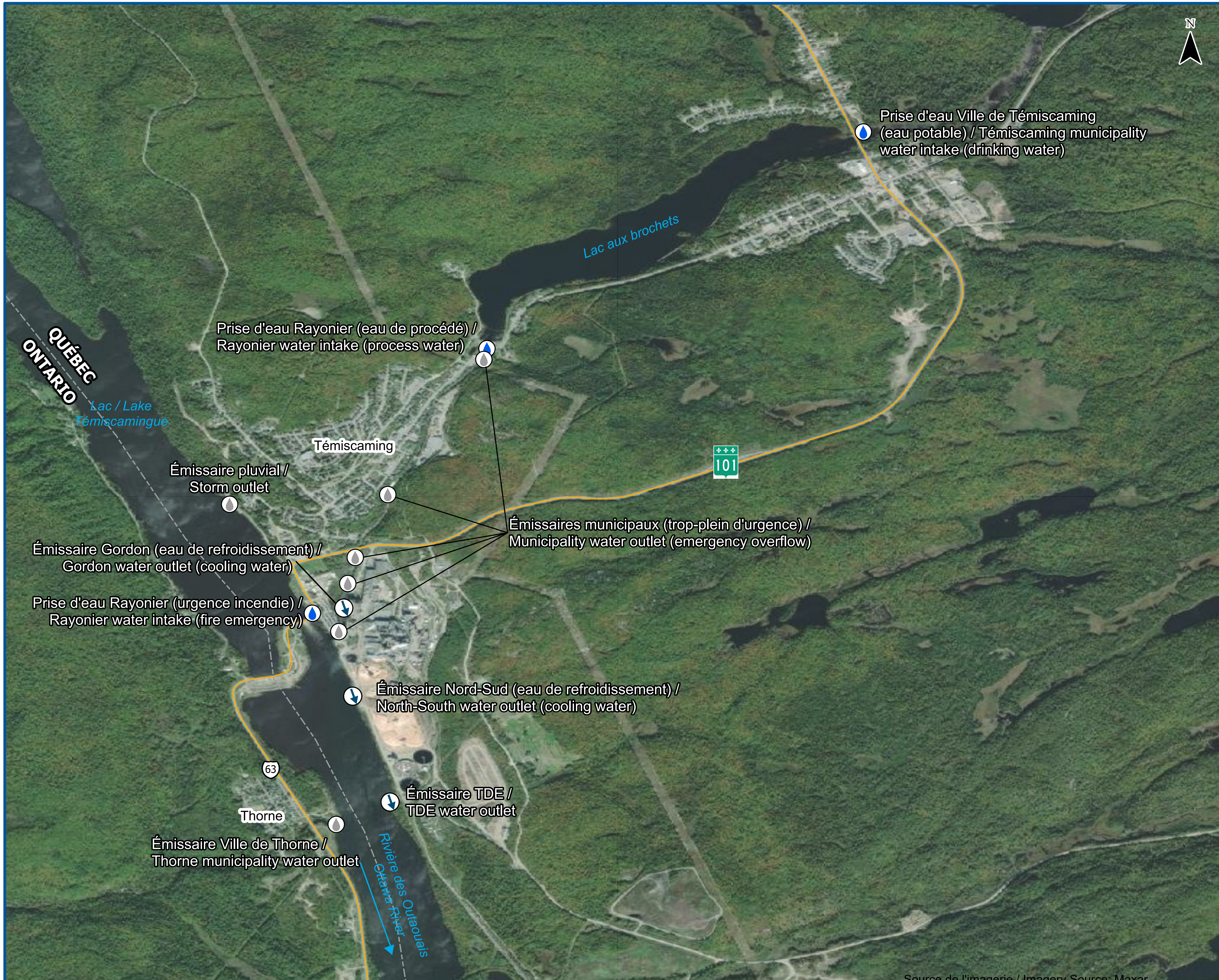
11.1.13.2 Gordon Creek

Gordon Creek is a tributary of the Ottawa River. Its mouth is approximately 125 m downstream of the Timiskaming complex. Its source is Lake Kipawa and it crosses the eastern part of the City of Témiscaming near the downtown area before joining the Ottawa River. Its course features cascades and a waterfall encased in a gorge near the City of Témiscaming.

In 2015, the Organisme de bassin versant du Témiscamingue (OBVT) conducted the first follow-up of water quality in the Gordon Creek watershed (OBVT, 2016). One of the monitoring stations is located along Gordon Creek, upstream of the City of Témiscaming's drinking water intake, not far from Lake Timiskaming. At this station, the following data were measured to calculate the IQPB6: total phosphorus, ammoniacal nitrogen, nitrites/nitrates, fecal coliforms, suspended solids (SS), total chlorophyll *a*. Although monitoring was also conducted in 2016 (OBVT, 2017),[16] it was not continued at this station in 2017 and 2018 (OBVT, 2017a and 2019).

Overall, the water is freshwater, well oxygenated (linked to strong currents and the turbidity of the river near where the samples were collected), with a pH that meets the criteria for aquatic life (Table 11.12) and a temperature representative of seasonal variations. In terms of nutrients, values were generally below the criteria for the protection of freshwater aquatic life, with the exception of nitrites in 2015 and total phosphorus in 2016. Concentrations of dissolved oxygen, together with chlorophyll *a* values that are characteristic of an environment with low productivity, indicate that enrichment of the aquatic environment is unlikely due to the high concentrations of phosphorus in May and September 2016. Concentrations of suspended solids were very low. However, fecal coliforms were observed in all of the samples, which may be linked to storm and sanitary sewer and/or septic system overflows. Concentrations exceeded the criterion for drinking water supply but met the criterion for recreational activities, e.g. swimming.

[16] 190225-rapport-echantillonnage-donnees-2016-OBVT_final.pdf



LÉGENDE / LEGEND

- Prise d'eau / Water intake
- Émissaire / Water outlet
- Émissaire municipal (trop-plein d'urgence) / Municipality water outlet (emergency overflow)
- Limite provinciale / Provincial border

Routes / Roads:

- Autoroute / Highway
- Route nationale / National road
- Route secondaire / Secondary road

TETRA TECH

Services publics et Approvisionnement Canada — Public Services and Procurement Canada

Projet de remplacement du barrage Témiscamingue du côté du Québec / Timiskaming Quebec Dam Replacement Project

Carte/Map 11.7: Localisation des prises d'eau et des émissaires de la zone d'étude/ Water intake and Water outlet location within the Project Area

CARTOGRAPHIE/CARTOGRAPHY	DATE
E. NAULT	2021-11-01
NO. PROJET/PROJECT NO.	FICHIER/FILE
32760TT	32760TT_Etude d'impact

ÉCHELLE/SCALE: 0 — 375 — 750 — 1 500 m

In 2015 and 2016, the data for chlorophyll were not precise enough and were excluded from the IQBP6 (index of bacteriological and physicochemical quality with six parameters) analysis. According to the partial index calculated from the other five parameters, the IQBP6 rates the quality of Gordon Creek, upstream of the City of Témiscaming's drinking water intake, as satisfactory for both years. The samples collected did not exceed the threshold for nitrites and nitrates and ammoniacal nitrogen. The parameters exceeding their thresholds were nitrates in 2015 and total phosphorus in 2016.

One effluent from the Rayonier (Gordon outfall, cooling water) is located upstream of Gordon Creek's mouth (Map 11.7). Municipal sewer network overflow sites are also present along the watercourse between "Lac aux Brochets" and the Ottawa River, as well as a municipal storm sewer overflow site (Map 11.7). Some of these outfalls could affect water quality locally, namely fecal coliforms concentrations.

The City of Témiscaminq's drinking water intake is located in Gordon Creek, upstream of "Lac aux Brochets" which is located northeast of the city, more than 2 km upstream of the river mouth (personal communication from Ms. Lise Leblanc, City of Témiscaming, February 22, 2017). Rayonier's supply of process water comes from "Lac aux Brochets" (personal communication from Ms. Nancy Bendwell, Rayonier, February 10, 2017).

Table 11.12 Water Quality Data for Gordon Creek, Upstream of the City of Témiscaming's Water Intake (Median Values)

Parameter	Criterion	2015	2016	2015	2016	2015	2016
		Spring		Summer		Fall	
Conductivity (µS/cm)	Variable depending on pH and temperature	17.05	24.40	21.65	21.00	15.02	19.15
Dissolved oxygen (mg/L)	>6 mg/L	14.36	11.70	8.30	7.96	11.87	9.01
pH	6.5 to 9	7.06	7.14	6.91	7.17	6.96	7.44
Temperature (°C)	-	13.20	11.80	21.30	21.85	15.20	16.05
Total chlorophyll *a*	3 (oligotrophic)	-	2.01	-	3.03	-	2.23
Nitrates (mg-N/L)	3	0.25	0.15	0.20	0.25	0.55	0.20
Ammoniacal nitrogen (mg-N/L)	Variable depending on pH and temperature	0.07	0.02	0.20	0.06	0.01	0.01
Total phosphorus (mg/L)	0.03 (and 0.1 USEPA)	0.02	0.10	0.04	0.03	0.02	0.15
Suspended solids (mg/L)	-	0.02	0.04	0.01	0.02	0.10	0.06
Fecal coliforms (UFC/100 ml)	<20 or <200*	4	52.5	8	131.5	5	3

*Criterion for drinking water (20) and for recreational activities, e.g. swimming (200)

11.2 EFFECTS ON THE PHYSICAL ENVIRONMENT

During consultations with Indigenous communities (see Chapters 8 and 13), the main concerns raised about the physical environment were related to water and sediment quality and water management (hydrology of the river). Actual nuisances such as air quality, soundscape and contamination were also mentioned. These effects on the physical components can in turn affect the biological and human components and the Indigenous rights or VCs. Where relevant, linkages are noted in Chapters 12 and 13.

Note that all mitigation measures mentioned in the text are included in the summary table at the end of each VC section.

11.2.1 Air

The VC "Air" includes the aspect of air quality itself, as well as some nuisances that spread by means of that medium, such as dust and noise.

11.2.1.1 Air Quality

11.2.1.1.1 Air Contaminants

Some components of the Project are likely to result in the emission of air pollutants that could affect air quality (CO, VOC, $PM_{2.5}$), including the use of machinery that runs on fossil fuels (trucks, generators, pumps, etc.). Note that blasting will be minimized. As noted in section 11.1.4, MELCC data concerning local air quality indicates poor quality between 17% and 41% of the time (based on ozone emissions and fine particulate matter ($PM_{2.5}$)), primarily from emissions from Rayonier. The Project must therefore be planned so as not to exacerbate this situation by implementing measures designed to limit machinery emissions. Emissions of certain contaminants that contribute to GHG are presented in section 11.2.1.1.3. Given the low residential density around the Project and the fact that these emissions will be temporary and limited to the construction period, it was felt that modeling of atmospheric dispersal was not needed.

The release of atmospheric contaminants due to fuel combustion by components of the Project has been estimated, using the U.S. EPA exhaust emission standards for heavy-duty nonroad engines[17] and heavy-duty highway engines[18]. SO_2 emissions have been calculated considering the federal standard of 15 mg of sulfur per kg of diesel[19].

On-site activities require the combustion of 745,800 liters of diesel, releasing 0.8 metric tons of CO, 0.09 tons of NO_X, 0.02 tons of SO_2, and 0.004 tons of $PM_{2.5}$ to the atmosphere. In addition to on-site emissions, an additional 425 978 liters of diesel burnt by transport trucks on public roads will emit 2.7 tons of CO, 0.03 tons of NO_X, 0.01 tons of SO_2, and 0.002 tons of $PM_{2.5}$.

It is to be noted that the atmospheric emissions of CO, NO_X, SO_2 and $PM_{2.5}$ due to the combustion of fuel in the Project are several orders of magnitude below the emission levels of the Rayonier facility.

---

[17] U.S. EPA Nonroad Compression-Ignition Engines: Exhaust Emission Standards
[18] U.S. EPA Heavy-Duty Highway Compression-Ignition Engines and Urban Buses: Exhaust Emission Standards
[19] Sulphur in Diesel Fuel Regulations (SOR/2002-254)

Possible effect: Emission of air contaminants during construction				
Potential interaction		Mitigation measures		
Machinery emissions (CO, NO_X, SO_2, VOC, $PM_{2.5}$)		1) Requirement to limit idling (shut off engines when truck or vehicle is stopped for extended periods of time). 2) Off-road construction equipment and on-road transport truck engines would be required to meet the latest Tier 4 emission standards of the U.S. Environmental Protection Agency (EPA). 3) Machinery and transportation trucks should be well maintained and kept in good working condition (e.g., exhaust system in good condition). 4) Manage loading and unloading activities to minimize idling time. 5) Cover loads on trucks transporting materials to and from the site. 6) Minimize any blasting.		
Residual effect				
Magnitude	**Geographic extent**	**Duration**	**Frequency**	**Reversibility**
Low	Local	Medium	Continuous	Reversible
Overall Assessment: Non-significant				
Monitoring and follow-up	Monitoring of the application of mitigation measures See Chapters 22 and 23 for more details			
Comments	During the work, monitor idling, machinery condition, site cleanliness and work schedules.			

11.2.1.1.2 Dust

Dust is treated separately from air contaminants in that it has an aesthetic aspect, particularly for residents adjacent to the site. Moreover, dust is not emitted directly by the machinery but is often the result of poor site control, resulting in the dispersal of dust by vehicle traffic. Activities related to the installation and removal of the cofferdam and the demolition of the existing dam are the Project elements that are most likely to result in the dispersal of dust for which dust abatement measures must be planned. This will be particularly important in this case given the presence of a provincial road on the dam, for road safety reasons, and the presence of an aquatic environment around the work site. In general, dust control on sites is a measure that is well applied by contractors, and mitigation measures such as watering are very effective. As a result, it was not considered necessary to estimate dust deposition in the aquatic and land environment.

The release of atmospheric dust due to on-site activities of the Project has been evaluated, including handling of aggregates and materials, and circulation of mobile machinery. Particle emissions due to materials handling are calculated from Equation (1) of the U.S. EPA AP-42 Section 13.2.4[20]. The amount of fill materials and aggregates handled during the Project is 151,279 metric tons. A multiplication factor of 3 is applied to the emission factors to take account of the fact that materials may be handled more than once during demolition or construction activities. Dust emissions from the circulation of mobile machinery on unpaved access roads are calculated from Equation (1a) of the U.S. EPA AP-42 Section 13.2.2[21]. A total of 37,290 hours of machinery time is expected for the Project, at an average speed of 0.2 km/h across all machines. An attenuation factor of 40% is applied due to approximately 150 days per year with precipitations.

[20] U.S. EPA AP-42 Section 13.2.4 "Aggregate Handling and Storage Piles"
[21] U.S. EPA AP-42 Section 13.2.2 "Unpaved roads"

On-site emissions due to on-site demolition and construction activities, including handling of aggregates and materials, and the circulation of mobile machinery, total 8.0 metric tons of total particulate matter, 2.0 tons of PM_{10}, and 0.2 tons of $PM_{2.5}$. Of those quantities, more than 95 percent are due to the circulation of mobile machinery.

Dust emissions due to the Project activity are 2 orders of magnitude below the emission levels of the Rayonier facility. Although they may cause nuisance to adjacent residents and aesthetic impact close to the Project site, the impact of dust emissions by the Project will reduce substantially with distance from the site.

<table>
<tr><th colspan="5">Possible effect: Emission of dust during construction</th></tr>
<tr><td colspan="2">Potential interaction</td><td colspan="3">Mitigation measures</td></tr>
<tr><td colspan="2">Dispersal of dust (trucks, stored materials, exhaust soot)</td><td colspan="3">1) Visual inspection and monitoring of dust emissions on and around the Project site should be carried out on a regular basis (i.e. daily or weekly).
2) Activities involving significant emissions of dust, or causing nuisance due to air emissions, should be identified, and mitigation measures should be implemented if necessary (i.e. dust clouds reaching privately owned or publicly accessible areas).
3) Complaints from neighbours regarding dust or air quality should be registered, analyzed, and addressed with the adequate mitigation measures.
4) Water work areas (water-based dust suppressants due to the proximity of an aquatic environment).
5) Clean public roads with sweeper trucks, cover stored materials.
6) Sweeping the access roads and circulation areas.
7) Cover truck loads with tarps.
8) During the cutting of concrete, water the work area.
9) During demolition, all measures must be put in place to limit dust emissions. Work should be stopped during high winds if a significant amount of dust is moved.
10) Limit speed to 20 km/h on on-site roads.
11) Prevent dirt track-out from the Project site to the public road network, using track-out grates or other technology.
12) Applying water to stockpiles that are causing dust emissions due to wind erosion.
13) Cover stockpiles that are causing dust emissions due to wind erosion
14) When available, dust control systems such as wet suppression systems (water sprays) and enclosures should be used. This applies most notably to drilling, crushing, and screening activities.</td></tr>
<tr><th colspan="5">Residual effect</th></tr>
<tr><th>Magnitude</th><th>Geographic extent</th><th>Duration</th><th>Frequency</th><th>Reversibility</th></tr>
<tr><td>Low</td><td>Project footprint to local</td><td>Medium</td><td>Cyclic</td><td>Reversible</td></tr>
<tr><th colspan="5">Overall Assessment: Negligeable to non-significant</th></tr>
<tr><td>Monitoring and follow-up</td><td colspan="4">Monitoring of the application of mitigation measures, particularly dust emissions
See Chapters 22 and 23 for more details</td></tr>
<tr><td>Comments</td><td colspan="4"></td></tr>
</table>

11.2.1.1.3 Greenhouse Gases

GHG emissions are anticipated only during the construction of the new dam and the demolition of the existing dam. During operations, emissions are deemed negligible due to the use of electricity for the operation of infrastructure equipment and are not considered in this analysis.

With respect to the construction phase, the construction of the new dam will take place in four stages. Once the new dam is built and operational, the existing dam will be demolished.

The identified GHG emission sources are related to the operation of machinery on the work site and road transportation of materials.

11.2.1.1.3.1 GHG Emissions Estimation

11.2.1.1.3.1.1 Identification of GHG Sources, Sinks or Reservoirs (SSR) Related to the Project

GHG emissions associated with the Project were grouped into the following three categories:

- Level 1 emissions: Direct emissions from sources owned or directly controlled by the Project proponent;
- Level 2 emissions: Indirect emissions due to the generation of electricity, heat or steam used by the Project;
- Level 3 emissions: All other indirect emissions occurring upstream or downstream from the Project.

Table 11.13 presents the activities included in the scope of the GHG estimation for all phases of the Project.

Table 11.13 Activities Included in the Scope of GHG Estimation

Category	Construction	Operation	Demolition
Level 1 Direct GHG emissions	Site machinery	N/A	N/A
Level 2 Indirect emissions – Supply of energy	N/A	Electricity consumption	N/A
Level 3 Indirect emissions – Upstream/downstream	Road transportation	N/A	N/A

11.2.1.1.3.1.2 Identification of GHG Sources, Sinks or Reservoirs (SSR) Related to the Project

The GHG sources, sinks and reservoirs (SSR) considered for the planned replacement of the Timiskaming Quebec Dam are listed for the various life components of the Project, to cover all activities identified in Table 11.13. This includes emissions from diesel combustion associated with machinery and road transport. Some SSRs may be excluded from the calculations if they are not applicable or if their contribution to GHG emissions is negligible.

Table 11.14 presents the SSRs considered for the life cycle of the Project and indicates whether they have been included in the calculations. Any exclusions are justified.

Table 11.14 GHG Sources, Sinks and Reservoirs Related to the Project

Type of SSR	Name	Included / excluded	Description
[SSR 1] Source	Machinery for the construction of the new dam	Included	Use of diesel fuel by machinery

Type of SSR	Name	Included / excluded	Description
[SSR 2] Source	Machinery for the demolition of the existing dam	Included	Use of diesel fuel by machinery
[SSR 3] Source	Transportation of materials for the new dam	Included	Use of diesel fuel by transport trucks: Backfill, concrete, steel reinforcement, etc.
[SSR 4] Source	Transportation of materials for the demolition of the existing dam	Included	Use of diesel fuel by transport trucks: Essentially residual materials from the demolition
Source	*Daily travel by workers*	*Excluded*	*Use of fuel for travel by workers to and from the Project site; estimated to be negligible compared to the total Project emissions*
Source	*Fuel production and distribution*	*Excluded*	*Production and distribution of fossil fuels upstream from their use*
Source	*Electricity consumption*	*Excluded*	*Negligible emissions compared to the total Project emissions*

11.2.1.1.3.2 Calculation of GHG Emissions

The GHG emissions associated with the Project are estimated by calculating the contributions of each SSR identified above. This section presents the calculation method for each SSR. The results of the calculation are presented later in section 11.2.1.1.3.3.

11.2.1.1.3.2.1 Model Parameters and Assumptions

11.2.1.1.3.2.1.1 Global Warming Potentials

The global warming potentials (GWP) considered for GHGs emitted by the Project are those proposed by Environment and Climate Change Canada in its most recent *Notice with respect to reporting of greenhouse gases (GHGs) for 2020*, and are presented in Table 11.15.

Table 11.15 Global Warming Potential of GHGs

Greenhouse gases	Global warming potential (*t-CO2e/t*)
Carbon dioxide (CO_2)	1
Methane (CH_4)	25
Nitrous oxide (N_2O)	298

11.2.1.1.3.2.1.2 Greenhouse Gas Emission Factors

The GHG emission factors for the combustion of fuel are from the most recent *National Inventory Report 1990–2019* (Environment and Climate Change Canada (ECCC), 2021) from Environment and Climate Change Canada, and are presented in Table 11.16.

Table 11.16 GHG Emission Factors

Fuel	Emission factor		
	CO_2	CH_4	N_2O
Diesel	2,681 g/l	0.11 g/l	0.151 g/l

11.2.1.1.3.2.1.3 Consumption of Diesel by Machinery and Transport Trucks

For the work during the construction phase of the Project, the rate of diesel consumption by machinery (excavators, front-end loaders, cranes, etc.) is estimated at 20 L/h on average by machine, based on data published by the manufacturer Caterpillar (2006). That value is considered to be representative of the average consumption by equipment needed for this type of work.

The rate of diesel consumption by highway transport trucks is 32 L/100 km on average per truck. That value reflects the average consumption of Class 8 heavy trucks, based on a study by the U.S. Energy Information Administration (2019).

11.2.1.1.3.2.1.4 Transport Truck Capacity

The estimate of transportation distances for materials and residual matter depends on the load capacity of the transport trucks. The calculations take into consideration the transport capacities indicated in Table 11.17.

Table 11.17 Transport Truck Capacity

Transportation	Capacity
Backfill/demolition debris	20 t/truck
Concrete	8 m^3/truck
Reinforcing steel	10 t/truck
Fabricated metals	10 t/truck
Residual matter	20 t/truck

11.2.1.1.3.2.1.5 Source of Materials

The exact source of the construction materials for the new dam and the destination of residual materials from the demolition of the existing structure are not yet known. For the purposes of calculating GHG emissions, the following assumptions were made:

- Backfill materials and concrete will come from North Bay;
- Residual matter will be transported to North Bay for management;
- Steel reinforcement and fabricated metals will come from Ottawa.

Table 11.18 summarizes the transportation distances considered for each type of material.

Table 11.18 Source of Materials

Transportation	Transportation distance (km – one way)	Comment
Backfill/demolition debris	70	Assumption: North Bay
Concrete	70	Assumption: North Bay
Reinforcing steel	375	Assumption: Ottawa
Fabricated metals	375	Assumption: Ottawa
Residual materials	70	Assumption: North Bay

11.2.1.1.3.2.2 Construction Phase

The GHG emissions considered for the construction phase are related to diesel consumption by machinery on the site and by road transportation off-site. The following equation is used to calculate GHG emissions (CO_2, CH_4, N_2O, total emissions) due to fuel combustion:

$$E_i[t] = Amount_{fuel}\ [l] \times EF_i[g/l] \times 10^{-6}\ [t/g]$$

Where:

i: greenhouse gas (CO_2, CH_4 or N_2O)

E_i: Amount of greenhouse gas emissions i

$Amount_{fuel}$: Amount of fuel consumed

EF_i: GHG emission factor associated with fuel consumption

Total GHG emissions are determined as follows:

$$E_{GHG}[tCO2_e] = \sum_{i=1}^{n} GWP_i * E_i[t]$$

Where:

GWP_i : Global warming potential of the greenhouse gas (see section 11.2.1.1.3.2.1.1).

The amounts of materials (backfill and demolition debris, reinforcing steel, fabricated metals) and the machinery hours were established based on the Class “A” estimate of Project costs for each phase.

Tables 11.19 and 11.20 respectively present the estimated machinery hours and quantities of materials for the construction phase of the Project.

Table 11.19 Estimation of Machinery Hours

Discipline	Machinery time		
	Construction of the new dam (h)	Demolition of the existing dam (h)	Total (h)
Duration of work [days]	542	82	624
Civil	27,506	4,161	31,668
Founding-structure	875	132	1,008
Dismantling sheet piling	4,008	606	4,614
Total	**32,390**	**4,900**	**37,290**

Table 11.20 Estimation of Quantities of Materials

Material	Density	Construction of the new dam		Demolition of the existing dam	
	t/m³	m³	t	m³	t
Backfill	1.6	55,000	88,000	14,695	23,512
Concrete	2.3	12,000	27,600	5,290	12,167
Reinforcing steel	-	-	1,222	-	6
Fabricated metals	-	-	29	-	48
Residual materials	-	-	0	2,035	4,070

11.2.1.1.3.2.2.1 [SSR 1] Machinery for the Construction of the New Dam

The construction activities for the new dam require the use of various pieces of mobile equipment: backhoe, front-end loader, bulldozer, crane, concrete pump, etc. According to an estimate by Tetra Tech, the work planned for the various phases of construction of the new dam require 32,390 machine hours, or 647,800 litres of diesel. The GHG emissions associated with this SSR are 1,737 t-CO_2, 0,07 t-CH_4 and 0.10 t-N_2O, for a total of 1,768 t-CO_2e.

11.2.1.1.3.2.2.2 [SSR 2] Machinery for the Demolition of the Existing Dam

The activities for the demolition of the existing structure require the use of mobile equipment. According to an estimate by Tetra Tech, the work planned for the demolition of the existing dam requires 4,900 machine hours, or 98,000 litres of diesel. The GHG emissions associated with this SSR are 263 tCO_2, 0.01 tCH_4 and 0.01 t-N_2O, for a total of 267 t-CO_2e.

11.2.1.1.3.2.2.3 [SSR 3] Transportation of Materials for the New Dam

Significant quantities of materials will need to be transported from their external sources to the Project construction site. The materials transported consist essentially of backfill and demolition debris, concrete, reinforcing steel and fabricated metals. An additional 10% of transportation distance has been provided for in the calculations to reflect transportation needs for materials or equipment that were not planned.

The transportation distance for materials for the construction of the new dam totals 1,011,760 km, as shown in Table 11.21. The related diesel consumption is 323,763 litres.

Table 11.21 Transportation of Materials for the Construction of the New Dam

Material	Density	Construction of the new dam			
		Quantity of materials		Number of trips	Distance travelled
	t/m³	m³	t	Round trip	km
Backfill	1.6	55,000	80,000	4,400	616,000
Concrete	2.3	12,000	27,600	1,500	210,000
Reinforcing steel	-	-	1,222	122	91,640
Fabricated metals	-	-	29	3	2,140
Residual materials	2	-	0	0	0
Contingency Various transportation (10%)	-	-			91,980
			Subtotal	**6,025**	**1,011,760**

The GHG emissions associated with this SSR are 868 t-CO_2, 0.04 t-CH_4 and 0.05 t-N_2O, for a total of 883 t-CO_2e.

11.2.1.1.3.2.2.4 [SSR 4] Transportation of Materials for the Demolition of the Existing Dam

During the demolition of the existing dam, significant quantities of residual matters from the work will need to be transported to external purchasers. An additional 10% of transportation distance has been provided for in the calculations to reflect transportation needs for materials or equipment that were not planned.

The transportation distance for materials for the demolition of the new dam totals 319,420 km, as shown in Table 11.22. The related diesel consumption is 102,214 litres.

Table 11.22 Transportation of Materials for the Demolition of the Existing Dam

Material	Density	Demolition of the existing dam			
		Quantity of materials		Number of trips	Distance travelled
	t/m³	m³	t	Round trip	km
Backfill	1.6	14,695	23,512	1,176	164,640
Concrete	2.3	5,290	12,167	662	92,680
Reinforcing steel	-	-	6	1	750
Fabricated metals	-	-	48	5	3,750
Residual materials	2	-	4,070	204	28,560
Contingency Various transportation (10%)	-	-			29,040
			Subtotal	**2,048**	**319,420**

The GHG emissions associated with this SSR are 274 t-CO_2, 0.01 t-CH_4 and 0.02 t-N_2O, for a total of 279 t-CO_2e.

11.2.1.1.3.2.3 Operational and Decommissioning Phases

The GHG emissions considered for the operational phase are deemed to be negligible. In fact, the operation of the structure uses electricity from the grid, which has a very low carbon footprint. Maintenance activities are not very intense in terms of machinery and materials.

No decommissioning phase is planned for the new structure. No GHG emissions have been calculated for this phase.

11.2.1.1.3.3 GHG Emissions Budget for the Project

11.2.1.1.3.3.1 Summary of Results

The GHG emissions budget for the Project is presented in Table 11.23, detailed by GHG and SSR. The GHG emissions for the Project total 3,197 t-CO_2e. The annual GHG emissions for the Project total 1,066 t-CO_2e/year, based on anticipated work period, as shown in Table 11.24.

Table 11.23 GHG Emissions Budget for the Project

Parameter	Unit	SSR 1	SSR 2	SSR 3	SSR 4	Total
		Machinery – New dam	Machinery – Demolition of existing dam	Transportation – New dam	Transportation – Demolition existing dam	
Hours of operation	h	32,390	4,900			37,290
Distance	km			1,011,760	319,420	1,331,180
Diesel consumed	L	647,800	98,000	323,763	102,214	1,171,778
CO_2 emissions	t	1,737	263	868	274	3,142
CH_4 emissions	t	0,07	0,01	0,04	0,01	0,13
N_2O emissions	t	0,10	0,01	0,05	0,02	0,18
GHG emissions	**t-CO_2e**	**1,768**	**267**	**883**	**279**	**3,197**

Table 11.24 Annual GHG Emissions Budget

Phase	Duration	CO_2	CH_4	N_2O	GHG
	year	t/year	t/year	t/year	t-CO_2e/year
Construction and demolition	3	1 047	0,04	0,06	**1 066**
Operation	*N/A*				
Decommissioning					

11.2.1.1.3.3.2 Breakdown of GHG Emissions by Area

The border between Ontario and Quebec is in the middle of the dam. Emissions from SSR 1 and SSR 2 (operation of machinery) at the site are therefore approximately half for Quebec and half for Ontario. For road transportation, it must be noted that it was assumed that the materials would come from the North Bay and Ottawa areas. The emissions for SSR 3 and SSR 4 (road transportation) are therefore entirely for Ontario.

- The construction of the new structure represents about 83% of the total emissions from the Project. Demolition of the existing structure represents 17% of total emissions;
- Machinery operations at the Project site represent 64% of total emissions, while emissions from road transportation represent 36% of total emissions;
- GHG emissions from the Project total 3,197 t-CO_2e, of which 2,180 t-CO_2e (68%) are in Ontario, and 1,018 t-CO_2e (32%) are in Quebec.

The Project presents a low rate of GHG emissions, particularly since emissions only occur during the construction phase and no GHG emissions will occur during the operation of the new structure.

11.2.1.1.3.4 GHG Emissions Reduction Strategy

GHG emissions from the Project are related to the operation of machinery and road transportation. The type of equipment and the duration of the machinery work depends on the nature of the work to be performed and no methods for mitigating emissions from SSR 1 and SSR 2 are realistically foreseeable.

For road transportation, the quantity of materials to be transported is defined by the nature of the Project. The source of the materials is dictated by the location of suppliers (backfill, steel, etc.) or purchasers (residual materials), and the proponent has relatively little control over these aspects.

A measure for mitigating GHG emissions is planned, namely to explore the option to install a portable concrete plant near the site to reduce transportation distances. Planning of the work foresees transporting the concrete by truck mixer from North Bay, over a distance of 70 km (one way). By installing a temporary concrete plant on or near the site, transportation distances can be reduced. Given that the cement is sent from North Bay and that aggregates are from existing sand pits and quarries in the area (< 50 km), the total transportation distance related to the concrete could be reduced by 76,000 km.

The reductions in GHG emissions attributable to the installation of a portable concrete plant are estimated at 66 t-CO_2e.

Moreover, emissions from the extraction and production of materials are excluded from this estimation, but the Project proponent is studying the possibility of using materials with less carbon footprint, including low-carbon concrete. Production of such concrete uses various supplementary cementing materials, such as fly ash or blast furnace slag, as a substitute for cement, which reduces the GHG emissions related to the material upstream from its implementation at the site. Although the reductions achieved by substituting a material for a low-carbon equivalent have not been calculated, it is undeniable that this is fully consistent with a reduction strategy for GHG emissions from the Project.

11.2.1.1.3.5 Uncertainty

The uncertainty of GHG emissions from the Project was determined using equation 6.3 from the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000):

$$U_{total} = \frac{\sqrt{(U_1 * x_1)^2 + (U_2 * x_2)^2 + \cdots + (U_n * x_n)^2}}{x_1 + x_2 + \cdots + x_n} = \frac{\sqrt{\sum_{i=1}^{n}(U_i * x_i)^2}}{\sum_{i=1}^{n} x_i}$$

Where:

U_{total}: Percentage of uncertainty of GHG emissions from the Project [t-CO_2e]

U_i: Percentage of uncertainty of the SSR i

x_i: Quantity of GHG emissions from the SSR [t-CO_2e]

i: SSR (between 1 and n)
n: Number of SSRs

The estimation of GHG emissions from the Project is subject to a low degree of uncertainty. Table 11.25 presents the estimated uncertainties.

Table 11.25 Uncertainties Concerning GHG Emissions from the Project

Activity	Unit	Degree of uncertainty	U_i	Quantity (x_i) GHG emissions
Construction				
[SSR 1] Machinery for the construction of the new dam	**t-CO_2e**	Moderate	10%	1,768
[SSR 2] Machinery for the demolition of the existing da	**t-CO_2e**	Moderate	10%	267
[SSR 3] Transportation of materials for the construction of the new dam	**t-CO_2e**	Moderate	10%	883
[SSR 4] Transportation of materials for the demolition of the existing dam	**t-CO_2e**	Moderate	10%	279
Project total	**t-CO_2e**			**3,197**
Uncertainty	**%**			**6.3%**

11.2.1.1.3.6 Assessment of the Significance of the Impact

Emission caps in Quebec vary from 49.08 million tCO_2eq for 2026 and 46.61 million tCO_2eq for 2028 (start and end of construction). The Project's contribution is therefore 0.002% (1,018 tCO_2eq in Quebec).

In Ontario, the ceiling cap was set at 102,958,000 tCO_2eq in 2026 and 95,719,000 tCO_2eq in 2028.[22] The Project's contribution is therefore 0.002% (2,180 t-CO2e in Ontario).

According to Canada's strengthened climate plan (2020), the projected emissions from the plan by 2030 are 511 megatons of carbon dioxide equivalent, while Canada's target for the same year is 503 megatons of carbon dioxide equivalent.[23] The total emissions from the Project (3,197 tCO_2eq) therefore account for 0.0006% of Canada's target for 2030.

[22] https://ero.ontario.ca/notice/013-1457
[23] https://www.canada.ca/content/dam/eccc/documents/pdf/climate-change/climate-plan/annex_modeling_analysis_healthy_environment_healthy_economy.pdf

Given the greenhouse gas emission caps imposed by the federal, provincial (Ontario and Quebec) and territorial (not applicable to this Project) governments, the extent of the residual effect is low.

At the local scale, the only large GHG emitter is the Rayonier pulp and paper plant. Rayonier's 2021 GHG emissions were 183,033 tCO_2eq, excluding CO_2 emissions from biomass. Annual GHG emissions from the Project (1,066 tCO_2eq/year i.e. 3,197 tCO_2eq over 3 years) account for 0,6% of the Rayonier plant's annual GHG emissions.

The extent is local, or regional, the duration is medium because the emissions will stop following construction, and the frequency is ongoing throughout construction. Ultimately, this effect is reversible as PSPC will explore options for carbon neutrality for this Project. This might be addressed throughout the tender call process and potential obligations from the general contractor to compensate for the construction activity emissions. The effect is therefore not significant. A GHG monitoring program is detailed in Chapter 22 and GHG emissions reduction incentives will be included in the contractor's contract.

<table>
<tr><th colspan="5">Possible effect: GHG emissions during construction</th></tr>
<tr><td colspan="2">Potential interaction</td><td colspan="3">Mitigation measures</td></tr>
<tr><td colspan="2">The operation of machinery and transportation of materials will generate GHGs.</td><td colspan="3">1) Explore the option to install a portable concrete plant near the site to reduce transportation distances.
2) Assess the possibility of using materials with a lower carbon footprint, particularly low-carbon concrete.
3) Explore options for carbon neutrality.</td></tr>
<tr><th colspan="5">Residual effect</th></tr>
<tr><th>Magnitude</th><th>Geographic extent</th><th>Duration</th><th>Frequency</th><th>Reversibility</th></tr>
<tr><td>Low</td><td>Local to regional</td><td>Medium</td><td>Continuous</td><td>Reversible</td></tr>
<tr><th colspan="5">Overall Assessment: Non-significant</th></tr>
<tr><td>Monitoring and follow-up</td><td colspan="4">Fuel used by machinery
Road transportation distance
See Chapter 22 for a detailed description of GHG monitoring</td></tr>
<tr><td>Comments</td><td colspan="4">Reduction incentives will be included in the contract.</td></tr>
</table>

11.2.1.2 Night Luminosity

Based on MTQ and MTO standards for street lamps, the lighting of the site and its surroundings is not expected to be modified during the Project, as it must meet the standards from those departments. As for the lighting of buildings and facilities owned by PSPC, it cannot be changed for security reasons (movements of dam operators at night). Finally, the rest of the light is from the Rayonier facilities and also cannot be changed for security reasons. In short, the levels of night luminosity will not be changed by the Project. The only difference is that the dam, and thus the street lights, will be located 25 m downstream from their current position.

No residual effect is therefore anticipated in operation, as the current levels will not be changed by the Project.

During the construction, lights will be directed towards the construction area. Lights will be used only during short fall or winter days, at the beginning and end of the working days.

11.2.1.3 Noise

11.2.1.3.1 Noise Perception

The issue of noise is highly subjective but nonetheless represents a considerable impact to be taken into consideration. To better understand the effect of various noise levels, Table 11.26 presents a scale of typical examples of noise levels.

Table 11.26 Subjective Scale of the Perception of Noise Levels

Level	Impression felt
140 dB	Pain threshold
130 dB	
120 dB	Painful
110 dB	Unbearable
100 dB	Hard to bear
90 dB	Very loud
80 dB	Loud
70 dB	
60 dB	Common noise
50 dB	
40 dB	Low
30 dB	Quiet
20 dB	Very quiet
10 dB	Silent
0 dB	Inaudible

Depending on the sensitivity of human ears, it is generally established that an acoustic increase of 3 dB makes it possible to perceive the sound contribution from a source. Examples of typical responses by the human ear to various noise levels are presented in Table 11.27.

Table 11.27 Typical Response of the Human Ear to an Increase in Noise Levels

Increase in noise level	Subjective response of the human ear
3 dB	Mildly perceptible
5 dB	Clearly perceptible
10 dB	Two times louder
20 dB	Four times louder

11.2.1.3.2 Relevant Regulations and Directives

11.2.1.3.2.1 Municipal Bylaws

According to Bylaw No. 168-06-2014 of the Regional County Municipality of Témiscamingue, an unorganized territory (Laniel and Témiscamingue Lakes), it is prohibited to cause noise that is likely to disturb the peace and well-being of the neighbourhood by doing construction, demolition or repair work between 10:00 p.m. and 7:00 a.m., unless it is emergency work to protect the safety of the site or of people.

A telephone check with the administrative department of Nipissing District revealed that there are no specific bylaws concerning construction noise for the municipality of Thorne.

11.2.1.3.2.2 Health Canada Guide

According to directives from *Health Canada*, in order not to interfere with understanding someone speaking, spoken words must be 15 dB higher than ambient noise. To properly understand someone speaking, the level of indoor noise should not exceed 45 dBA, and 60 dBA outdoors.

Also according to directives from *Health Canada (2016)* applicable to the Project, the change in the percentage of people who are highly annoyed (%HA) is an appropriate indicator of the impacts on human health, in relation to noise during the operation phase of the Project and long-term exposure (over one year) to noise during the construction phase. Noise mitigation measures must be considered if a change in the percentage of people who are highly annoyed calculated for each receptor exceeds 6.5%, or if noise levels associated with the Project alone exceed a standardized daytime noise level (L_RDN) of 75 dBA. The recommended target values are presented in Table 11.28.

Table 11.28 Summary of the Various Recommendations Applicable According to Health Canada for the Construction and Operation Phases

Metric	Ld (7:00 - 10:00 (Daytime sound level between 7:00 a.m. and 10:00 p.m.)	L_RDN (Standardized sound level over a 24-h period)	Increase in the percentage of people highly annoyed %HA
Recommended target	<60 dBA	<75 dBA	<6.5%

11.2.1.3.3 Acoustic Modeling and Assessment of Noise Levels

To assess impacts during construction, the equipment needed for the various phases of the work were first identified (Table 11.29). As the exact methodology used by the contractor is not known at this time, this list is preliminary but is based on a realistic work sequence approach. Considering that there is a possibility that blasting may be required for the demolition of a portion of the existing dam, this activity has also been included. However, as no details are available at this time, the assessment is based on measurements performed in the past by SoftdB (estimation based on measures on past project), as well as on theoretical data (theoretical estimation) established following a literature review.

Table 11.29 List of Phases and Anticipated Equipment

Work area	Phase	Description	Equipment
-	1.0	- Site mobilization and installation - Installation of temporary wastewater disposal measures	-
Long Sault Island and Quebec shore	1.1	- Installation of Berlin walls for the abutments on the right and left shores - Installation of temporary support for the culvert for the fish passage - Excavation behind the retaining walls - Excavation of the fish passage downstream - Construction of the downstream cofferdam and temporary access - Backfill of the depression downstream of the existing apron (bays 10 to 1) - Partial demolition of the new apron (bays 10 to 1) - Reconstruction of the apron (bays 10 to 1) - Construction of the new apron downstream (bays 10 to 1) with thresholds - Construction of piles 6 to 10, with built-in parts, of the abutment on the right shore and of retaining walls on the right and left shores	1 Crane 1 Concrete mixer 1 Jack drill 1 Truck 1 Tramak 1 Scoop 1 Diesel pump 1 Bulldozer
Quebec shore	1.2	- Installation of sheet pile wall at pile 6 and downstream of the apron - Rock ballast behind the downstream apron - Dry testing of the beams upstream and downstream of bays 6 to 10	1 Pile driver 1 Crane
Long Sault Island and Quebec shore	2.0	- Removal of downstream access on the left shore - Demolition of the downstream cofferdam - Reopening of bays 10 to 6	1 Scoop 1 Truck
Quebec shore	2.1	- Construction of piles 5 to 2 and the abutment on the left shore	1 Scoop

Work area	Phase	Description	Equipment
		- Installation of built-in pieces and heating elements for the new keyways	1 Crane 1 Truck 1 Concrete mixer
Long Sault Island and Quebec shore	2.2	- Construction of the bridge and operations aprons bays 10 to 1 - Construction of the metal footbridge upstream, the cable trough and the open-grate of the apron - Construction of the sidewalks and installation of guardrails and street lamps (bays 10 to 1) - Installation of the waterproof membrane (bays 10 to 1) - Installation of the hot water line	1 Crane 1 Concrete mixer
Long Sault Island	2.3	- Construction of the fish passage (downstream) - Construction of the fish passage foot bridge (downstream)	1 Pile driver 1 Scoop 1 Crane 1 Truck 1 Concrete mixer
Long Sault Island and Quebec shore	2.4	- Construction of the deviation road - Construction of the culvert for the fish passage - Modification of the road layout - Relocation of the Energir gas pipe - Paving of the roadway and connections, road marking	1 Compactor 1 Paver 1 Crane 1 Grader 1 Truck 1 Scoop
-	3.0	- Reopening of the road	-
Long Sault Island	3.1	- Removal of the diversion road - Construction of the electrical duct bank - Construction of the service building	1 Scoop 1 Truck
Long Sault Island	3.2	- Relocation of the Energir gas pipe - Construction of the fish passage (upstream) - Construction of the fish passage foot bridge (upstream)	1 Pile driver 1 Scoop 1 Crane 1 Truck 1 Concrete mixer
Quebec shore	3.3	- Installation of sluice gates and hoists - Installation of heating elements - Dry testing of the sluice gates for bays 5 to 1	1 Crane
Quebec shore	3.4	- Removal of the sheet piles on the apron	1 Crane
-	4.0	- Reopening of bays 5 to 1	-
Long Sault Island	4.1	- Installation of the hydraulic crane for sluice gate handling - Tests in water of the sluice gates for bays 10 to 1 - Tests in water of the sluice gates for bays 5 to 1	1 Crane
Long Sault Island and Quebec shore	4.2	- Demolition of the existing dam	1 Scoop 1 Crane 1 Tramak 1 Truck 1 Concrete mixer

Work area	Phase	Description	Equipment
Long Sault Island and Quebec shore	4.2 (blasting, if needed)	- Demolition of the existing dam using dynamite	Blasting with dynamite

The CadnaA software tool from DataKustic was used to calculate the noise levels produced by the construction site and during the operation phase of the dam. The software uses the ISO-9613 calculation method. Simulations were performed at the receptors presented in Figure 11.6 (Section 11.1.6).

The following results are presented for each phase of construction and operation:

- Current sound situation (residual noise);
- Sound contributions from the site and the future dam;
- Total of current sound levels and sound contributions from the site and the future dam. These levels will be representative of the level that can be perceived at each evaluation point identified in Figure 11.6.

The results will be compared to the criteria from the Health Canada Guide presented above:

- Speech intelligibility;
- Daytime reference noise level;
- Change in percentage of people highly annoyed.

11.2.1.3.3.1 Assessment of Noise Levels during the Construction Phase

This section presents the simulated results of noise levels during construction for the various phases. According to these results, for phases 1.1, 2.3, 2.4 and 3.2, the noise generated by potential site activities would not comply with the speech intelligibility criterion for the two receptors closest to the site (receptors P2 and P3). However, the noise contribution from the site would only exceed the residual noise level before the work during phases 1.1 and 2.4 at receptor P2. The criterion related to the change in the percentage of people highly annoyed is compliant with the Health Canada Guide for each receptor and for each phase.

Adjustments to the simulations may be needed when the contractor has more information about the machinery used and the hours of operation.

11.2.1.3.3.1.1 Speech Intelligibility during the Construction Phase

Table 11.30 presents the daytime residual noise levels, the acoustic contributions from the site for the various phases and the daytime ambient noise levels during the construction phase.

In the table, the colour codes have the following meanings:

- In green: Noise levels do not exceed the criterion;
- In orange: Noise levels are at the limit of the criterion for residual noise and exceed the criterion by adding residual noise and the contribution from the site;
- In red: Noise levels exceed the limit of the criterion for residual noise or the noise contribution from the site.

Only the daytime period is presented because, according to the municipal bylaw from the City of Témiscaming, no work other than emergency work can be carried out during the night.

Table 11.30 Daytime Residual Noise Levels, Acoustic Contribution from the Site and Ambient Noise Levels for Each Phase

Metric	Phase	Point P1	Point P2	Point P3	Point P4	Point P5
Residual noise levels (current ambient noise levels) measured during the day $Ld_{(7h-22h)}$ in dBA (Current noise levels without work)	-	52.7	62.9	59.2	53.8	53.0
Daytime noise contributions from the site in dBA (Simulation results)	1.0	-	-	-	-	-
	1.1	48.0	69.8	58.8	50.8	48.9
	1.2	39.9	50.6	49.5	39.2	36.9
	2.0	34.1	55.0	44.3	37.4	35.2
	2.1	40.4	50.2	52.1	53.6	37.0
	2.2	32.7	54.6	43.9	35.3	33.3
	2.3	38.8	61.5	57.8	46.3	39.9
Daytime noise contributions from the site in dBA (Simulation results)	2.4	41.2	63.3	57.7	47.3	42.6
	3.0	-	-	-	-	-
	3.1	33.5	55.8	57.5	45.8	35.2
	3.2	38.8	61.5	57.8	46.3	39.9
	3.3	32.1	42.4	49.5	39.2	30.6
	3.4	32.1	42.4	49.5	39.2	30.6
	4.0	-	-	-	-	-
	4.1	28.5	50.2	42.4	33.5	30.9
	4.2	49.3	60.0	53.6	53.6	46.4
	4.2 (Theoretical)	30.4	46.1	34.6	29.6	24.1
	4.2 (Based on measures on other projects)	18.1	32.7	21.8	17.3	12.0
Ambient daytime noise levels during construction phases in dBA Total of current noise levels with noise contributions during construction phases)	1.0	-	-	-	-	-
	1.1	54.0	70.6	62.0	55.6	54.4
	1.2	52.9	63.1	59.6	53.9	53.1
	2.0	52.8	63.6	59.3	53.9	53.1
	2.1	52.9	63.1	60.0	56.7	53.1
	2.2	52.7	63.5	59.3	53.9	53.0
	2.3	52.9	65.3	61.6	54.5	53.2
	2.4	53.0	66.1	61.5	54.7	53.4
	3.0	-	-	-	-	-

Metric	Phase	Point P1	Point P2	Point P3	Point P4	Point P5
	3.1	52.8	63.7	61.4	54.4	53.1
	3.2	52.9	65.3	61.6	54.5	53.2
	3.3	52.7	62.9	59.6	53.9	53.0
	3.4	52.7	62.9	59.6	53.9	53.0
	4.0	-	-	-	-	-
	4.1	52.7	63.1	59.3	53.8	53.0
	4.2	54.3	64.7	60.3	56.7	53.9
	4.2 (Theoretical)	52.7	63.0	59.2	53.8	53.0
	4.2 (Based on measures on other projects)	53.4	63.2	59.7	52.9	53.0

In the Long Sault Island sector (P2), noise contributions from construction phases 1.1, 2.3, 2.4, 3.2 and 4.2 will further reduce speech intelligibility on the island.

At receptor P3, the noise contribution of the work is close to the limit for speech intelligibility. Noise from the work, added to already high background noise, will exceed the speech intelligibility criterion during certain phases of the work.

For the other receptors, the noise from the work will meet the speech intelligibility criterion used by Health Canada for each phase of the work.

The daily noise contribution from blasting is low compared to the peak sound levels that will be heard at the time of detonation.

During blasting, peak sound levels can be significant. Sound levels will be highly dependent on the distance and the explosive charge used. Therefore, it is recommended that a 150 m radius around the blasting site be unoccupied. In addition, to reduce the magnitude of the peak sound levels, a delay between each charge is recommended.

11.2.1.3.3.1.2 Daytime Reference Noise Level during the Construction Phase

Table 11.31 presents the 24-hour baseline reference noise levels, the 24-hour reference noise levels for simulated construction phases representative of the various sensitive areas, and the 24-hour baseline reference noise levels during the construction phase. In the table, the colour code has the following meaning:

- In green: Noise level does not exceed the criterion.

Table 11.31 24-hour Reference Noise Levels, Reference Noise Levels during the Construction Phase, and Baseline Levels during the Construction Phase

Metric	Phase	Point 1	Point 2	Point 3	Point 4	Point 5
Baseline L_RDN in dBA for a 24-hour period (Current noise levels, without work, over a standard 24-hour period)	-	59.7	69.4	66.0	59.4	59.4
	1.0	-	-	-	-	-

Metric	Phase	Point 1	Point 2	Point 3	Point 4	Point 5
L_RDN in the construction phase for a 24-hour period in dBA (noise contributions from the site over a standard 24-hour period)	1.1	43.7	65.5	54.5	46.6	44.6
	1.2	35.6	46.3	45.3	34.9	32.6
	2.0	29.9	50.7	40	33.1	30.9
	2.1	36.2	46	47.8	49.3	32.7
	2.2	28.4	50.3	39.6	31	29
	2.3	34.6	57.3	53.5	42	35.6
	2.4	37	59.1	53.4	43	38.3
	3.0	-	-	-	-	-
	3.1	29.3	51.5	53.3	41.6	30.9
	3.2	34.6	57.3	53.5	42	35.6
	3.3	27.8	38.1	45.3	34.9	26.3
	3.4	27.8	38.1	45.3	34.9	26.3
	4.0	-	-	-	-	-
	4.1	24.2	45.9	38.1	29.3	26.6
	4.2	45	55.7	49.4	49.3	42.1
	4.2 (Theoretical)	28.3	44.0	32.5	27.5	22.0
	4.2 (Based on measures on other projects)	16.1	30.6	19.8	15.2	9.9
Baseline L_RDN and during construction for a 24-hour period in dBA (Total standardized current noise levels with standardized noise contributions from the site over a 24-hour period)	1.0	-	-	-	-	-
	1.1	59.8	70.9	66.3	59.6	59.5
	1.2	59.7	69.4	66.0	59.4	59.4
	2.0	59.7	69.5	66.0	59.4	59.4
	2.1	59.7	69.4	66.1	59.8	59.4
	2.2	59.7	69.5	66.0	59.4	59.4
	2.3	59.7	69.7	66.2	59.5	59.4
	2.4	59.7	69.8	66.2	59.5	59.4
	3.0	-	-	-	-	-
	3.1	59.7	69.5	66.2	59.5	59.4
	3.2	59.7	69.7	66.2	59.5	59.4
	3.3	59.7	69.4	66.0	59.4	59.4
	3.4	59.7	69.4	66.0	59.4	59.4
	4.0	-	-	-	-	-
	4.1	59.7	69.4	66.0	59.4	59.4
	4.2	59.8	69.6	66.1	59.8	59.5
	4.2 (Theoretical)	59.7	69.4	66.0	59.4	59.4

Metric	Phase	Point 1	Point 2	Point 3	Point 4	Point 5
	4.2 (Based on measures on other projects)	59.7	69.3	66.0	59.4	59.4

Based on the results, the daily noise levels caused by the various phases of the Project comply with and are lower than the maximum prescribed threshold (75 dBA).

The daily noise contribution from blasting is low compared to the peak sound levels that will be heard at the time of detonation.

During blasting, peak sound levels can be significant. Sound levels will be highly dependent on the distance and the explosive charge used. Therefore, it is recommended that a 150 m radius around the blasting site be unoccupied. In addition, to reduce the magnitude of the peak sound levels, a delay between each charge is recommended.

11.2.1.3.3.1.3 Change in the Percentage of People Highly Annoyed during the Construction Phase

Table 11.32 presents the changes in the percentage of people highly annoyed for the various construction phases.

Table 11.32 Changes in the Percentage of People Highly Annoyed during the Construction Phases

Metric	Phase	Point 1	Point 2	Point 3	Point 4	Point 5
Change in %HA during the construction phase	1.0	-	-	-	-	-
	1.1	0.1	3.6	0.5	0.2	0.1
	1.2	0.0	0.0	0.1	0.0	0.0
	2.0	0.0	0.1	0.0	0.0	0.0
	2.1	0.0	0.0	0.1	0.4	0.0
	2.2	0.0	0.1	0.0	0.0	0.0
	2.3	0.0	0.6	0.4	0.1	0.0
	2.4	0.0	0.9	0.4	0.1	0.0
	3.0	-	-	-	-	-
	3.1	0.0	0.2	0.4	0.1	0.0
	3.2	0.0	0.6	0.4	0.1	0.0
	3.3	0.0	0.0	0.1	0.0	0.0
	3.4	0.0	0.0	0.1	0.0	0.0
	4.0	-	-	-	-	-
	4.1	0.0	0.0	0.0	0.0	0.0
	4.2	0.1	0.4	0.2	0.4	0.1
	4.2 (Theoretical)	0.0	0.0	0.0	0.0	0.0
	4.2 (Based on measures on other projects)	0.0	0.0	0.0	0.0	0.0

Based on the results, the changes in the percentage of people highly annoyed for the various construction phases comply with the maximum threshold to be met (%HA increase of 6.5%).

Since blasting operations take place over a very short period of time, the change in the percentage of people severely inconvenienced is zero.

11.2.1.3.3.1.4 Summary of Construction Phase

Table 11.33 presents a summary of sound compliance during the construction phase. The criterion of sleep disruption due to noise from the construction site during the night in the Health Canada Guide is not assessed here because the work will only be carried out during the day under the municipal bylaw prohibiting noise from construction sites at night.

The daily and 24-hour noise contribution from blasting is low compared to the peak sound levels that will be heard at the time of detonation.

During blasting, peak sound levels can be significant. Sound levels will be highly dependent on the distance and the explosive charge used. Therefore, it is recommended that a 150 m radius around the blasting site be unoccupied. In addition, to reduce the magnitude of the peak sound levels, a delay between each charge is recommended.

Since blasting operations take place over a very short period of time, the change in the percentage of people severely inconvenienced is zero.

Table 11.33 Comparison of the Various Metrics and Health Canada Recommendations during Construction

Metric	Daytime noise levels ($Ld_{(7h-22h)}$) Speech intelligibility (<60 dBA)	Standardized noise levels over a 24-hour period (L_RDN) (<75 dBA)	Increase in the percentage of people highly annoyed %HA (<6.5%)
Reference/measured (Situation prior to work)	Yes for P1, P4 and P5 Limit for P3 No for P2	-	-
Construction Phase (Situation during the construction phase)	Yes for P1, P4 and P5 Limit for P3 (phases 1.1, 2.3, 2.4 and 3.2) No for P2 (phases 1.1, 2.3, 2.4 and 3.2)	Yes	Yes

11.2.1.3.3.2 Mitigation Measures during the Construction Phase

Based on the results of simulations and the Health Canada Guide, noise mitigation measures should be put in place to maintain good intelligibility for businesses and residences located on Long Sault Island during the more critical phases. Adjustments may be needed if levels are exceeded based on sound surveys at the site.

11.2.1.3.3.2.1 Noise Monitoring at the Site

In acoustic monitoring of noisy phases, the contractor must mandate a firm specializing in sound surveys to confirm noise levels using the method that it chooses. If work phases are found to be noisier than expected, solutions must then be adopted to meet the Project targets as set out in the Project noise monitoring plan. During certain construction phases the noise can affect the staff and custumers of the Algonquin Canoe Company. If the proposed measures do not mitigate adequately the effects, modifications to the mitigation measures will be discussed and determined in consultation with WLFN.

Given the long-term criteria in the Health Canada Guide, only monitoring of at least 24 hours for noisy phases will be appropriate.

11.2.1.3.3.2.2 Consultation and Notification

The community is more likely to be understanding and accepting of Project noise if related information is provided and is frank, and does not attempt to understate the likely noise level, and if commitments are respected. The following measures are therefore planned:

- Provide advance notification to residents and Indigenous communities concerning construction duration, activities and their expected duration;
- Provide information to neighbours and Indigenous communities before and during construction through media;
- Install an information board in front of the Project site with contact information for Project concerning any questions or problems and the Project's website address for information on the Project.

11.2.1.3.3.2.3 General Mitigation Measures

The following measures will apply throughout the construction period:

- Regularly train workers and contractors to use equipment in ways that minimize noise;
- Ensure that site managers periodically check the site, nearby residences and other noise-sensitive receptors so that solutions can be quickly applied;
- Avoid the use of radios and stereos outdoors and the overuse of public address systems where neighbours can be affected;
- Keep truck drivers informed of designated vehicle routes, parking locations, acceptable delivery hours and other relevant practices (e.g. minimizing the use of engine brakes and periods of engine idling).

11.2.1.3.3.2.4 Site and Equipment

In terms of both cost and results, controlling noise at the source is one of the most effective methods of minimizing the noise impacts from any construction activities. Several measures can be put in place to reduce noise, as described below.

11.2.1.3.3.2.4.1 Quieter Methods

- Examine and implement, where feasible and reasonable, alternatives to rock-breaking work methods, such as hydraulic splitters for rock and concrete, hydraulic jaw crushers, chemical rock and concrete splitting, and controlled blasting, such as penetrating cone fracture;
- Consider alternatives to diesel and gasoline engines and pneumatic units, such as hydraulic or electric-controlled units, where feasible and reasonable. When there is no electricity supply, consider using an electrical generator located away from residences.

11.2.1.3.3.2.4.2 Temporary Noise Barriers

- Use temporary site buildings and material stockpiles as noise barriers;
- Use natural landform as a noise barrier. Place fixed equipment in cuttings or behind earth berms;
- If the criterion of speech intelligibility must absolutely be observed, additional modeling of noise barriers must be performed;
- It is recommended that simulations be updated once the contractor has determined the methodology and equipment to be used. It is also recommended that the effectiveness of noise barriers be verified before they are installed using simulations and that their effectiveness be confirmed by measurements during the work;

- If the noise levels measured at the site do not comply, the installation of noise barriers may be considered. The minimum composition of barriers is presented for information purposes in Figures 11.26 and 11.27. Plans for mitigation measures must be signed and sealed by an engineer. The data sheet for the wool must be approved by the supervisor before manufacturing begins;
- Sound barriers must be positioned as close as possible to the equipment to limit noise spreading to sensitive areas. The barriers must have a solid base that facilitates transportation and installation. "New Jersey" concrete bases could also be used. Waterproof seals must be provided on the sides to avoid leaks when the barriers are placed side by side.

Figure 11-26 Minimum Composition for an Absorbing Noise Barrier

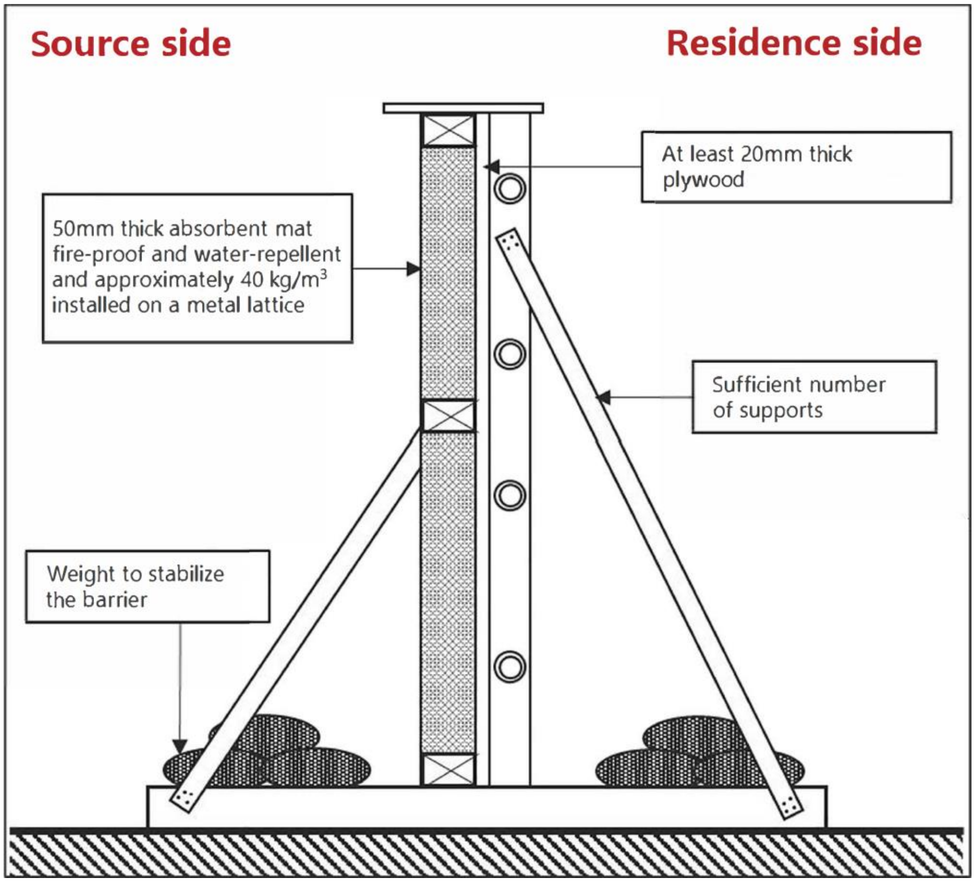
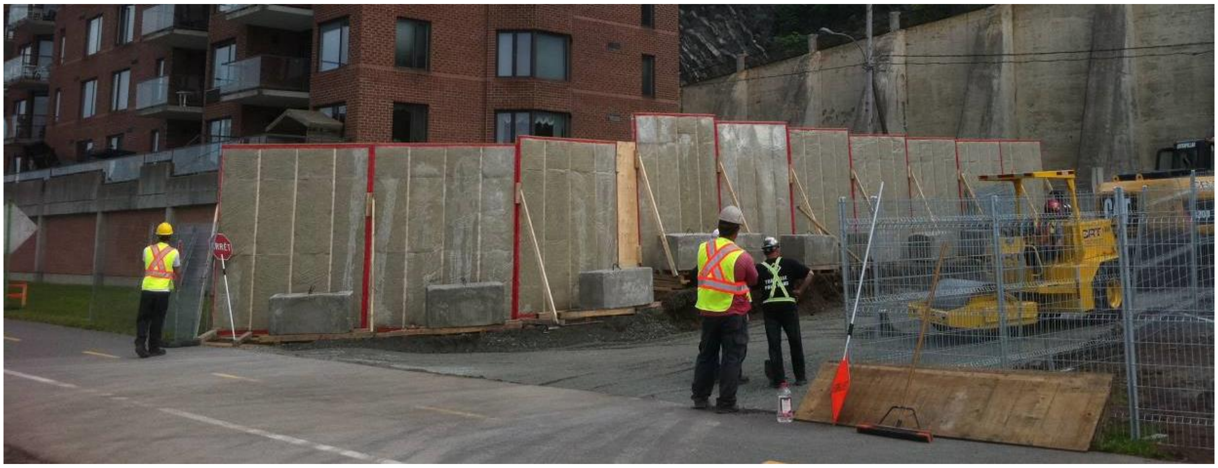


Figure 11-27 Example of a Noise Barrier at a Construction Site



11.2.1.3.3.2.4.3 Dump Truck Impact

- The shock absorbers on dump trucks help reduce noise levels during trucking operations. There should also be ongoing monitoring to remind truck drivers not to needlessly bang the panels on their dump trucks.

11.2.1.3.3.2.4.4 Reversing Alarms

- Avoid the use of reversing alarms by designing the site layout to avoid reversing, such as by including drive-through for parking and deliveries;
- Smart alarms can be used for the contractor's equipment that is on site throughout the work; However, it would be hard to install reversing backup alarms for suppliers or subcontractors who occasionally come to the site;
- The smart alarm must be adjusted to a maximum of 10 dBA above the ambient noise on the site. However, the installation of smart reversing alarms must take into account the safety of workers on the site;
- The ECCO SA914, GROTE 73080 and PRECO 1048 models are examples of smart reversing alarms that can be used for equipment on the site.

11.2.1.3.3.2.4.5 Restrictions Concerning the Delivery of Materials and Equipment

- When materials or equipment are delivered, they must be carefully placed on the ground and not dropped, to avoid impact noises.

11.2.1.3.3.2.4.6 Heavy Truck Restrictions

- The use of engine brakes is prohibited on site and on access roads to the site except where safety may be compromised;
- To limit noise and air pollution, idling of truck engines is limited to a maximum of five minutes. After that time, the engine must be shut down.

Possible effect: Noise during construction	
Potential interaction	Mitigation measures
Noise emissions during construction	1. If levels are too high based on actual site conditions, quickly adopt solutions to meet the Project targets as set out in the Project noise monitoring plan. 2. During certain construction phases, the noise can affect the staff and costumers of the Algonquin Canoe Company. If the proposed measures do not mitigate adequately the effects, modifications to the mitigation measures will be discussed and determined in consultation with WLFN. 3. Provide advance notification to residents and Indigenous communities concerning construction duration, activities and their expected duration. 4. Provide information to neighbours and Indigenous communities before and during construction through media. 5. Install an information board in front of the Project site with contact information for Project and the Project's website address. 6. Regularly train workers and contractors to use equipment in ways that minimize noise. 7. Ensure that site managers periodically check the site, nearby residences and other noise-sensitive receptors to identify and quickly address problems. 8. Avoid the use of radios and stereos outdoors and the overuse of public address systems where neighbours can be affected.

Possible effect: Noise during construction				
	9. Keep truck drivers informed of designated vehicle routes, parking locations, acceptable delivery hours and other relevant practices (e.g. minimizing the use of engine brakes and periods of engine idling).			
Noise emissions during construction	10. Examine and implement, where feasible and reasonable, alternatives to rock-breaking work methods, such as hydraulic splitters for rock and concrete, hydraulic jaw crushers, chemical rock and concrete splitting, and controlled blasting, such as penetrating cone fracture. 11. Consider alternatives to diesel and gasoline engines and pneumatic units, such as hydraulic or electric-controlled units, where feasible and reasonable. When there is no electricity supply, consider using an electrical generator located away from residences. 12. The shock absorbers on dump trucks help reduce noise levels during trucking operations. There should also be ongoing monitoring to remind truck drivers who needlessly bang the panels on their dump trucks. 13. Avoid the use of reversing alarms by designing the site layout to avoid reversing, such as by including drive-through for parking and deliveries. 14. Smart alarms can be used for the contractor's equipment that will be on site throughout the work. However, it would be hard to install reversing alarms for suppliers or subcontractors who occasionally come to the site. 15. The smart alarm must be adjusted to a maximum of 10 dB(A) above the ambient noise on the site. However, the installation of smart reversing alarms must take into account the safety of workers on the site. 16. The ECCO SA914, GROTE 73080 and PRECO 1048 models are examples of smart reversing alarms that can be used for equipment on the site. 17. When materials or equipment are delivered, they must be carefully placed on the ground and not dropped, to avoid impact noises. 18. The use of engine brakes is prohibited on site and on access roads to the site except where safety may be compromised. 19. To limit noise and air pollution, idling of truck engines is limited to a maximum of five minutes. After that time, the engine must be shut down. 20. If blasting is required, ensure that a 150 m radius around the site to be blasted is cleared and ensure that there is a delay between charges.			
Residual effect				
Magnitude	**Geographic extent**	**Duration**	**Frequency**	**Reversibility**
Low	Local	Medium	Continuous	Reversible
Overall Assessment: Non-significant				
Monitoring and follow-up	Noise measures during construction and additional mitigation measures if the method chosen by the contractor generates more noise See Chapters 22 and 23 for more details			
Comments				

11.2.1.3.3.3 Assessment of Sound Levels during the Operation Phase

11.2.1.3.3.3.1 Speech Intelligibility during the Operation Phase

Table 11.34 presents the residual sound levels (current) during the day, the acoustic contribution of the dam during the operation phase, ambient daytime noise levels and ambient nighttime noise levels.

The projected ambient noise level was calculated by subtracting the measured sound contribution of the current dam and adding the sound contribution of the future dam. These levels will be representative of the perceived levels during the operation phase.

Table 11.34 Residual Daytime and Nighttime Sound Levels (Ambient Noise Levels), Acoustic Contribution of the Dam during the Operation Phase and Ambient Daytime and Nighttime Sound Levels during the Operation Phase

Metric	Point P1	Point P2	Point P3	Point P4	Point P5
Residual noise levels measured during the day, including noise from the current dam, $Ld_{(7h-22h)}$ in dBA	52.7	62.7	59.2	53.8	53.0
Residual noise levels measured at night, including noise from the current dam, $Ln_{(22h-7h)}$ in dBA	53.4	63.0	59.7	52.9	53.0
Acoustic contribution of the current dam in dBA	28.4	50.1	38.5	29.1	31.2
Acoustic contribution of the new dam in dBA	29.0	50.0	37.2	30.0	31.5
Projected levels of ambient daytime noise in dBA (Total residual noise levels measured during the day, with noise contributions from the dam)	52.7	62.9	59.2	53.8	53.0
Projected levels of ambient nighttime noise in dBA (Total residual noise levels measured during at night, with noise contributions from the dam)	53.4	63.2	59.7	52.9	53.0

Residual daytime and nighttime noise levels (current) at point P2 exceed the criterion from Health Canada for speech intelligibility.

At point P3, the residual daytime and nighttime noise levels (current) are at the limit for the criterion for speech intelligibility.

The estimated acoustic contribution from operation of the future dam is negligible at all evaluation points during the day and at night.

The acoustic contributions of the new and old dams will be similar at all receptors.

Differences in noise levels from the new and old dams will not be perceptible. Note that an audible and stroboscopic alarm is planned. The alarm must be activated by the operator before a sluice is operated, particularly when opening it, to alert people who may be on the shore or on the water downstream. Given the occasional nature of this noise source, and the fact that it is needed for safety reasons, the overall impact on the noise environment will be non-significant.

11.2.1.3.3.3.2 Daytime Reference Noise Levels during the Operation Phase

Table 11.35 presents the baseline reference noise levels (current) over a period of 24 hours, the simulated daytime reference noise levels during the operation phase, and the baseline reference noise levels during the operation phase over a period of 24 hours.

Table 11.35 Baseline 24-hour Reference Noise Level during the Operation Phase and Baseline for the Operation Phase of the New Dam

Metric	Point 1	Point 2	Point 3	Point 4	Point 5
Baseline L_RDN level measured or a period of 24 hours in dBA (Current noise levels over a standardized period of 24 hours)	59.7	69.3	66.0	59.4	59.4
Estimated L_RDN during the operation phase, estimated over a period of 24 hours, in dBA (Noise contributions from the operation of the future dam standardized over a period of 24 hours)	35.4	56.4	43.6	36.4	37.9
Estimated baseline L_RDN during the operation phase over a period of 24 hours in dBA (Total standardized current noise levels with standardized noise contributions from the operation of the dam over a 24-hour period)	59.7	69.5	66.0	59.4	59.4

Based on the results, the daytime noise levels from the operation of the new dam will hardly change compared to the current situation. They comply with and are lower than the maximum prescribed threshold of 75 dBA.

11.2.1.3.3.3.3 Change in the Percentage of People Highly Annoyed during the Operation Phase

Table 11.36 presents the changes in the percentage of people highly annoyed for the operation phase.

Table 11.36 Baseline Daytime Reference Noise Levels and for the Operation Phase

Noise levels	Point 1	Point 2	Point 3	Point 4	Point 5
Change in %HA during the operation phase	0.0	0.5	0.0	0.0	0.0

Based on the results, the changes in the percentage of people highly annoyed during the operation phase is negligible and complies with the minimum threshold to be met (%HA increase of 6.5%).

Possible effect: Noise during operation				
Potential interaction		Mitigation measures		
Noise emissions during operation		NIL		
Residual effect				
Magnitude	**Geographic extent**	**Duration**	**Frequency**	**Reversibility**
Low or NIL	Local	Permanent	Continuous	Irreversible
Overall assessment: Non-significant, or NIL				
Monitoring and follow-up	-			
Comments	Noise during operation will be similar to the current noise.			

11.2.2 Soil

The VC “soil” includes risks from the management of soil and sediments, contaminated or not, that could be found on the site of the Project, as well as contaminations that may be caused by Project activities.

11.2.2.1 Sediment Volumes and Quality

During the pre-construction phase, vegetation clearing and earthworks for setting up the site and storage areas are likely to result in soil particles in the aquatic environment due to surface runoff during rainy periods. To limit this effect, sediment barriers will be placed along the edges of the site areas to capture particles and prevent them from entering the aquatic environment.

During the installation of the cofferdam (Phase 1), sediment may be suspended again while pouring the materials that make up the cofferdam. Note that very little sediment is present in the riverbed in that area due to strong currents that prevent it from settling (see Figure 11.13). To limit this dispersion, and that of finer particles from the cofferdam materials, a turbidity curtain (Photo 11.5) will be installed downstream of the cofferdam area before it is installed, to capture potential sediments. This turbidity curtain will be secured to the riverbed and all contours.

Moreover, since there is very little sediment and for safety reasons, no sampling for chemical analyses could be done before the work to assess quality. At first glance, as they are from upstream, where upstream sources of contamination do not seem to have affected sediment quality (see the conclusions in section 11.1.9.4 of the study by Arbour, 2020), they are unlikely to be contaminated in excess of the criteria for protecting the aquatic environment (except for mercury – however, Station 1 upstream and Stations 2 and 3 downstream of the dam present the lowest mercury concentrations among the 17 sampled stations). Despite this, once the existing dam is closed and the turbidity curtain is in place and before the construction of the cofferdam, sediment samples will be taken in the areas where sediment is visible. This will be conducted by divers. These will be analyzed and managed based on their level of contamination. If the sediments are contaminated, a protocol will be developed to recover them before the cofferdam is built.

Photo 11.5 Examples of Turbidity Curtains

Source: https://innovex.ca/en/products/sediment-control/floating-barriers/

During the removal of the cofferdam at the end of Phase 1, sediment is likely to be carried downstream. To limit this effect, the turbidity curtain installed at the start of Phase 1 will remain in place throughout that phase. In that way, the sediment will be captured by the curtain and can be recovered before it is removed. Despite this, it may not be possible to fully recover finer particles present in the curtain and some may be carried downstream. However, those fine particles from the cofferdam do not contain any contaminants. Section 11.2.3.4 provides more details on those particles and their potential transportation and dispersion in the river based on different scenarios analyzed using the hydrological model.

During Phase 4 (demolition of the existing dam), fine particles are likely to be generated by the erosion of the concrete during demolition, for example. To limit this effect, the new dam will be closed during this operation to serve as a cofferdam and to avoid particles and debris being carried downstream. All debris and particles must be recovered before the new dam is opened. An underwater inspection will be conducted to ensure this. Given that water is collected for fire safety at Rayonier nearby, and for buildings on the island upstream on the Ontario side, as a preventive measure, a turbidity curtain will also be installed upstream before the demolition of the existing dam begins.

Accidental spills can result in sediment contamination. Preventive measures and an emergency plan will be applied to avoid such situations or quickly and effectively respond to them if they occur.

Note that, since current speeds will remain similar to what they are at this time during the construction and operation phases, to the right of the area where contaminated sediments were found (along the edges of the Ottawa River, downstream from the mouth of Gordon Creek, see section 11.1.9.4), it is highly unlikely that the contaminated sediment in those areas will be raised and carried downstream.

Finally, the community of Antoine has raised the fact that floating rafts of organic matter had already been seen on the river. The source of those floating rafts is not known, but they could be the result of the accumulation of organic matter over the years from the operation of the pulp and paper mill. Although this phenomenon is unpredictable, as a mitigation measure, the contractor will conduct regular checks on the river downstream and, if such floating rafts are seen, they will be recovered and disposed of according to current standards.

Possible effect: Soil particles being carried to the aquatic environment, sediment being carried downstream, possible contamination from accidental spills	
Potential interaction	Mitigation measures
Carrying of soil particles from site areas through runoff Sediment in the work area or finer particles from the cofferdam being carried Debris and fine particles being carried from the demolition of the existing dam Accidental spill leading to sediment contamination Appearance of floating rafts of organic matter	1. Install and maintain sediment barriers around the areas of the site. This turbidity curtain will be secured to the riverbed and all contours 2. Conduct sampling by divers where sediment is visible once the existing dam is closed and turbidity curtain is in place (and before the construction of the cofferdam). Sediment will be managed based on their level of contamination. If the sediments are contaminated, a protocol will be developed to recover them before the cofferdam is built. 3. Install and maintain a turbidity curtain downstream of the cofferdam throughout Phase 1, and when possible during Phases 2 and 3. 4. Develop appropriate work methods with adequate measures to protect the shoreline. 5. Train employees to react and take action quickly in case of any accidental spill. 6. Recover most particles from the cofferdam before removing the turbidity curtain. 7. Use the new dam as a cofferdam during the demolition of the current dam and install a turbidity curtain upstream from the work area (Phase 4). 8. Develop appropriate work methods for the demolition of the existing dam. 9. Recover all debris and fine particles from the demolition of the current dam before opening the new dam. 10. Provide preventive measures to avoid accidental spills and prepare an emergency plan in the event of a spill. 11. Conduct regular checks for floating rafts of organic matter and recover them, as needed. 12. If measures to limit the erosion and transportation of sediment are deficient, stop the work until more effective measures are in place or the current measures are corrected.

Possible effect: Soil particles being carried to the aquatic environment, sediment being carried downstream, possible contamination from accidental spills				
Potential interaction		Mitigation measures		
		13. Prepare a soil and sediment management plan and an erosion and sediment control plan.		
Residual effect				
Magnitude	**Geographic extent**	**Duration**	**Frequency**	**Reversibility**
Low	Local	Medium	Cyclic	Reversible
Overall Assessment: Non-significant				
Monitoring and follow-up	Conduct sampling by divers where sediment is visible once the existing dam is closed and turbidity curtain is in place (and before the construction of the cofferdam). Sediment will be managed based on their level of contamination. If the sediments are contaminated, a protocol will be developed to recover them before the cofferdam is built. Monitor water quality (see description of this monitoring in Section 22.1.4)			
Comments				

11.2.2.2 Soil Volumes and Quality

11.2.2.2.1 Existing Contamination

As noted in Section 11.1.9.3, about 30 m^3 of contamination from petroleum hydrocarbons and PAHs has been confirmed on Long Sault Island. No action was taken, as the risk of migration was deemed to be low. As the site is located away from the new dam and the new road layout, no particular measures are required. However, a sediment and soil management plan will be prepared to address potential unexpected contaminated sediments and soils.

11.2.2.2.2 Potential Contamination

An accidental spill in the work areas could cause soil contamination in those locations. To limit the risk, preventive measures and an emergency plan will be applied to avoid such situations, or to quickly and effectively respond to them if they occur.

The use of a large amount of equipment operating on fossil fuels means that a significant number of hydrocarbons will be used and potentially stored at the site. The negative effects are related primarily to incorrect handling during fueling and transfer and incidents involving vehicles (collision, break of a hydraulic line, etc.). These potential effects can be mitigated by following restrictive hydrocarbons storage provisions and by developing and implementing a detailed environmental emergency plan.

Possible effect: Contamination of soil by an accidental spill	
Potential interaction	Mitigation measures
Spill during the handling of hydrocarbons Spill following an accident	1. Inspect machinery on a daily basis to detect the presence of hydrocarbon leaks, etc. 2. Have an accidental spill recovery kit on the site at all times. 3. Limit storage of hydrocarbons onsite for one work week for the equipment used during that week. 4. Require double containment structures for the storage of hydrocarbons. 5. Prohibit the storage of hazardous equipment or materials in the area dried by the cofferdam. 6. Report any spill as soon as possible in order to react quickly. 7. Develop and implement a detailed environmental emergency plan.

Possible effect: Contamination of soil by an accidental spill				
Potential interaction		Mitigation measures		
		8. Require the use of vegetable-based hydraulic oils in machinery when working in water and in close proximity to water. 9. Prepare a sediment and soil management plan to address unexpected contaminated sediments and soils.		
Residual effect				
Magnitude	**Geographic extent**	**Duration**	**Frequency**	**Reversibility**
Low	Project footprint	Short	Punctual	Reversible
Overall assessment: Negligible				
Monitoring and follow-up	Tour of the site to detect signs of spills on the ground.			
Comments	Complementary environmental emergency plan with measures to protect waterways Site rehabilitation in the event of an accidental spill			

11.2.3 Water

The VC “water” includes several aspects:

- The groundwater dynamic;
- Groundwater quality;
- The surface water dynamic;
- Surface water quality;
- Ice.

11.2.3.1 Groundwater Dynamic

The groundwater dynamic at the Project site is largely dominated by the Ottawa River itself. During construction (Phase 1, mid-July to December), a portion of the river between the current dam and the cofferdam will be drained. This could result in a decrease in the water table level on adjacent lands (Long Sault Island and the left shore of the Ottawa River). There are no residences on the left shore of the river, to the right of the area to be dried. The buildings on the island are fed by a water intake located upstream of the island, on the Ontario side. As that water intake draws water directly from Lake Timiskaming, the potential decrease in the water table on the island has no impact on that supply. Once the area is covered in water again at the end of Phase 1, the water table level will quickly return, as the table is fed by the river.

No baseline data are available for monitoring the water table level in the Timiskaming Dam area. The soil characterization work conducted on the island noted that the groundwater has not been reached during digging. In addition, a study carried out on the site of the Rayonier plant in 2006 in an area located downstream of the mouth of Gordon Creek, mentioned that the aquifer is at a depth of approximately 4.5 to 5.0 m below the ground level in a sandy silt horizon (Trow Associates Inc., March 2006). As mentioned above, the dewatering of the work area is an activity that is likely to result in a punctual drawdown of the water table on the land surrounding the dry area. Considering the relatively low permeability of the materials in which the groundwater table is located (silt-sandy), the anticipated drawdown will be over a short distance from the Ottawa River. Also, considering that the water table is at a depth of about 4.5 to 5.0 m below the ground level, the hydraulic gradient caused by the drying of the work area will be relatively low. Finally, considering that the water level of the Lake Timiskaming upstream of the dam will be maintained at its normal level for the duration of the work, the water pumped from the dewatering area will come largely from infiltration from the Lake Timiskaming. The anticipated impacts on the water level due to the dewatering of the cofferdam of the Gordon Creek are considered negligible.

Knowing that the Project does not aim to change the management of water levels during the operation phase, but simply to replace the Timiskaming Dam of Quebec to maintain its current function, there is no anticipated impact on the groundwater dynamic during the operation period.

Possible effect: Decrease in the water table around the drained area during Phase 1 of the work				
Potential interaction		Mitigation measures		
Decrease in the water table to the right of the area to be drained in Phase 1		NIL		
Residual effect				
Magnitude	**Geographic extent**	**Duration**	**Frequency**	**Reversibility**
Low	Project footprint	Short	Cyclic	Reversible
Overall assessment: Negligible				
Monitoring and follow-up	None			
Comments				

11.2.3.2 Groundwater Quality

Groundwater quality is closely linked to the quality of the soil that holds the water. The main risks identified for groundwater quality are related to spills and similar incidents on the soil. As a result, the measures set out in Section 11.2.2.2.2 are adequate to mitigate those risks.

Possible effect: Contamination of groundwater by an accidental spill				
Potential interaction		Mitigation measures		
Spill during the handling of hydrocarbons Spill following an accident		1. Require limitations on the storage of hydrocarbons on the site for one work week for the equipment used during that week. 2. Require secondary containment for the storage of hydrocarbons. 3. Report any spill as soon as possible in order to react quickly. 4. Develop and implement a detailed environmental emergency plan.		
Residual effect				
Magnitude	**Geographic extent**	**Duration**	**Frequency**	**Reversibility**
Low	Project footprint	Short	Punctual	Reversible
Overall assessment: Negligible				
Monitoring and follow-up	Tour of the site to detect signs of spills on the ground.			
Comments	Complementary environmental emergency plan with measures to protect waterways			

11.2.3.3 Surface Water Dynamic – Hydraulics

11.2.3.3.1 General

The Timiskaming Dam of Quebec is part of a complex of structures used to manage floods and its operational mode seeks to protect property and populations upstream and downstream while promoting the spawning of fish species valued by the community. The planned reconstruction of the dam does not seek to modify the management of water levels, but to replace the Timiskaming Dam of Quebec to maintain its current function. In that context, overall, no impact is anticipated on the general dynamic of surface water.

11.2.3.3.2 Water Management during Construction

The construction of the new dam must be done in dry conditions. Water in the work area must therefore be controlled. To that end, cofferdams are to be installed during various phases. Each of those phases is described in detail in Section 7.2 of this document. The installation of cofferdams during construction will temporarily change the distribution of flow between the dams on the Ontario and Quebec side, particularly during floods.

11.2.3.3.2.1 Phase 1

For the first phase of cofferdams, the entire east branch of the Ottawa River will be blocked by closing all bays on the Quebec dam and installing a cofferdam measuring approximately 100 m downstream from the current dam. Under those conditions, all the water in the river will flow toward the Ontario dam and the cofferdam will make it possible to dry the work area (see Figure 11.28). The figure shows the cofferdam (green line) and the dry area in grey. As shown in the figure, the flow lines (represented by white vectors) upstream from the current Quebec dam are diverted toward the Ontario dam. The downstream side of the cofferdam will be kept in water due to the discharge of water caused by management of the Otto Holden dam on water levels in this area. In effect, the average water level downstream from the Timiskaming Dam Complex is 177.0 m and the minimum level is 174.0 m, usually observable in March and April. We also note the presence of Gordon Creek in the area that is a regular water supply downstream from the cofferdam.

During the first phase of the construction under the preferred option, all flow from the Timiskaming reservoir will be managed through the Ontario dam, which has a maximum hydraulic capacity of 1,955 m^3/s, at maximum operation of the reservoir. That flow corresponds to a 10-year flood. That capacity is deemed to be sufficient for this phase, which takes place in a period (mid-July to December) when the average flow entering the Timiskaming Dam Complex is 750 m^3/s. During this work, particular attention will be paid to monitoring the hydrological situation in the catchment area of the Ottawa River to anticipate potential floods and properly plan management of the dam on the Ontario side. In effect, the use of just one of the dams will reduce management flexibility and may require a greater number of bay operations on the dam on the Ontario side to maintain the desired reservoir thresholds.

Since the hydrological forecasts show a high risk of exceeding the maximum operating level for the reservoir, measures must be put in place to evacuate the site and remove the cofferdam within 24 to 48 hours to allow for water to be released on the entire dam on the Quebec side.

Such a situation could occur when water levels upstream are already at their maximum threshold (179.56 m) and when a flow greater than 1,940 m^3/s enters the reservoir. If the water level in the reservoir is not at its maximum threshold, the possibility of storing the high water could be an option. Note that PSPC does not want to change the management thresholds for the reservoir during the work, but it would be possible to manage certain situations by lowering the level of the upstream reservoir to store some of a potential flood during this phase of the work.

The triggering of this emergency plan will be managed by PSPC based on hydrological forecasts and recommendations from the Ottawa River Regulation Planning Board (see Chapter 15 for more details).

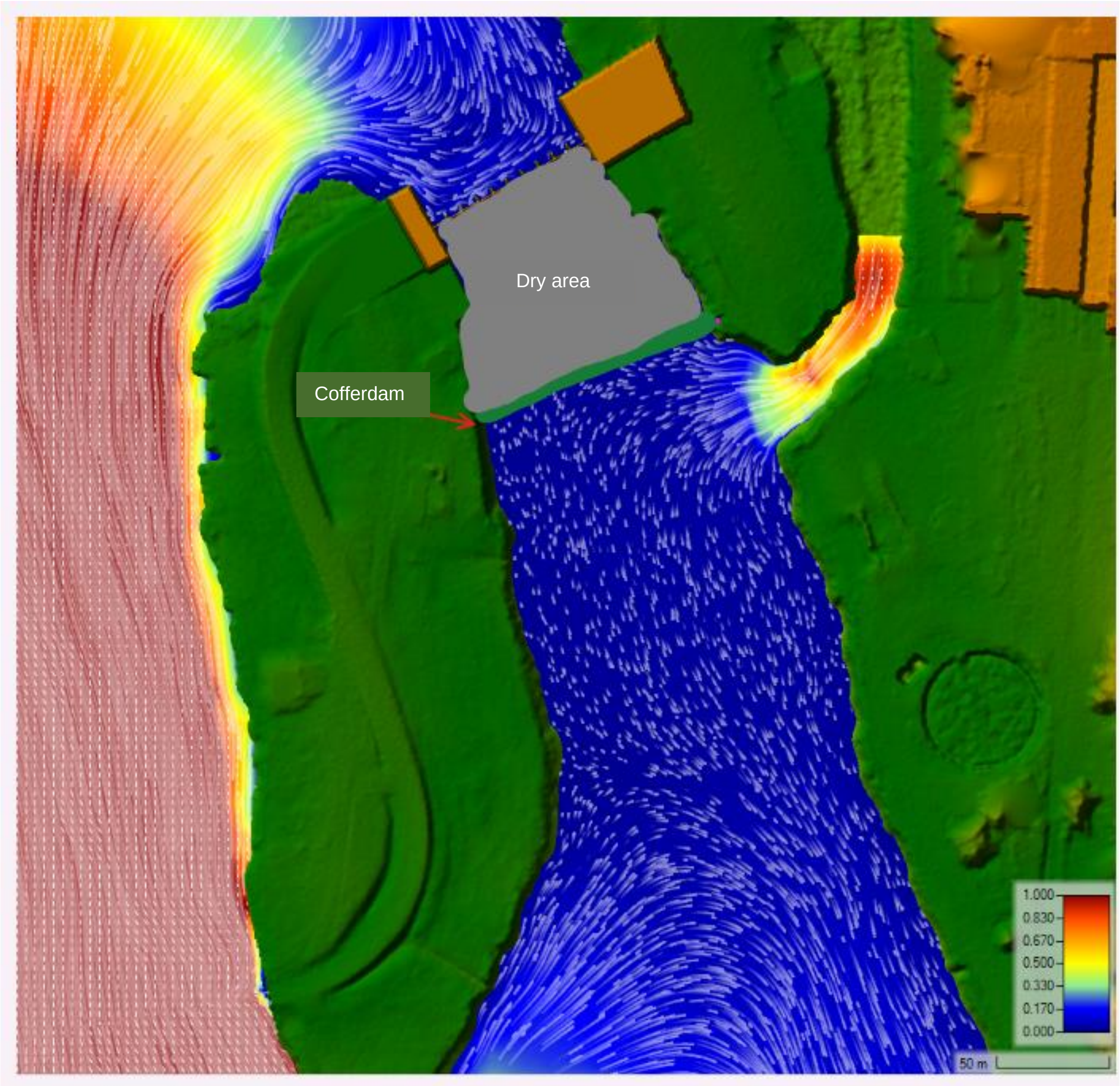
The impacts of such a situation are the same as those described in Scenarios 5 and 6 presented in Section 11.2.3.4.1. The relatively short time frame to remove the cofferdam does not change the impact but the effort that will be required by the contractor will be greater (e.g. use of more equipment to remove the cofferdam).

The flow that will pass through the sluice gates on the Ontario side will be of the order of a 10-year flood and will not be greater than the discharge capacity of the Ontario dam. These are therefore events for which the bed and bank protection structures have been designed. In this context, no impact or modification of the current state is anticipated. The duration during such event (i.e. high flow) will be however longer than the normal dam operation condition considering that the flow from the Lake Timiskaming will be all routed through the Ontario dam compare to the current situation where the flow is divided equally between the two dams. In the case of the banks, we observe that the immediate downstream area of the dam is characterized by a widening of the flow section and thus by a rapid decrease in flow velocities due to the expansion of the flow section. The main change will be therefore related to the increase in the duration of the section that will be wetted (saturated). However, this modification of the saturation time is not likely to have an impact on the morphology of the watercourse and the local sediment regime.

In the case of the riverbed, the change that will be observable is the maintenance of high flow velocities for a longer period of time in the reach immediately downstream of Ontario Dam. However, the magnitude of the velocities remains below the design values of the riverbed protection structure. In this context, no impact is expected with regard to the morphology of the watercourse and sediment dynamics.

The results of hydraulic simulations conducted by Tetra Tech show that the supply from Gordon Creek does not have an impact on the water level at the foot of the cofferdam during this phase. In effect, the level reached is entirely controlled by the Otto Holden dam. The main change that can be observed during this phase of the construction is a decrease in current in the east channel of the river between the downstream foot of the cofferdam (or downstream of the turbidity curtain that will be installed a few meters downstream of the cofferdam) and the end of Long Sault Island. Figure 11.28 shows an excerpt from the 2D hydraulic model, including added elements (cofferdam) and the flow velocities at the foot of the proposed cofferdam. This modeling work was done using version 6.0.0 of the HecRas 2D software. We see that the flow velocities are less than 0.3 m/s in the entire blue area downstream from the cofferdam, while velocities without the cofferdam would be 1.5 to 2.0 m/s for an equivalent flow.

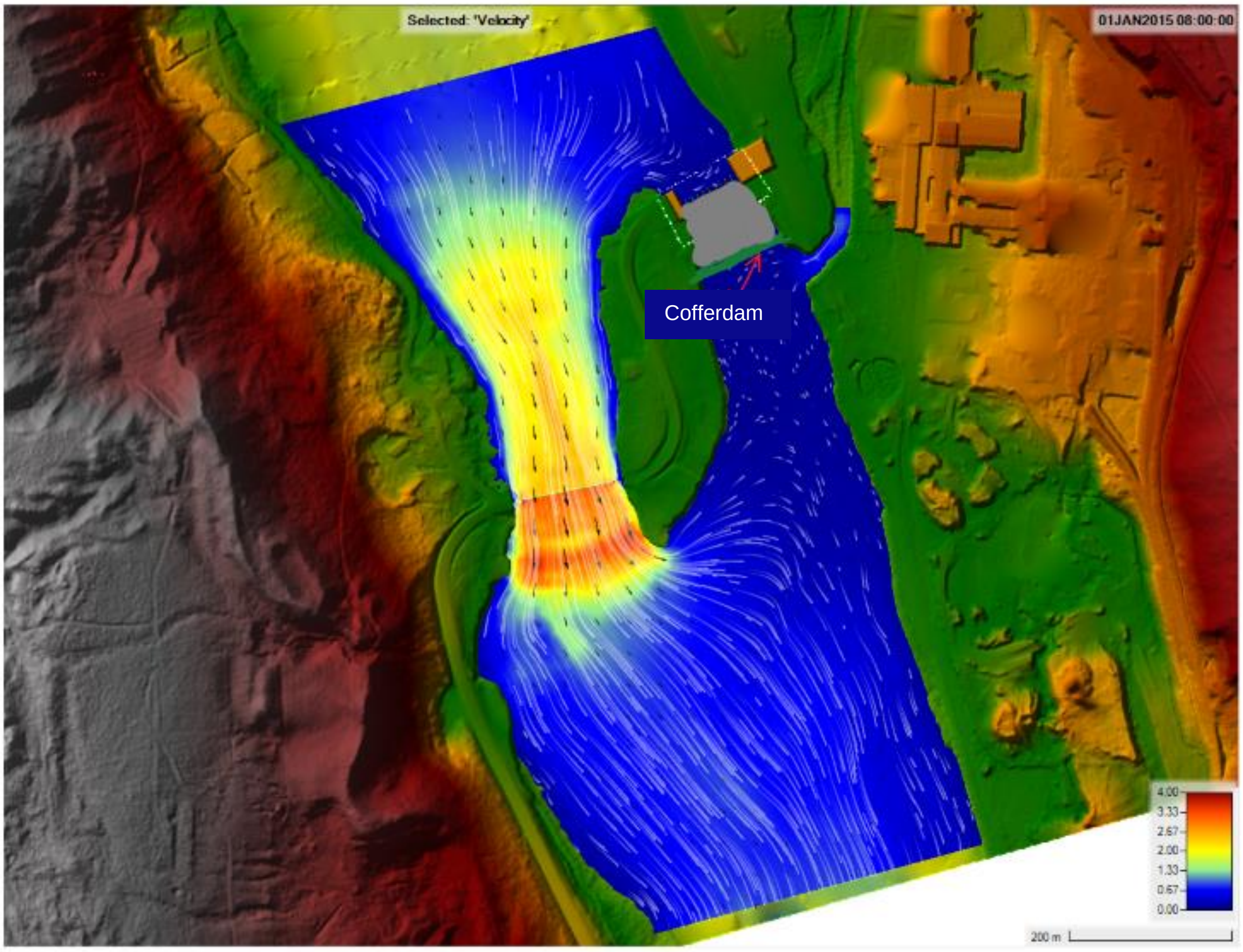
Figure 11-28 Excerpt from the Hydrological Model for the Design of the Cofferdam (Phase 1)



This change in water flow velocity downstream from the cofferdam will be local and temporary and will not prevent the use of the area for the various wildlife and navigation purposes. The free circulation at the mouth of Gordon Creek will not be changed by the presence of the cofferdam. The main mitigation measure associated with this phase is to minimize the duration (mid-July to December of the first year) of the time this cofferdam will be in place by ensuring sound planning of the contractor's work and deadlines.

For information purposes, Figure 11.29 shows the current velocities calculated for the entire study area when the Quebec dam is fully closed and given a maximum operational level of the reservoir (179.56 m). We see that velocities reach a value of 2.5 m/s in the channel upstream from the Ontario dam (yellow areas on Figure 11.29) and over 4 m/s immediately downstream of the Ontario dam (orange area on Figure 11.29). The impact on the increase in velocity under these conditions ends at a distance of about 200 m downstream from the end of Long Sault Island.

Figure 11-29 Excerpt from the Hydraulic Model for the Design of the Cofferdam (Phase 1)



11.2.3.3.2.2 Phases 2 and 3

For these phases of the work, a cofferdam of sheet piles is to be built to block half of the bays (1 to 5). The cofferdam will begin at the foot of pile 5 and extend parallel to the direction of the river's flow for approximately 45 m before reaching the left shore upstream from the mouth of Gordon Creek (see Figure 11.30).

In that configuration and given the maximum operating level of the Timiskaming reservoir (179.56 m), the hydraulic study showed that it is possible to evacuate about 2,733 m^3/s (100% in Ontario and 50% in Quebec), which corresponds to a flood recurrence of 1:20 years. The hydraulic study also showed that it is possible to achieve the management objectives for the Timiskaming reservoir for the draining period and for the flood storage period for the Ottawa River. However, an emergency plan similar to the one implemented in the first phase of the work must be in place to allow for safe management of flows in the event of a major flood.

In these conditions, considered to be critical, the modeling done using version 11.2 of the FLOW-3D software shows that the flow velocities between the piles reach values of 8 m/s (orange area on Figure 11.30), while they reach 5.5 m/s on the concrete apron along the cofferdam (yellow area on Figure 11.30).

During this phase of the work, the flow can only be on half of the Quebec dam, meaning that, during critical episodes (strong flows), the flow will be concentrated on one side of the river, which will increase flow velocities locally in the reach immediately downstream from the dam over about 75 m, as shown in Figures 11.31 and 11.32.

Note that, under normal operating conditions, all of the bays on the Quebec dam are not necessarily used in the current mode of operation and that the water flows through a limited number of bays, meaning the velocity conditions downstream would not necessarily change with the presence of the cofferdams during this phase.

Figure 11-30 Excerpts from the Simulation Results using the 3D Model

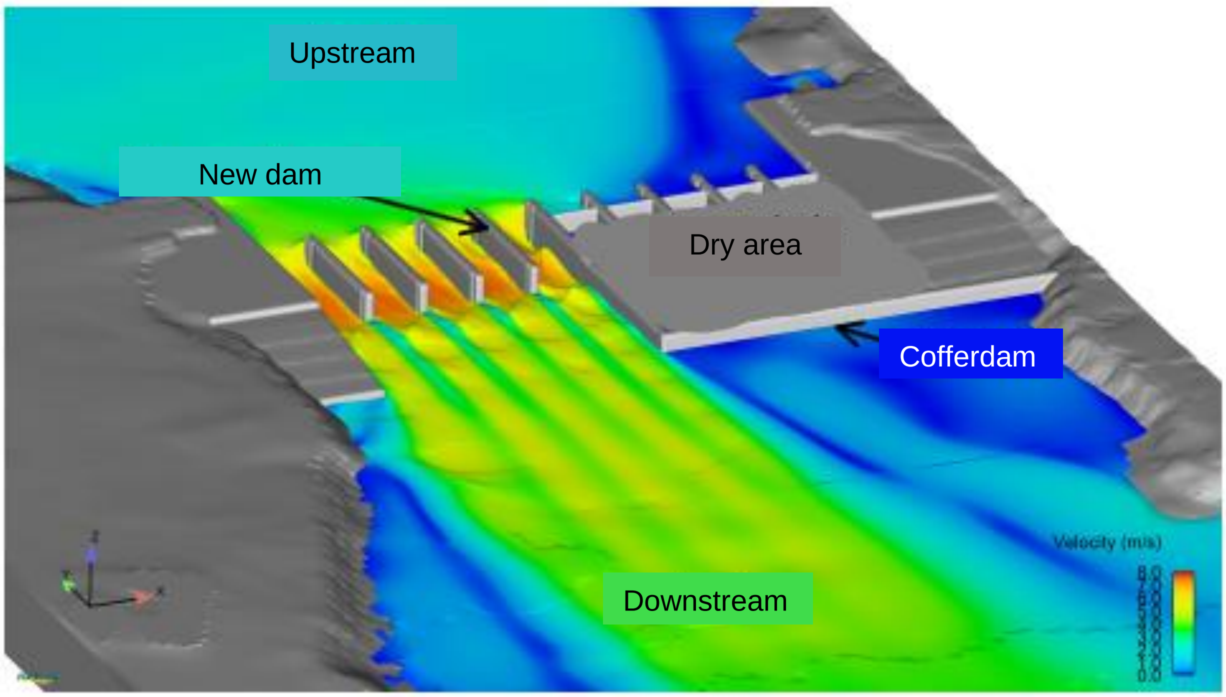


Figure 11-31 Flow Velocities Calculated during Flood Periods with and without the Presence of a Cofferdam

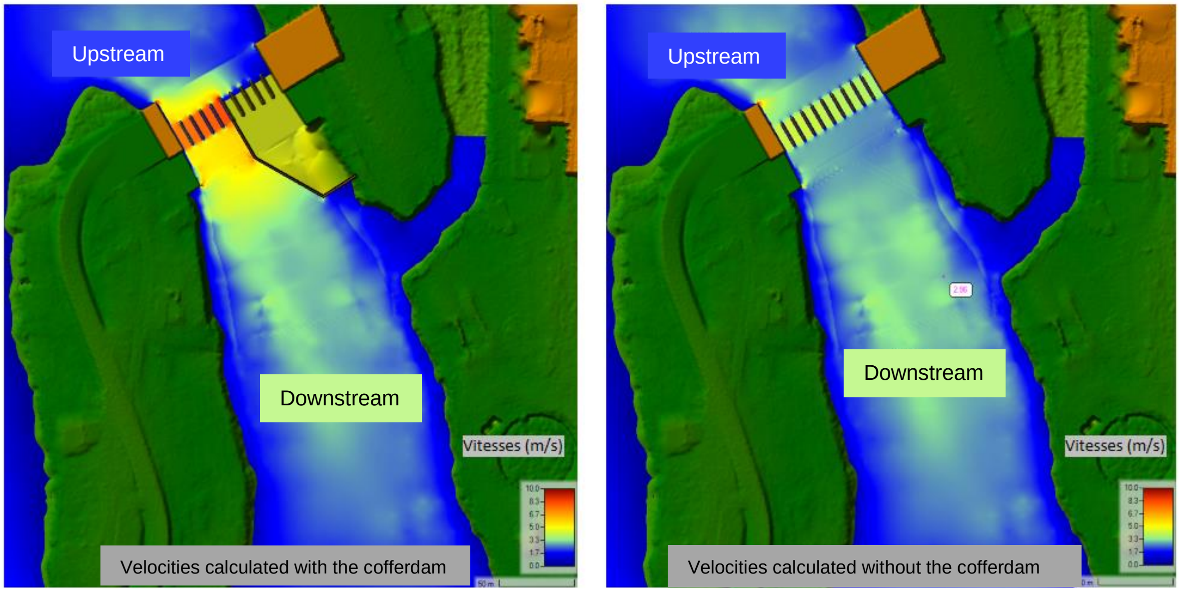
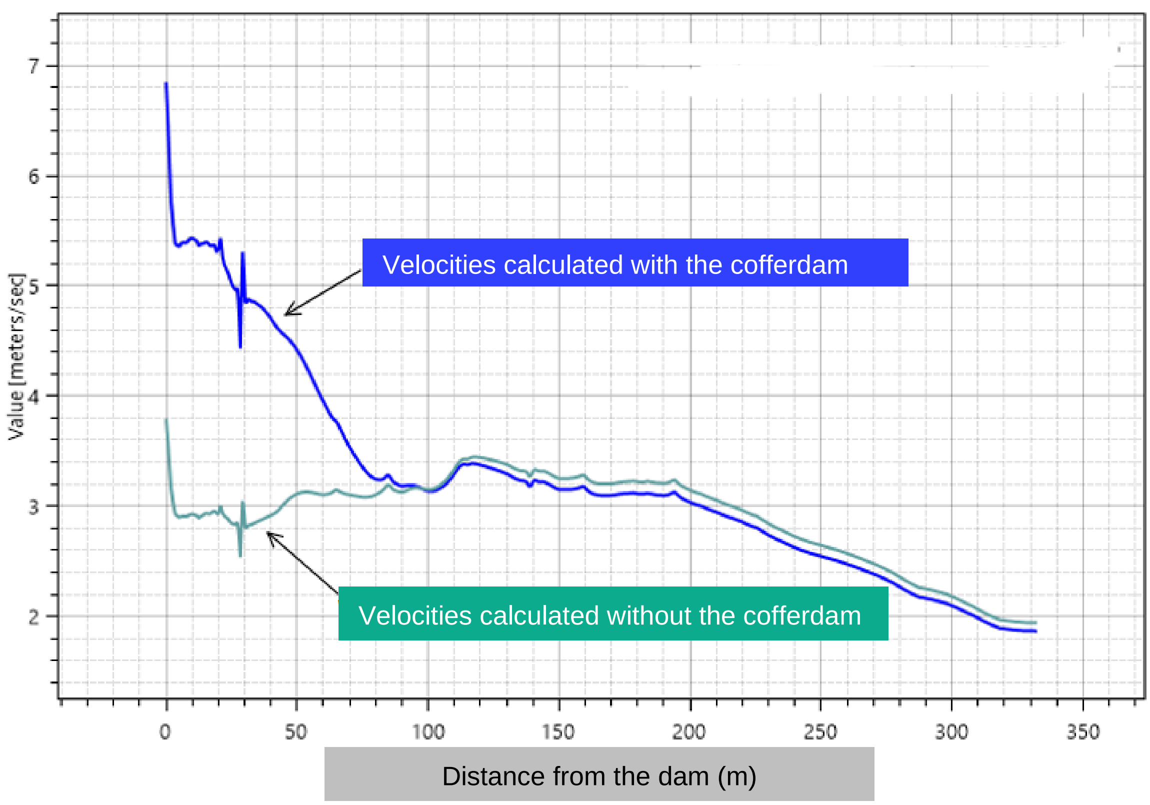


Figure 11-32 Flow Velocities Calculated during a Flood with and without the Presence of a Cofferdam on a Longitudinal Profile at the Centre of the River (the Dam is at Chain 0 m)



11.2.3.3.2.3 Phase 4

During the fourth and final phase of the work, the new dam on the Quebec side will be closed to allow the demolition of the existing dam. The capacity for evacuation will be the same as in phase 1, but the duration will be shorter.

In addition to the management objectives for the Timiskaming reservoir, particular attention must be paid during bay operations on the dam on the Quebec site to ensure the safety of workers on the site. Although the cofferdams and other diversion structures will need to be able to support the pre-established design floods, any decision concerning the management of the structure that could result in a significant increase in levels must be submitted to the site managers. This aspect must be part of the emergency plan to be developed in cooperation with PSPC, Tetra Tech and the contractor responsible for the work.

11.2.3.3.2.4 Summary of the Impacts on Water Levels during the Work

In general, during each phase of the work, water levels downstream from the structures will not be influenced, as they are essentially controlled by the management of water at the Otto Holden dam located downstream.

Upstream from the Timiskaming Dam Complex, under normal operating and flow conditions, the water level will not be influenced by the work. However, under flood conditions, given that the evacuation capacity of the Quebec dam will be lower during certain phases of the work due to the presence of cofferdams, the water level upstream in a single flood may be greater than what is currently observable. This will all depend on the significance of the flood, the management of the dam in Ontario, the specific phase of the work (the number of bays available on the Quebec side) and the management of the Otto Holden dam, due to its influence on the level downstream.

Possible effect: Change in hydraulic conditions during the work				
Potential interaction		Mitigation measures		
Change in flows, velocities and water levels during the work		1. Prepare an emergency plan for high flow rates during phases when a cofferdam is present and follow the communication procedure included in the Emergency plan presented in Chapter 15. 2. Ensure construction staging area and activities don't impact the dam operations.		
Residual effect				
Magnitude	**Geographic extent**	**Duration**	**Frequency**	**Reversibility**
Low	Local	Medium	Cyclic	Reversible
Overall Assessment: Non-significant				
Monitoring and follow-up	Monitoring of water levels during the work and implementation of the emergency plan if needed			
Comments				

11.2.3.3.2.5 Summary of Impacts during the Operation Phase

During the operating phase, the new dam will not change the water management plan currently in place for the current dam. The normal and maximum operating levels will remain the same. The winter emptying and spring filling periods will remain unchanged.

The new dam will be equipped with sluice gates rather than wood beams as seen in the current structure. In this context, the water flows through the base (the bottom), so under pressure under the sluice, rather than by overflowing above the beams. Figure 11.33 shows an example of these two types of flow. On the left, we see a flow above the beams, creating more turbulence on the water surface, while the right shows water flowing below the sluice, creating higher velocities at the bottom of the river.

For information purposes, Figure 11.34 shows the results of simulations for the two types of evacuation systems calculated for the Quebec dam, considering a two-year flood. Bays 2 and 4 are equipped with sluice gates open at 50% capacity and bays 6, 8 and 10 are equipped with beams open at 50% capacity. Flow velocities are 4 m/s downstream of the sluice gates and 2 m/s downstream of the bays with beams. Note that this difference can be seen over a distance of about 50 m downstream of the structure.

Figure 11-33 Example of Flow below a Sluice Gate vs. a Beam

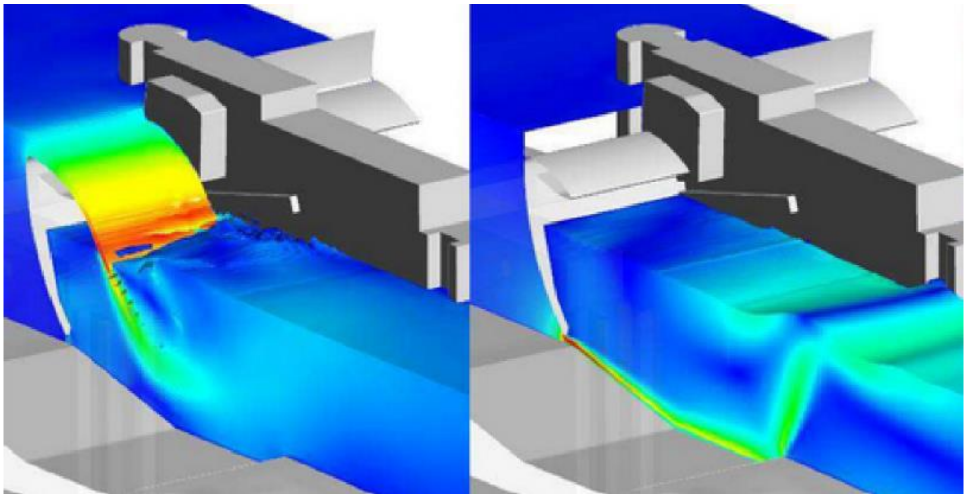
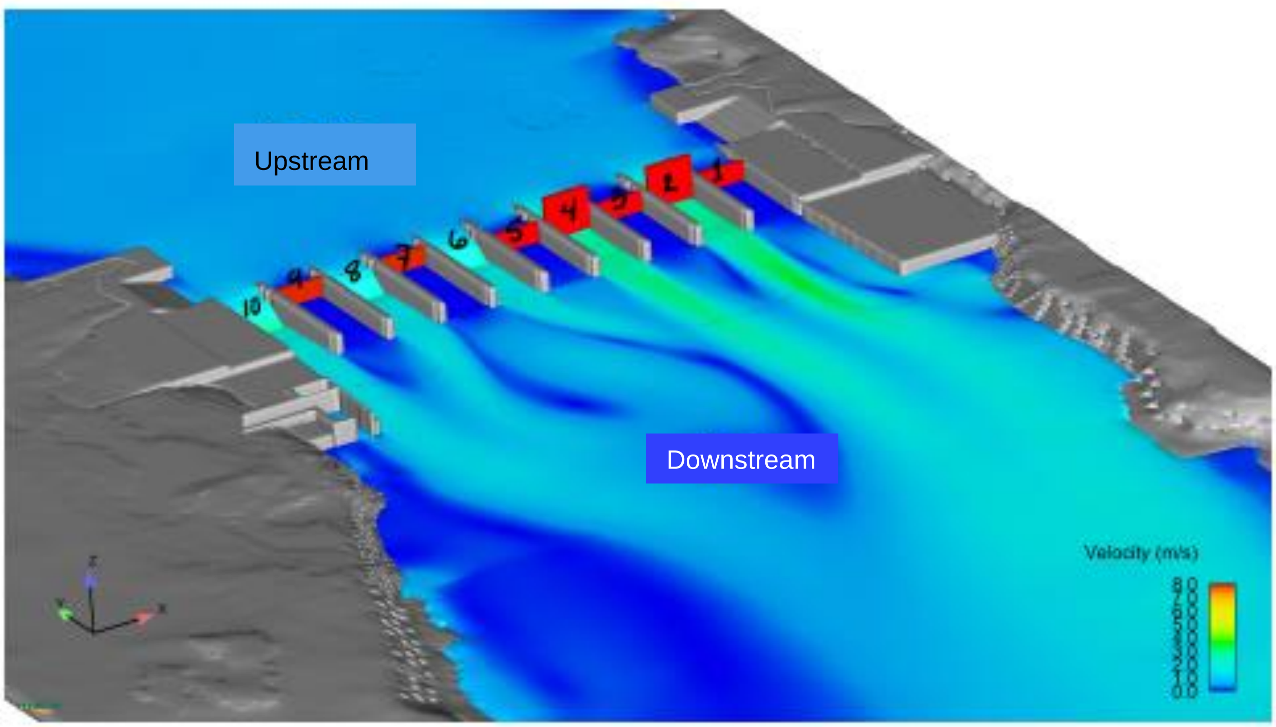


Figure 11-34 Excerpts from the Results of the Simulation using the 3D Model



11.2.3.4 Surface Water Quality

Surface water quality refers to the chemical characteristics of the water, e.g., the constituent elements such as metals and nutrients, as well as parameters such as pH and water temperature. Surface water quality has the potential to affect aquatic habitats and biota.

During the preparation of the site, risks to surface water quality may result in particular from vegetation clearing and earthworks. During construction, the work in water is the main source of impacts, such as the installation and removal of the cofferdam, drying the work area, construction of the upstream portion of the fish passage and demolition of the existing dam. There is also the risk of spills and leaks directly in the aquatic environment. The concrete of the new dam and the demolition of the old dam can modify the pH of the Ottawa River. The discharge of concrete mixer wash water can also affect the pH if no treatment is done before the release.

The main contaminants from these risks are:

- Suspended solids (SS) and other contaminants released by the work or by runoff from the stripped shoreline;
- Debris from the demolition of the existing dam;
- De-icing salt (during construction and operation) and the water temperature during operation;
- Hydrocarbons from construction machinery during construction and operation (risk of accidental spills).

Simulations with modeling were conducted for suspended solids. The results have been compared with DFO criteria (see Section 22.4) and mitigation measures are suggested following the analysis of the results (installation of a turbidity curtain). As for the other contaminants, simulations cannot be conducted, either because there is no model, or because the anticipated effects are practically zero considering the mitigation measures, or because the assumptions to be considered for predictions cannot be established with sufficient certainty. However, all the results of the water quality monitoring will be compared with CCME and Quebec Guidelines and if exceeded, mitigation measures will be put in place, as mentioned in the next sections and in Section 22.4.

11.2.3.4.1 Suspended Solids during Construction

Suspended solids (SS) could come from runoff on the work areas. To counter this phenomenon, sediment barriers will be installed around the site to capture these particles before they reach the aquatic environment.

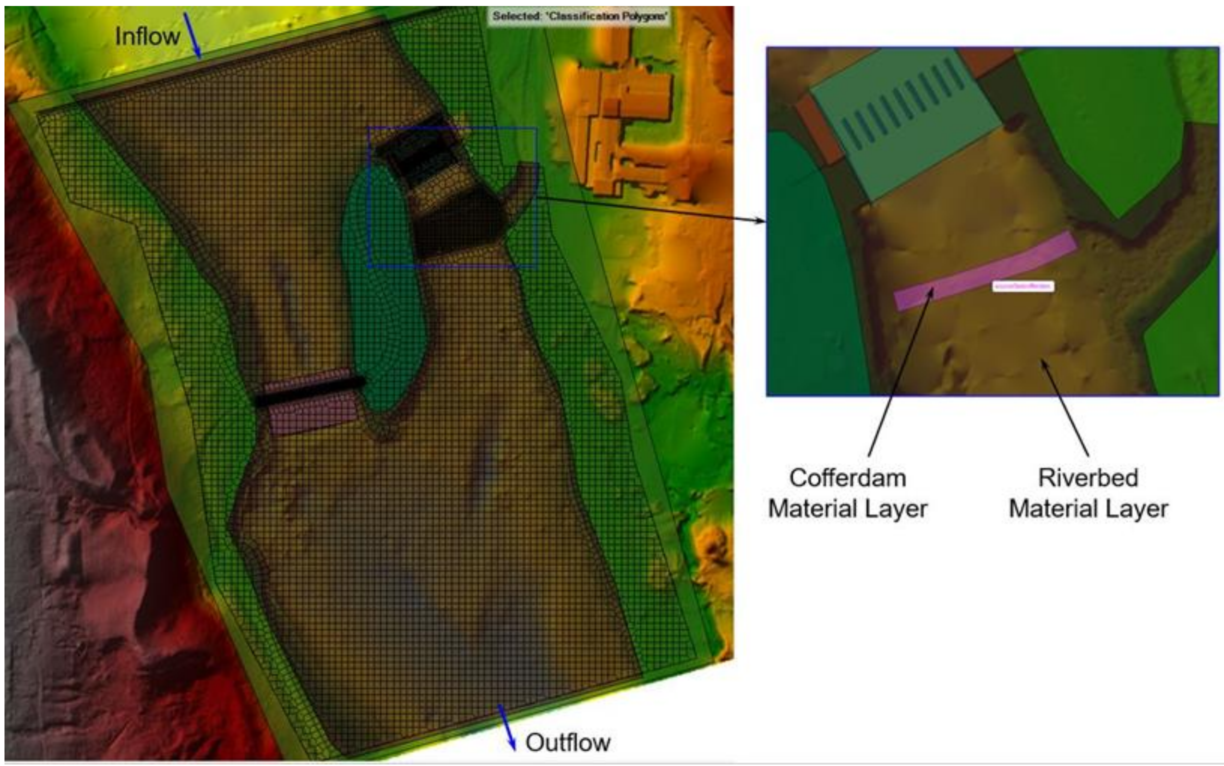
Suspended solids may also stem from the installation and removal of the cofferdam during Phase 1 of the work (see Section 11.2.3.3.2.1 for the anticipated impacts in the event of a high flood during this phase, which will be the same as those described for Scenarios 5 and 6).

The transportation and dispersion of SS in the Ottawa River during the various phases of the work were modelled to determine the potential impacts of the work on the local sediment dynamic and water quality in the river, as well as the potential impact on the fish habitat and surrounding spawning grounds.

Based on recommendations from the Department of Fisheries and Oceans (DFO) from other recent projects, the contractor must ensure that the work produces less potential SS in the waterway. For instance, for the construction of dismantling of the Champlain Bridge (Montréal, Quebec area), concentrations of SS generated by the work were not to exceed the natural concentrations in the environment by more than 25 mg/L (ambient concentration) at 100 m from the work, and more than 5 mg/L at 300 m from the work for more than 6 consecutive hours, as required in the authorization issued under the *Fisheries Act*. Similar requirements can be expected from DFO for the Project.

A two-dimensional (2D) model was created using version 6.0.0 Beta of the HEC-RAS modeling software to conduct various scenarios concerning the hydro-sedimentary transportation in the east branch of the Ottawa River. The hydraulic model used in this study is the one developed and calibrated as part of previous detail designs (Tetra Tech, 2017 and 2018). The hydraulic model consists of a mesh with 15,222 cells extending up to 200 m upstream and 800 m downstream from the dam being studied on the Quebec side. The mesh covers both sides of Long Sault Island and has an average resolution of 10 m. A finer mesh density is used to the right of the Ontario and Quebec dams, where the cells have a resolution of 1 m. The mesh is associated with the digital terrain model (DTM) build from the topographical bathymetric surveys acquired in 2016. Figure 11.35 shows an excerpt of the simulated mesh to the right of the Quebec dam.

Figure 11-35 View of the HEC-RAS 2D Model used for Modeling Sediment Transportation



The model's boundary conditions for all modeling are a water level upstream of 179.56 m and a water level downstream of 177.70, with these levels corresponding to the maximum operating levels for the Timiskaming and Otto Holden dams (Tetra Tech, 2018). The boundary conditions for sediment are not required for the inflow upstream because that was specified as being a stage condition. Thus, the inflow from Gordon Creek was specified as a balance condition and was set at 21 m³/s, or a 10-year flow (Tetra Tech, 2018). A sublayer of the bed was defined at the location of the cofferdam to specify the particle size of sediments under various scenarios. The thickness of the sublayer was calculated based on the volume of sedimentary material and the area of the surface sublayer. The HEC-RAS software also identifies a composite layer on the bed, made up of several particle sizes. To study the plume of sediment generated by removing the cofferdam, the bed of the waterway was considered to be a non-erodible surface, as it consists primarily of metric blocks and layered stones forming a natural cobbling on the bed.

To reflect the impact of the work on sediment transportation, the particle size characteristics of the cofferdam in Phase 1, described in Table 11.37, were included in the existing hydraulic mode. For the modeling, a high proportion of fine particles was used, as that is the most critical case for water quality and the fish habitat.

As part of this study, the natural erosion of the banks was ignored in order to only model disruptions caused by the work. As noted above, the riverbed was considered to be a non-erodible surface, as it consists primarily of metric blocks and layered stones forming a natural cobbling on the bed. Also, the reach located between the current dam and the cofferdam in Phase 1 will be excavated and replaced with 900–1100 mm stones during Phase 1 of the work, which are not erodible materials. In that context, only the cofferdam in Phase 1 was considered an erodible structure.

With a view to analyzing sensitivity, several different scenarios were modelled:

- Scenario 1: The cofferdam in Phase 1 is 25% built and the Quebec dam is completely closed;
- Scenario 2: The cofferdam in Phase 1 is 50% built and the Quebec dam is completely closed;
- Scenario 3: The cofferdam in Phase 1 is 75% built and the Quebec dam is completely closed;
- Scenario 4: The cofferdam in Phase 1 is 100% built and the Quebec dam is completely closed;
- Scenario 5: The cofferdam in Phase 1 was removed but, hypothetically, it is assumed that a volume of 37 m^3 of sediment 0.080 mm in diameter (i.e., fine particles) could not be removed and remains dispersed uniformly on the riverbed. That volume corresponds to 10% of the finest material used for the cofferdam in Phase 1. The new Quebec dam operates at 100% capacity;
- Scenario 6: The cofferdam in Phase 1 was removed but, hypothetically, it is assumed that a volume of 370 m^3 of sediment 0.080 mm in diameter (i.e., fine particles) could not be removed and remains dispersed uniformly on the riverbed. That volume corresponds to 100% of the finest material used for the cofferdam in Phase 1. The new Quebec dam operates at 100% capacity.
- Scenario 9 : The cofferdam in Phase 1 was removed but, hypothetically, it is assumed that a volume of 277.5 m^3 of sediment finer than 5 mm in diameter could not be removed and remains dispersed uniformly on the riverbed. That volume corresponds to 1/16th of the material finer than 5 mm in diameter used for the cofferdam in Phase 1. The cofferdam in Phase 2 is still in place and the new Quebec dam operates at 50% capacity (only sluices 6 to 10 are opened).

A 1-in-10 year return period has been used for the simulations for all scenarios.

Table 11.37 Particle Sizes and Volumes for the Cofferdam in Phase 1

Area 2 – Granular materials							
Lower limit				Upper limit			
D_{50} (mm)	Cumulative percentage	%	m^3	D_{50} (mm)	Cumulative percentage	%	m^3
300	100	15	1,110	300	100	0	0
200	85	25	1,850	200	100	0	0
80	60	20	1,480	80	100	0	0
40	40	10	740	40	100	5	370
20	30	15	1,110	20	95	15	1,110
10	15	5	370	10	80	20	1,480
5	10	10	740	5	60	25	1,850
1.25	0	0	0	1.25	35	20	1,480
0.315	0	0	0	0.315	15	10	740
0.080	0	0	0	0.080	5	5	370

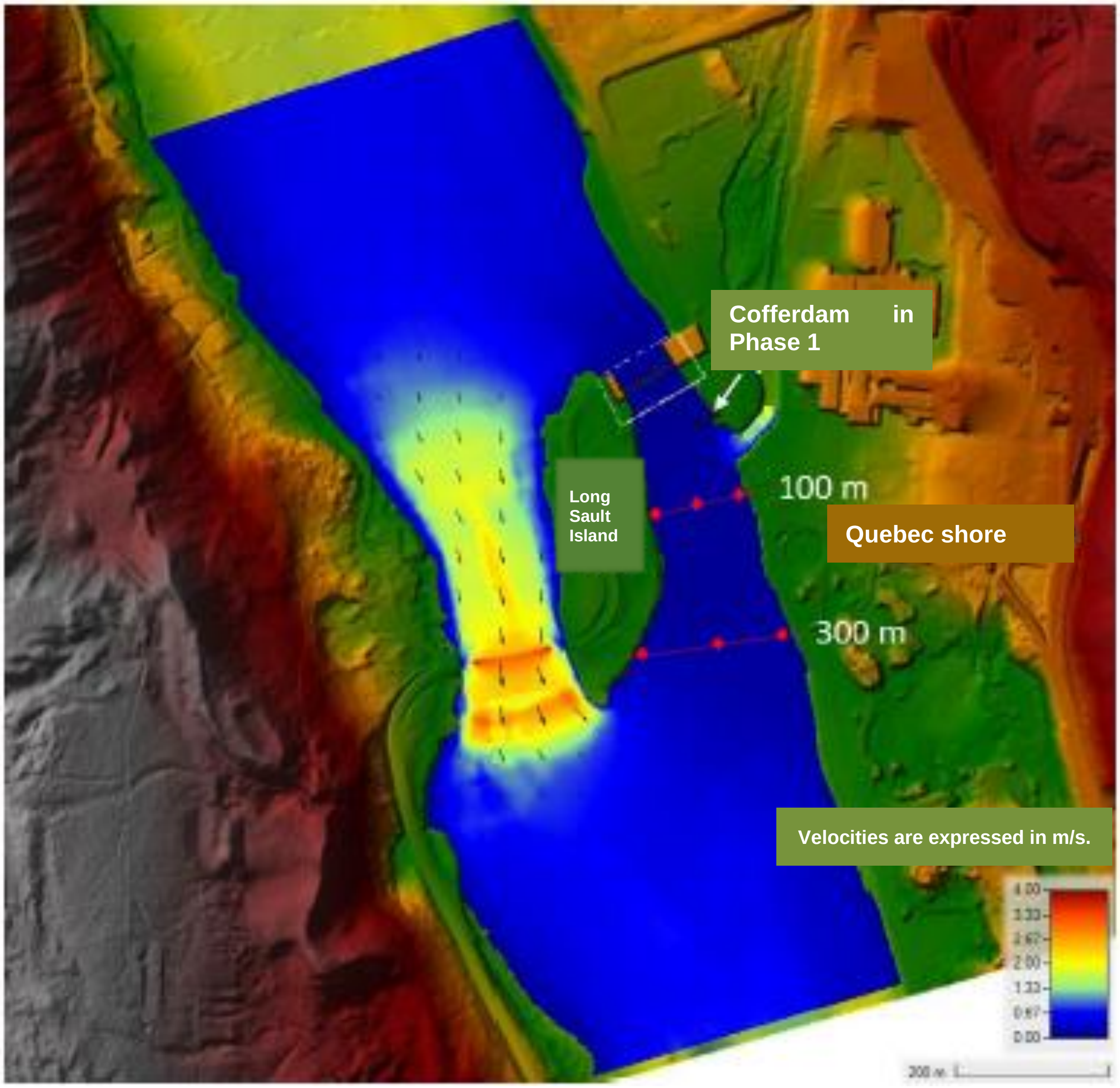
The purpose of scenarios 1 to 4 was to model hydrodynamic conditions in the east branch during Phase 1 of the work to assess the risks related to erosion of the cofferdam in Phase 1 during its construction. The dispersion of sediment discharged during this phase is modeled using empirical sedimentation equations. The purpose of scenarios 5 and 6 was to model the dispersion of a certain amount of material from the cofferdam that would have been left at the site when the Quebec dam was fully or partially opened. In effect, although the planning of the work specifies that the cofferdam in Phase 1 will be entirely removed and that the riverbed will be restored to its natural state, these scenarios present results for hypothetical cases considering that some of the fine material from the cofferdam cannot be entirely recovered by machinery (too fine of a thickness of deposits, material deposited in intergranular or inter-block spaces on the riverbed, etc.). These deposits will be suspended again when the Quebec dam is partially or fully reopened. Depending on the amount left in place, the criteria for SS concentrations could be temporarily exceeded at that time, and there may be re-sedimentation of those deposits in sensitive fish habitats located downstream. The purpose of scenarios 5 and 6 is therefore as follows:

(1) Analyze sensitivity to assess the impact of various volumes of material from the cofferdam that may have been left in place in relation to criteria concerning SS concentrations at 100 m and 300 m when the bays on the new dam are reopened;
(2) Identify areas of the riverbed that will be affected by the sedimentation of those deposits.

However, it must be noted that these scenarios are theoretical limits, as they involve significant amounts of construction material from the cofferdam not being recovered, which, in principle, would not be authorized.

The results of the 2D modeling show that the current velocities in the east branch of the Ottawa River when all bays on the Quebec dam or closed (Phase 1 of the work) are almost nil (Figure 11.36). The current velocities calculated vary from 0.01 m/s to 0.07 m/s 100 m downstream from the cofferdam in Phase 1 and 0.003 m/s to 0.17 m/s 300 m from the cofferdam, regardless of progress in the construction of the cofferdam (HEC-RAS scenarios 1 to 4). However, in the Ontario branch, velocities can reach 4 m/s for the modelled hydraulic conditions, the maximum operating level for the Timiskaming Dam Complex.

Figure 11-36 Flow Velocities in the Ottawa River Modelled during Phase 1 of the Work (Scenario 1) and Location of Transects and Stations for the Calculation of Average Concentrations over six Hours



The HEC-RAS software does not allow for modeling of occasional sediment spills that will occur during the construction of the cofferdam in Phase 1. The dispersion of sediment was calculated using analytical equations representing classic sedimentation phenomena. Those equations provide the rate at which sedimentary particles settle based on their median diameter D_{50}. This makes it possible at a given depth to calculate the time during which a given particle will remain suspended in the column of water. If current velocities are also known, it is also possible to calculate the distance that the particle will settle from its point of origin. This method thus makes it possible to calculate the maximum propagation of the turbidity plume generated by the spill of all types of materials in the river during the construction of the cofferdam in Phase 1.

Bathymetric surveys and diving surveys conducted in 2016 indicate that the depth of the water in the east branch of the Ottawa River varies from 4 m to 6 m for the water levels being considered. Table 11.38 indicates the maximum distances for dispersion of construction materials from the cofferdam in Phase 1 based on their particle size class for an average water depth of 5 m and a current velocity of 0.14 m/s, double the modelled velocity at 100 m downstream from the cofferdam as a safety measure. The results show that all particles emitted into the environment should remain confined within an area of approximately 167 m due to the absence of currents in the east branch while the Quebec dam is fully closed, regardless of the particle size considered. Although hydrodynamic conditions on their own should make it possible to meet the SS concentration criteria 100 m and 300 m downstream of the site, SS concentrations and the impacts of the turbidity plume on the fish habitat could be further reduced by using turbidity curtains downstream from the site of the cofferdam construction in Phase 1.

Table 11.38 Maximum Distance of Dispersion of Materials to be used in the Construction of the Cofferdam in Phase 1 if all Bays on the Quebec Dam are Closed (Scenarios 1 to 4)

Material	D_{50} (mm)	Sedimentation velocity		Sedimentation time		Distance of transportation (m)
		Min (mm/s)	High (mm/s)	(s)	(min)	
Loam	0.080	4	6	1,190	19.8	167
Medium sand	0.315	34	45	148	2.5	25.2
Coarse sand	1.250	138	156	36	0.6	5.0
Gravel	6.000	329	343	15	0.3	2.1

If 10% of the finest material used for the cofferdam in Phase 1 cannot be removed from the riverbed (Scenario 5), the modeling results show that a plume of SS appears as soon as the bays on the new dam are opened. Concentration inside that plume can reach 110 mg/L at the centre of the channel in the first five minutes of opening (Figure 11.37). However, the plume is quickly carried downstream by the current and, after an hour, is already at the southern point of Long Sault Island (Figure 11.38).

SS concentrations are already below the DFO criteria at 100 m after only 10 minutes and are below DFO criteria at 300 m after 40 minutes. After an hour, concentrations in the column of water are 1.9 mg/L at 100 m and 2.95 mg/L at 300 m. After 3 hours, the plume reaches the downstream limit in the model, at about 750 m from the dam, and SS concentrations at 100 m and 300 m are then only 0.3 mg/L and 1.05 mg/L, respectively. As for the average concentration over 6 hours, the values do not exceed 0.7 mg/L at 100 m and 1.35 mg/L at 300 m (Figure 11.39).

Figure 11-37 Scenario 5 – Evolution of SS Concentrations at 100 m (in Red) and at 300 m (in Blue) along the Quebec Shore, at the Centre of the Channel and on the Long Sault Island Shore

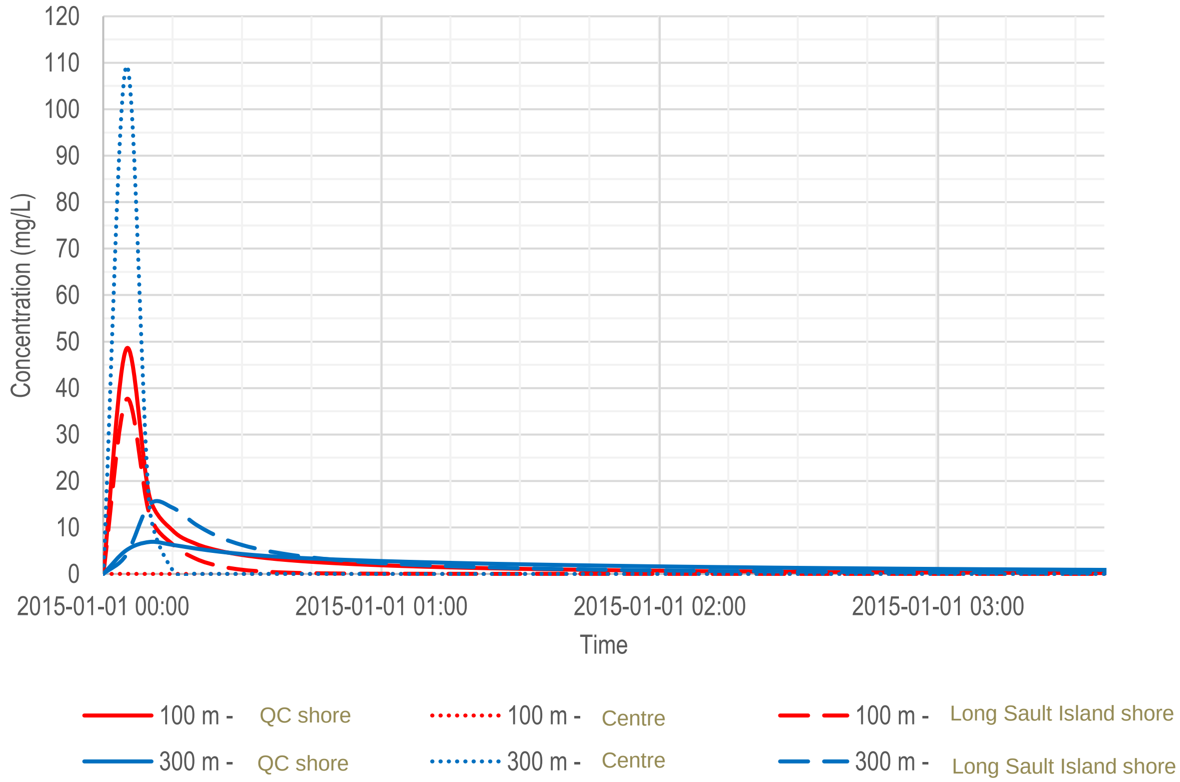
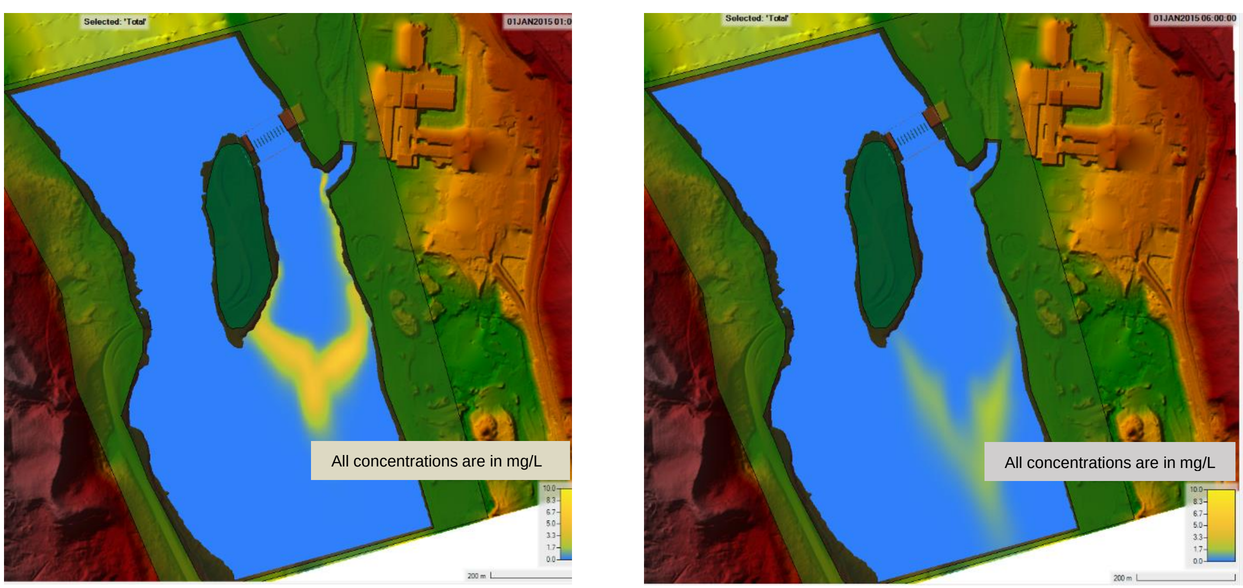


Figure 11-38 Scenario 5 – Plan View of the Plume of Sediment Dispersion after 1 hour (Top Left) and after 3 hours (Top Right), and Cross Profiles of Total SS Concentrations after 1 Hour and 3 Hours at 100 m (on the Left) and 300 m (on the Rright)



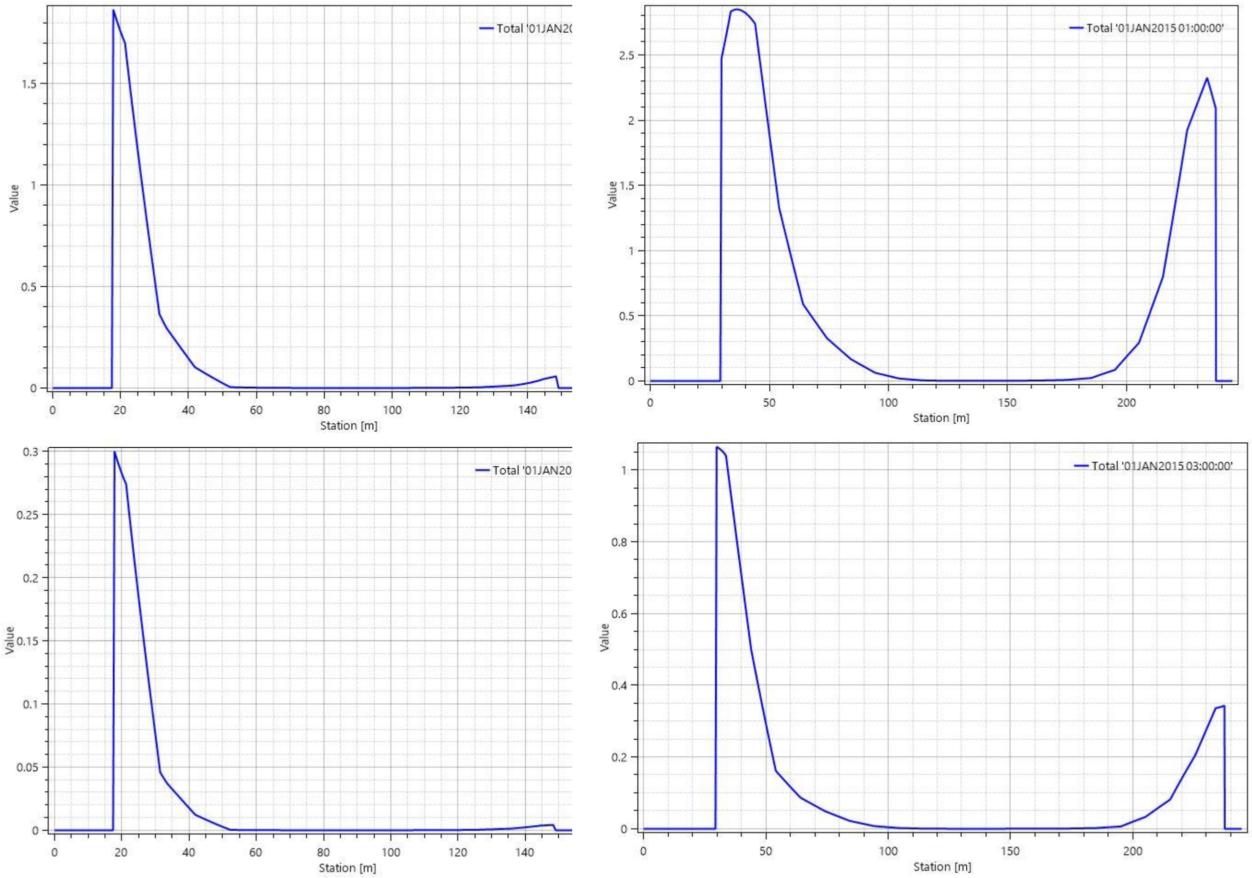
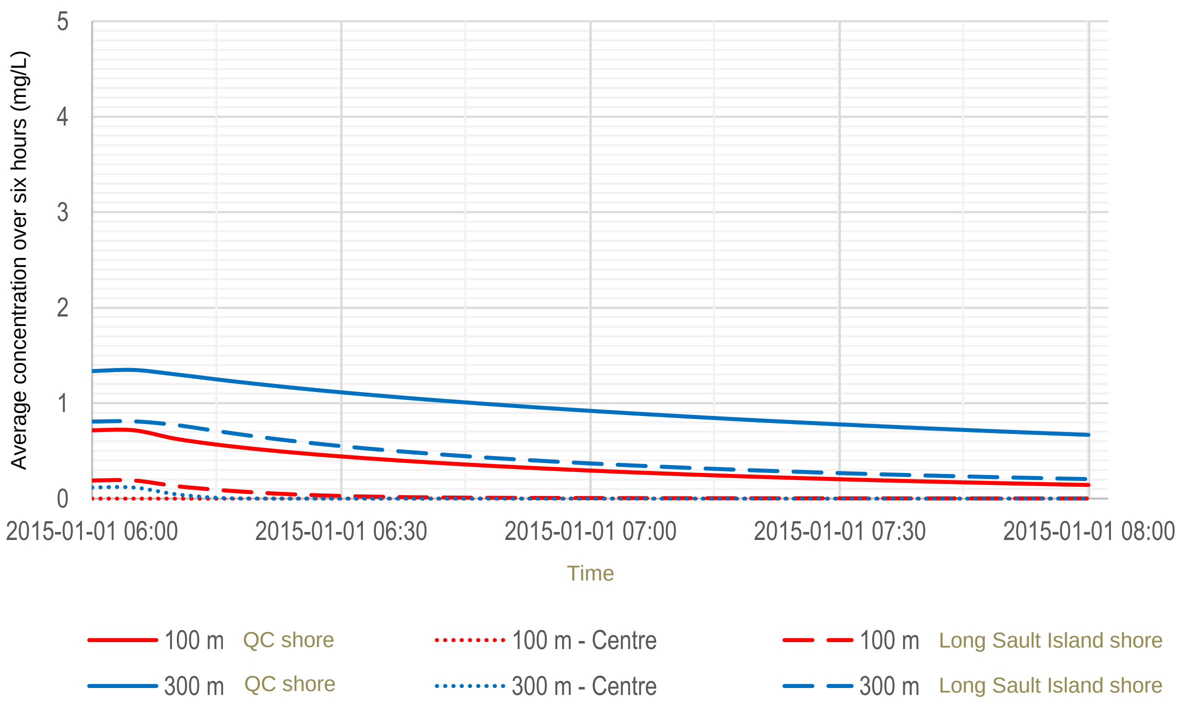


Figure 11-39 Scenario 5 – Evolution of the Average Concentration over 6 Hours at 100 m (in Red) and at 300 m (in Blue) along the Quebec Shore, in the Centre of the Channel and on the Long Sault Island Shore



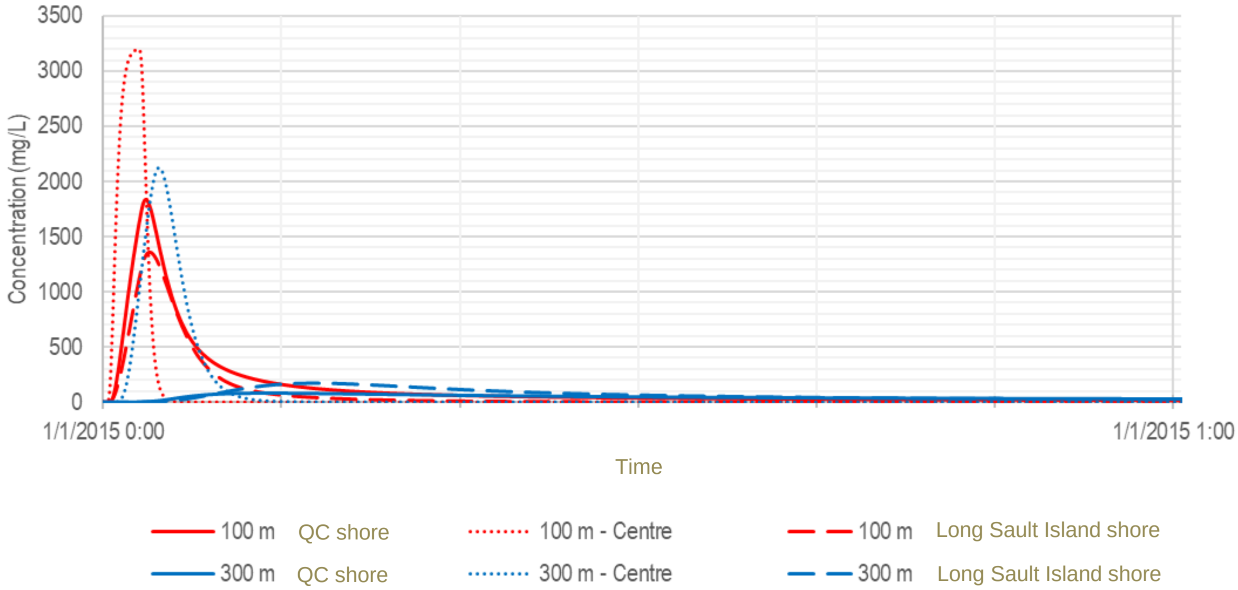
For this scenario (Scenario 5), as the plume of SS consists of a reduced volume of fine sand and loam, its impact on the riverbed is very limited and no significant variation is observed on the bottom after it passes. The only observable variations are in the plume itself, as some of the sediment is transported by bottom load. However, the variations caused during the passage of that bottom load do not last long (under 30 minutes) and are very limited in amplitude, as they are less than 1 cm in elevation.

In a hypothetical and very pessimistic situation where the amount of fine sediment left on the riverbed is greater and would correspond to 100% of the volume of silt accepted in the specifications (scenario 6), the results show that the rate of dispersion of the material in the environment would be similar to that observed in Scenario 5 (Figure 11.38), but the concentrations within the plume would be much higher, with maximum values of 3,194 mg/L at 100 m and 2,122 mg/L at 300 m (Figure 11.40). These values are reached in the center of the channel, but concentrations along the banks also remain high, with maxima of 1,359 to 1,836 mg/L at 100 m, and 81 to 171 mg/L at 300 m. These SS peaks are reached two minutes (at 100 m) and ten minutes (at 300 m), respectively, after the dam reopens. It takes about 40 minutes for concentrations at 100 m to return below the DFO’s thresholds of 25 mg/L, and between two and a half and five hours for concentrations at 300 m to fall below the DFO’S thresholds of 5 mg/L.

After one hour, the plume already extends to the tip of the Long Sault Island and concentrations within it can still reach 30 mg/L, especially along the Quebec side of the river where SS concentrations decrease more slowly than in the center of the channel or along the Long Sault Island shoreline (Figure 11.41). The model results show that SS concentration along the Quebec shoreline exceeds DFO's allowable thresholds at 300 m for more than five hours, compared to two and a half hours along the Long Sault Island and ten minutes in the center of the channel. The six-hour average SS concentrations exceeded DFO's authorized thresholds for more than three hours at 300 m, with maximum values between 5.5 and 11.8 mg/L (Figure 11.42). In contrast, the six-hour average concentrations at 100 m do not exceed DFO’s criteria, with calculated maximum values reaching only 4.1 mg/L after six hours. Although this is where the SS peak is highest, the very short duration of the event means that the weight of these values on the six-hour geometric mean is low and explains why the DFO’s criterion was not exceeded at 100 m, despite a SS peak of more than 3000 mg/L. On the other hand, the criterion is exceeded at 300 m because SS concentrations remain high for a longer period of time (between two and a half and five hours), so the influence of these values on the geometric mean is not negligible.

With regard to the impact of sediment transportation on the morphology of the riverbed, the results of the modeling indicate that this is limited and that no significant variation is observed on the riverbed after the passage of the plume of material. The only observable variations are located at the level of the plume itself, but the thickness of the sediment do not exceed 1 cm and are therefore negligible.

Figure 11-40 Scenario 6 – Evolution of SS Concentrations at 100 m (in Red) and at 300 m (in Blue) along the Quebec Shore, in the Centre of the Channel and on the Long Sault Island Shore. The Top Graph shows the SS Concentrations during the First Hour after the Dam is Reopened. The Lower Graph Shows the Evolution of SS Concentrations during 8 Hours.



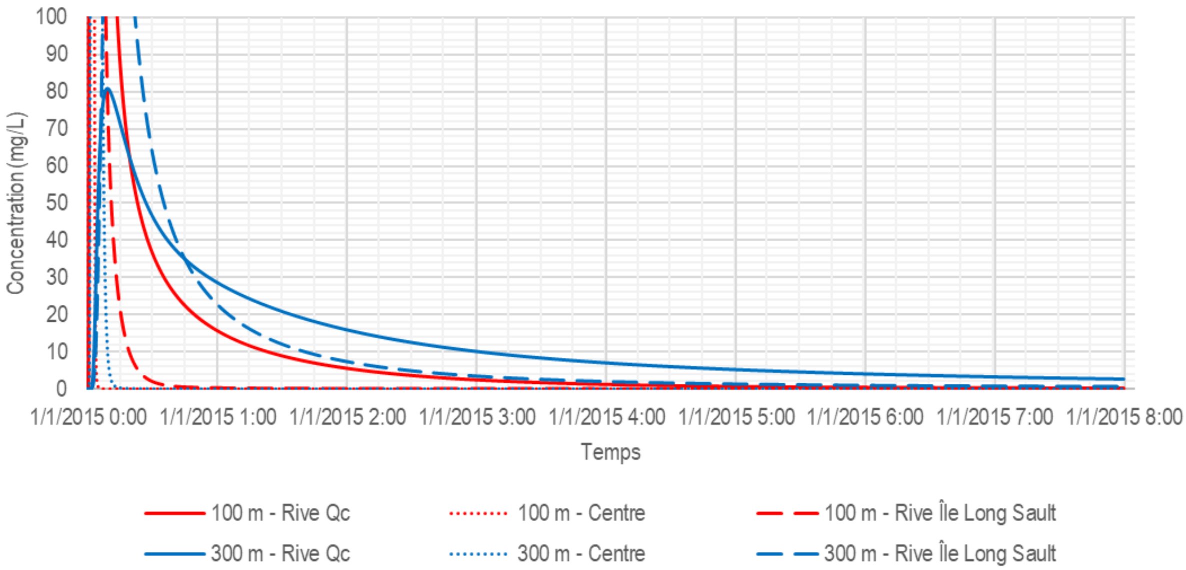


Figure 11-41 Scenario 6 – Plan View of the Plume of Sediment Dispersion after 1 Hour (Top Left) and after 6 Hours (Top Right), and Cross Profiles of Total SS Concentrations after 1 Hour and 6 Hours at 100 m (on the Left) and 300 m (on the Right)

All concentrations are in mg/L

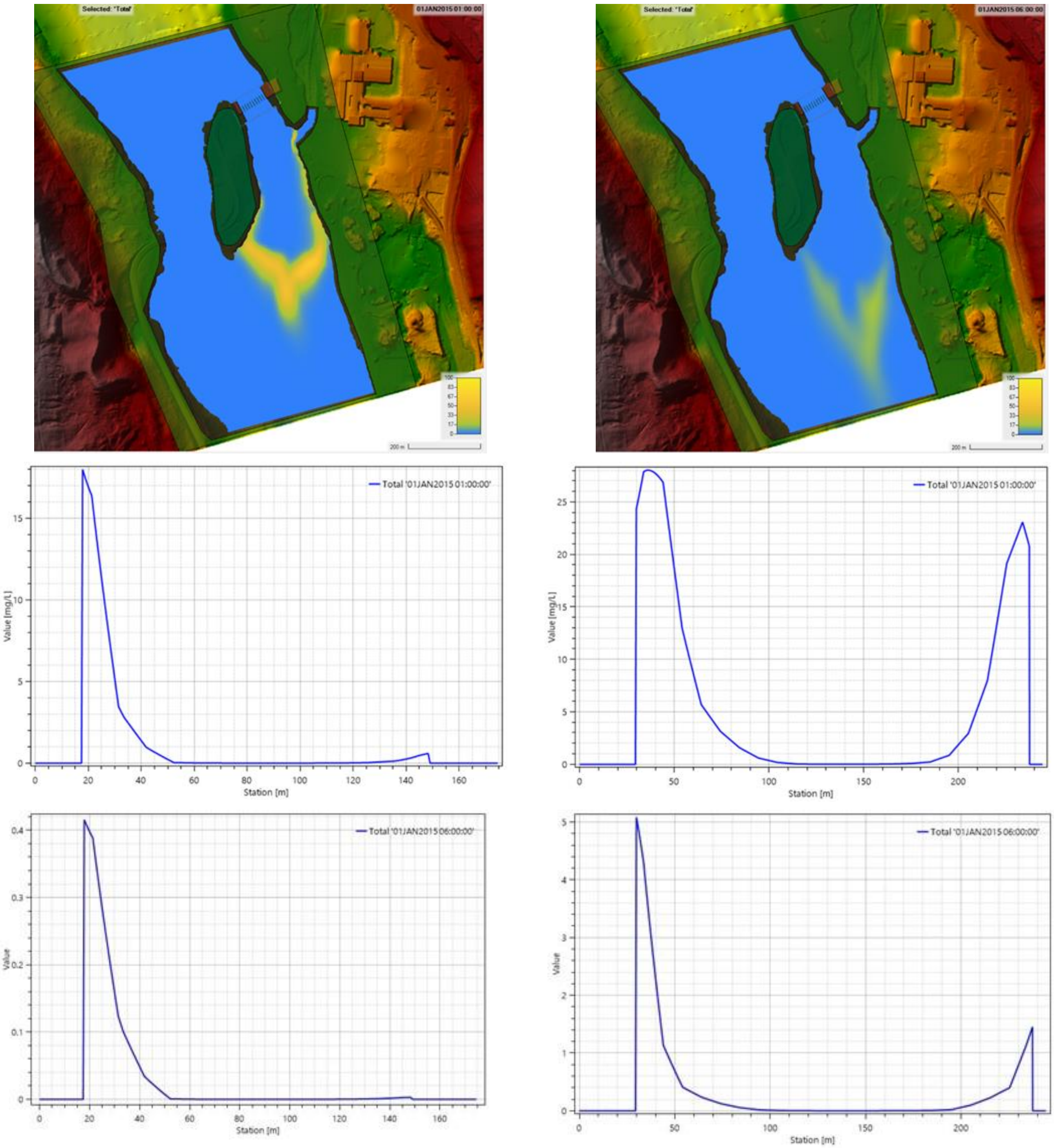
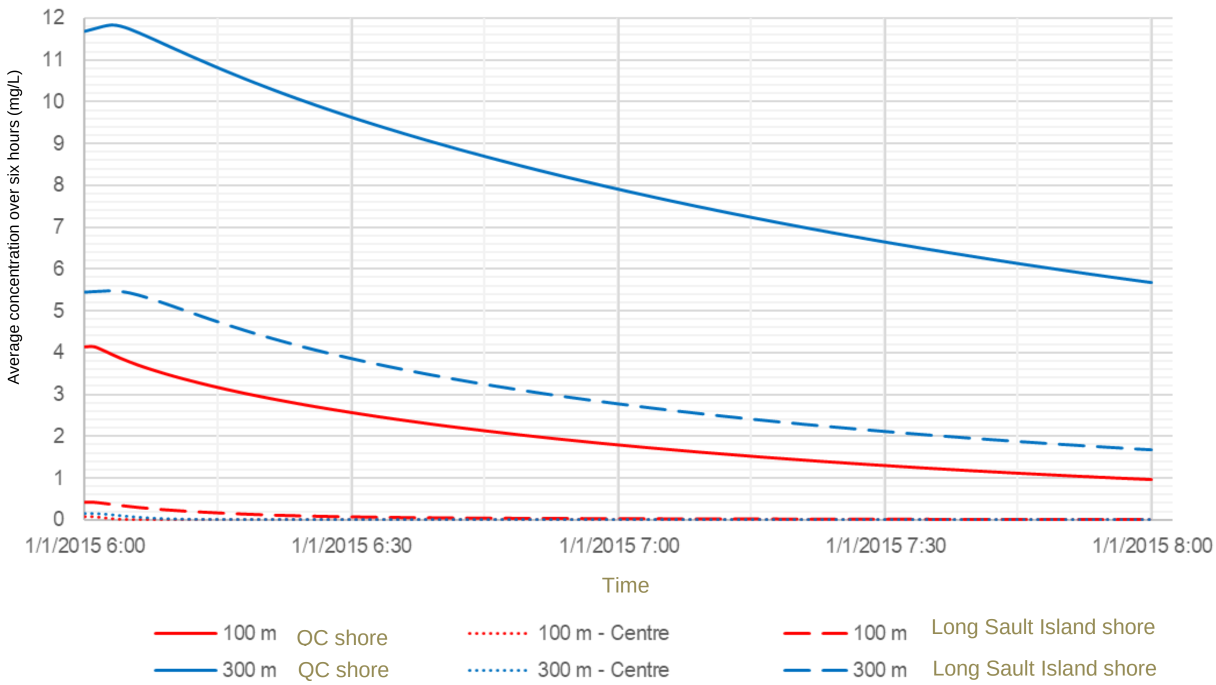


Figure 11-42 Scenario 6 – Evolution of the Average Concentration over 6 Hours at 100 m (in Red) and at 300 m (in Blue) along the Quebec Shore, in the Centre of the Channel and on the Long Sault Island Shore



Finally, in the case of a partial reopening of the Quebec dam (sluice gates 6 to 10) with 277.5 m³ of sandy-gravelly material left on the riverbed (Scenario 7), the models show that the rate of dispersion of the material in the environment is slower and has lower SS values because of the lower flow from the Quebec dam (Figure 11.43 and Figure 11.44). After one hour, the finest particles have already reached the tip of the Long Sault Island, while the coarser material is still located at the mouth of Gordon Creek. After six hours, the plume of fine material is no longer visible, while the plume of coarser material is still in the east channel. The maximum SS values observed over the modeling period are 52 mg/L at 100 m and 10.4 mg/L at 300 m. These values are observed in the center of the channel, while concentrations along the banks remain below the DFO's criteria at all times, with maxima of only 12.6 to 25.2 mg/L at 100 m, and 1.2 to 3.6 mg/L at 300 m. SS peaks are reached between ten and 20 minutes (at 100 m) after dam reopening and between 50 and 120 minutes (at 300 m), respectively. Two concentration peaks are present on the graphs. The first corresponds to the more mobile fine sediments (silts and fine sands), while the second peak corresponds to the transport of coarser sediments (coarse sand and gravel) with a slower movement speed. The second concentration peak occurs between 60 and 170 minutes after the first peak at 100 m from the construction area, while it occurs about six hours after the first peak at 300 m.

With respect to the six-hour average concentration calculated by the geometric mean method, the values do not exceed 17.4 mg/L at 100 m and 2.4 mg/L at 300 m, well below the limits required by DFO.

As for the impact on the riverbed, it is again very limited and no noticeable change is observed on the riverbed after the passage of the plume. The only observable variations are located at the level of the plume itself, since part of the sediment transport is carried out by bed load, but the thickness of the sediment does not exceed 5 cm locally and the morphology of the riverbed returns to its natural elevation once the plume of material has gone.

Figure 11-43 Scenario 9 - Evolution of SS Concentration at 100 m (Red) and 300 m (Blue) along the Quebec Shoreline, in the Center of the Channel and along the Shoreline of Long Sault Island

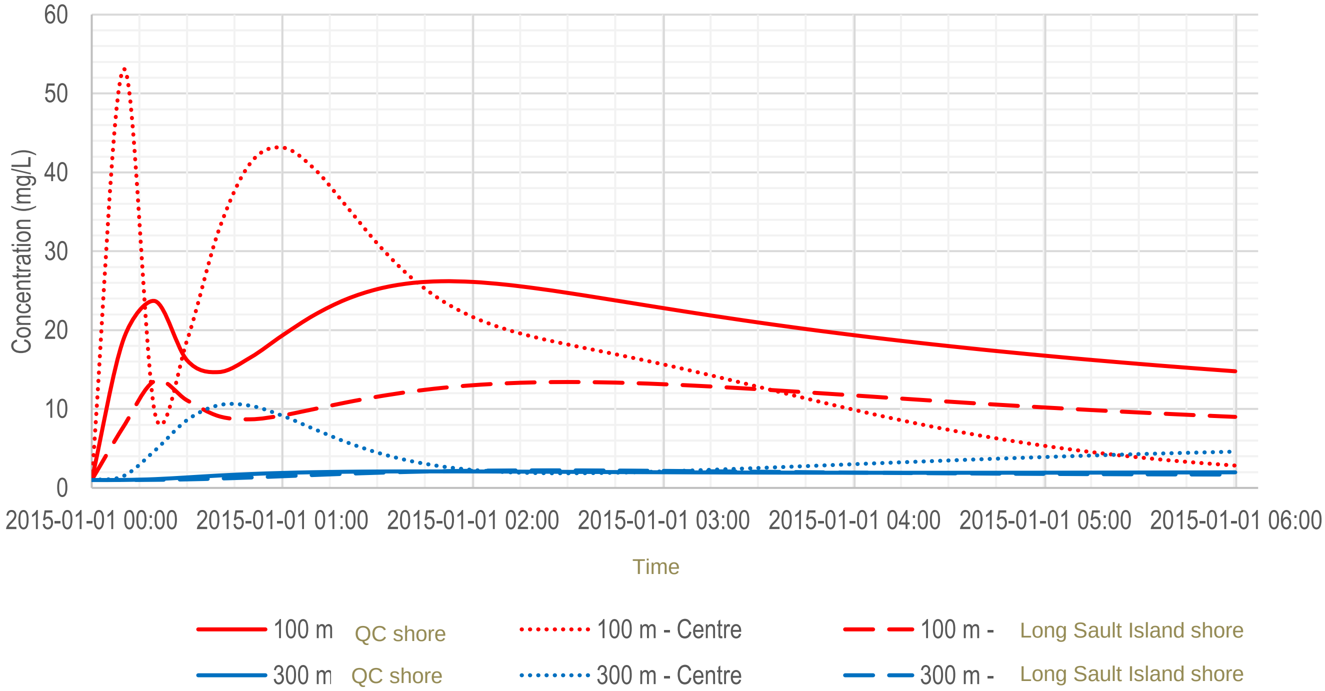
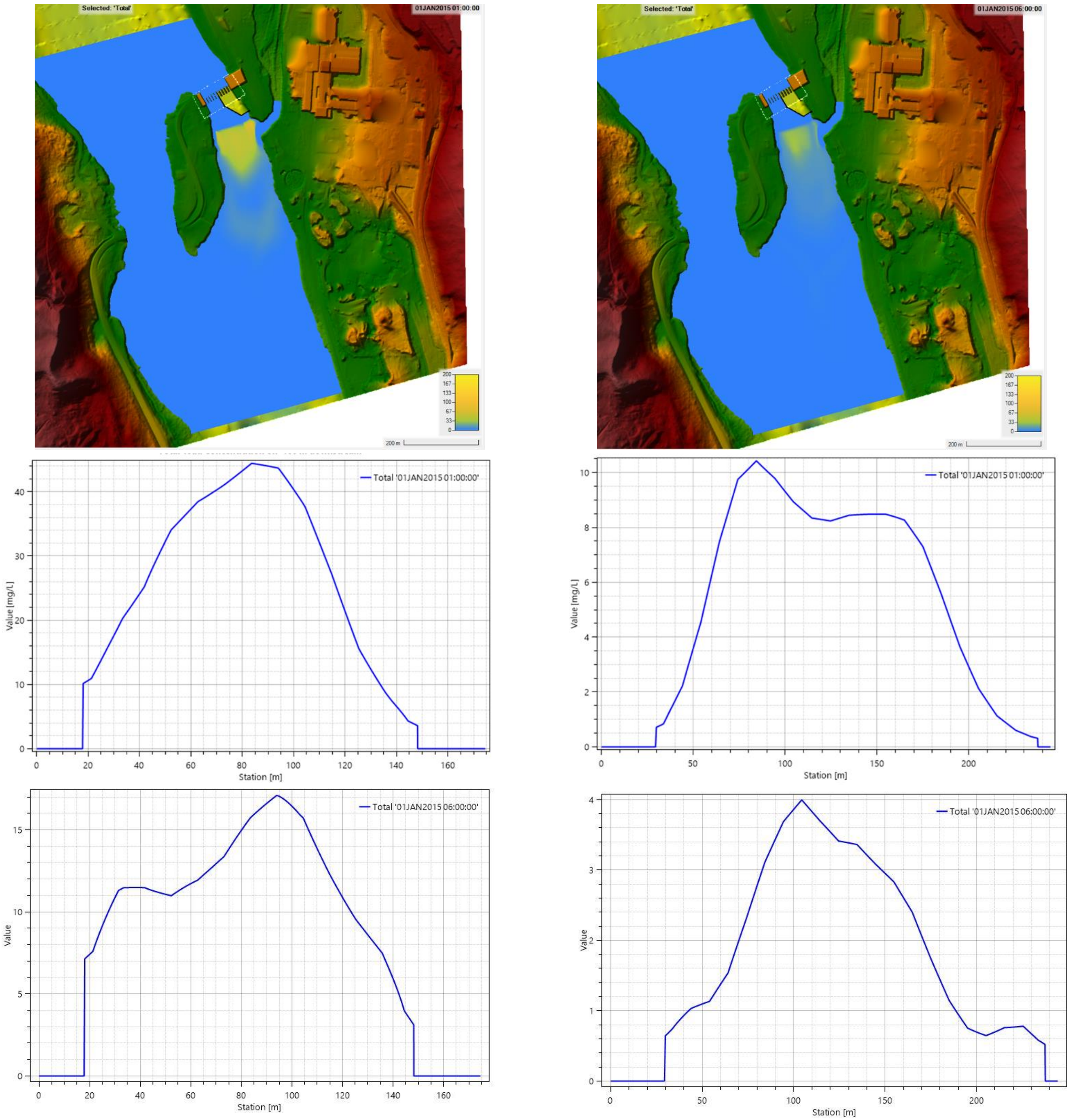


Figure 11-44 Scenario 9 - Plan Views of the Sediment Dispersion Plume after 1 Hour (Top Left) and after 6 Hours (Top Tight), and Cross-sectional Profiles of Total SS Concentrations after 6 Hours at 100 m (Bottom Left) and 300 m (Bottom Right)

All concentrations are expressed in mg/L.



In conclusion, although hydrodynamic conditions on their own should make it possible to meet the SS concentration criteria 100 m and 300 m downstream of the site, SS concentrations and the impacts of the turbidity plume on the fish habitat could be further reduced by using turbidity curtains. For this reason, a turbidity curtain will be installed during Phase 1 to improve the control of SS dispersion into the environment.

In addition, a sensitivity analysis shows that the DFO thresholds are not met if 227 m^3 of material is left in place (1/16 of material under 5 mm used for the cofferdam in Phase 1) (Scenario 9). The contract will therefore include an obligation to recover at least 97.5% of material from the construction of the cofferdam in Phase 1 when it is removed in order to minimize the potential environmental impacts associated with the resuspension and transportation of the material not recovered when the new Quebec dam is recommissioned.

11.2.3.4.2 Contaminants other than SS

During consultations with Indigenous communities, several concerns were raised about the emission of other contaminants into the water, such as mercury or metals, or organic matter and other residues accumulated in the river downstream from Gordon Creek, along the left shore.

Simulations show that velocities in areas where such accumulations are present will be similar to those seen during all phases of the work and during operation. Hydraulic modifications related to the construction will therefore have no impact on those areas.

As noted, there is very little fine sediment in the work area. A characterization of sediment, if any, will be conducted in the area between the cofferdam and the current dam to determine its quality and manage it based on its level of contamination before the cofferdam is removed (see Section 22.5 for the characterization program). The turbidity curtain to be installed downstream before the cofferdam is put in place will help keep those particles near the work area.

Based on the results of the characterization of the sediment at Station 1 (Table 11.5, Section 11.1.9), which should be representative of the sector downstream from the dam, only mercury exceeds the criteria for protecting aquatic life. In general, metals, including mercury, are highly absorbed by fine sediment and especially by organic matter. There is ample scientific literature demonstrating the high affinity of natural organic carbon for mercury and considerable evidence exists demonstrating that environmental mercury frequently is associated with natural organic matter (Loux, 1998).

For instance, controlled experience showed that adsorption percentages for the concentrations of sediment (200 and 1000 mg/L) and metals (1 mg/L) reached the following maximum values: Pb (99-l00%), Zn (80-90 %), Cd (75-85 %) and Cu (70-80%) (Serpaud *et al*., 1994)

Other authors stated that ionized forms of mercury are strongly adsorbed by soils and sediments and are desorbed slowly. Mercury also can exist in organic forms with the most frequently encountered in nature being methylmercury ($(CH_3)_2Hg$). Mercury methylation is primarily a result of anaerobic microbial activity in sediments, which is typically enhanced in environments with high concentrations of organic matter (USEPA, web page: CLU-IN | Contaminants > Mercury > chemistry and behavior).

In other controlled adsorption experiments, it was shown that newly added HgO was rapidly adsorbed to the sediment and this adsorption was positively correlated with the organic matter content and negatively correlated with the particle size and dissolved oxygen concentrations of the water immediately above the sediment. Artificial change in sediment pH did not significantly influence HgO adsorption to sediment (Bouffard, 2008).

In the aquatic environment, mercury is generally adsorbed on organic matter. It can exist in three forms: elemental, Hg+ and Hg2+. The two oxidized forms of mercury can be methylated by microorganisms under aerobic and anaerobic conditions. However, the production rate of methylmercury increases when the oxygen content in the environment decreases. Furthermore, solubilization and methylation are higher under acidic conditions (Jaagumagi, 1992, Development of the Ontario Provincial Sediment Quality Guidelines for Arsenic, Cadmium, Copper, Iron, Lead, Manganese, Mercury, Nickel, and Zinc. Water Resources

Branch, Ontario Ministry of the Environment mentioned in Répercussions environnementale du dragage et de la mise en dépôt des sediments. 1994. Les consultants Jacques Bérubé pour Environnnement Canada). The Canadian guidelines for the Protection of Aquatic Life provides detailed explanations about the chemistry of mercury and how it is transformed in methylmercury (Canadian Water Quality Guidelines for the Protection of Aquatic Life - Mercury - Inorganic mercury and methylmercury (ccme.ca)).

Given the very low quantity of fine sediments in the area of the cofferdam, the fact that mercury and metals are strongly bond to sediments and organic matter, and that the work will not strongly disturb the sediment (no dredging work), there are no risks of these contaminants being desorbed to the point that they affect water quality, given the significant volume of water in the river.

The discharge of concrete mixer wash water directly into the aquatic environment without prior treatment can also affect the pH of the water. The contractor will have to reuse that water or treat it so water quality criteria are respected before releasing it in the environment. Water sampling will be conducted daily to ensure the respect of water quality criteria. A Waste Water Management Plan will also be prepared for the Project.

11.2.3.4.3 Debris from the Demolition of the Existing Dam

In general, the debris will consist primarily of concrete, which could increase the pH of the water at times due to its basic nature.

During the demolition of the existing dam, the new dam will be closed to serve as a cofferdam downstream and a turbidity curtain will be installed upstream as a preventive measure. The area will be practically waterproof. Debris that falls into that area will therefore not affect the water quality downstream, as it will not be in direct contact with that water. All debris will be recovered before the new dam opens at the end of this phase. A Waste Management Plan that will include waste reduction workplans will be prepared including debris from the demolition as well as all other debris and waste from the construction site.

11.2.3.4.4 Demolition and New Dam Presence - pH Change

Concrete is made of natural materials, those being aggregates (gravel, pebbles, sand), cement (composed of limestone and clay) and water. Aggregates and cement materials come from quarries or sandpits authorized by provincial governments subject to provincial government regulations which do not allow for the addition of contaminants. Admixtures (chemicals) are generally added during the mixing of concrete in small quantities (less than 5% of the mass of the concrete) to improve certain characteristics such as its setting or sealing time[24].

Little information is available regarding the effect of the presence of a concrete structure on surrounding water quality and fish habitat. Two studies address the subject of the impact of concrete on water quality.

The first study compares the water quality impact that PVC pipe and concrete pipe have on water quality in a rainwater harvesting system (Davies *et al*., 2010). To make the comparison, three types of water were used, namely: water from roofs (pH of 4.79), water from a reference watercourse in a natural environment (pH of 5.5) and water from a watercourse draining an urban environment (pH of 7.35). The study demonstrates that the concrete pipe has a significant effect on the quality of water from rooftops and natural stream water; specifically, a significant increase in pH and certain other parameters including calcium and bicarbonate levels. The changes were less significant in the water from the stream already draining an urban environment as it had a higher starting pH than the other two water sources. The study therefore suggests that concrete would have a significant influence on water chemistry (e.g. increase in pH), particularly for water with a more acidic pH. This influence would be due to the dissolution in an acid medium of the potassium, bicarbonate and calcium ions of the concrete pipe.

[24] http://www.guidebeton.com/composition-beton

The second study characterizes the water leaching potential of three different construction products, including concrete slabs (Cone Shiopu, 2007). After several tests carried out on the concrete slabs (leaching tests, physicochemical characterization and pilot scale test), the study concludes that the concrete slabs impose a basic pH on the medium and have a strong acid-base neutralization capacity. Concrete has a high resistance to external aggressions with respect to the release into the water. The contact time of water with building materials has a direct influence on leaching from materials, including concrete.

Based on these two studies, although concrete is an inert material when cured, it appears to have an effect on the pH of water, i.e. concrete tends to raise the pH of the surrounding water. The more acidic the water in the contact medium, the higher the increase in pH will be and the longer the contact time with the water (standing water vs. runoff), the higher the increase in pH will also be. In this case, the pH of the water at the Timiskaming dam is on average 7.3 (varying from 6.8 to 7.4 – Table 11.10), which is slightly acidic. In addition, the contact time between the water passing through the sluice gates and the concrete itself is very short (high water velocity). Consequently, and also considering the high flows passing through the dam, the effect should not be perceptible or detectable downstream. It should be recalled that the water quality criteria for the protection of aquatic life state that the pH must be between 6.5 and 9.0.

11.2.3.4.5 Construction and Operation of the Dam – De-icing Salts

De-icing operations on the road that crosses the bridge, both during construction and operation, are likely to affect the water quality through the release of chlorides, if they reach the aquatic environment. This situation is similar to the current situation. The departments of transport responsible for maintaining roads and bridges already have guidelines for minimizing the spread of de-icing salts into sensitive areas and for choosing substances that have the least possible impact on waterways. Here again, given the large volumes of water going through this area, there is a lot of dilution and this effect is undetectable in the results from the water quality monitoring stations.

11.2.3.4.6 Operation of the Dam – Water Temperature

Given that the water will flow through sluice gates that open from bottom to top instead of beams that open from top to bottom, the water going through the dam will come more from the bottom of the Lake Timiskaming than from the surface layer. In deep lakes like the Lake Timiskaming, there is a thermocline during the summer and the surface water is warmer than the deep water. In the fall, we see a natural disturbance of the water in which thermocline disappears and the water temperature is relatively uniform throughout the water column in the winter and spring. This would suggest that the temperature of the water going through the sluices would be colder that what goes over the beams in the future in the summer. However, the reach upstream from the dam is much shallower than the rest of the lake and the disruption of water from high velocities on the approach to the dam is significant, such that it is very likely that there will be no thermocline there in the summer and that the water will be the same temperature throughout the water column. In addition, as it goes through the dam, there is a significant mixing of the water column, which also mitigates potential temperature differences compared to the current situation. In short, it would be highly unlikely that there would be a significant difference in water temperature downstream from the dam compared to the current situation.

11.2.3.4.7 Accidental Spills from Machinery during Construction and Operation

Similar to the effects on soil quality, an accidental spill can have a significant impact on water quality if the hydrocarbons reach the aquatic environment. Preventive measures and an emergency plan serve to prevent such situations and manage them quickly when they occur.

11.2.3.4.8 Assessment of the Residual Effect

Several mitigation measures, summarized below, are possible to avoid or limit the various anticipated or potential negative effects on water quality.

Possible effect: Contamination of surface water	
Potential interaction	Mitigation measures
During construction, water quality could be altered when preparing the site (earthworks, etc.), during construction, due to water control (cofferdam), construction and demolition of the existing dam. During operation, alteration could occur during maintenance and repair work (painting, descaling, etc.). In an emergency, alteration could occur due to a spill or malfunction.	Work Preparation 1. Begin work on the start-work date. 2. Limit work to the designated work areas. 3. Recover trees and arable land. 4. Follow natural drainage patterns. 5. Avoid work and storage in the riparian strip (RS). 6. Provide areas for disposing of waste materials (and prepare a Waste Management Plan that will include waste reduction workplans). 7. Provide sediment and erosion control plan. 8. Provide a spill response plan. 9. Provide a health and safety plan. 10. Stabilize soils and plant vegetation. Construction Motors 11. Ensure they are in good condition, maintained and inspected. 12. Circulate in designated areas, outside waterways and RS, except when required and providing for cleanup. 13. Provide a response plan in the event of a leak or spill. 14. Handle petroleum products outside waterways and at least 30 m from them. Turbidity, SS and other contaminants 15. Sample and analyze sediments between the current dam and the turbidity curtain before the cofferdam is in place and manage them based on their level of contamination. 16. Avoid the discharge of turbid water (treat pump water before discharging it into an aquatic environment). 17. Control water with sediment or other barriers and treat water using appropriate methods, settling tanks, etc. 18. Install a turbidity curtain downstream before construction of the cofferdam begins. This turbidity curtain will be secured to the riverbed and all contours. 19. Install a turbidity curtain upstream before the demolition of the current dam. 20. Provide appropriate cleaning areas. 21. Recover all debris from the demolition of the existing dam before the new dam is opened. 22. Use clean equipment and avoid cleaning it in the waterways or in the RS. 23. Provide portable toilets. 24. Work in the waterway in designated areas and ensure containment of all work in water. 25. Sample concrete mixer wash water daily and treat them, if needed, so they respect water quality criteria before its release in the environment (prepare a Waste Water Management Plan) Debris and residual materials 26. Contain materials outside the waterway. 27. Provide appropriate storage areas. 28. Place residual hazardous materials (RHM) at least 30 m from the waterway.

<table>
<tr><th colspan="5">Possible effect: Contamination of surface water</th></tr>
<tr><td colspan="2">Potential interaction</td><td colspan="3">Mitigation measures</td></tr>
<tr><td colspan="2"></td><td colspan="3">29. Ensure that all discharged material is removed from the waterway.
30. Refuel equipment more than 30 metres from the river.
<u>End of work</u>
31. Recover at least 97.5% of the cofferdam construction material from Phase 1 during removal.
32. Provide for site cleanup.
33. Plant vegetation and stabilize the site and shoreline.</td></tr>
<tr><th colspan="5">Possible effect: Contamination of surface water (continued)</th></tr>
<tr><td colspan="2">Potential interaction</td><td colspan="3">Mitigation measures</td></tr>
<tr><td colspan="2">During construction, water quality could be altered when preparing the site (earthworks, etc.), during construction, due to water control (cofferdam), construction and demolition of the existing dam.

During operation, alteration could occur during maintenance and repair work (painting, descaling, etc.).

In an emergency, alteration could occur due to a spill or malfunction.</td><td colspan="3">34. Restore the riverbed.
<u>Operation period</u>
35. Ensure the containment of work to avoid discharges in the water.
36. Decontaminate and restore sites in the event of a spill.
<u>Emergency situations</u>
37. Provide an emergency procedure.
38. Provide sediment and erosion control measures.
39. Stabilize soils and plant vegetation.
40. Decontaminate and restore sites in the event of a spill.</td></tr>
<tr><th colspan="5">Residual effect</th></tr>
<tr><th>Magnitude</th><th>Geographic extent</th><th>Duration</th><th>Frequency</th><th>Reversibility</th></tr>
<tr><td>Low</td><td>Local</td><td>Medium</td><td>Cyclic</td><td>Reversible</td></tr>
<tr><th colspan="5">Overall Assessment: Non-significant</th></tr>
<tr><td>Monitoring and follow-up</td><td colspan="4">Monitoring is required to ensure the application of mitigation measures at the site to monitor the integrity of structures (cofferdam) and flows.
Assess the quality of sediments in the area between the turbidity curtain and the existing dam when turbidity curtain is in place (and before the construction of the cofferdam)
Monitor water quality during the work (SS or turbidity, temperature, pH, metals and mercury).
See Chapters 22 (Table 22.2) and 23 for more details</td></tr>
<tr><td>Comments</td><td colspan="4"></td></tr>
</table>

11.2.3.5 Ice Regime

During construction of the new dam, ice cover conditions immediately upstream and downstream of the dam will be directly affected by the construction phase. During the first phase, when the dam on the Quebec side will be completely closed (mid-July to December), hydraulic conditions will be conducive to the formation of a full and stable ice cover that could cover the entire east channel depending on temperatures in November and December in the year in which the work takes place (see Photo 11.6). Downstream, full ice cover may also be observed up to the confluence with Gordon Creek. Depending on the flow and temperature of the water in that creek, ice will likely not be able to form at its mouth (as is currently the case, with no ice forming there under current conditions).

Photo 11.6 Example of the Formation of Ice Cover Upstream from the Dam on the Ontario Side During Reconstruction Work due to Reduced Current Velocities. On the Right, we see the Quebec Side Completely Ice-free.

In the second and third phases of the work, when the left half of the bays on the Quebec dam will be closed (including the winter period from January to December of the second year), ice cover can be expected to form on the upstream side from the shoreline to extend toward the centre of the channel, running along the closed or partially closed bays. The extent may be limited to the areas with low velocities. The same phenomenon may be observed downstream in the protected area with low velocity due to the presence of the cofferdam on the left shore (half of the river).

Based on the description of the ice regime presented above, the new dam will have no significant impact on the formation and extent of the ice cover once the work is completed. The analysis conducted suggests that the ice regime is controlled by a combination of the thermal budget and flow velocity. These are dependent on weather conditions, the temperature of the river itself, warm water tributaries (typical temperatures of 1°C to 4°C) along the Ottawa River and the morphology of the river that generates an increase in flow velocities. The dam itself thus seems to have a very local impact on ice.

<table>
<tr><th colspan="5">Possible effect: Change to ice conditions upstream and downstream from the dam during construction</th></tr>
<tr><td colspan="2">Potential interaction</td><td colspan="3">Mitigation measures</td></tr>
<tr><td colspan="2">Change to the ice cover in the presence of the rock cofferdam (Phase 1) or the sheet pile cofferdam (Phases 2 and 3).</td><td colspan="3">NIL</td></tr>
<tr><th colspan="5">Residual effect</th></tr>
<tr><th>Magnitude</th><th>Geographic extent</th><th>Duration</th><th>Frequency</th><th>Reversibility</th></tr>
<tr><td>Low</td><td>Project footprint to local</td><td>Medium</td><td>Cyclic</td><td>Reversible</td></tr>
<tr><th colspan="5">Overall Assessment: Negligeable to non-significant</th></tr>
<tr><td>Monitoring and follow-up</td><td colspan="4">None</td></tr>
<tr><td>Comments</td><td colspan="4"></td></tr>
</table>

Appendix 11.1 - Data sheet - Contamination

Répertoire des terrains contaminés

Les renseignements présentés sont ceux qui ont été portés à l'attention du Ministère avant le 16 novembre 2020.

L'ensemble du répertoire compte 11278 enregistrements.
4 enregistrements répondent au critère suivant : Municipalité : Témiscaming

Exporter au format Excel | Raffiner votre recherche | Nouvelle recherche

Nom du dossier▲▼[3] / Numéro de la fiche▲▼	Adresse / Latitude Longitude (Deg. Déc. NAD83)	MRC	Nature des contaminants[1]		État de la réhabilitation (R)[2] et qualité des sols résiduels AVANT réhabilitation(Qav) APRÈS réhabilitation(Qap)	Date de création ou date de mise à jour▲▼
			Eau souterraine	Sol		
(08) Abitibi-Témiscamingue						
Emprise ferroviaire CP Angliers/Ville-Marie/Témiscaming 1573		Témiscamingue		Benzène (pot), Cuivre (Cu), Hydrocarbures aromatiques polycycliques*, Nickel (Ni), Produits pétroliers*, Soufre total (S), Xylènes (o,m,p) (pot)	R : Terminée en 2000 Qav : Non précisée Qap : Plage B-C	2005-09-07
Lumsden, Barrage de 6994	46,7281254817 -79,090331662	Témiscamingue		Cadmium (Cd), Chrome total (Cr), Cobalt (Co), Cuivre (Cu), Hydrocarbures aromatiques polycycliques*, Nickel (Ni), Plomb (Pb), Zinc (Zn)	R : Terminée en 2005 Qav : Non précisée Qap : Plage B-C	2006-07-19
Site Opémican - Pointe Opimica 10554	46,8321679834 -79,1913002562	Témiscamingue	Cuivre (Cu)	Benzo(a)anthracène, Benzo(a)pyrène, Benzo(b+j+k)fluoranthène, Benzo(c)phénanthrène, Benzo(g,h,i)pérylène, Chrysène, Fluoranthène, Hydrocarbures aromatiques polycycliques*, Hydrocarbures pétroliers C10 à C50, Indéno(1,2,3-cd)pyrène, Méthyl naphtalènes (chacun), Plomb (Pb), Zinc (Zn)	R : Non terminée Qav : > RESC Qap : Non précisée	2017-10-25
Station-service Pétroles Esso Canada 1525	527, chemin Kipawa Témiscaming 46,722638 -79,09464	Témiscamingue	Benzène, Éthylbenzène, Hydrocarbures pétroliers C10 à C50, Toluène, Xylènes (o,m,p)	Benzène (pot), Éthylbenzène (pot), Hydrocarbures pétroliers C10 à C50, Toluène (pot), Xylènes (o,m,p) (pot)	R : Terminée en 1993 Qav : > C Qap : Plage B-C	2014-10-30

(1) : Certains renseignements concernant ce terrain n'y apparaissent pas compte tenu qu'ils sont susceptibles d'être protégés en vertu de la Loi sur l'accès aux documents des organismes publics et sur la protection des renseignements personnels. Si vous désirez obtenir la communication de ces renseignements pour ce terrain en particulier, vous devez en faire la demande au répondant régional en matière d'accès à l'information. Votre demande sera alors examinée et une décision sur l'accessibilité à ces renseignements sera rendue et vous sera communiquée dans les délais légaux.

(2) : L'inscription « R : Non nécessaire » signifie qu'il n'est pas nécessaire de réhabiliter le terrain puisque le résultat d'une étude de caractérisation démontre que le niveau de contamination des sols est jugé conforme à l'usage actuel du terrain. Par exemple, un niveau de contamination situé dans la plage B-C est conforme à un usage industriel.

(3) : Peut ne pas correspondre au nom du propriétaire actuel.

* : Contaminant non listé dans la Politique de protection des sols et de réhabilitation des terrains contaminés.

Gouvernement du Canada Government of Canada

Secrétariat du Conseil du Trésor du Canada

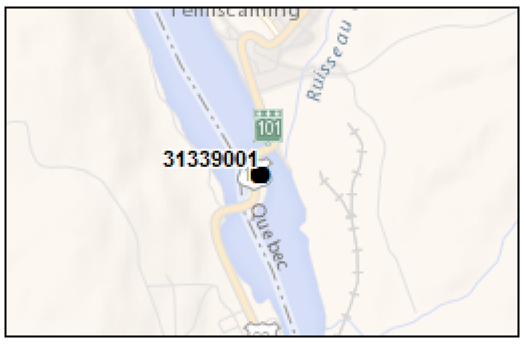
Site 31339001 - Barrage de Témiscamingue (côté ontarien)

Statut	Échantillonnage de confirmation terminé. Aucune autre mesure nécessaire.
Statut du site	Fermé
Type de classification	Priorité d’intervention nulle

Détails du Site

Organisation déclarante	**Services publics et Approvisionnement Canada**
Raison de la participation	Biens immobiliers fédéraux
Type de bien	Fédéral (Numéro du bien **31339**)

Emplacement du site



Latitude, Longitude	46,71033, -79,101
Municipalité	Témiscaming, QC
Circonscription électorale fédérale	Abitibi--Témiscamingue

Stratégie de gestion du site

- Autre type de gestion

Détails de la contamination

Estimation de la contamination

Mètres cubes	30

Les milieux contaminés suivants ont été identifiés sur le site :

Type de contaminant	Type de milieu
HCP (hydrocarbures pétroliers)	Sol
HAP (hydrocarbures aromatiques polycycliques)	Sol

Plan d'action

Selon l'utilisation actuelle de la propriété, aucune autre action future n'est nécessaire

Renseignements additionelles

Des sols contaminés aux hydrocarbures pétroliers ont été observés dans le garage, à proximité de la fosse de réparation.

Population

Le tableau contient les estimations de la population dans les environs du site.

Rayon	Population
1 km	55
5 km	1 589
10 km	1 971
25 km	3 705
50 km	23 411

Renseignements financiers/annuels

2009-2010 | **2008-2009** | **2007-2008** | **2006-2007** | **2005-2006**

2009-2010

Organisation déclarante	Services publics et Approvisionnement Canada
Identificateur interne	National Capital 31339001

Mesure la plus élevée prise	**09** Échantillonnage de confirmation et rapport final
Total des dépenses pour les travaux d'évaluation	0,00 $
Total des dépenses de restauration	0,00 $
Total des dépenses d'entretien et maintenance	0,00 $
Total des dépenses suivi	0,00 $
Dépenses d'évaluation dans le cadre du PASCF	0,00 $
Dépenses de restauration dans le cadre du PASCF	0,00 $
Dépenses d'entretien et maintenance dans le cadre du PASCF	0,00 $
Dépenses suivi dans le cadre du PASCF	0,00 $
Superficie réelle restaurée en mètres cubes	0 m^3
Superficie réelle restaurée en hectares	0 ha
Poids réel restauré en tonnes	0 t
Fermée	Oui

Version: 32.0