Development of a New Landfill in Nemaska – Environmental and Social Impact Assessment

FINAL REPORT

Prepared for:

Cree Nation of Nemaska

Prepared by:

Stantec Consulting Ltd.

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Approval Registry

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Table of Contents

ABBREVIATIONS ..... **VI**

GLOSSARY ..... **VII**

1.0 INTRODUCTION **1**

1.1 PROJECT PROPONENT 2
1.2 MANDATED CONSULTANT 2
1.3 PROJECT LOCATION 2
1.4 LEGAL CONTEXT 5
1.4.1 James Bay and Northern Quebec Agreement 5
1.4.2 Federal Legislation 5
1.4.3 Provincial Legislation 6
1.4.4 Waste Management – Municipal By-Laws 7
1.5 PROJECT JUSTIFICATION 8
1.5.1 Existing Waste Management Facilities 8
1.5.2 Population Projections 8
1.5.3 Waste Projections and Landfilling Needs 8

2.0 SITE AND ACCESS ROAD SELECTION PROCESS **10**

2.1 TECHNOLOGICAL OPTIONS STUDIED 10
2.2 SITE SELECTION PROCESS 11
2.3 ACCESS ROAD SELECTION PROCESS 12

3.0 PROJECT DESCRIPTION **14**

3.1 PROJECT CONSTRUCTION 14
3.1.1 General Site Layout 14
3.1.2 Access Road 15
3.1.3 Trench Landfill 16
3.1.4 Construction Workforce and Schedule 18
3.2 PROJECT OPERATIONS 19
3.2.1 Access Road 19
3.2.2 Main Gate and Fences 19
3.2.3 Landfill Operation Activities 20
3.2.4 Closure and Post-closure Management of the Proposed Landfill 22
3.3 PROJECT COSTS 23
3.4 INTEGRATION OF QUEBEC SUSTAINABLE DEVELOPMENT OBJECTIVES 24

4.0 DESCRIPTION OF RECEIVING ENVIRONMENT **26**

4.1 STUDY AREA 26
4.2 PHYSICAL ENVIRONMENT 26
4.2.1 Project Location Ecological Context 26
4.2.2 Topography, Geology and Surficial Deposits 29

4.2.3 Hydrography and Hydrogeology 29
4.2.4 Climate 33
4.3 NATURAL ENVIRONMENT 35
4.3.1 Survey Area 35
4.3.2 Vegetation 35
4.3.3 Wetlands 41
4.3.4 Aquatic Wildlife 43
4.3.5 Terrestrial Wildlife 44
4.3.6 Avian Wildlife 45
4.4 HUMAN ENVIRONMENT 45
4.4.1 Demographics and Socio-economic Context 45
4.4.2 Infrastructure and Services 46
4.4.3 Emergency Response 47
4.4.4 Transportation Network 47
4.4.5 Land Use and Tenure 47
4.4.6 Archaeological and Cultural Resources 48

5.0 CONSULTATION AND ENGAGEMENT 53

5.1 METHODOLOGY 53
5.1.1 Interviews with the Tallyman of Trapline R16 53
5.1.2 Radio Show 53
5.1.3 Information and Consultation Sessions (2) 53
5.2 RESULTS 54
5.2.1 Main Concerns and Questions from CNN Members 54
5.2.2 Recommendations from CNN Members 55

6.0 IMPACT ASSESSMENT METHOD 57

6.1 SELECTION OF VALUED COMPONENTS 57
6.2 POTENTIAL INTERACTIONS BETWEEN PROJECT AND VC 58
6.3 IMPACT ASSESSMENT CRITERIA 58
6.3.1 Value of Component 58
6.3.2 Degree of Disturbance 60
6.3.3 Intensity of Impact 60
6.3.4 Extent of Impact 61
6.3.5 Duration of Impact 62
6.4 MITIGATION OF NEGATIVE IMPACTS 62
6.5 DETERMINATION OF IMPORTANCE OF RESIDUAL IMPACTS 62

7.0 IMPACTS ON ENVIRONMENT 64

7.1 SOURCES OF IMPACT 64
7.2 IMPACT ON PHYSICAL ENVIRONMENT 66
7.2.1 Slope Stability / Soil Erosion 66
7.2.2 Surface and Groundwater 67
7.2.3 Soil Quality 69
7.2.4 Air Quality 71
7.2.5 GHG emissions 72



7.3 IMPACT ON BIOLOGICAL ENVIRONMENT 74
7.3.1 Vegetation 74
7.3.2 Wetlands 75
7.3.3 Terrestrial and Avian Wildlife 76
7.4 IMPACT ON HUMAN ENVIRONMENT 79
7.4.1 Land and Resource Use 79
7.4.2 Infrastructure and Equipment 82
7.4.3 Visual Environment 83

8.0 CLIMATE CHANGE IMPACTS ON PROJECT 86

9.0 ACCIDENTS, MALFUNCTIONS AND UNPLANNED EVENTS 87

9.1 FIRE 87
9.2 LEAKS AND SPILLS 87

10.0 ENVIRONMENTAL MONITORING AND FOLLOW-UP PROGRAMS 88

10.1 ENVIRONMENTAL MONITORING 88
10.1.1 Construction Phase 88
10.1.2 Operation Phase 88
10.1.3 Closure Phase 89
10.1.4 Post-closure Phase 90
10.2 ENVIRONMENTAL FOLLOW-UP PROGRAM 90
10.2.1 Groundwater Monitoring 90
10.2.2 Surface Water Monitoring 90
10.2.3 Sampling and Analysis Parameters 90

11.0 CLOSURE OF EXISTING LANDFILL 92

12.0 REFERENCES 93

LIST OF TABLES

Table 1-1 Provincial Regulation for Trench Landfills 7
Table 1-2 Population Growth Rates, 2022 to 2041 8
Table 1-3 Estimated Volume of Waste to be Landfilled in the New Nemaska Landfill (Including 10% of Soil for Cover), 2026–2060, in m^3 9
Table 2-1 Parameters Considered for Site Selection 11
Table 2-2 Access Road Option Features 12
Table 3-1 Road Construction Activities 15
Table 3-2 Volume of Materials, Capacity and Estimated Lifespan of the Site 17
Table 3-3 Construction Activities and Equipment Required 18
Table 3-4 Proposed Schedule for the Project 19
Table 3-5 Access Road Operation Activities 19
Table 3-6 Fence and Gate Operation Activities 20
Table 3-7 Landfill Operation Activities 21
Table 3-8 Opinion of Probable Construction Cost 23
Table 3-9 Opinion of Probable Annual Operation Cost 23

Table 3-10 Integration of Sustainable Development Principles in the Project 24
Table 4-1 Temperature, Rainfall, Snowfall, and Wind Normals Between 1981 and 2010 34
Table 4-2 Distribution of Nemaska Labour Force by Industry, in 2021 46
Table 5-1 Main Concerns and Questions 54
Table 5-2 Recommendations 55
Table 6-1 Value of Project Valued Components 59
Table 6-2 Evaluation Grid for the Determination of Impact Intensity 61
Table 6-3 Determination of Importance Evaluation Grid 63
Table 7-1 Project Interactions Summary Table 65
Table 7-2 Slope Stability / Soil Erosion Impact Summary Table 67
Table 7-3 Surface and Groundwater Impact Summary Table 69
Table 7-4 Soil Quality Impact Summary Table 70
Table 7-5 Air Quality Impact Summary Table 72
Table 7-6 GHG Emissions by Emission Source 72
Table 7-7 GHG Emissions by Phase 73
Table 7-8 Total Potential GHG Emissions Reduction 73
Table 7-9 GHG Emissions at the Provincial, National, and Sector-based Levels 74
Table 7-10 Vegetation Impact Summary Table 75
Table 7-11 Wetlands Impact Summary Table 76
Table 7-12 Terrestrial and Avian Wildlife Impact Summary Table 78
Table 7-13 Land Use Impact Summary Table 82
Table 7-14 Infrastructure and Equipment Impact Summary Table 83
Table 7-15 Visual Environmental Impact Summary Table 85

LIST OF FIGURES

Figure 3-1 General Site Layout 14
Figure 3-2 Access Road Typical Cross-sections 15
Figure 3-3 Berm Cross-section 16
Figure 3-4 Fence and Gate Section 17
Figure 3-5 Filling Sequence at the Landfill Site 21
Figure 3-6 Typical Cross-section of the Final Cover 22

LIST OF MAPS

Map 1-1 General Project Location 3
Map 4-1 Study Areas 27
Map 4-2 Groundwater Elevation 31
Map 4-3 Vegetation and Watercourse Survey 39
Map 4-4 Trapline R-16 49
Map 4-5 Archaeological Potential 51

LIST OF APPENDICES

APPENDIX A DIRECTIVE

APPENDIX B SITE SELECTION STUDY

APPENDIX C LANDFILL ACCESS ROAD OPTIONS STUDY

APPENDIX D DRAWINGS

APPENDIX E SURFACE WATER SAMPLES ANALYSIS RESULTS

APPENDIX F HYDROGEOLOGICAL ASSESSMENT REPORT

APPENDIX G GROUNDWATER SAMPLES ANALYSIS RESULTS

APPENDIX H CLIMATE IMPACT ASSESSMENT

APPENDIX I FLORISTIC AND BIOPHYSICAL DATA

APPENDIX J ARCHAEOLOGICAL STUDY

APPENDIX K GHG EMISSIONS REPORT

ABBREVIATIONS

ATV	All-terrain vehicle
CDPNQ	Centre de données sur le patrimoine naturel du Québec
COMEV	Environmental and Social Impact Evaluating Committee
COMEX	Environmental and Social Impact Review Committee
CNG	Cree Nation Government
CNN	Cree Nation of Nemaska
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
ESIA	Environmental and socio-economic impact assessment
GHG	Greenhouse Gas
JBNQA	James Bay and Northern Quebec Agreement
LSA	Local study area
MBCA	Migratory Birds Convention Act
MDDELCC	Ministère du Développement durable, de l'Environnement et de la Lutte contre les Changements climatiques
MELCCFP	Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs
MRNF	Ministère des Ressources naturelles et des Forêts
PDA	Project development area
RRLIRM	Regulation Respecting the Landfilling and Incineration of Residual Materials
RSA	Regional study area
SAR	Species at risk
SARA	Species at Risk Act
SDBJ	Société de développement de la Baie-James

GLOSSARY

Category III land	Pursuant to the *James Bay and Northern Quebec Agreement*, lands where Indigenous communities can pursue their hunting, fishing and trapping activities but only have exclusive rights on certain species
Cover materials	Soil or other granular materials that are spread over compacted waste
Diversion programs	Services that contribute to reducing the amount of waste ending up at the landfill, for example: recycling, composting or ecocentre services
Drumlin	A low hill composed of compact glacial till, or other kinds of drift, and shaped by the flow of the ice
Eeyou Istchee	The “People’s land”: traditional territory of the James Bay Cree, which includes 11 Cree communities
Intermittent watercourse	A watercourse that flows only at certain periods of the year
Leachate	The liquid that has been in contact with waste and has undergone chemical or physical changes; water which has percolated through stacked waste or organic materials
Mitigation	Preventing and/or minimizing potential negative effects from a development project through, for example, design features, construction practices or operational procedures
Monitoring well	A well (cavity constructed in the soil) which provides access to underground water for collection of water samples and other tests
Proponent	A company or other organization that intends to undertake a project, program or activity having potential environmental effects
Trapline	Area where harvesting activities are by tradition carried on under the supervision of a tallyman
Trench landfill	Landfill established within an excavated area

1.0 INTRODUCTION

The Cree Nation of Nemaska (CNN) is located in the Eeyou Istchee James Bay territory in the region of Northern Quebec on the shores of Champion Lake. The CNN was relocated there in 1977 because their initial establishment site was affected by a hydroelectric project. They are part of the Cree communities recognized by the James Bay and Northern Quebec Agreement (JBNQA).

The CNN currently operates a trench landfill that provides waste disposal services for its residents, establishments, businesses and the Hydro-Québec camp. The site is located 22 km from the community on the Route du Nord. This trench landfill has been in operation since 2000.

In 2010, a certificate of authorization was issued by the Ministère du Développement durable, de l'Environnement et des Parcs (now the Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP)) for the conversion of the Nemaska trench landfill, as defined under the Regulation respecting solid waste, into one that conforms to the Regulation respecting the landfilling and incineration of residual materials (RRLIRM). In 2012, the CNN conducted a Waste Management Master Plan Study (CNN, 2012) to determine the possible waste management options and landfilling needs in the next 30 years. The study determined that the current trench landfill lifespan was less than two or three years. Indeed, it was discovered that a part of the existing trench landfill's remaining areas cannot be used, as the groundwater is too close to the surface, reducing the trench landfill lifespan. Stantec prepared a Landfill Action Plan in 2014 that detailed short- and long-term options. The proposed long-term option was to build a new trench landfill. As the opening of a new site takes several years, it was required that the lifespan of the existing trench landfill be increased. The best option identified in the Landfill Action Plan was to develop a continuous trench above the already filled areas in the West section. This Project involved the excavation of soil and the installation of a berm. A modification of certificate of authorization was issued by the MDDELCC in July 2017 to cover these changes.

The CNN is planning to open the new landfill site near km 306 of the Route du Nord. The review process for this Project was initiated with the submission of a Project description by the proponent, the CNN, to the Administrator. In response, the directive was provided by the Administrator and the Environmental and Social Impact Review Committee (COMEV) in January 2020 (Appendix A). The ESIA was prepared on the basis of the Administrator and COMEV specifications.

1.1 PROJECT PROPONENT

The contact details of the Project proponent are as follows:

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Project Manager: Natasha M. Leroux – Capital Projects Manager
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Project Manager (Environment): Kenneth Tanoush – Director of Land and Sustainable Development
Phone: 819-673-2512, Ext. 305
Email: ktanoush@nemaska.ca

1.2 MANDATED CONSULTANT

The contact details of the consultant mandated by the Project proponent to carry out the environmental and social impact study are as follows:

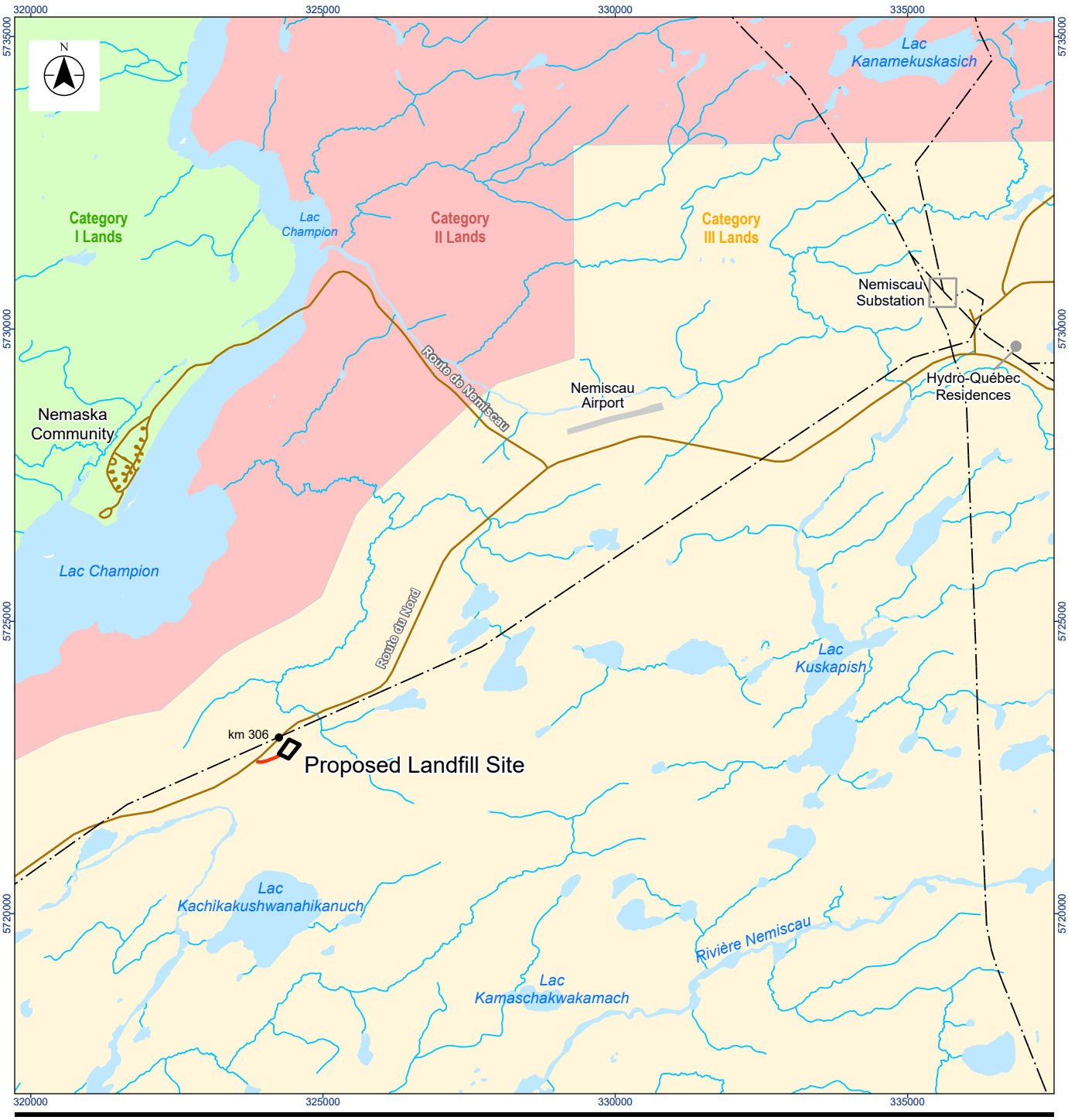
Consultant: Stantec
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Project Manager: Julien Rosset, BSc, MBA
Phone: 514-669-8924
Email: julien.rosset@stantec.com

1.3 PROJECT LOCATION

The proposed site for the new landfill is located approximatively 5 km southeast of the community of Nemaska along the Route du Nord, near kilometre point 306 (see Map 1-1).

The site is located at the following geographic coordinates: latitude 51.640546 and longitude -76.216502 (centre point).





- Proposed Landfill site
- Proposed Access road
- Watercourse
- Waterbody
- Road
- Power line

Land Category Limits

- Category I Lands
- Category II Lands
- Category III Lands

0 1 000 2 000 m

(At original document size of 8.5x11) 1:100 000

Notes

1. Coordinate System: NAD 1983 CSRS MTM 9
2. Data Sources: Stantec, 2019
3. Power Lines and Category Lands: Poly-Geo, 2016
4. Background: CanVec, 2018

Stantec

Project Location	Prepared by Prosper Ravo on 2024-03-06
Nemaska	TR by Émilie Charest on 2024-03-06
Québec	IR Review by Julie Massicotte on 2024-03-06

Client/Project 167020077-300-101-0001-0A_LocProj_20231201 REVA

Cree Nation of Nemaska
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Map No.
1

Title
Project Location

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1.4 LEGAL CONTEXT

1.4.1 James Bay and Northern Quebec Agreement

The JBNQA was signed by the nine communities of Eeyou Istchee (Grand Council of the Cree of Quebec) in 1975. The boundaries of the communities and related rights were set out in the JBNQA. Addressing issues such as housing, infrastructure, environmental protection and social and economic development, the Agreement influences the way in which planning takes place in the nine Cree communities. Section 5 of the Agreement defines the categories of lands (I to III) within the boundaries of the James Bay Territory. The proposed landfill is located on Category III lands, which are public lands where the Cree have harvesting rights, respecting the principle of conservation, so long as their activity does not conflict with public safety. Category III lands can be used for economic development.

Section 22 of the JBNQA establishes the environmental and social protection regime applicable in the territory of the JBNQA below the 55th parallel. It includes a complete environmental impact assessment and review process for development projects (Gouvernement du Québec, 1998). As per section 22.5.1, all developments listed in Schedule 1 are automatically subject to the impact assessment and review procedures. The list mentions solid waste collection and disposal, including land fill and incineration, which are automatically subject to an assessment (section 5.b).

1.4.2 Federal Legislation

1.4.2.1 Environment

The Impact Assessment Act (IAA) outlines the federal process for impact assessments and the prevention of significant adverse environmental effects. Projects designated by Physical Activities Regulations must undergo the impact assessment process. Regarding potential IAA triggers, there are no conditions within the IAA-issued Physical Activities Regulations that would designate this Project under the IAA.

The following federal regulations are applicable to the present Project:

- Species at Risk Act (SARA), which protects species listed under Schedule 1 of the federal SARA as Endangered, Threatened, or Special Concern;
- Migratory Bird Convention Act, 1994, which protects migratory birds, the nests of migratory birds and/or their eggs from harm;
- Fisheries Act, whereby fish and fish habitat are protected from destructive activities in marine and inland waters.

1.4.2.2 Transport Canada

The Transport Canada (TC) Guide to the Management of Wildlife Hazards (TC 2004) recommends that landfill sites be located more than 8 km from airports in order to limit potential impacts of the landfill on

airport management. A main concern is that landfill sites tend to attract birds, and this could disturb airport operations. The new landfill site is located 6.8 km from the airport.

1.4.2.3 Waste Management

At the federal level, the Indian Reserve Waste Disposal Regulations specify the obligation for a reserve or person to obtain a permit to be allowed to operate a landfill, use land for the disposal or storage of waste or burn waste on reserve land. The permits are given by the Minister of Indian Affairs and Northern Development or the Band Council if authorized by the Minister, and they must be renewed every year.

1.4.3 Provincial Legislation

1.4.3.1 Environment

Projects located on Category II and III Lands may be subject to the social and environmental impact assessment and review procedure under Chapter II of the Environment Quality Act (EQA) (R,S,Q). The projects automatically subject to the assessment and review procedure are listed in Schedule A of the Act, while the projects automatically exempted are listed in Schedule B.

Among the projects listed as automatically subject to the assessment and review procedure, the following applies to the Project: “(l) all systems for the collection and disposal of residual materials, except mine tailings and hazardous materials.”

The following provincial regulations are also applicable to the present Project:

- Act respecting threatened or vulnerable species (E-12.01 – LEMV, 2018), and Regulations, which protect floristic species designated as Threatened or Vulnerable;
- Act respecting the conservation and development of wildlife, which protects wildlife habitats designated by Regulations.

1.4.3.2 Waste Management

The Regulation respecting the landfilling and incineration of residual materials (RRLIRM) (Q-2, r.6.02) was introduced by the Gouvernement du Québec on May 12, 2005, and it came into effect on January 19, 2006. The RRLIRM applies to the establishment of all new solid waste disposal installations, as well as to the extension or enlargement of existing installations. On June 3, 2011, a new Regulation respecting the landfilling and incineration of residual materials came into effect.

After having a study conducted to compare the construction and operation of an engineered landfill and a trench landfill, as described in Section 3.1, the CNN has chosen to develop a trench landfill, in accordance with the RRLIRM. A list of provincial requirements for trench landfills is presented in Table 1-1.



Table 1-1 Provincial Regulation for Trench Landfills

RRLIRM Requirements	Trench Landfills
Distance between trench area and watercourse or waterbody	150 m (Section 88)
Distance between trench area and catch point of water for human consumption	500 m and 1,000 m for water used for bottled water production (Sec. 88)
Within the 100-year flood plain	Prohibited (Sec. 88)
Area where ground movement is likely to occur	Prohibited (Sec. 88)
Land underneath which there is free groundwater having a high potential aquifer (25 m^3/h)	Prohibited (Sec. 88)
Integration into the surrounding landscape (1 km)	Required (Sec. 88)
Buffer zone around the site	50 m (Sec. 88)
Not visible from a public area or road within a radius of 1 km	Required (Sec. 89)
Containment protection	Not required
Distance between bottom of landfill and groundwater level	1 m, not possible to lower the groundwater level (Sec. 88)
Distance between bottom of trenches and bedrock	1 m (Sec. 88)
Leachate and water collection and treatment including drainage layer and a network of drainage pipes	Not required
Drainage of surface water	Required (Sec. 88)
Additional leachate collection system if 2 membranes	Not applicable
Every component of a treatment system for leachate or water to be leakproof	Not applicable
Collection and removal of biogas	Not applicable
Destruction of biogas if capacity >1,500,000 m^3 or 50,000 tonnes/year	Not applicable
Installation of groundwater monitoring wells and annual monitoring	Required, max 300 m (Sec. 89)

1.4.4 Waste Management – Municipal By-Laws

The management of residential, business and institutional solid waste is the responsibility of the CNN. There are no specific by-laws related to waste management in the community.

1.5 PROJECT JUSTIFICATION

1.5.1 Existing Waste Management Facilities

The existing trench landfill has reached its end of life and is near full capacity. In order to maintain waste disposal services for the community during the opening process for a new landfill site, modification to the site was approved by the Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC) in 2017, as described in Section 1. An ecocentre was also built in 2019 to recover bulky waste and construction waste, decreasing the quantity of waste sent to the landfill.

1.5.2 Population Projections

In order to provide a projection for waste generation, the population growth of each community was assessed over a 40-year period. According to the 2021 census, the CNN population was 832 residents (Statistics Canada).

Projected growth was calculated using Quebec Statistical Institute for Eeyou Istchee rates from 2021 to 2041. The growth rate stabilizes after 2041. From the projected rates, the CNN population was then estimated for a 45-year period.

Waste from the Hydro-Québec camp and from the Nemaska Lithium company is also landfilled at Nemaska's landfill site. The number of equivalent full-time workers in Hydro-Québec's (HQ) Nemiscau facilities in 2012 was 67 according to HQ. The number of workers will increase to 80 in 2025 (Dessau, 2013). Waste generation for Nemaska Lithium (NL) was not estimated using population data.

Table 1-2 Population Growth Rates, 2022 to 2041

Period	Eeyou Istchee Growth Rate yearly projection
2022 to 2026	1.454%
2027 to 2031	1.246%
2032 to 2036	1.096%
2037 to 2041	0.967%
After 2041	0.967%

1.5.3 Waste Projections and Landfilling Needs

Waste projections were estimated for a 35-year period.

To facilitate the preparation of an annual report required by the RRLIRM, landfilled volumes were estimated since 2013. Using information in these reports, it is possible to assess waste generation per person per year. Note that waste produced by HQ's Nemiscau facilities is also included in the annual generation within the annual report. For that reason, annual generation was calculated using population from the CNN and HQ. Average waste generation was estimated at 2,282 m^3/year between 2013 and

2018, based on the assumption that the average value corresponds to a generation in 2015 (approximately midway in the period between 2013 and 2018). Similarly, dividing the average value of the total population in the same year (2015), the waste generation is calculated at 2.84 m^3/person/year in 2015.

According to the environmental and social impact assessment (Nemaska Lithium, 2013), Nemaska Lithium will manage its wastes efficiently by applying the 4R (Reduce, Reuse, Recycle and Recover) principles, as recommended in the most recent Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC) 2019–2024 policy on residual materials. Nemaska Lithium expects that it will need to send approximately 150 tonnes of waste per year to an appropriate landfill. The rest of the residual materials generated at the mine will be recycled or reused. Ultimately, Nemaska Lithium will dispose of 375 m^3 of waste each year at Nemaska's landfill.

The following assumptions were used for the calculation:

- Waste generation growth rate was 2.0% in 2013; it will decrease by 0.05% per year until it reaches 1.0%;
- Waste generation growth rate will be 1.0% per year from 2033 to 2054;
- Waste generation growth rate will be 0.5% per year after year 2054;
- Cover materials will constitute 10% of landfilled waste.

Total landfilling needs, including waste and weekly cover in cubic metres, are presented in Table 1-3.

Table 1-3 Estimated Volume of Waste to be Landfilled in the New Nemaska Landfill (Including 10% of Soil for Cover), 2026–2060, in m^3

Year	CNN	HQ	NL	Annual volume	Cover material	Total	Cumulative volume
2026	3,110	275	375	3,760	376	**4,136**	**4,136**
2030	3,487	297	375	4,160	416	**4,575**	**21,779**
2035	3,954	319	375	4,648	465	**5,113**	**46,259**
2040	4,458	343	375	5,176	518	**5,693**	**73,541**
2045	5,038	369	375	5,782	578	**6,360**	**103,968**
2050	5,715	399	375	6,489	649	**7,138**	**138,055**
2055	6,509	433	0	6,943	694	**7,637**	**175,184**
2060	7,128	452	0	7,580	758	**8,338**	**215,444**

As indicated, it is estimated that 215,444 m^3 will be landfilled over the site's 35-year lifespan.

2.0 SITE AND ACCESS ROAD SELECTION PROCESS

2.1 TECHNOLOGICAL OPTIONS STUDIED

The CNN currently operates a trench landfill and worked on the design of a new landfill. Two types of landfills could be implemented according to the applicable regulations: an engineered landfill or a trench landfill. A study was conducted by Stantec in 2019 to compare the construction and operation of these two types of landfills (Stantec, 2019a):

- Trench landfill: basic installation where waste is deposited, compacted and covered;
- Engineered landfill: installation with waterproof cells, leachate collection and treatment, and biogas management.

There are more regulatory requirements for the construction and operation of an engineered landfill than for a trench landfill. However, site selection criteria are more restrictive with a trench landfill, which includes a buffer of one metre between the bottom of the trench and groundwater or bedrock.

Due to the presence of a membrane at the bottom of the cell and a drainage system, an engineered landfill allows for the recovery of leachate while avoiding its percolation into the ground. Without it, contamination of the ground and the groundwater by the leachate is expected. However, a proper design and good operation and maintenance practices can help reduce leachate production in any case.

Biogas collection, required on an engineered landfill, limits the greenhouse gas emissions as well as the risks of landslide once the site is closed. There is less probability of gas storage within the cell.

Opinion of probable capital costs showed an important difference between both landfill types: the engineered landfill being very expensive, as it requires the implementation of a drainage system for leachate and biogas. Opinion of probable costs also showed a considerable difference between both landfill types in terms of operation and post-closure costs. The main difference is due to the leachate analysis and treatment costs as well as drainage system maintenance costs.

In both types of landfills, groundwater monitoring is mandatory and completed three times a year. Monitoring makes it possible to observe the landfill impacts on groundwater and take necessary actions to reduce contamination if necessary.

The trench landfill option was selected by the CNN.

Another study was conducted in 2019 (Stantec, 2019b) to identify, compare and analyze alternative waste management technologies: composting, recycling, and waste-to-energy. The CNN showed interest in recycling and composting initiatives; these are expected to be implemented in the coming years and will, therefore, reduce the waste quantities to be landfilled as well as associated leachate and biogas generation. In contrast, waste-to-energy is only partially applicable to the community, requiring more complex operation and offering minimal energy needs fulfilment. The CNN chose not to implement this solution.



2.2 SITE SELECTION PROCESS

Site selection by Stantec began in 2016. Aerial photo interpretations identified nine potential sites meeting the landfill site selection requirements. The nine sites were assessed as per the agreed-upon selection requirements: topography, drainage, flora, fauna, heritage and distance from waterbodies and watercourses (see Table 2-1).

Table 2-1 Parameters Considered for Site Selection

Parameters	Description
General Topography	Slope, presence of natural depressions and depth of rock: factors used to determine landfill layout
Approximate Usable Surface	Surface area available: factor that will influence landfill lifespan
Approximate Thickness of Surface Materials	Depth of bedrock: factor that will influence landfill lifespan
Waterbodies and Watercourses	Distance of 150 m between the landfill site and waterbodies/watercourses
Groundwater Depth	Trench bottom to be 1 m above the groundwater, with usable areas being those where groundwater is a minimum of 3 m from the surface Depth measured in monitoring wells
Access	Presence of an existing access road and distance that needs to be built
Distance to Community	Not too close (to avoid nuisance) and not too far (to limit transportation impacts)
Distance from Airport	Ideally more than 8 km to limit nuisance caused by presence of birds
Land Use	Current and future land use
Environmental Risks	Proximity of residences, proximity of water sources, wind direction (odours) and presence of wetlands
Nature and Properties of Materials	Soil sampling by test pit or borehole

Sites 4, 7 and 8 were identified as being the best potential sites and were selected for further analysis. The location of the sites is available in the Site Selection and Baseline Study for a New Landfill Site in Nemaska report (Stantec, 2018) in Appendix B. Available information was used to complete a selection matrix comparing the three sites. Site 4 was rated the highest for the following reasons:

- Sufficient available land area for at least 25 years of operation;
- Proximity of access road;
- Good drainage and adequate soil type;

- Groundwater depth greater than 5.0 m below the ground surface (mbgs), and bedrock depth greater than 4.4 mbgs;
- No known archaeological or cultural areas of interest;
- Accepted by local authorities (main road, airport and zoning by-law).

In short, Site 4 met all the selection requirements, including land area, environment and topography, culture and nature, infrastructure and development, and regulatory requirements, especially those of the RRLIRM and the Zoning By-Law of the Eeyou Istchee James Bay Regional Government. As a result, Site 4 was recommended and approved by the Band Council in November 2017.

2.3 ACCESS ROAD SELECTION PROCESS

A new road to access the proposed landfill site is required. Three potential access road options were proposed for desktop and field evaluation (Stantec, 2016). They were identified from aerial photo interpretation conducted by a geomorphologist. The road layouts were determined by taking into account topography, drainage, flora, fauna, heritage and distance from waterbodies. The location of the three options is available in the Nemaska New Landfill Access Road Options memorandum (Stantec, 2023) in Appendix C. Their characteristics are presented in Table 2-2.

Table 2-2 Access Road Option Features

Parameter	Option 1	Option 2	Option 3
Localization	Northernmost	Middle road	Southernmost
Length	440 m	450 m	880 m
Topography	Steep slope (4.6%)	Gentle slope (3.2%)	Gentle slope (2.7%)
Flora	Black spruce stand, jack pine forest and shrubby field	Peatland - Shrubby swamp	Open peatlands - small wooden swamp
Safety	Junction with Route du Nord within a curve section	Junction with Route du Nord in straight section	Junction with Route du Nord in straight section
Soil type	Till	Till with shrubby swamp and open peatland	Till with small open peatland areas
Water crossing	0	0	0
Wetland	0 m intersected	86 m intersected	88 m intersected
Vegetation	440 m wooded	360 m wooded	785 m wooded
Wildlife and birds	Wooded and open terrestrial habitat	Mostly wooded area	Wetlands and wooded areas

Parameter	Option 1	Option 2	Option 3
Hunting and Trapping	Beaver (alternating) Beaver lodges 300 m from Option 1	No activities reported	No activities reported
Fishing	Creek located 300 m from Option 1	No activities reported	No activities reported
Berries and plant gathering	No activities reported	No activities reported	No activities reported
Camps and trails	Utilization of the powerline right-of-way to circulate by snowmobile	No activities reported	No activities reported
Water Quality	Creek located 300 m from Option 1	No bodies of water	No bodies of water
Utilities	Crossing of Hydro-Québec powerline right-of-way	-	-
Works required and maintenance	Normal	Normal	Normal
Excavation/backfill	Normal	Normal	Normal
Operational costs	Low	Low	Average

Option 1 poses safety issues related to the junction with the Route du Nord. It has been deemed unacceptable for further consideration.

Options 2 and 3 present similar features. However, option 2 is selected due to the shorter length and therefore fewer impacts on the environment. It is also the less expensive solution of the two options.

3.0 PROJECT DESCRIPTION

3.1 PROJECT CONSTRUCTION

3.1.1 General Site Layout

The Project involves the construction and operation of a new trench landfill site and an access road connecting the new landfill at its southwestern end to the Route du Nord. The drawings are available in Appendix D.

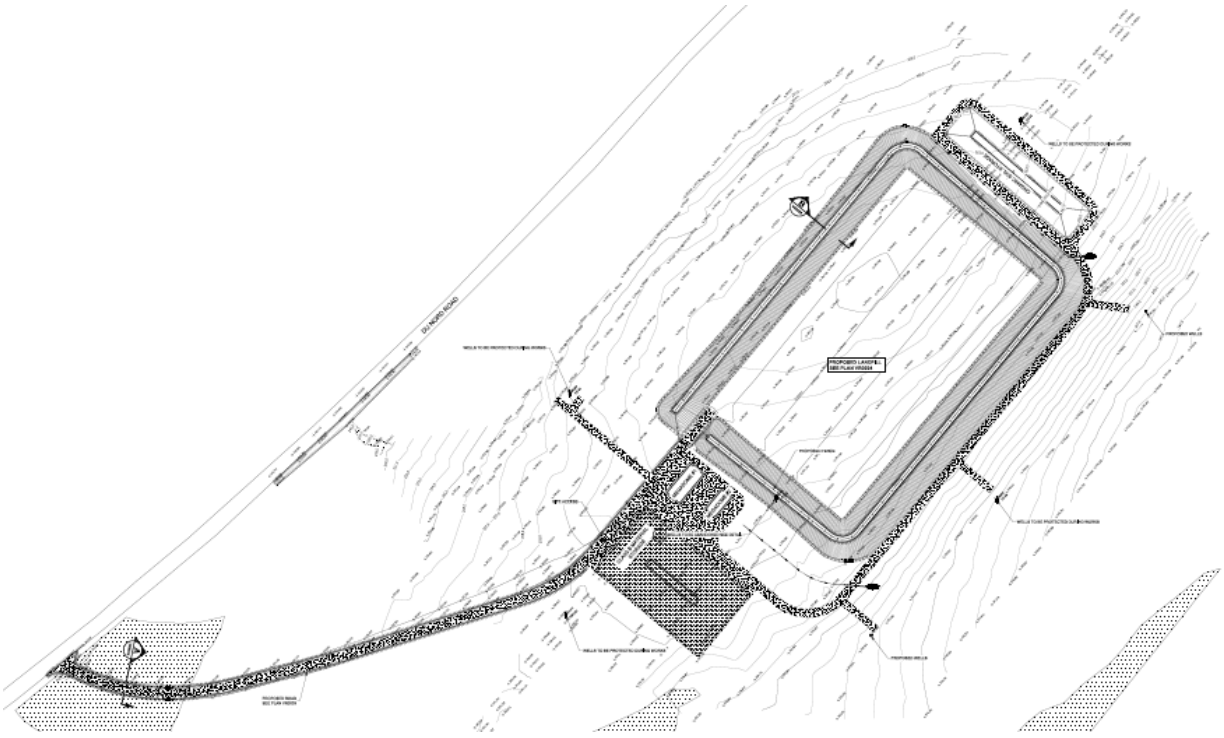


Figure 3-1 General Site Layout

The site has an available land area of 215,000 m^2. The site is generally flat, and the terrain slopes gently towards the northeast and the southwest, resulting in a 4 to 5 m difference in elevation. Sparse boulders are present on the site; however, they do not represent a major constraint to the Project development. The site is very well drained. The subsurface profile at the proposed site consists of a thin layer of topsoil over a silty sand or sand-and-silt layer with traces of some gravel. Cobbles and boulders were also encountered at various depths in the boreholes within the sand layers (Stantec 2018).

The landfill design includes the excavation of a trench and building of a surrounding berm with the excavated materials. The berm will increase landfill capacity, limit visibility of landfilling operations, prevent contamination of surface water and prevent wind-dispersed waste from spreading. As sections of the landfill are progressively filled in, operators will cover the waste with granular material to prevent waste dispersion, deter nuisance animals, and reduce odour emissions. The landfill site will be fenced,

and a gate will be installed to limit public access. The fence will also reduce wildlife prowling and scavenging, as well as waste spreading by animals and wind outside the landfilling area.

3.1.2 Access Road

A new access road is required for the Project. The construction of the road will comply with all applicable regulations in order to reduce dust, noise and other impacts of the works.

The proposed access road will be 450 m long and will have a 7 m wide running surface, allowing for one lane in each direction. The road right-of-way will have a total width of 19 m: a 7 m-wide running surface, plus a 6 m buffer on each side of the road, which includes ditches and cleared area. It will be composed of the following materials (from bottom to top): a geotextile, a layer of 150 mm of MG-20 and a layer of MG-112, whose thickness will depend on the natural conditions (bedrock, till or sand). A culvert will be installed in the wetland to maintain connectivity. The granular material will be sourced from the community when available.

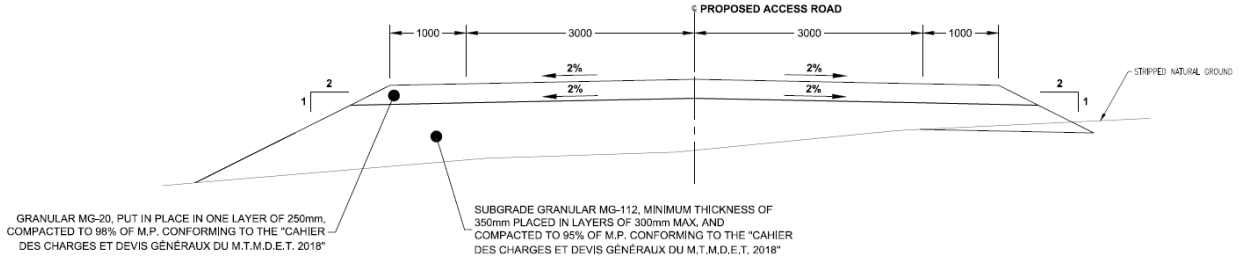


Figure 3-2 Access Road Typical Cross-sections

Activities during each stage of construction are described in Table 3-1.

Table 3-1 Road Construction Activities

Activity	Associated Activities and Equipment
Transportation of equipment - common with all construction works	Equipment will be transported by truck and low-bed trailer to the site along public roads. Contractors will be instructed to meet all road use requirements (e.g., signage, load restrictions, haul routes). Equipment: truck and low-bed trailer
Construction work area installation and rehabilitation - common with all construction works	At the beginning of the works, installation of a temporary construction work area with mobile buildings, power generator, and temporary storage area for granular materials At the end of construction works, rehabilitation of the construction work area Equipment: excavator, loader, bulldozer
Site preparation (vegetation clearing and soil salvage)	Vegetation will be cleared from the right-of-way. Topsoil will be salvaged and retained in a stockpile for use during future site reclamation. Equipment: excavator, loader, dump truck, bulldozer

Activity	Associated Activities and Equipment
Road construction (backfill and grading, ditches, culverts)	Backfill and grading are required to prepare the road. Construction of ditches and culverts is also required for managing run-off water. Equipment: excavator, loader, dump truck, bulldozer, grader

3.1.3 Trench Landfill

The landfill construction includes the excavation of one continuous trench and the development of a berm surrounding the excavation. Design specifications are based on existing landfills developed for James Bay Cree Communities (continuous trenches in excavation and with surrounding berms).

The landfill site has a land area of 52,550 m^2 including the surrounding berm. Vegetation will be cleared, and the topsoil will be removed and stored on site to be reused as a vegetative layer for the berms and the final closure. The excavated materials will be used to build the berm, and the surplus will be stored on site to be reused as weekly cover during the operations.

To limit groundwater contamination, the bottom of the trench has to be located at least 1 m above the depth of bedrock or groundwater level. According to the groundwater soundings and preliminary plans, the trench bottom will be more than 5 metres from groundwater. In order to prevent surface water from being contaminated by waste and from penetrating into the disposal area, surrounding berms and drainage ditches will be built to direct water away from the landfill site.

The continuous trench will be excavated to a depth of 2 to 5 metres. A berm of between 3 and 9 metres in height above natural ground, and 15 to 35 metres in width, will be constructed along the perimeter of the excavated trench to increase landfill capacity. The estimated capacity of the site is illustrated in Table 3-2.

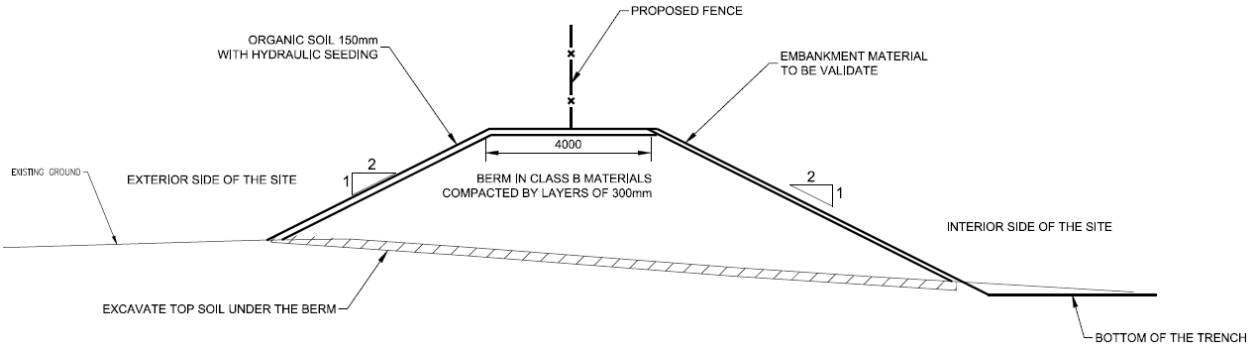


Figure 3-3 Berm Cross-section

A vegetative layer on the top and surface of the berm will prevent erosion. The berm also serves as a visual barrier between the nature surrounding the site and the landfilling area.

Table 3-2 Volume of Materials, Capacity and Estimated Lifespan of the Site

Feature	Value
Disposal area	25,575 m^2
Excavated materials	93,170 m^3
Volume of berm	67,480 m^3
Capacity	220,000 m^3
Minimum lifespan	35 years
Volume of soil required for 35 years of weekly cover	19,210 m^3
Volume of soil required for final cover	17,315 m^3

Although the Project design is not final, the current scenarios under study allow disposal for a period extending between 35 and 40 years. The landfill lifespan estimate considers growing waste generation rates. The CNN population 35-year growth forecast indicates that roughly 215,000 m^3 of residual materials (including 10% of cover materials) will have to be disposed of within the new landfill.

The installation of a fence around the landfill and a gate at the entrance of the site will keep the public from gaining access to the site outside operation hours and prevent waste from spreading in the surrounding area. An 8-foot-high fence will be installed around the landfill area (approximately 830 linear metres). The fence will be buried at least 2 feet below the surface to prevent wildlife from digging under the fence.

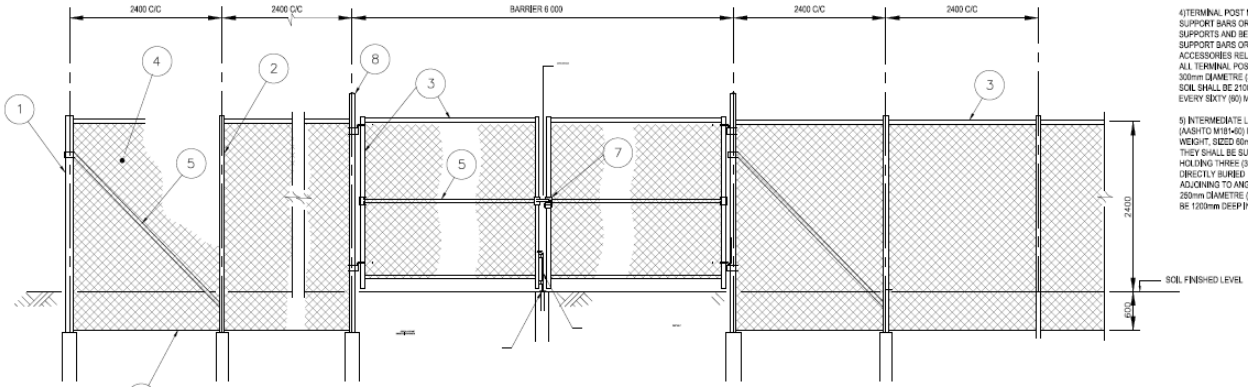


Figure 3-4 Fence and Gate Section

To limit the risk of fires, the area surrounding the landfill will be cleared of vegetation, creating a 15-metre-wide buffer.

Two megadomes will be included on site: one to park the compactor, and another one to store various equipment.

To facilitate monitoring of the groundwater quality, two existing wells will be kept to characterize the site, and two additional wells are planned, for a total of one well upstream and three wells downstream. A permanent path is planned to access each of the wells.

Activities during each stage of construction are summarized in Table 3-3.

Table 3-3 Construction Activities and Equipment Required

Activity	Associated Activities and Equipment
Transportation of equipment - common with all construction works	Equipment will be transported by truck and low-bed trailer to the site along public roads. Contractors will be instructed to meet all road use requirements (e.g., signage, load restrictions, haul routes). Equipment: truck and low-bed trailer
Construction work area installation and rehabilitation - common with all construction works	At the beginning of the works, installation of a temporary construction work area with mobile buildings, power generator, and temporary storage area for granular materials At the end of construction works, rehabilitation of the construction work area Equipment: excavator, loader, bulldozer
Site preparation: vegetation clearing	Vegetation will be cleared from the landfill area and 15 m buffer surrounding the site. Equipment: excavator, loader, dump truck, bulldozer
Site preparation: topsoil removal	Topsoil excavated and stockpiled for future use in the final cover Equipment: excavator, loader, dump truck, bulldozer
Excavation of trench	Excavation of materials will reach the level set on the plans, with grading at the bottom of trench. The excavated materials will be used for construction of the berm, and the surplus will be stored in the trench for future use as weekly cover. Equipment: dump truck, loader, excavator, bulldozer
Berm construction	Placement of excavated material surrounding the landfill to create the berm; compaction and grading of the berm; geocell installation; topsoil placement and seeding on the top and outside face of the berm; ditch excavation surrounding the berm; and fence installation Equipment: dump truck, loader, excavator, bulldozer, compactor
Access road construction within the landfill area	Construction of access road for trench; construction of access roads to the monitoring wells (see methods of construction for main access road) Equipment: dump truck, loader, excavator, bulldozer, compactor

3.1.4 Construction Workforce and Schedule

A workforce of approximately 20 people will be required for the construction phase of the Project, and they will be present on site for a total period of maximum 10 weeks to complete the entire Project. Workers will be drawn from an existing local workforce when possible.

A proposed work schedule was developed and is presented in Table 3-4. The construction activities will be completed over three months. The operations could start in fall 2025.

Table 3-4 Proposed Schedule for the Project

Project item	Schedule
Final Plans and Specifications and Tender Documents	Fall 2024–Winter 2025
Call for Proposals	Winter 2025
Request for Authorization to MELCCFP and Approval	Fall 2024–Spring 2025
Land Clearing Permit	Spring 2025
Construction	Summer 2025
Beginning of Operations and Training	Fall 2025
Closure Plans and Tender Process	Fall 2025–Winter 2026
Closure of the Existing Landfill	Summer 2026

3.2 PROJECT OPERATIONS

3.2.1 Access Road

The access road will be used for the transportation of garbage and heavy equipment to the landfill site. It will be maintained regularly, as will the main road, to ensure access to the site at all seasons. The speed on the access road will be limited to 30 km/h in order to reduce noise and dust generation.

Table 3-5 Access Road Operation Activities

Activity	Associated Activities and Equipment
Truck access to the landfill site	Eight to ten times a week, garbage trucks will use the access road in order to unload the waste at the landfill site. Roll-off trucks and dump trucks will use the access road up to once a week to bring mixed construction and bulky waste that cannot be recovered at the ecocentre. Equipment: garbage trucks, roll-off trucks, dump trucks, flat-bed trailers
Access road maintenance	The access road will be maintained through pothole repair and regular addition of granular material to the road surface and grading. Maintenance of ditches, culverts, and vegetation near the road Use of heavy equipment for winter snow removal on the road Calcium chloride will be added to the access road after rain in order to reduce dust creation from traffic. Equipment: grader, loader, dump truck

3.2.2 Main Gate and Fences

The fence and gate will be regularly maintained and repaired when required, in order to prevent access to the public outside opening hours and keep the site clean.

Table 3-6 Fence and Gate Operation Activities

Activity	Associated Activities and Equipment
Fence maintenance	Repair of broken parts or holes Equipment: pick-up truck, small excavator, or loader
Gate maintenance	Gate repair or replacement when required Equipment: pick-up truck, small excavator, or loader

3.2.3 Landfill Operation Activities

The CNN will operate the new landfill. Landfill site operators will be given landfill operation and maintenance training.

The waste accepted at the landfill will include garbage from residences, businesses and institutions, construction waste and bulky waste. Septic tank sludge will not be accepted at the landfill. Hazardous waste will be prohibited at the landfill. The operator will perform a visual inspection during unloading to help reduce the risk of leachate generation and groundwater contamination.

In order to limit negative impacts, operators will follow a strict filling sequence: each week a tipping area is established where waste is unloaded into the trench. The tipping area will move progressively along the border of the trench as the trench is filled.

Waste is then pushed, placed and compacted on the working area of the landfill. It is covered with soil from the excavation of the landfill, and a new tipping area is established for the following week. Maintaining the tipping area surface as small as possible and having a weekly cover are efficient ways to limit the impacts of waste landfilling. The filling sequence is presented in Figure 3-5.

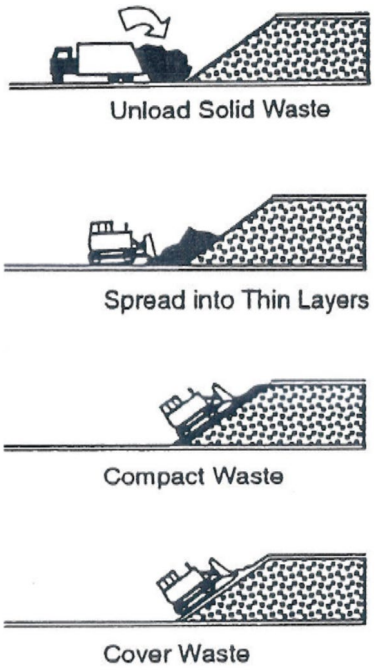


Figure 3-5 Filling Sequence at the Landfill Site

Residual materials containing asbestos, sludge and animal carcasses or animal parts will be covered as soon as they are deposited. An area for the disposal of animal remains is being considered as part of the Project operations. Animal remains will be covered shortly after they are disposed of to prevent scavenging and odour.

A litter patrol will take place once a year to clean the area surrounding the site. Closed sections will be inspected to identify deficiencies such as water ponding and erosion, and deficiencies will be corrected.

Operation activities are summarized in Table 3-7.

Table 3-7 Landfill Operation Activities

Activity	Associated Activities and Equipment
Unloading waste	Garbage trucks will unload waste at the tipping area and place it at the bottom of the working face. The area between the working face and unloading area will be limited. Equipment: garbage truck
Pushing and placing waste	At least once a week, a compactor will push the waste from the bottom towards the top of the working face. The area of the working face is minimized as much as possible. Equipment: compactor
Compacting waste	Waste is compacted to a thickness of one to two feet with the use of a compactor.

Activity	Associated Activities and Equipment
	The compactor drives over the waste several times to achieve optimal compaction. Equipment: compactor
Covering waste	Excavated materials are used to cover the waste weekly. Equipment: loader, compactor
Moving excavated materials	Once a month, a loader moves excavated materials used for covering the waste close to the working area. Equipment: loader
Annual cleaning	Once a year, a litter patrol will conduct a cleaning operation to clean the fences and surrounding area of scattered waste.
Maintenance of ditches and fire barrier	Cleaning and reprofiling of ditches when required; vegetation clearing in the fire barrier (15 m buffer) Maintenance of ditches, culverts, and vegetation near the road Equipment: grader, loader, dump truck

Most of the equipment maintenance works will be performed directly on site in the megadomes.

3.2.4 Closure and Post-closure Management of the Proposed Landfill

3.2.4.1 Future Landfill Closure Management

When the height of the waste deposited in the continuous trench reaches the berm height at the perimeter of the landfill area, it will be covered with a 60 cm soil layer including, in its upper portion, a 15 cm layer of organic soil suitable for vegetation. The soils required for the closure will be sourced from the initial excavation and from the community. A typical cross-section is presented in Figure 3-6.

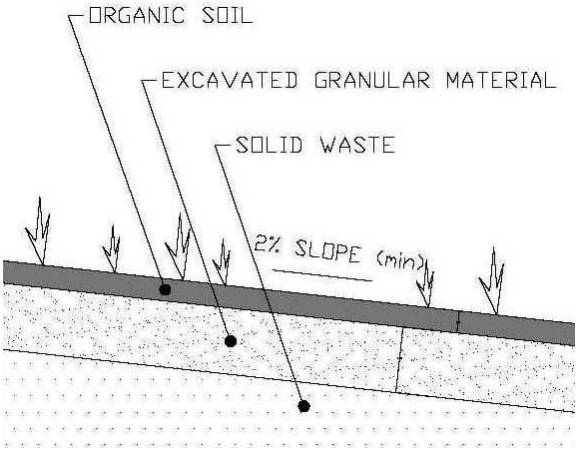


Figure 3-6 Typical Cross-section of the Final Cover

3.2.4.2 Future Landfill Post-closure Management

The environmental supervision and monitoring program implemented during the operation phase will be maintained during the post-closure period. Environmental supervision will include the following:

- Maintenance of final cover integrity: final cover to be inspected to identify deficiencies, such as water ponding or erosion, and then corrected;
- Maintenance of groundwater monitoring wells: cleaning and upkeep of wells;
- Water sampling and analysis campaign.

3.3 PROJECT COSTS

Construction costs were estimated, including indexation and several levels of contingencies (according to the cost category), as presented in Table 3-8. Annual operation costs were estimated, including 15% contingencies, as presented in Table 3-9.

Table 3-8 Opinion of Probable Construction Cost

	Item	Cost CAD
1.0	Studies	$156,298
2.0	Construction (access road and landfill)	$8,225,759
3.0	Engineering	$220,872
4.0	Construction supervision	$129,129
5.0	Permitting Fees (Government)	$28,955
	Subtotal	$8,761,013
6.0	Indexation 2023–2025	$869,894
7.0	Contingencies	$1,882,310
	TOTAL	$11,513,217

Table 3-9 Opinion of Probable Annual Operation Cost

	Item	Annual cost CAD
1.0	Supervision and administration	$6,881
2.0	Landfill operation	$101,051
3.0	Maintenance	$18,613
4.0	Miscellaneous	$29,502
5.0	Financial guarantees	$2,908
	Subtotal	$158,955
6.0	Indexation 2023–2025	$12,521
7.0	Contingencies (15%)	$25,722
	TOTAL	$197,198

3.4 INTEGRATION OF QUEBEC SUSTAINABLE DEVELOPMENT OBJECTIVES

Even if the Sustainable Development Act (RLRQ ch. D-8.1.1) does not apply in the Eeyou Istchee territory, the MELCCFP Directive for the environmental assessment strongly recommends integrating sustainable development principles into the Nemaska landfill Project.

In this regard, the 16 principles of sustainable development set out in the law will be considered by the Cree Nation of Nemaska during the Project development process, as detailed in Table 3-10.

Table 3-10 Integration of Sustainable Development Principles in the Project

Principle	Link	Integration into the Project
Health and quality of life	Safety of individuals	The multi-criteria site selection was carried out to identify the best technical, economic, and environmental solution. The selection of access road to the landfill includes an evaluation of safety issues related to the junction with the Route du Nord. The site is closed by a gate and fences. Access to the site is monitored and allowed only during opening hours.
Social equity and solidarity	Equity and access to essential services	The Project will provide services to the entire community of Nemaska.
Environmental protection	Mitigation measure and compensation	The multi-criteria site selection was carried out to identify the best technical, economic, and environmental solution. The environmental assessment process considers the protection measures applicable in similar projects, results of consultations, expert opinions, and results in the integration of environmental measures into the Project design and the implementation of mitigation or compensation measures to reduce environmental effects (see Section 7.0).
Economic efficiency	Economic and environmental health	Technology and site selection criteria considered technical, economical and environmental constraints to identify an optimal project as much as possible for the community.
Participation and commitment	Consultation and engagement	Information and consultation activities were organized by the Cree Nation of Nemaska (CNN) and tallyman, with support from Stantec for the CNN community (see Section 5.0).
Access to knowledge	Knowledge development Training	Studies have documented the receiving environment (hydrogeology, vegetation, archaeology, land use). Training will be provided to personnel and leadership at the landfill.
Subsidiarity	Consultation and engagement	Information and consultation activities were organized by the Cree Nation of Nemaska (CNN) and tallyman, with support from Stantec for the CNN community (see Sections 5.0).
Inter-governmental partnership and cooperation	Exchanges with ministry	The MELCCFP was consulted for aspects falling within its field of competence. Discussions occurred with Nemaska Lithium and Hydro-Québec as well, in relation to the waste generated by these two stakeholders.

Principle	Link	Integration into the Project
Prevention	Accident prevention	The selection of access road to the landfill includes an evaluation of safety issues related to the junction with the Route du Nord.
Precaution	Project impacts on the environment	The Project is the subject of an impact study that identifies the anticipated environmental and human impacts, as well as the possibilities of avoiding such impacts, and then identifies the mitigation or compensation measures required to reduce these impacts as much as possible, or even eliminate them.
Protection of cultural heritage	Archaeological and cultural resources	An archaeological potential assessment was carried out at the projected landfill infrastructures and access road plus a 500 m buffer zone. The results of this assessment show that the impact risks on archaeological heritage is low, and measures of impact mitigation will not be necessary under the current layout of the planned infrastructures.
Biodiversity preservation	Flora, fauna and wetlands	The Project considers the presence of flora and fauna species with a precarious status and sensitive environments in its planning. Preventing Project components from affecting these environments is a priority; when it is not possible to avoid them, mitigation measures are planned to reduce the anticipated impacts.
Respect for ecosystem support capacity	Natural resources	An environmental inventory was carried out on the various ecosystems. Mitigation measures are planned to reduce impacts on flora and fauna.
Responsible production and consumption	Waste management	To decrease the quantity of waste sent to landfill, an ecocentre was built in 2019 to recover bulky waste and construction waste. Recycling and composting programs are under study, and training will include procedures to optimize compaction of waste and increase the lifespan.
Polluter pays	Contaminant emissions	Costs associated with the implementation of mitigation measures to prevent the emission of contaminants (water, air, soil), an environmental emergency measures plan, and environmental monitoring are included in the Project cost. In the event of an environmental incident, the person responsible will ensure that the situation is restored and will bear the costs.
Internalization of costs	Integrity of the environment	The community invested in an ecocentre in 2019 to collect bulky waste and reduce the need for landfilling. Dangerous goods are also collected separately and disposed of at approved facilities to prevent soil and water contamination.



4.0 DESCRIPTION OF RECEIVING ENVIRONMENT

4.1 STUDY AREA

The extent of the study area was used to describe the receiving environment, namely the Project development area (PDA), the local study area (LSA) and the regional study area (RSA) (Map 4-1). The PDA includes the area of physical disturbance associated with the construction and/or operations of all Project components, i.e., the landfill site and access road.

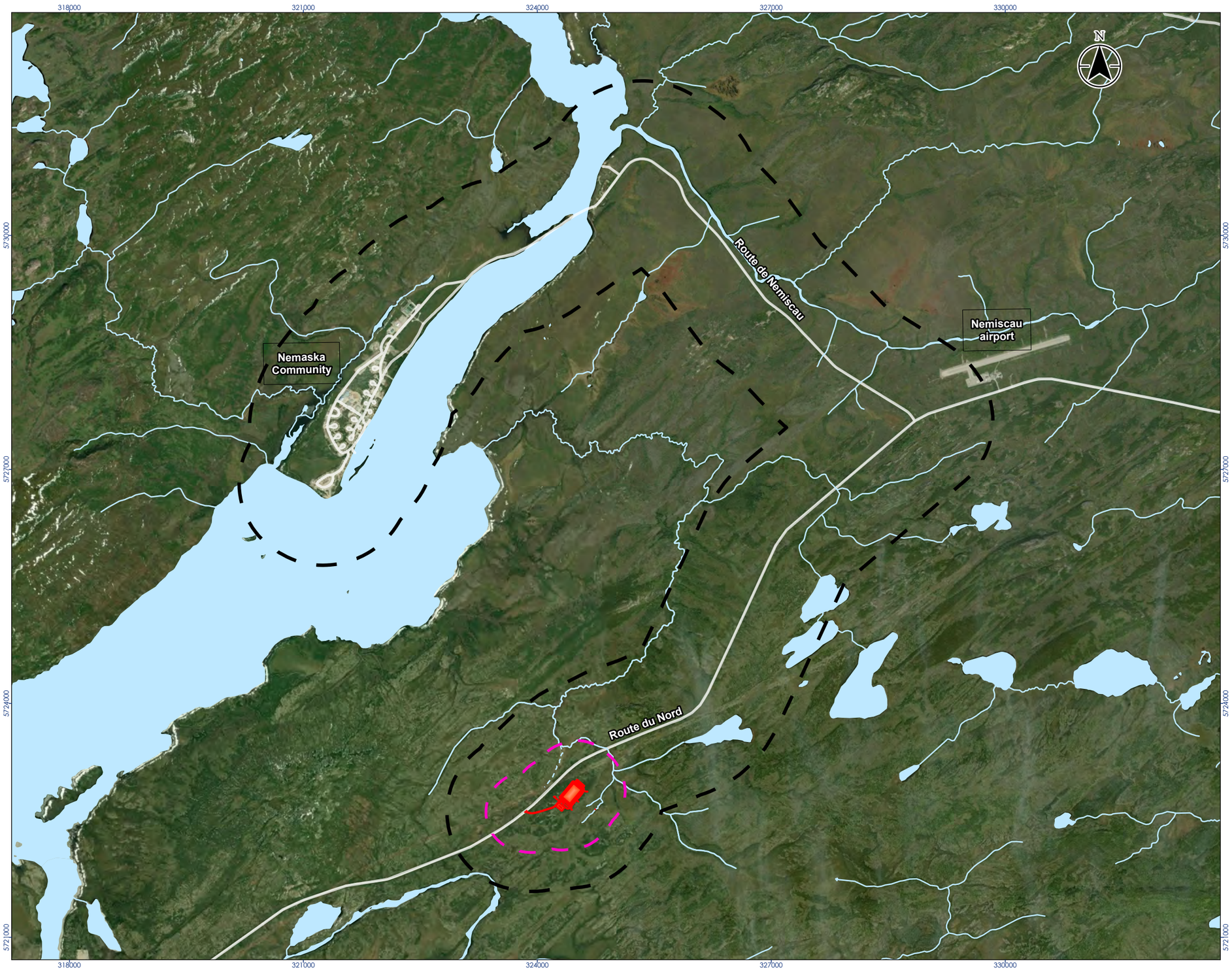
The LSA includes the area over which the environmental and/or socio-economic effects of the Project could be measurable. For the purposes of the present ESIA, the LSA encompasses an area that extends 500 m beyond the PDA. The RSA comprises the Nemaska community, a buffer of 1 km along the Nemaska access and Route du Nord between the community and the PDA.

4.2 PHYSICAL ENVIRONMENT

Quebec's natural province boundaries are determined by contrasts in physiographic features including bedrock characteristics, topography, surficial deposits, and hydrography (MELCC 2019). There are 15 natural provinces in Quebec as described by the Cadre écologique de référence du Québec (CERQ), and the study area is located in Province G: Hautes-terres de Mistassini. Province G covers a surface area of 93,000 km^2. At the federal level, the region is classified within the Boreal Shield Ecozone.

4.2.1 Project Location Ecological Context

The Project is located in the Rivière Rupert Plateau Ecoregion (100), which extends over 600 km from north to south. It includes the Mistassini Hills at the western limit of the boreal coniferous forest in west-central Quebec. This ecoregion is classified as having a mid-to-high boreal ecoclimate. The Chibougamau Hills occur southwest of Lac Mistassini in west-central Quebec. They are underlain by massive, crystalline, Archean granites, acidic intrusive, and volcanic rocks. Open stands of white spruce with lichen and paper birch occur occasionally on well-drained sites. Feathermoss is a common ground cover, whereas sphagnum occurs in poorly drained depressions. Summits are usually more than 1,065 m in elevation in the Otish Mountains and stand 760 m above the lake. The region is underlain by Precambrian granites and gneisses, has an undulating drift-covered surface, and is generally lower than adjoining uplands to the east. Surficial deposits are predominantly thin, discontinuous veneers of sandy and stony till. Humo-Ferric Podzols are the dominant soils, whereas Mesisols and Fibrisols are common in peat-filled depressions (ESWG 1995).



Stantec

Project components

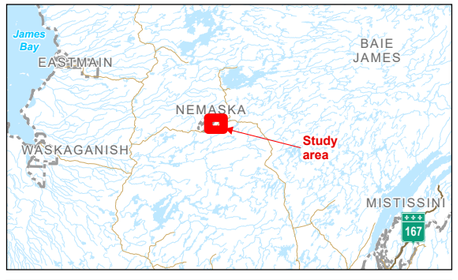
- Landfill site
- Local Study area (500 m)
- Regional Study area (1 km)
- Watercourse
- Waterbody

0 1 2 km

1:50 000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 MTM 9
2. Project Components: Poly-Geo, 2017 and Stantec, 2018-2019-2023
3. Watercourse and Waterbody: CanVec © Natural Resources Canada. All rights reserved.
4. Orthoimagery: Esri World Imagery, 2016



Project Location
Nemaska, Quebec

167020077-300-0002-0A_StudyAreas_20231204 REVA
Prepared by Prosper Ravo on 2024-03-06
Technical Review by Émilie Charest on 2024-03-06
Independent Review by Julie Massicotte on 2024-03-06

Client/Project

Cree Nation of Nemaska
Development of a new landfill in Nemaska - ESIA

Map No.
4-1

Title
Study areas

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4.2.2 Topography, Geology and Surficial Deposits

The study area is in a relatively flat region with some small hills. The new landfill site is located on one of those hills with a high point reaching an elevation of 260 m and the nearest low point being the existing road access (Route du Nord) at 244 m.

The study area is located in the Superior Province, which is the core of the Canadian Shield and North America. Its north, west and southeast boundaries (Trans-Hudsonian and Grenvillian orogens) are mainly tectonic, while in the south (Penokean Orogen) and northeast (Northern Quebec Orogen), the Superior Province is unconformably overlain or overthrust by Paleoproterozoic supracrustal sequences (Card and Poulsen, 1998). The Superior Province consists largely of Neoarchean rocks (2.8 to 2.5 Ga) (Gouvernement du Québec, 2017).

The stratigraphy unit of the area is from the Valiquette Pluton, which consists of locally pegmatitic, medium-to-coarse-grained biotite granite. It is homogeneous, massive to very weakly foliated. It generally contains biotite, hornblende and magnetite. The Valiquette Pluton also contains metric enclaves of gneissic tonalite, amphibolite, diorite and porphyritic granodiorite (Gouvernement du Québec, 2019).

The surficial deposit of the study area consists mostly of sediment of glacial origin characterized by till in generally continuous cover. This layer of sediment is composed of a diamicton blanket consisting mainly of lodgment and ablation facies, and whose thickness is greater than 1 m (Gouvernement du Québec, 2021). A smaller portion of the area surrounding the watercourse and the wetland complex to the East presents a surficial deposit of organic origin of undetermined formation process (Gouvernement du Québec, 2021).

The 23 test pits excavated at the site indicate that the till matrix at this site is generally sandy, containing 32% to 34% silt and clay, <10% gravel, <10% cobbles and <10% boulders (Poly-Géo, 2017). Within the till, boulders range up to 1,500 mm in diameter. Some sparse boulders were observed on the surface, but their presence is unlikely to cause complications should the site be developed as a waste disposal area.

4.2.3 Hydrography and Hydrogeology

A permanent watercourse is present approximately 1.3 km south of the Project (see Map 4-3). It flows to the north from the wetland complex present in the study area and reaches the Champion Lake by passing under the Route du Nord. This lake is the starting point of the Pontax River watershed, which flows westward for over 200 km into the Rupert Bay, a few kilometres north of the Rupert River, at the southeast end of James Bay (Gouvernement du Québec, 2012). Two surface water samples were taken in 2018: one upstream (SW-2) and one downstream (SW-4). Analysis results from surface water samples are available in Appendix E.





Stantec

Project components
- Landfill site
- Access roads

Ground elevation
- Contour line (m)
- 240 Elevation
- Monitoring Well, active
- Monitoring Well, collapsed
- Monitoring Well, projected
- Monitoring Well, to be condemned
- Surface water station

Watercourse
- Permanent watercourse
- Intermittent watercourse
- Surface water Flow direction

Groundwater elevation (m)
2020-08-06
- 248,276 - 248,5
- 248,501 - 249,0
- 249,001 - 249,5
- 249,501 - 250,0
- 250,001 - 250,5
- 250,501 - 251,0
- 251,001 - 251,5
- 251,501 - 252,0
- 252,001 - 252,5
- 252,501 - 253,0
- 253,001 - 253,5
- 253,501 - 254,0
- 254,001 - 254,5

0 100 200 meters

1:4 000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 MTM 9
2. Project Components: Poly-Geo, 2017 and Stantec, 2018-2019-2023
3. Field Inventory (Wetland, Terrestrial Environment and Flora Survey): Stantec, 2019
4. Wetland: CanVec © Natural Resources Canada. All rights reserved.
5. Contour Line interval generated with the Canadian Digital Surface Model (CDSM), resolution 0.75 cm, 2000, Poly-Geo
6. Watercourse: GRHQ, 2019 and Stantec, 20197, Orthoimagery: P6675_HQ10_03_025_34_094_geotiff_50cm.tif, Hydro-Québec, 2010



Project Location
Nemaska, Quebec

167020077-300-101-C0004 REVA
Prepared by Véronique Faucher on 2024-03-08
Technical Review by Émilie Charest on 2024-03-08
Independent Review by Julie Massicotte on 2024-03-08

Client/Project
Cree Nation of Nemaska
Development of a new landfill in Nemaska - ESIA

Map No.
4-2

Title
Groundwater and surface water monitoring locations and elevation

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A total of 23 test pits were excavated in 2016 and 2017 by Poly-Géo (2017), as were six boreholes by Stantec (2017). Static water levels were measured on December 1-8, 2017, August 1, 2018, August 4, 2020, and June 16, 2021. A desktop review, including assessment of the borehole logs, was also undertaken by BluMetric in 2023. The latest hydrogeological assessment is presented in Appendix F.

The observed till thickness ranged from 3.1 m to more than 5.3 m. Surficial drainage on the site was excellent, and no excess water was observed on the surface, even though it was rainy during the September surveys. The main groundwater flow direction is oriented toward the tributary river to Champion Lake, east/southeast of the site. Three groundwater samples were taken in 2018: two upstream (PZ-01 and PZ-03) and one downstream (PZ-06). Analysis results from the groundwater samples are available in Appendix G.

The conclusion of the hydrogeological assessment indicates that, according to the information available, there are no existing or planned collective water catchment structures within a one-kilometre radius of the site, nor are there any planned developments. There are no known private surface or groundwater catchment structures within 1 km of the study site. There is consequently no potential for the hydrostratigraphic units to be used as a water supply source within one kilometre of the site. Thus, the hydrogeological till formation at the target site is Class III with a weak hydraulic connection where present. Class III is justified by the insufficient quantity of water and uneconomical extraction. In addition, the assessment concluded with the suggestion that the landfill be built over an impermeable layer of soil.

4.2.4 Climate

4.2.4.1 Current conditions

The proposed Nemaska Landfill Climate Impact Assessment (Stantec, 2023) describes a climate profile for the area. For more information, see the report in Appendix H.

Data used to produce the climate profile was collected at the Eastmain weather monitoring station (ID: 7092305), situated along the coast of James Bay, some 175 km away. Because of limitations regarding data availability and time range at this station, a data set was also used from the La Grande Rivière Airport (ID: 7093715), which is approximately 240 km from Nemaska (Environment Canada 2021b). Due to the lack of wind data in the immediate vicinity of the study area, the wind data presented below is from the La Grande Rivière A (ID: 7093715) weather monitoring station—the closest weather station with published wind data—located approximately 240 km northwest of Nemaska. Wind data observed at La Grande Rivière Airport, including extreme winds, may not be completely reflective of the winds for Nemaska, but climate data indicate that similar general weather patterns have occurred in the region.

They represent climate normal data recorded at the Station between 1981 and 2010 and presented in Table 4-1 below. Moreover, historical data (1981–2010) indicate an average of 151 frost-free days.

Table 4-1 Temperature, Rainfall, Snowfall, and Wind Normals Between 1981 and 2010

Period	Avg. Temp (C°)	Precipitation (mm)	Wind Direction	Wind Speed (km/h)
Annual	-1.2	759	W	13.6
Winter	-18.3	126	W	13.7
Spring	-2.9	128	W	14.2
Summer	13.9	253	W	14.4
Autumn	2.4	252	W	14.9

4.2.4.2 Climate Trends and Predictions

Future climate projections are based on the Intergovernmental Panel on Climate Change (IPCC) RCP 8.5. RCPs are Representative Concentration Pathways that utilize a wide range of predicted changes in future anthropogenic (i.e., human) greenhouse gas (GHG) emissions. RCP 8.5, also referred to as “business as usual,” assumes continued anthropogenic (human generated) GHG emissions after 2100.

Stantec’s climate projection research indicated that in recent decades, the area has seen an increase in temperatures in all seasons, an increase in rainfall in all seasons, and a decrease in snowfall particularly in the fall and spring months.

Temperature

The data and literature show that the air temperature is warming and will continue to increase; seasonal increases vary, with the strongest increase in winter, followed by spring and autumn.

According to the analysis, frost-free days are expected to increase significantly as shown below.

- Historical 1984–2013 average frost-free days: 151
- Projected RCP 8.5 2020s average frost-free days: 164
- Projected RCP 8.5 2050s average frost-free days: 181
- Projected RCP 8.5 2080s average frost-free days: 198

Rainfall

Winter rain events show an increased occurrence in recent years. The data shows slight increases in rainfall in the spring and autumn. Summer rainfall shows a slight decrease.

Ouranos (2017) indicates, “+13-20% and more extreme precipitation. High uncertainty about the amplitude of the increase and regional variability.” The IDF curves generated using the ICLR Computerized IDF Generator confirm the above statement and show significant increases in extreme precipitation. For example:



- The intensity of a 50-yr return, 30-minute storm is projected to increase by 31% (current: 76.8 mm/hr; future: 100.3 mm/hr) by the 2080s.
- The intensity of a 100-yr return, 10-minute storm is projected to increase by 51% (current: 147.6 mm/hr; future: 194.3 mm/hr) by the 2080s.

The above also points to an increase in the frequency of rain events. In the example of the 50-year return rainfall above, it is projected that this event will have a return period of less than 25 years in the future.

Snowfall

Ouranos (2017) reports, “Decrease in snow cover and duration in the north and change of its characteristics. Large year-to-year variability and likelihood of differing snow trends across the region (potential increase in the South)”.

Climate Observations

Aboriginal people living in the Boreal Shield have observed trends in increasing temperatures, which have caused major changes in snowfall patterns, such as shallower snow cover and earlier snow melt. Changes in water temperature are linked to a reduction in cold-water fish, such as lake trout, but increase in warm water fish, such as smallmouth bass. Aboriginal people have also observed changes in blueberries. With the increased temperature, drought and fire suppression, blueberry growth may be reduced (ESTR Secretariat 2014).

4.3 NATURAL ENVIRONMENT

4.3.1 Survey Area

The survey area was established to identify and describe all the natural components (vegetation, wetlands and watercourses) that might be impacted by the Project. It covers all Project components, i.e. the new landfill as well as the three options for the access road. With a buffer of 150 m around the landfill and 50 m on either side of the potential access roads, the study area covers approximately 470 m^2.

4.3.2 Vegetation

The Project is located in the Boreal Shield Ecozone in west-central Quebec according to Canada’s ecological land classification system (Statistics Canada, 2018). It is included in the spruce-moss bioclimatic domain (Gouvernement du Québec, 2022). This zone is represented by a uniform forest dominated by the black spruce and an undergrowth composed of hypnaceous mosses and ericaceous shrubs. Herbaceous species are rare in this area.

Consultation of the interactive map from the Centre de données sur le patrimoine naturel du Québec (CDPNQ) provided information on vegetation species at risk within 8 km of the Project. According to the CDPNQ (2023), no plant species of concern was registered on the study site or in a radius of 8 km. Stantec also carried out vegetation field surveys between September 3 and 5, 2019. During these

surveys, all observations of plant species designated Threatened or Vulnerable, or likely to be so designated, were recorded using the Garmin GNSS GLO receiver.

A total of 49 survey stations were inventoried in terrestrial environments inside the Project development area (PDA), including the three access road options and the proposed landfill site. During the field surveys, no provincially or federally listed species at risk were found. Field visits enabled the identification of three types of terrestrial environments: three black spruce stands, three jack pine forests and one shrubby field (Map 4-3). A short description of each terrestrial environment is presented below. The floristic and biophysical data for each survey station is found in Appendix I.

Black spruce stand

The black spruce stand is composed of terrestrial environments TE02, TE04 and TE07 (Map 4-3). Most of these stands are found in well-drained forested lands and in mid-slope elevations. Eleven survey stations (S04, S06, S07, S08, S15, S16, S18, S19, S26, S42 and S78) were conducted in these terrestrial environments (Photo 1).



Photo 1 Black spruce stand, survey station S16

The tree layer is dominated by black spruce (*Picea mariana*) but is also composed of jack pine (*Pinus banksiana*). The shrub layer is mostly composed of sheep-laurel (*Kalmia angustifolia*). It also comprises velvet-leaved blueberry (*Vaccinium myrtilloides*) and speckled alder (*Alnus incana ssp. rugosa*). The herbaceous layer is dominated by mosses and sphagnums (*Sphagnum sp*.).

No hydrological indicators were observed in theses stands. Soil analysis revealed mainly a podzol soil type with a thin layer of organic matter on it (5 cm or less). These terrestrial environments cover 92,961 m², or 19.6% of the study area.

Jack pine forest

The jack pine forest is the most common terrestrial environment association identified in the study area and is composed of terrestrial environments TE01 and TE03 (Map 4-3). Most of this forest is found in well- or very-well-drained forested lands and in a flat area or on top of a slope. Thirty-five survey stations were conducted in these terrestrial environments (Photo 2).

The tree layer is strongly dominated by jack pines, with density varying from 10 to 35%. The tree layer is also composed of black spruce in low density (0-10%). The shrub layer is mostly composed of sheep-laurel. It is also composed of velvet-leaved blueberry and speckled alder. The herbaceous layer is almost non-existent, and soils and rock are often covered by mosses, sphagnums and lichens.

No hydrological indicators were observed in these forests. Soil analysis revealed mainly a podzol soil type with a thin layer of organic matter on it (5 cm of less). In some places, the bedrock was right under the thin organic layer. These terrestrial environments cover 220,661 m², or 47.1% of the study area.



Photo 2 Jack pine forest, survey station S36

Shrubby field

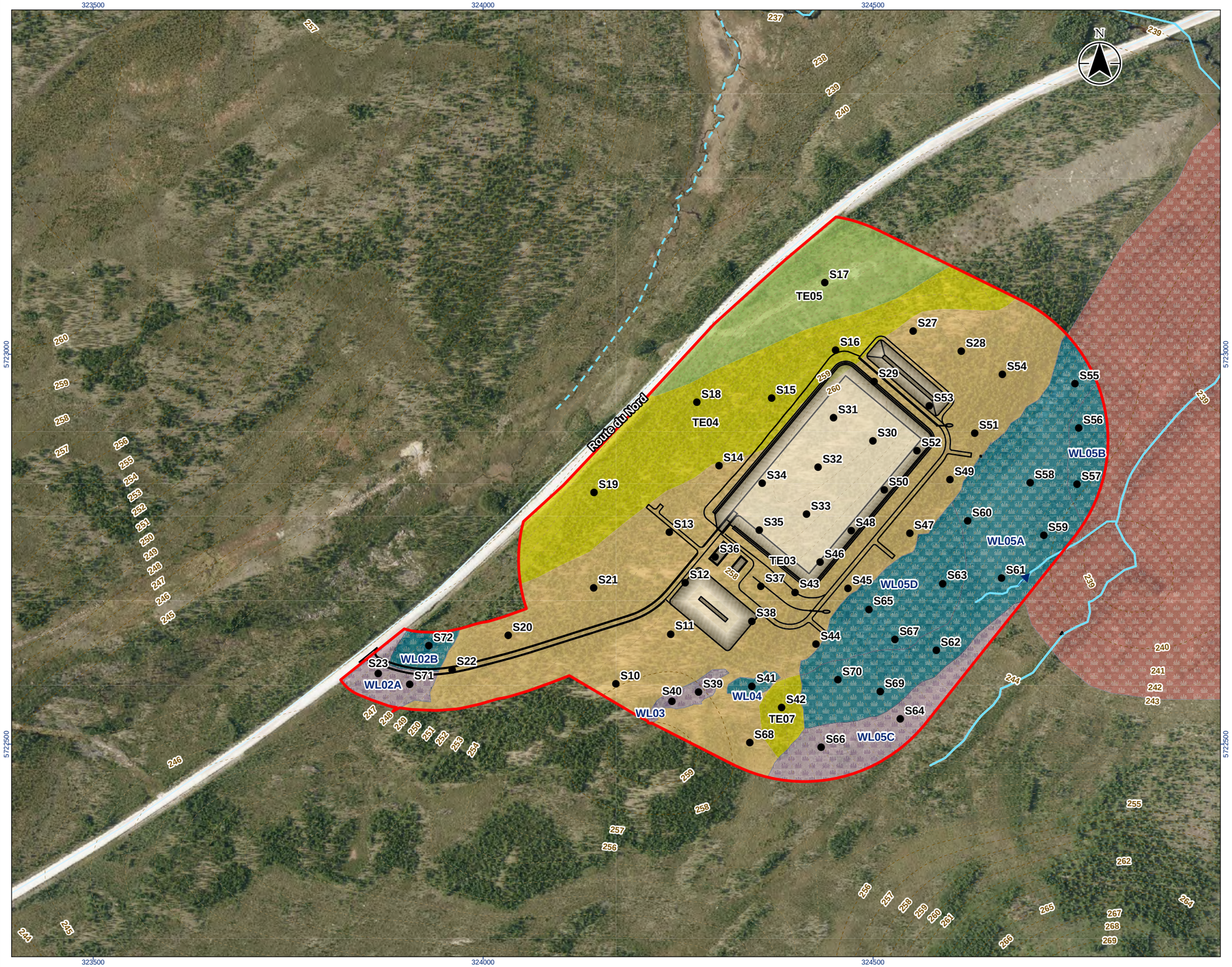
The shrubby field is composed of terrestrial environment TE05 (Map 4-3). This environment consists of the area under Hydro-Québec's power line. The terrain is mostly flat and well drained. Two survey stations (S17 and S25) were conducted in this terrestrial environment (Photo 3).

The tree layer is almost non-existent and is composed of a few jack pines. The shrub layer is dominated by speckled alder, velvet-leaved blueberry and sheep-laurel. There is no herbaceous layer in this area, except for some lichens, mostly on the bedrock, around survey station S25.

No hydrological indicators were observed in these stands. Soil analysis revealed mainly a podzol soil type with no layer of organic matter. This terrestrial environment covers 36,965 m², or 7.9% of the study area.



Photo 3 Shrubby field, survey station S17



Stantec

Project components
- Survey area (378,240 sq m)
- Landfille site
- Access roads

Ground Elevation
- Contour line (m)
- 240 Elevation

Watercourse
- Permanent watercourse
- Intermittent watercourse
- Flow direction

Wetland (WL)
- Open peatland (80, 467 sq m)
- Shrubby swamp (23,186 sq m)
- Wetland (Natural Resources Canada)

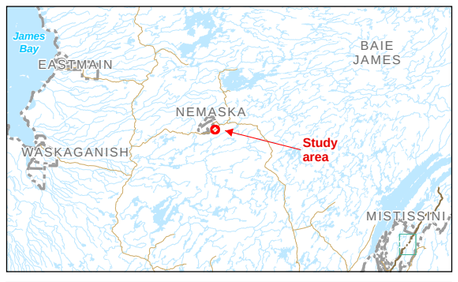
Terrestrial Environment (TE)
- Black Spruce stand (60,896 sq m)
- Jack Pine forest (185,055 sq m)
- Shrubby Field (28,614 sq m)

Flora survey (S)
- Sampling station

0 100 200 m

1:5 000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 MTM 9
2. Project Components: Poly-Geo, 2017 and Stantec, 2018-2019-2023
3. Field Inventory (Wetland, Terrestrial Environment and Flora Survey): Stantec, 2019
4. Wetland: CanVec © Natural Resources Canada. All rights reserved.
5. Contour Line interval generated with the Canadian Digital Surface Model (CDSM), resolution 0.75 cm, 2000, Poly-Geo
6. Watercourse: GRHQ, 2019 and Stantec, 20197. Orthoimagery: P6675_HQ10_03_025_34_094_geotiff_50cm.tif, Hydro-Québec, 2010



Project Location
Nemaska, Quebec

167020077-300-101-C0003 REVA
Prepared by Prosper Ravo on 2024-03-06
Technical Review by Émilie Charest on 2024-03-06
Independent Review by Julie Massicotte on 2024-03-06

Client/Project
Cree Nation of Nemaska
Development of a new landfill in Nemaska - ESIA

Map No.
4-3

Title
Vegetation and Watercourse survey

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4.3.3 Wetlands

The method employed for field surveys was adapted from the guide to identifying and delineating wetlands in southern Quebec, entitled *Identification et délimitation des milieux humides du Québec méridional* (Bazoge et al., 2015). This method combines vegetative, hydrological and soil analysis. Simplified delineation or expert delineation can be used:

Simplified delineation: when the topography shows a marked break, or if the wetland has an artificial boundary and the vegetation abruptly changes from typical wetland vegetation to vegetation not typical of wetlands, the wetland boundary is established very simply, on the basis of vegetation. Soil samples can be taken to specify this limit.

Expert delineation: where simplified delineation cannot be used, the boundary of the wetland is positioned using transects established perpendicularly to a clearly defined wetland area. For each transect, the wetland limit is located where at least one of the following two indicators is found: vegetation typical of wetlands or hydromorphic soils.

No official guide specific to northern wetlands of Quebec is currently available. Therefore, the Bazoge method must be used with caution in northern environments to delineate wetlands, especially regarding hygrophilous vegetation. Some species found almost exclusively in wetlands in southern Quebec have a much larger ecological range when it comes to hydrological conditions at higher latitudes, such as black spruce (*Picea mariana*) and common Labrador tea (*Rhododendron groenlandicum*).

Moreover, organic matter depth is an important indicator for wetland diagnosis, as a peatland is a type of wetland characterized by an organic deposit of 30 cm or more, according to the Environment Quality Act of Quebec (CQLR, c. Q-2, Government of Quebec, 2019a). In the study area, peatlands are abundant, as the cold and acidic conditions of the boreal forest at this latitude allow for slower organic matter decomposition. However, at the boundary of peatlands, organic matter depth follows a gradient that is not always easily discernible through vegetation response. Therefore, numerous soil samples up to 1 m deep were conducted along transects around wetlands, spaced 50 to 100 metres apart, where the wetland limit was not evident (expert delineation). As discussed with and agreed to by the MELCCFP (virtual meeting, April 30, 2020, see Appendix I), the peatland limit was placed between stations where organic matter depth shifted from less than 30 cm to above 30 cm.

The wetland limit was positioned using an Eos Positioning Systems Arrow GNSS (global navigation satellite system) receiver, which has submetric precision. Sampling stations are positioned using the same receiver or using the GLO receiver by Garmin, which has a precision of 3 to 5 m. In the context of the present study, wetland limits were not marked on site using forestry tape. As the submetric precision of the Arrow receiver is greater than the precision obtained by positioning the wetland boundary using the botanical method, it is not relevant to mark the boundary for surveying (no gain in precision).

During field surveys carried out from September 3 to 5, 2019, 15 wetlands were identified: 11 open peatlands, three shrubby swamps and one wooded swamp (Map 4-3). A total of 30 survey stations were inventoried in wetlands inside the PDA, including the three access road options and the proposed landfill site. These wetlands were delineated and characterized using floristic composition, hydrological indicators, and soil analysis.



Where possible, a soil survey was conducted at sampling stations, as well as at a few locations surrounding wetlands, to confirm the terrestrial nature of the surrounding environment. A short description of each wetland type is presented below.

Open peatland

Open minerotrophic peatlands, also called fens, are the most common wetland type within the study area. They are composed of wetlands WL01, WL02B, WL04, WL05A, WL05B, WL05D, WL06, WL07A, WL08, WL09 and WL10 (Map 4-3). The southeast part of the study area is constituted primarily of one large peatland complex, while many smaller peatlands occur in the west part of the study area. The big peatland complex is drained by a permanent watercourse. Twenty-three sampling stations (S05, S41, S55, S56, S57, S58, S59, S60, S61, S62, S63, S65, S67, S69, S70, S72, S73, S74, S75, S76, S77, S79 and S80) were conducted in these peatlands (Photo 4).

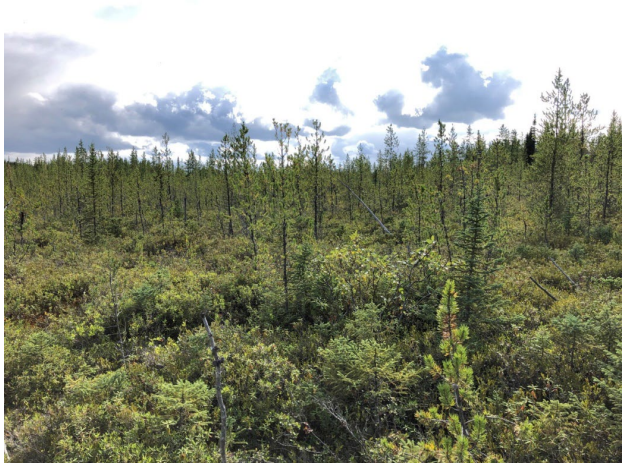


Photo 4 Open Peatland, survey station S70

The tree layer is composed mainly of black spruce (*Picea mariana*) and jack pine (*Pinus banksiana*) in low density (0-10%) and short heights (max 5 metres). The shrub layer is dominated by leatherleaf (*Chamaedaphne calyculata*) and common Labrador tea (*Rhododendron groenlandicum*). The shrub layer is also composed of glandular birch (*Betula glandulosa*) and pale bog laurel (*Kalmia polifolia*). This layer is very dense in all peatlands (60 to 100%). The herbaceous layer is diversified and not dense. We can observe the presence of few-seeded sedge (*Carex pauciflora*), tussock cottongrass (*Eriophorum vaginatum*) and cloudberry (*Rubus chamaemorus*), among others. At some survey stations, the soil was covered by mosses and sphagnums.

The hydrological indicator observed in this wetland is mainly water saturation in the first 30 cm and sometimes a smell of sulfur. Soil analysis revealed mainly a thick layer of organic matter (30 to 60 cm or more). These wetlands cover an area of 94,644 m² (20.2% of the study area).

Shrubby swamp

Shrubby peatlands are less abundant within the study area. They are composed of wetlands WL02A, WL03 and WL05C (Map 4-3) and are mostly in flat areas and at the bottom of a slope. Six sampling stations (S23, S39, S40, S64, S66 and S71) were conducted in this shrubby swamp (Photo 5).

The tree layer is less than 10% cover, composed mainly of jack pine (0-5%). The shrub layer is very dense (80 to 100%) and diverse. It is dominated by leatherleaf and common Labrador tea. The shrub layer is also composed of jack pine and sheep-laurel (*Kalmia angustifolia*). The herbaceous layer is diverse and not dense. It is composed mainly of cloudberry, sphagnum mosses and lichens.



Photo 5 Shrubby swamp, survey station S66

The hydrological indicator observed in this wetland is the water saturation in the first 30 cm. Soil analysis revealed mainly a sandy loam soil type with a thin layer of organic matter (5-10 cm). These wetlands cover an area of 23,186 m² (4.9% of the study area).

Wooded swamp

There is only one wooded swamp within the study area (WL07B), and it is located near the road in the west part of the study site (Map 4-3). One sampling station (S02) was conducted in this wooded swamp (Photo 6).



Photo 6 Wooded swamp, survey station S02

The tree layer is composed mainly of jack pine. The shrub layer is dense and dominated by speckled alder (*Alnus incana ssp. rugosa*) and common Labrador tea. The shrub layer is also composed of glandular birch and sheep-laurel. There is no herbaceous layer.

No hydrological indicators were observed in this wetland. Soil analysis revealed mainly a podzol soil type with a thin layer of organic matter on it (5 cm). This wetland covers an area of 0.8 m² (0.0002% of the study area).

4.3.4 Aquatic Wildlife

The main fish species that can be found around Nemaska are lake whitefish, northern pike, trout, walleye, sturgeon, burbot and sucker.

No specific wildlife inventory occurred in the context of this study. During the field visits, no aquatic wildlife was observed.

There is one permanent watercourse partially in the southeast part of the study area that flows to the West and into another watercourse outside the study area. No fish or aquatic wildlife was observed during the field visit, but the watercourse is potentially fish bearing.

The watercourse is a small stream, barely visible at some points, about 0.75 m in width and 0.10 m in water depth on the day it was visited. Watercourse banks were about 0.20 m high with a slope of less than 30%.

4.3.5 Terrestrial Wildlife

Consultation of the interactive map from the Centre de données sur le patrimoine naturel du Québec (CDPNQ) provided information on species at risk within 8 km of the Project. According to the CDPNQ (2023), no wildlife species of concern were registered on the study site or in a radius of 8 km.

4.3.5.1 Amphibians

Five amphibian species are present in the Nemaska area: American toad, mink frog, spring peeper, wood frog and a creek salamander species (Northern two-lined salamander).

4.3.5.2 Mammals

Overall, the region has a limited carrying capacity for wildlife, owing to the environment's low productivity (Hydro-Québec, 2003). Shrub heathlands and burnt areas, which cover a large fraction of the territory, have little value for terrestrial fauna. Conversely, the riparian biotopes and the few mixed populations, characterized by a more diversified vegetation, support a greater variety of fauna species (Hydro-Québec, 2003).

Big game

Moose (*Alces alces*) habitat is scarce in the area of the Project, as shown by the species' low population density, which does not exceed 10 moose per 100 km^2.

According to Hydro-Québec (2003), a critical habitat for woodland caribou (*Rangifer tarandus*) is located around 150 km southwest of the study area, between the Rupert, Manitu, and Boisrobert lakes (Hydro-Québec, 2003).

The black bear (*Ursus americanus*) is quite common throughout this region. Trapline owners mentioned its presence throughout the riparian habitats of the Bay and the Rupert River, as well as in the coniferous woods north of the Jolliet and Mwakw Kachikachisch lakes (Hydro-Québec, 2003).

Furbearers

The most common types of fur-bearing animals on the territory are porcupine (*Erethizon dorsatum*), snowshoe hare (*Lepus americanus*), beaver (*Castor canadensis*), American marten (*Martes americana*), American mink (*Neovison vison*), lynx (*Lynx canadensis*), red fox (*Vulpes vulpes*), grey wolf (*Canis lupus*), weasel (*Mustela nivalis*) and red squirrel (*Tamiasciurus hudsonicus*). Muskrat (*Ondatra zibethicus*) and wolverine (*Gulo gulo*) are considered rare species nowadays (Nemaska Lithium, 2013).



No specific wildlife inventory occurred in the context of this study. During the field visits, no terrestrial wildlife was observed.

4.3.6 Avian Wildlife

In Quebec, the black spruce-moss environment provides habitat for 150 breeding bird species. The most commonly observed in the Nemaska area are the American black duck, Canada goose, snow goose, brant, common loon, sharp-tailed grouse, spruce grouse, ruffed grouse, willow ptarmigan, osprey, bald eagle and other small forest birds.

No specific wildlife inventory occurred in the context of this study. During the field visits, no avian wildlife was observed.

4.4 HUMAN ENVIRONMENT

The Cree community of Nemaska is located on the northwest shore of Champion Lake, north of the Rupert River, some 200 km inland from James Bay in northern Quebec, within Eeyou Istchee, the traditional territory of the eastern James Bay Cree.

The CNN had previously lived in the Nemaska Lake area since time immemorial and had a settlement there. Known as Old Nemaska, or Old Nemaska Post, the site had been serviced by a Hudson Bay Company trading post from approximately 1908 to 1970. As a consequence of Hydro-Québec's Nottaway Broadback Rupert (NBR) Project, which would have resulted in the flooding of the area, the CNN members were forced to relocate in 1970. After years of living scattered in other communities and locations, members of the CNN decided in 1977 to permanently relocate to their current home on Champion Lake. Construction of the village started in 1979 with housing.

The proposed new landfill site is located southeast from the community, approximately 17 km by road.

4.4.1 Demographics and Socio-economic Context

At the time of the 2021 census, Nemaska had 832 residents. It represented a 9.5% increase from the 2016 census, while the province of Quebec's population saw a 3.3% increase during the same period. Nemaska's population was composed of 260 residents aged between 0-14 years, 510 residents aged 15-64 years, and 70 residents aged 65 years and over. The median age of the population was 28.6 years, while the province of Quebec's median population age was 43 years (Statistics Canada, 2021). According to the department formerly known as Indigenous and Northern Affairs Canada (INAC), the registered population of Nemaska in October 2023 was 848 residents (INAC, 2023).

The community counted 291 private dwellings in 2021, among which 221 that were occupied by usual residents. The average household size was 3.7 people, but the majority of the private dwellings (33.3%) were occupied by five people or more. Most Nemaska residents (92.1%) identified the Cree language as their mother tongue, with 4.2% of them speaking neither English nor French. Cree is the language most spoken at home; however, 82.4% of Nemaska residents know English, 3.0% know French, and 11.0% know both English and French (Statistics Canada, 2021).



Of the 400 people from that population aged 15 years and over who were part of the active labour force in 2021, 370 were employed at the time of the census. Table 4-2 presents the distribution of the labour force by industry for Nemaska residents. The term “industry” refers to the general nature of the business carried out in the establishment where the person worked (Statistics Canada, 2021).

Table 4-2 Distribution of Nemaska Labour Force by Industry, in 2021

Industry	Labour Force Population aged 15 and over
All categories	395
Mining, quarrying and oil & gas extraction	10
Construction	15
Retail trade	15
Transport and warehousing	10
Finance and insurance	10
Professional, scientific and technical services	10
Educational services	50
Health care and social assistance	85
Arts, entertainment and recreation	10
Accommodation and food services	15
Other services	15
Public administration	155

Note: The adjustment to counts of the total population for any dissemination block is controlled to ensure that the population counts for dissemination areas will always be within 5 of the actual values. The adjustment has no impact on the population counts of census divisions and large census subdivisions.

Source: Statistics Canada, 2021

4.4.2 Infrastructure and Services

Numerous services and infrastructures are established on the main road (Chistaastihkw Road) within the community, including the Cree Nation Government offices, police station, justice facility, municipal and public works garages, warehouses and storage, church, old and new cemetery, antennas (Radio Shack and Bell Mobility), ecocentre, gas station, lodge, pumping station, wastewater treatment plant, water treatment plant, and sewage disposal pond. The Canada Post office, the First Nation Bank and a restaurant are located in the mini mall, also on Chistaastihkw Road.

Additional community infrastructure and services are provided in Nemaska, such as the Band Office, wellness centre, radio centre, health clinic, youth centre, school and Cree School Board, daycare, local Cree Trappers Association (CTA) office, sports and cultural complex, arena, multiservice centre and administration office.

Waste management is a service governed by the CNN Department of Public Works, and environmental conformity is under the responsibility of the Land and Sustainable Development department. Services include Ecocentre and Eco patrol. Built and operated by Hydro-Québec, the Nemiscau airport is located approximatively 8 km northeast of the PDA. Hydro-Québec owns several infrastructures and facilities in the area, including two electrical substations: the Nemiscau substation, located some 13 km east of the PDA; and the Albanel substation, approximately 40 km east of the Nemiscau substation. Electrical transmission lines (735 kV) connecting both stations run alongside the Route du Nord, and a 69 kV power line connects the community to the Nemiscau substation.

4.4.3 Emergency Response

The CNN provides police, ambulance, firefighter and rescue services to its members. The regional police services in Eeyou Istchee are provided by the Eeyou Eenou Police Force (EEPF) through the Nemaska local detachment.

4.4.4 Transportation Network

In the Nemaska area, the Route du Nord is owned by Hydro-Québec and managed by the Société de développement de la Baie-James (SDBJ). Main local roads in the community are paved, but most local roads are unpaved. Old Nemaska is only accessible through waterways: by boat, during the “open water” period, or through an ice road during winter.

4.4.5 Land Use and Tenure

Given its location approximately 5 km from the community boundaries, the proposed site does not interfere with any current or future land use plans. At a regional level, the Eeyou Istchee James Bay Regional Government zoning by-law provides no special requirements within zone 51-06-R, where the proposed site is situated (Stantec, 2018). The proposed site is bounded to the north by a powerline right-of-way, located at least 50 m from it (see Map 4-3).

The proposed site is located on trapline R16, which already hosts various CNN and Hydro-Québec infrastructures (see Map 4-4). Communication was established with the tallyman of trapline R16 during the site selection process, in 2016, and has been ongoing since then.

To gather information regarding land and resources use, an interview was conducted in April 2021 with the tallyman of trapline R16, where the potential landfill site would be located. This interview could not be completed, due to time constraints. A second meeting (September 2021) was thus held to finalize the interview. A validation interview then took place in person with the tallyman and his brother Redfern Cheezo on February 1, 2023.

The Cheezo family used to camp outside the potential landfill site, some 4 km northeast. They would trap beaver there during the winter near this camp. Fishing also takes place within the area around the camp.

The vicinity of the potential landfill area is used for small game hunting activities, such as rabbit snaring and lynx trapping. Beavers can also be trapped by the tallyman around the PDA area. Martens and



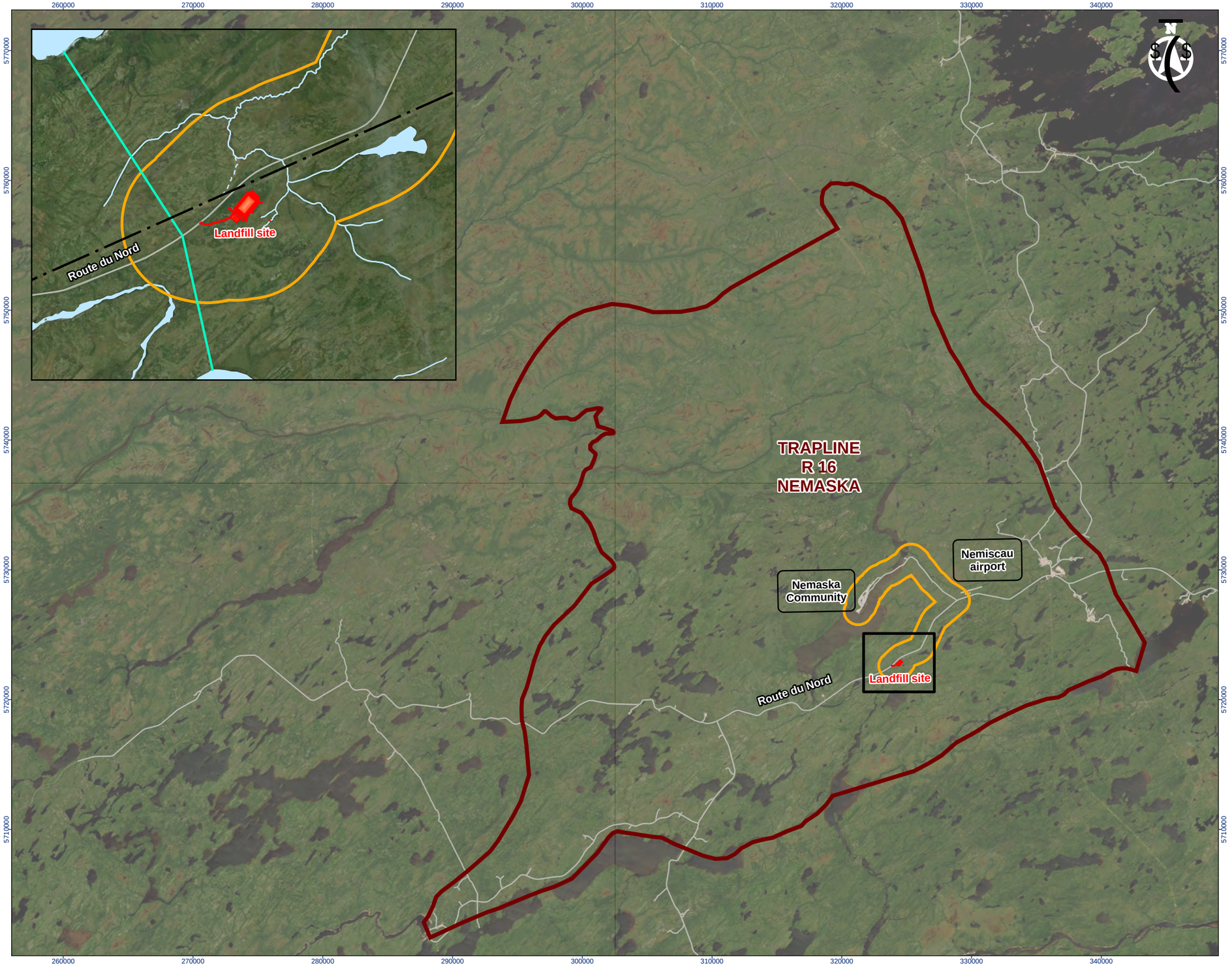
squirrels cross the Route du Nord in that area, too. Big game—mostly bears and moose—cross the vicinity of the area, especially during the fall.

Since the area is easily accessible by the Nemaska Road and the Route du Nord, several community members use the land and resources on trapline R16 without informing the tallyman, so it is possible that berry-gathering activities are taking place in proximity to the potential landfill site.

The tallyman and other land users access the powerline right-of-way to circulate by snowmobile and all-terrain vehicle (ATV). Another snowmobile trail is located west of the proposed landfill footprint.

4.4.6 Archaeological and Cultural Resources

An archaeological potential study carried out by consultant archaeologist Francois Guindon in 2019 covered all projected landfill infrastructures and the access road, plus a 500 m buffer zone (see Map 4-5). That report is presented in Appendix J. The study determined that archaeological potential in the LSA was low to moderate. However, the only area with moderate archaeological potential that will not be affected by the planned infrastructures is located at the southern end of the projected landfill and road access. Guindon (2019) therefore concluded that, based on the current layout of the planned infrastructures, the risk of impacts on archaeological heritage is low, and impact mitigation measures will not be required.



Stantec

Project components

- Landfill site
- Regional Study area (1 km)
- Power line

Human environment

- Trapline area
- Snowmobile trail

Others

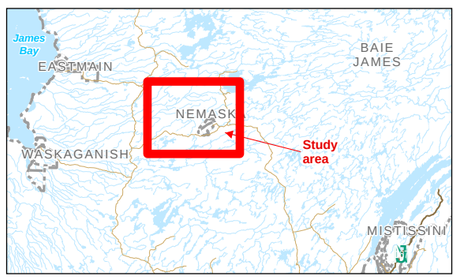
- Road
- Watercourse
- Waterbody

0 5 10 km

1:300 000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 MTM 9
2. Project Components: Poly-Geo, 2017 and Stantec, 2018-2019-2023
3. Powerline, Watercours and Waterbody: CanVec © Natural Resources Canada. All rights reserved.
4. Trapeline, Snowmobile Trail : Cree Nation of Nemaska, 2024
5. Orthoimagery: Esri World Imagery, 2016



Project Location

Nemaska, Quebec

167020077-300-0005 REVA

Prepared by Prosper Ravo on 2024-03-08

Technical Review by Émilie Charet on 2024-03-08

Independent Review by Julie Massicotte on 2024-03-08

Client/Project

Cree Nation of Nemaska

Development of a new landfill in Nemaska - ESIA

Map No.

4-4

Title

Trapline R-16

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Stantec

Project components

- Landfill site
- Archaeological survey area (500 m)
- Power line
- Road

Archaeological potential

- Moderate
- Low
- Rock Outcrop of interest

Hydrologie

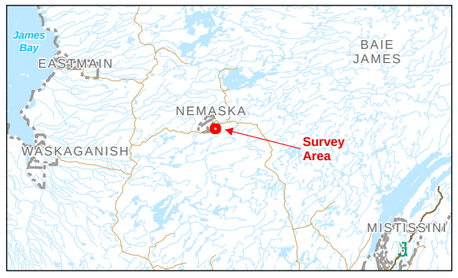
- Watercourse
- Waterbody

0 250 500 m

1:10 000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 MTM 9
2. Project Components: Poly-Geo, 2017 and Stantec, 2018-2019-2023
3. Powerline, Watwercours and Waterbody: CanVec © Natural Resources Canada. All rights reserved.
4. Contour Line interval generated with the Canadian Digital Surface Model (CDSM), resolution 0.75 cm, 2000, Poly-Geo
5. Archeological potential, Rock Outcrop : François Guindon, consultant archaeologist, 2020
6. Orthoimagery: Esri World Imagery, 2016



Project Location

Nemaska, Quebec

167020077-300-0006 REVA
Prepared by Prosper Ravo on 2024-03-08
Technical Review by Émilie Charest on 2024-03-08
Independent Review by Julie Massicotte on 2024-03-08

Client/Project

Cree Nation of Nemaska
Development of a new landfill in Nemaska - ESIA

Map No.

4-5

Title

Archaeological potential

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5.0 CONSULTATION AND ENGAGEMENT

Information and consultation activities were organized by the CNN with support from Stantec for the CNN community, including the following:

- Interviews with the tallyman of trapline R16, where the potential landfill is to be located;
- Radio show;
- Public information and consultation sessions (2).

5.1 METHODOLOGY

In preparation for the activities, Stantec provided a poster and a brief information text to the CNN Project Team to support publicizing the information sessions. Approximately 10 days before the information and consultation activities, a notice inviting CNN members to listen to the radio interview and attend the sessions was posted on the “Nemaska Announcements” Facebook page and at the CNN Band Office. The week before the radio show, a notice advertising an upcoming interview with the Stantec team about the new landfill Project was posted on Champion Lake Radio’s Facebook page.

5.1.1 Interviews with the Tallyman of Trapline R16

In April and September 2021, Stantec conducted interviews with Mr. Charles Cheezo, tallyman of trapline R16, where the potential landfill site would be located. The objectives of these interviews were to document the land and resource use within the potential landfill site’s general area; present the three access road options; and gather his comments and recommendations. A validation interview with the tallyman and his brother, Redfern Cheezo, took place in person on February 1, 2023. The detailed interview notes are available upon request. Section 4.4.5 provides a summary of land and resource uses by the tallyman and members of the Nemaska community.

5.1.2 Radio Show

On Wednesday, February 1, 2023, an information session was held at the local radio station (Champion Lake Radio) in Nemaska. A representative from Stantec presented the new landfill Project with consecutive interpretation from English to Cree by the Radio Host. The presentation, including interpretation, lasted approximately 30 minutes. Due to a problem with the phone line, the listeners could not call in to ask their questions and share their comments on the Project. However, they were invited to do so at the public information and consultation sessions that were planned for the following day.

5.1.3 Information and Consultation Sessions (2)

Two information and consultation sessions were held on February 2, 2023—one in the afternoon (8 participants) and another in the evening (3 participants)—at the CNN Administration building in Nemaska. Reference maps (“Figure 1 – Proposed Site Location” and “Figure 1 – Proposed landfill site with the three access road options and the environmental components”) were placed on a table. A PowerPoint presentation was also projected on a screen as a visual aid for the presentation. Stantec



presented the new landfill Project in terms of context; site selection process; landfill design and operation; proposed access road options; and potential impacts. Participants were invited to ask their questions and share their comments at any time during the presentation, and the invitation was repeated at the end of the presentation. The sessions were translated (English-Cree/Cree-English).

5.2 RESULTS

5.2.1 Main Concerns and Questions from CNN Members

Table 5-1 Main Concerns and Questions

Concerns and questions	Answers
Potential impacts on visual aesthetics and odours in proximity to the landfill site	The waste will be unloaded and compacted inside the area defined by the berms. The operations will not be visible from outside. Greenery is planned for the exterior surface of the berms for better visual integration. Regular waste will be compacted once unloaded and covered with soil on a weekly basis. Both operations will reduce odours. Very smelly waste will be compacted and covered with soil as soon as unloaded.
Big game, especially bears, crossing Route du Nord and the landfill access road	The site will be fenced (two feet deep and seven feet high). Operators of the site are trained to manage bear risk.
Deforestation: concerns about the mature jack pines that would need to be removed	The site is designed to optimize the area used. The use of a compactor will help reduce the footprint impact as well. The implementation of additional waste landfill diversion solutions (recycling, composting) will help in reducing the future needs for a landfill site and thus the associated impacts on the forest.
Depth of water table and water quality: concerns about percolation and contamination of surface water travelling to Champion Lake	The bottom of the trench will be five metres minimum from the groundwater. Some pollutants will be naturally filtered by the soil before reaching the groundwater. Any water within the trench will have to percolate through the soil. The water outside the trench will never be in contact with waste.
Proximity to an important snowmobile trail, since access road options 2 and 3 are close to it	Specific signage will be implemented in the area where the access road and the snowmobile trail are the closest.
Why can't we burn the waste? While being aware that burning has negative impacts on air quality and is not authorized under the *Regulation respecting the landfilling and incineration of residual materials (RRLIRM)*, some participants highlighted that it presents the advantages of	As mentioned, it is forbidden and has negative impacts on air quality and therefore on the flora and the fauna (particles in the air and ashes). As for the "advantages" highlighted, they can be met with alternative solutions:

Concerns and questions	Answers
keeping the birds and other animals away, limiting the amount of waste spread by the wind and animals, therefore reducing the volume of waste	• Keeping the birds and other animals away: compaction and regular cover of waste with soil will help reduce animal and bird presence. Implementation of organic waste landfill diversion solutions, such as composting, will reduce the organic waste quantities brought to the site and, similarly, the number of animals and birds. • Limiting the amount of waste spread by the wind and animals: compaction and regular cover of waste with soil will help reduce waste spreading. The top of the berms will be fenced to avoid waste spreading outside the trench. An annual clean-up of the fences will help reduce visual impact. • Reducing the volume of waste: waste will be compacted. In addition, solutions to increase waste landfill diversion (composting, recycling) will be implemented by the community in the coming years.

5.2.2 Recommendations from CNN Members

Table 5-2 Recommendations

Recommendations	Answers
Develop the new landfill further away from Route du Nord.	The site location has been chosen by the community from among nine options as the best balance between environmental impacts and costs. Locating it further from Route du Nord would mean more impacts on the environment to build the access road (deforestation, potential wetlands), as well as higher construction and operational (waste transportation, road maintenance) costs.
Study the possibility of developing the new landfill in an old borrow pit.	The site selection process took several years. Nine sites were assessed, including a former borrow pit (Sakami Moraine). After analyzing the regulatory constraints as well as best balance between environment impacts and costs, the community chose the site described in this report. The Site Selection and Baseline Study for a New Landfill Site in Nemaska report (Stantec, 2018) is available in Appendix B.
Bury the fence around the landfill at least two feet into the ground and/or surround the bottom part of the fence with big rocks (boulders).	It is included in the preliminary design presented in this report.
Implement a recycling and composting program in Nemaska (door-to-door collection) and require	It is part of the community's plans for the coming years.

Recommendations	Answers
Get Hydro-Québec (HQ) residences, the workcamps and Nemaska Lithium, who will also be using the site, to start recycling and composting as well.	
Ban plastic bags in Nemaska. A by-law was approved by the Chief and Council but was not enforced.	This suggestion should be addressed to the community's Chief and Council.
Train the landfill operators regarding best practices.	Training will be included as part of the site commissioning procedure.
Control the landfill entrance with a fence and a lock.	That measure is included in the preliminary design presented in this report.
Select access road option #2 (instead of #3) in order to avoid the snowmobile trail.	That option is included in the preliminary design presented in this report.
Install an electric fence.	This is not included as the first solution. A two-foot-deep fence is expected to suffice to prevent animals from crossing into the site. However, it could be added in the future according to the lessons learnt during the first years of operation if required.
Cover the entire landfill with fence ("chicken-wire" type) or some kind of net (similar to nets used in orchards).	The site is too big to accommodate this kind of solution. However, the waste will be compacted and covered with soil on a weekly basis. It will reduce the bird impact. In addition, if a composting program is implemented, it will help reduce the organic waste landfilled at the site.
Install new "no shooting" signs along the Route du Nord and the new landfill access road.	Appropriate signage will be implemented along the access road. For the Route du Nord: to be discussed between the community, the road owner, and the road manager.
Implement a food recovery program with Hydro-Québec residences and the workcamps to reduce food waste.	This is part of the community's plans for the coming years.
Implement a scrap lumber recovery program: HQ should notify CNN members when they discard lumber, so members can recover and use it.	This will be addressed in the community's next waste management plan.

6.0 IMPACT ASSESSMENT METHOD

This section outlines the methods used to evaluate the potential residual Project impacts on the receiving environment. The analysis of residual impacts takes into account the Project description (Section 3), detailed description of the receiving environment (Section 4) and public consultation (Section 5), as well as information on environmental monitoring proposed for similar projects realized in northern environments.

6.1 SELECTION OF VALUED COMPONENTS

The ESIA process is designed to focus on the identification of Valued Components (VCs). VCs are components of the environment, both natural and social, that are valued by society. VC selection is based on the environmental setting and issues scoping (professional judgment; issues raised by regulators, including Project guidelines; and issues raised during public consultations, workshops, and meetings with key stakeholders).

The VC selection process also considered the nature as well as temporal and spatial scope of the Project, and it anticipated potential interactions between the Project and the environment. From the scoping activities conducted for the Project, the following VCs—or main environmental and social components that can potentially be affected by the Project—were selected:

1. Slope Stability / Soil Erosion
2. Surface and Groundwater
3. Soil Quality
4. Air Quality
5. GHG Emissions
6. Vegetation
7. Wetlands
8. Terrestrial and Avian Wildlife
9. Land and Resource Use
10. Infrastructure and Equipment
11. Visual Environment



6.2 POTENTIAL INTERACTIONS BETWEEN PROJECT AND VC

The interactions between the VCs and Project components are identified for each Project phase. Interactions between key Project activities and the environment are ranked according to their potential for an activity to interact with one or more VC.

6.3 IMPACT ASSESSMENT CRITERIA

Impacts are evaluated for each Project phase: construction, operation, and closure. Three criteria are considered in the impact evaluation for each component: the **intensity** of the impact, **extent** of the impact, and **duration** of the impact. The intensity of the impact is based on the component value and the degree of disturbance apprehended.

6.3.1 Value of Component

The relative value of each component takes into consideration the abundance of the resource; distribution of that resource; susceptibility of that resource to modifications (sensitivity, resilience, integrity); ecological role of the resource; and importance of the resource to the local population, specialists, regulators, and other interest groups. If a component's value differs according to its role in the ecosystem or local economy, the strongest value for that component is retained. Given these criteria, the value of a component can be low, moderate, or high.

Low

A low value is attributed to a component when the modification of that component does not concern interest groups for its conservation, protection, or maintenance of integrity. In general, components with low value are not used by the population.

Moderate

A moderate value is attributed when the modification of a component represents a moderate level of concern to interest groups for its conservation, protection, or maintenance of integrity. A moderate value can be given to components of economic interest, components used by a significant portion of the population or cases in which there is a lack of consensus among interest groups with respect to the value of that resource. This value does not necessitate legal protection of the resource.

High

A strong value is attributed to a component that is protected by legislation, is the object of specific protection or conservation measures, is essential to human activities (potable water, recognized archaeological value, used for subsistence) and/or has particular value as agreed upon by various interest groups. Often, a component of strong value is unique or rare.

The value of each Project valued component is identified in Table 6-1.



Table 6-1 Value of Project Valued Components

VC	Value	Rationale
Slope Stability / Soil Erosion	Low	Land profile and slope stability refer to the natural topography of the ground and the stability of the soil during and after the construction activities. Excavation and earthworks as well as deforestation may alter the slope stability of the land. It is important to level the soil properly and build stable slopes to prevent erosion. Considering the largely flat topography in the local area and low risk of landslides, a low value was granted.
Surface and Groundwater	High	Surface water quality refers to the physicochemical characteristics of waterbodies and watercourses. This component is valued in relation to the diversity of organisms and habitats that surface waters shelter and support, and the high vulnerability and low groundwater regeneration rate.
Soil Quality	Moderate	Soil quality is established from the natural physicochemical characteristics of the soil. Soil quality may be affected by accidental spills of petroleum or other products during refuelling of vehicles and machinery or during work on undeveloped land. The scarcity of soil use by the local population and, more precisely, the very limited alteration thereof gives this component a moderate value.
Air Quality	Moderate	Air quality refers to the chemical quality of the ambient air, the disruption of which may affect human health. Air quality is not an issue during the construction and operation phases, as activities will be limited to machinery operations. A moderate environmental value was given to this component.
GHG Emissions	Low	The Project will result in the release of greenhouse gas (GHG) emissions that will affect the atmospheric environment. It is expected that GHGs will be released from organic waste degradation and machinery operation only during Project lifetime.
Vegetation	Low	Species considered are abundant from an ecological point of view. Protected species and subsistence species are considered in the Species of Concern and Land Use components respectively.
Wetlands	Moderate	Wetlands are considered as sensitive habitats and are protected under provincial environmental regulations. However, wetlands are abundant in the regions, and the landfill design must comply with the setback distance outlined in the legislation. For these reasons, a moderate value was granted.
Terrestrial Wildlife	Low	Species under consideration are abundant from an ecological viewpoint. Protected species and subsistence species are considered in the Species of Concern and Land Use components respectively. No critical wildlife habitat was identified within the PDA.
Land and Resource Use	Moderate	The Cheezo family used to camp outside the potential landfill site, some 4 km northeast. The vicinity of the potential landfill area is used for hunting and trapping. Several community members may use the land for berry-gathering activities. Beside the landfill site, land uses will be maintained in the LSA; a moderate value was therefore given to this component.
Visual Environment	Moderate	Visual environment may have implications on a land user's sense of place and cultural identity. As the site will be visible to land users, a moderate value was granted.

6.3.2 Degree of Disturbance

The degree of disturbance assesses the magnitude of the negative changes in the structural and functional characteristics of the component affected by the Project.

Low

A low degree of disturbance is attributed when the effect of the impact doesn't cause observable changes to the quality, utilization, or integrity of the component.

Moderate

A moderate degree of disturbance is attributed when the effect of the impact decreases or increases the quality or utilization of a component without compromising its integrity.

High

A high degree of disturbance is attributed when the effect of the impact puts the integrity of the component at risk or there is strong modification of the integrity or utilization of that component that is irreversible.

Indeterminate

An indeterminate value is attributed when it is impossible to predict the degree to which a component may be impacted. When the degree of disturbance has a value of indeterminate, the evaluation of the impact cannot be completed for that component.

6.3.3 Intensity of Impact

The intensity of impact is determined by relating a given component's degree of disturbance to its value. The disturbance of a Project component depends on how the integrity and function of that component are modified by the Project. The degree of disturbance can range from low to high or be indeterminate.

Determination of Intensity

Once the degree of disturbance is determined to be low, moderate, or high, the evaluation grid below can be used to relate the component value and determine the overall intensity of the disturbance.



Table 6-2 Evaluation Grid for the Determination of Impact Intensity

		Value of component		
		High	**Moderate**	**Low**
Degree of disturbance	**High**	High	High	Moderate
	Moderate	High	Moderate	Low
	Low	Moderate	Low	Low

The intensity of a Project's impact on a component can range from low to high.

Low

A Project impact of low intensity implies the slight modification of a component without jeopardizing the integrity, utilization and/or function of that component.

Moderate

A Project impact of moderate intensity implies a modification of a component's integrity, utilization and/or function.

High

A Project impact of strong intensity implies the destruction of a component or considerable modification of the quality of that component and/or a major change in its utilization.

6.3.4 Extent of Impact

The extent of a Project impact refers to the surface area and the portion of the population that will be impacted. The extent can be classified as site specific, local, or regional.

Site specific (PDA)

The extent of the Project impact is considered site specific when it is limited to a small area within the work zone, or the impact will only be felt by a few individuals.

Local

The extent of the Project impact is local when the impacted surface area is confined to the LSA, or the impact is felt by a portion of the local population.

Regional

The extent of a Project impact is regional when repercussions of that impact are anticipated over the RSA or on a large segment of the population.

6.3.5 Duration of Impact

The duration of the impact refers to the period a Project impact will be experienced in the environment. The duration can be short, moderate, or long.

Short

The duration of a Project impact is considered short when it is experienced continuously or discontinuously over a short period of time that ranges from days to one year.

Moderate

The duration of a Project impact is considered moderate when it is experienced continuously or discontinuously over a period of time that is shorter than the life of the project. The duration of the impact ranges from one to five years.

Long

The duration of a Project impact is considered long when it is experienced continuously or discontinuously for five years or more. Long duration impacts are felt over the entire life of the Project, after Project completion, and can include impacts that are considered permanent.

6.4 MITIGATION OF NEGATIVE IMPACTS

The proposed mitigation measures are based on projects that have been realized with similar parameters and under similar environmental conditions. Social context and concerns have been taken into consideration in the development of recommendations and given equal weight during the analysis. All mitigation measures are summarized in a table for each VC.

6.5 DETERMINATION OF IMPORTANCE OF RESIDUAL IMPACTS

The determination of importance of impacts (including Project design mitigation) and residual impacts (including post-Project design mitigation) is based on the three criteria used to characterize Project impacts: intensity, extent and duration. The nature of the impact (negative, positive, indeterminate) is established during the Determination of Importance step of the analysis.

Impacts are classified as major, moderate, or minor. See Table 6-3 for the evaluation grid used to determine the importance of residual impacts.

Table 6-3 Determination of Importance Evaluation Grid

Intensity	Extent	Duration	Importance of impact
High	Regional	Long	Major
		Moderate	Major
		Short	Major
	Local	Long	Major
		Moderate	Major
		Short	Moderate
	Site specific	Long	Major
		Moderate	Moderate
		Short	Moderate
Moderate	Regional	Long	Major
		Moderate	Moderate
		Short	Moderate
	Local	Long	Moderate
		Moderate	Moderate
		Short	Minor
	Site specific	Long	Moderate
		Moderate	Minor
		Short	Minor
Low	Regional	Long	Moderate
		Moderate	Minor
		Short	Minor
	Local	Long	Minor
		Moderate	Minor
		Short	Minor
	Site specific	Long	Minor
		Moderate	Minor
		Short	Minor

7.0 IMPACTS ON ENVIRONMENT

7.1 SOURCES OF IMPACT

The identification of the Project impacts was carried out based on the analysis grid presented in Table 7-1. This grid includes the environmental components potentially affected by the Project activities (described in Section 4) and lists these activities according to the Project implementation stage (described in Section 3).

The identification of potential interactions considers the following elements:

- Technical characteristics of the Project and the proposed working methods;
- Knowledge of the environmental setting through existing documentation and data from the field;
- Lessons learned from similar projects;
- Community concerns about the Project.

Table 7-1 Project Interactions Summary Table

		Receiving Environment Components										
		Physical Environment					Biological Environment			Human Environment		
		Slope Stability / Soil Erosion	Surface and Groundwater	Soil Quality	Air Quality	GHG Emissions	Vegetation	Wetlands	Terrestrial and Avian Wildlife	Land and Resource Use	Infrastructure and Equipment	Visual Environment
Construction	Vegetation clearing	▼			▼	▼	▼		▼	▼		▼
	Construction of the access road	▼		▼	▼	▼		▼	▼	▼	▼	▼
	Traffic				▼	▼			▼	▼	▼	
	Construction of the landfill and berm	▼		▼	▼	▼			▼	▼		▼
Operation	Traffic				▼	▼			▼	V	▼	
	Landfill operations (waste unloading, compaction and progressive cover, equipment maintenance)	▼	▼	▼	▼	▼			▼	V		▼
Closure	Closure of landfill site	+		+	▼	▼	+		+			+

Legend: ▼ Minor negative V Moderate negative + Positive

7.2 IMPACT ON PHYSICAL ENVIRONMENT

7.2.1 Slope Stability / Soil Erosion

7.2.1.1 Description of Impacts

Construction Phase

Removal of vegetation is required, as is backfilling, grading and installation of structural layers, for the development of the new access road from the Route du Nord to the landfill. These activities will level the area, changing the topography within the PDA and increasing the risk of erosion and soil compaction.

Operation Phase

The compaction and progressive cover of the waste could affect slope stability while the machinery works near the berm. No additional impacts on slope stability are expected during the operation phase.

Closure Phase

The final cover of the landfill will add a soil layer of at least 60 cm thick, including a 15 cm layer of organic soil suitable for vegetation. The final cover will be graded to a slope of between 2% and 5%.

7.2.1.2 Evaluation of Impacts

The backfilling and grading of the access road will alter the topography over an area that is 450 m long and 7 m wide. According to the plan, the bottom of the trench will be more than 5 m from groundwater. The continuous trench will be excavated to a depth of 2 to 5 m. A berm of between 3 and 5 m in height above natural ground will be constructed along the perimeter of the excavated trench to increase landfill capacity.

A vegetative layer on the top and surface of the berm will prevent erosion. The berm also serves as a visual barrier between the nature surrounding the site and the landfilling area.

During construction and operation, the intensity of the collective impacts is low given that the component value is low, and the disturbance is not expected to change the surrounding topography integrity. The extent of the disturbance is site specific, confined to the PDA. The impact result is short during construction but then long in duration, as the topography will remain changed for the life of the Project and during the closure and monitoring phases.

During the construction and operation, when the Determination of Importance Evaluation Grid is applied (see Table 7-2), the impact on slope stability is minor.

During closure of the landfill, soil will be added and graded to improve flow away from the landfill. The sites will also be vegetated to manage the risk of erosion. The impact will be positive in nature.

7.2.1.3 Mitigation and Residual Impacts

The duration of soil exposure will be minimized, where practical, by careful scheduling of work to coincide with dry seasons or specified construction activities. Any soil stockpiles will be protected from wind and water erosion during construction. Dust suppressant will be applied in very dry conditions during construction.

Disturbed areas will be covered and vegetated with native species in order to prevent soil erosion. If there is insufficient time remaining in the growing season, the site should be stabilized (e.g., cover exposed areas with erosion control blankets to keep the soil in place and prevent erosion) and vegetated the following spring.

The residual impacts are considered minor.

Table 7-2 Slope Stability / Soil Erosion Impact Summary Table

Sources	Vegetation clearing (▼) Construction of landfill site and access road (▼) Landfill operations (▼) Closure of landfill site (+)
Nature of Impact (construction/operation): Negative	
Intensity	Low
Extent	Site specific
Duration	Short/Long
Importance of Impact (construction/operation): Minor	
Mitigation Measures in Addition to Project Design Features	Construction work during dry period, where practical, to reduce dust emissions Protect soil piles from wind and water erosion. Vegetate any disturbed areas with native species and cover such areas with mulch to prevent erosion and help seeds germinate. Maintain effective sediment and erosion control measures until re-vegetation of disturbed areas is achieved.
Residual Impact (construction/operation): Minor	

7.2.2 Surface and Groundwater

7.2.2.1 Description of Impacts

Construction Phase

There is no watercourse within 150 m of the PDA; therefore, no impacts on surface water are anticipated during construction. Machine operation and maintenance during construction increase the risk of contamination from leaks and spills in the PDA. If left unmanaged, these could be a source of contamination for groundwater (see Section 9).

Operation Phase

Local drainage will be modified by the presence of the new infrastructures. Ditch and culvert structures will maintain the local drainage as close to the natural state as possible around the landfill and along the access road.

Machine operation and maintenance increase the risk of contamination from leaks and spills in the PDA. If left unmanaged, these could be a source of contamination for surface and groundwater (see Section 9).

Waste disposal in the area of the landfill can create leachate that could cause groundwater contamination over time. Contaminants that exceeded recommendations in similar trench landfills may include manganese, fecal coliforms, iron, nickel, sulfides, ammoniacal nitrogen and boron. To reduce the risk of contamination from leachate, and as per regulation, the site selection and Project design considered groundwater depth (measured by piezometer); the landfill will be excavated to a maximum depth of five m above groundwater resources. To reduce water contact with contaminants and creation of leachate, surrounding surface runoff will be directed away from the landfill by berms and ditches. No hazardous waste will be accepted at the new landfill site. Hazardous waste will be collected at the ecocentre in the community and sent for treatment in authorized facilities.

Closure Phase

Assuming that the Project design considered groundwater depth to reduce risk of contamination from leachate, no additional impacts on groundwater quality are expected during the closure phase. Similarly, no additional impact is expected with regard to water flow during closure flow, because surrounding surface runoff will still be directed away from the landfill by berms and ditches.

7.2.2.2 Evaluation of Impact

Runoff in contact with wastes and leachate may affect surface water and groundwater quality. Project mitigation during design includes planning of the landfill depth in relation to groundwater (minimum of 1 m above groundwater resources); and planning ditch construction for redirection of clean surface water away from waste. The landfill location was also modified to increase the distance from nearby surface water and wetlands.

During operation, the intensity of the collective impacts will be moderate, as the value of this component is high; and the disturbance will be low, considering the operating methods. The extent of the disturbance is local. The result of the impact will be long in duration, as contamination will continue during the life of the Project and following closure if left unmitigated. When the Determination of Importance Evaluation Grid is applied (see Table 7-3), the impact on surface and groundwater quality has been evaluated as moderate.

7.2.2.3 Mitigation and Residual Impacts

Several mitigation measures will be implemented during operation. Groundwater resources will be monitored throughout the life of the Project and following landfill closure. Groundwater will be sampled from installed wells. Sampling results will be available to the public in order to keep communities

informed, and mitigation solutions will be implemented if contamination takes place. As with the operation of the current landfill, no dangerous waste will be collected at the proposed landfill site.

An awareness campaign will be conducted at the opening of the new site to remind the community that such waste must be disposed of at the ecocentre and that the new landfill is not designed to manage dangerous waste.

The residual impacts are considered minor.

Table 7-3 Surface and Groundwater Impact Summary Table

Sources	Waste disposal (▾)
Nature of Impact (operation): Negative	
Intensity	Moderate
Extent	Local
Duration	Long
Importance of Impact: Moderate	
Mitigation Measures in Addition to Project Design Features	Groundwater monitoring Mitigation if contamination takes place Awareness program
Residual Impact: Minor	

7.2.3 Soil Quality

7.2.3.1 Description of Impacts

Construction Phase

Topsoil will be removed from the PDA during site and work area preparation and set aside for rehabilitation activities. Machine operation and maintenance increase the risk of leaks and spills that could contaminate soils in the PDA (see Section 9).

Operation Phase

Machine operation and maintenance increase the risk of leaks and spills that could contaminate soils in the PDA (see Section 9).

Waste disposal in the landfill will create leachate that could contaminate soil over time. The operator will perform a visual inspection during unloading to limit leachate generation as much as possible. Proper management of the landfill, notably the application of weekly cover, will help reduce the risk of soil contamination.

Closure Phase

Active machine operation and maintenance activities will have ceased by closure, since no more waste will be disposed of in the landfill. As such, no negative impacts are expected on soil quality during the closure phase. Topsoil will be used to restore the site. The impact will be positive in nature.



7.2.3.2 Evaluation of Impacts

Removal and repurposing of topsoil will impact soil quality in the PDA. The intensity of the impacts on soil resources is minor: as the component value is moderate and the disturbance is low, the impacted area will be limited and topsoil will be reused. The extent of the disturbance is site specific. The result of the impacts will be long in duration, since the topsoil will be reused only at the site closure. When the Determination of Importance Evaluation Grid is applied (see Table 7-4), the impact on soil resources is minor.

During operation, soils that come in contact with waste leachate will be contaminated and quality reduced. Reducing the propagation of contaminants in surface and groundwater resources will prevent soil contamination locally. Propagation is prevented by keeping contaminants out of contact with water resources, excavation depth and ditch construction. The intensity of the collective impacts on soil resources is moderate: both the component value and disturbance are moderate, as the quality decrease will not compromise the site vocation (landfill). The extent of the disturbance is site specific. The result of the impacts will be long in duration, since contamination will continue during the life of the Project and following closure. When the Determination of Importance Evaluation Grid is applied (see Table 7-4), the impact on soil resources is moderate. These impacts on soil quality are negative.

7.2.3.3 Mitigation and Residual Impact

Residual impacts on soil will be mitigated by the conservation of topsoil and its reuse during rehabilitation of the site during closure.

No dangerous waste will be accepted at the new landfill site. Dangerous waste will be collected at the community ecocentre and disposed of in conformity with regulations.

Contamination of water resources will be monitored throughout the Project life and following landfill closure. Information on the propagation of contamination in water resources could help determine whether further mitigation measures are necessary for soils. The residual impact on soil resources is considered minor.

Table 7-4 Soil Quality Impact Summary Table

Sources	Construction of landfill and access road (▼) Landfill operations (▼) Closure of the landfill site (+)
Nature of Impact (construction/operation): Negative	
Intensity	Low/Moderate
Extent	Site specific
Duration	Short/Long
Importance of Impact: Minor/Moderate	
Mitigation Measures in Addition to Project Design Features	Groundwater monitoring Mitigation if contamination takes place Awareness program
Residual Impact: Minor	

7.2.4 Air Quality

7.2.4.1 Description of Impacts

Construction Phase

Traffic and operations of machinery during all construction activities are likely to generate air contaminant emissions and dust that can affect air quality locally.

Operation Phase

Regular traffic during operations will include trucks to deliver waste (six times a week). A bulldozer will service the site once a week to push and compact waste in the trench, and a loader will periodically prepare covering material and stockpiles. These activities will create dust and air contaminant emissions locally that could affect air quality.

Closure Phase

The use of machinery will be required to cover the site with a final soil layer. The soils required for the closure will be sourced from the initial excavation and the community. These are likely to generate air contaminant emissions and dust that can affect air quality locally.

7.2.4.2 Evaluation of Impacts

The value of this component is considered to be moderate. The degree of disturbance in all three phases of the Project is considered as low, as is the resulting intensity. The extent of the disturbance will be local. Impact duration will be short during construction and closure phases, but long during the landfill operation lifespan. When the Determination of Importance Evaluation Grid is applied (see Table 7-5) for dust and air pollutants, the impact on air quality will be minor for all Project phases.

7.2.4.3 Mitigation and Residual Impacts

Residual impacts from dust will be mitigated by the following mitigation measures:

- During transport, materials containing fine particles must be covered with tarpaulins that are securely fastened;
- Apply a dust suppressant during dry conditions;
- Enforce speed limits;
- Avoid idling of equipment and vehicles when not necessary;
- Maintain equipment and vehicles in good working order with functioning catalytic converters, mufflers and/or silencers, as available.

With these mitigation measures in place, the overall residual impact will remain minor.



Table 7-5 Air Quality Impact Summary Table

Sources	Vegetation clearing (▼) Construction of landfill site and access road (▼) Traffic during construction (▼) Traffic during operation (▼) Landfill operations (▼) Closure of the landfill site (▼)
Nature of Impact (construction/operation/closure): Negative	
Intensity	Low
Extent	Local
Duration	Short/Long
Importance of Impact: Minor	
Mitigation Measures in Addition to Project Design Features	During transport, materials containing fine particles must be covered with tarpaulins that are securely fastened. Spray dust suppressant in dry periods. Enforce speed limit. Avoid idling of equipment and vehicles when not necessary. Maintain equipment and vehicles in good working order with functioning catalytic converters, mufflers and/or silencers, as available.
Residual Impact: Minor	

7.2.5 GHG emissions

7.2.5.1 Description and Evaluation of Impacts

The first source of GHG emissions during construction is related to mobile combustion systems. The production of GHG emissions in operation is linked to traffic but, above all, by the burying of organic waste. Appendix K provides identification and quantification of GHGs by emission source and during the various Project phases. The GHG emissions anticipated by emission source are detailed in Table 7-6 below and by phase in Table 7-7.

Table 7-6 GHG Emissions by Emission Source

Emission sources	Emission Estimate (tonnes)			
	CO_2	CH_4	N_2O	CO_2e
Deforestation[2]	1,305.58	-	-	1,305.58
Stationary combustion systems	1.08	0.00	0.00	1,13[1]
Mobile combustion systems [2]	2,789.83	0.16	1.15	3,137.17
Transportation of materials	1,140.91	0.05	0.06	1,161.20
Waste landfill operation (35 years)	-	2,313.31	-	57,832.64
Total	5,237.40	2,313.51	1.22	63,437.73

[1] As the quantities of CH_4 and N_2O are rounded to the nearest hundredth of a tonne, the totals may not correspond to the numbers presented.

[2] Emissions from equipment used for deforestation are included in emissions from mobile combustion systems.



Table 7-7 GHG Emissions by Phase

Phase	Emission Estimate (tonnes)			
	CO_2	CO_2	CO_2	CO_2
Construction	1,758.00	0.03	0.18	1,811.55
Operations – 35 years	3,122.73	2,313.47	0.91	61,229.78
Closure	97.42	0.01	0.03	107.02
Post-closure – 30 years	259.25	0.01	0.10	289.38
Total	5,237.40	2,313.51	1.22	63,437.73

7.2.5.2 Mitigation and Residual Impacts

It is possible to reduce GHG emissions during the construction phase if the equipment used is based in or near the community. Doing so will reduce the mileage of haulers and trucks used to transport equipment and materials. During the operation phase, GHG emissions can be reduced through the burial of fewer organic and fibrous materials (target of 60% recycling), this item being the largest generator (more than 90%) of the Project's GHGs. The implementation of a composting program in the community is planned in the medium term. In addition, a reduction of the waste collection frequency (three times a week instead of five) could help to reduce the GHG as well. The potential reduction of GHG emissions by method is detailed in Table 7-8 below.

Table 7-8 Total Potential GHG Emissions Reduction

Methods	t CO_2e avoidable over 35 years
Composting and recycling	33 036
Reduce waste collection frequency	253
100% local equipment for construction and closure work	5
Total	**33 294**

A monitoring plan will be put in place to monitor the data supporting the quantification of GHG emissions and the reductions implemented. It will consist of periodic collection and recording of information to be able to estimate GHG emissions linked to the Project. The monitoring plan is presented in Section 6 of the GHG emissions report in appendix L.

Because the effect on climate change from the contribution of a single Project cannot be accurately measured or attributed, it is not reasonable to determine the significance of residual effects on atmospheric GHG concentrations or climate change from a single project's GHG emissions. Consequently, the evaluation of Project residual effects focuses on estimation of GHG releases, mitigation, and evaluation of Project GHG releases in relation to provincial, national and sector-based GHG totals and the Government of Canada's GHG reduction targets. Using the 2021 Canada and Quebec GHG emission totals as a baseline, construction and operation activities will emit 0.0009% of the Canada GHG emission total, 0.008% of the Quebec GHG emission total, and 0.008% and 0.16% of the waste management sector emission total in Canada and Quebec respectively (Table 7-9).



Table 7-9 GHG Emissions at the Provincial, National, and Sector-based Levels

Scope	Canada	Waste management in Canada	Quebec	Waste management in Quebec
2021 value in t CO_2e	670	47.0	77.56	4.02
Project Contribution (%)	0.0009%	0.0013%	0.0082%	0.1578%
Source	Environment and Climate Change Canada, 2023	Environment and Climate Change Canada, 2023	MELCCFP, 2023	MELCCFP, 2023

7.3 IMPACT ON BIOLOGICAL ENVIRONMENT

7.3.1 Vegetation

The vegetation component considers species at risk. However, no federally or provincially protected species were reported in CDPNQ, nor were any observed on site.

7.3.1.1 Description of Impacts

Construction Phase

Vegetation will be cleared from the access roads and landfill. During field surveys, the jack pine forest is the most common terrestrial environment association. The tree layer is strongly dominated by jack pines. The tree layer is also composed of black spruce in low density. The shrub layer is mostly composed of sheep-laurel but also contains velvet-leaved blueberry and speckled alder. The herbaceous layer is almost non-existent, and soils and rock are often covered by mosses, sphagnums and lichens. Operational PDA, access road and work areas will be kept to a minimum. The loss of vegetation will be temporary in the work areas, as the latter will be restored upon completion of the work. However, loss of vegetation will be permanent in the location of the new infrastructures and buffer (15 m) for fire protection (8.7 ha).

Machinery and vehicle use, movement, fuelling and maintenance have the potential to contaminate the vegetation with hydrocarbons in the event of a breakdown, accident or accidental spill (see Section 9).

Operation Phase

No additional impacts on vegetation are anticipated during the operation phase.

Closure Phase

During the landfill closure, soil will be added, and the site will be graded and revegetated with native species. The impact will be positive in nature.

7.3.1.2 Evaluation of Impacts

The value of the vegetation component is considered low. Vegetation species that will be impacted are abundant throughout the region. During the construction phase, the degree of disturbance is considered

low, as the effect of the impact decreases the quantity of vegetation by a small area (8.7 ha) without compromising its integrity.

Considering the low value and low degree of disturbance during construction, the overall impact intensity is considered low. The extent of the disturbance due to clearing, revegetation and vegetation management will be site specific (PDA). The impact duration will be long, since vegetation populations will be altered for the life of the Project. When the Determination of Importance Evaluation Grid is applied for vegetation, considering both extents, the result of the impact is minor. Closure of the landfill will include revegetation.

7.3.1.3 Mitigation and Residual Impacts

Vegetation removal will be limited to Project needs only, and the temporary work area will be revegetated. All planned areas and accesses for construction work will be identified and marked, and work and traffic will be contained within the marked zones.

Topsoil will be stockpiled separately from backfill materials for reuse during restoration. The residual impact is considered minor.

Table 7-10 Vegetation Impact Summary Table

Sources	Vegetation clearing (▼) Closure of the new landfill site (+)
Nature of Impact (construction): Negative	
Intensity	Low
Extent	Site specific
Duration	Long
Importance of Impact: Minor	
Mitigation Measures in Addition to Project Design Features	Operational PDA, access road and work area kept to a minimum Temporary work areas to be revegetated
Residual Impact: Minor	

7.3.2 Wetlands

7.3.2.1 Description of Impacts

Construction Phase

The proposed landfill site was specifically selected to avoid a wetland area. As required by Regulation, the landfill will be located a minimum of 150 m from wetlands. The access road will, on the other hand, cross several wetlands. A total surface of 730 m^2 of wetland will be directly affected by the construction of the access road.

Operation Phase

The landfill will be located a minimum of 150 m from wetlands. No impacts on wetlands are expected during operation activities.

Closure Phase

No additional impacts on wetlands are expected during closure activities.

7.3.2.2 Evaluation of Impacts

The wetland component value is moderate, and the degree of disturbance is considered low, as there will be encroachment on a small area of wetlands (730 m^2).

With the value being moderate and degree of disturbance low, the overall intensity of the impact is thus considered low. The disturbance extent is site specific. The result of the impact will be of long duration, since the vegetation will be affected for the Project's life. When the Determination of Importance Evaluation Grid is applied, the impact is minor.

7.3.2.3 Mitigation and Residual Impacts

The encroachment on wetlands will be kept as minimal as possible. All planned areas and accesses for construction work will be identified and marked to contain work and traffic within the marked zones. A culvert will be installed in the wetland to ensure a drainage connection between the remaining portions of wetland on each side of the road. The overall intensity will be minor.

Table 7-11 Wetlands Impact Summary Table

Sources	Construction of access road (▼)
Nature of Impact (construction): Negative	
Intensity	Low
Extent	Site specific
Duration	Long
Importance of Impact: Minor	
Mitigation Measures in Addition to Project Design Features	Restrict clearing and construction activities to the approved construction footprint. Restrict off-road access to approved routes.
Residual Impact: Minor	

7.3.3 Terrestrial and Avian Wildlife

The terrestrial wildlife component considers species at risk. However, no federally or provincially protected species were reported in CDPNQ, nor were any observed on site.

7.3.3.1 Description of Impacts

Construction Phase

Vegetation will be cleared from the access road and landfill. Vegetation clearing will reduce habitat for terrestrial fauna within the PDA. Vegetation clearing will also potentially affect active bird nests and eggs if completed during the breeding season. In total, a surface of 8.7 ha of terrestrial habitat will be directly affected by the construction of the access road and landfill.

The presence of workers, traffic, and noise from machinery during the construction phase will cause animal avoidance in the local area. There will also be a risk of collision with wildlife, thereby causing their mortality. These activities will last 10 weeks.

Operation Phase

Regular traffic during operations will include trucks to deliver regular waste (six times a week). A bulldozer will be used on site once a week to push and compact waste in the trench, and a loader will be used periodically to prepare covering material and stockpiles. Species that are sensitive to noise will avoid the area. The traffic will increase the risk of collisions with wildlife species.

Waste disposal will attract animals, providing a new food source that could change wildlife populations locally. Gulls, raven, black bears, wolves, dogs and foxes are present in the RSA and known to be drawn to landfills. Large animals such as bears become a safety risk once habituated (Environment and Climate Change Canada 2017). The best means to prevent safety concerns is to eliminate the food source (MFFP 2013). Once a bear is habituated, it is possible to relocate the animal; however, this may be complicated, as bears can travel long distances and will favour anthropogenic food sources once habituated, especially when natural food sources are scarce.

As a last resort, problem bears may have to be killed to eliminate a safety risk. Fencing will act as a deterrent, keeping large nuisance animals out and eliminating the food source. Regular maintenance of the fence will be important. Proper waste compaction and regular progressive cover will reduce food sources for rodents and other small terrestrial animals that can pass through the fence.

Literature documents the increase of predatory avian species around landfill sites. It can therefore be expected that their increase will modify local bird populations. Regular progressive cover will reduce access to waste food sources for nuisance avian species, such as gulls and ravens, that are also predatory on other avian species.

The fence will act as a small barrier to movement for any large terrestrial species that would normally pass freely through the area.

Closure Phase

During closure of the landfill, soil will be added, and the site will be graded and revegetated with native species. The impact will be positive in nature.

7.3.3.2 Evaluation of Impacts

The value of the terrestrial wildlife component is considered low for this evaluation. During the construction phase, the degree of disturbance is considered moderate, as the effect of the impact decreases natural habitat quality without compromising its integrity. During operation, the disturbance degree is considered low, as the integrity and function of animal populations in the local area and the region will not be affected.

Considering that the value is low, and degree of disturbance is moderate during construction and low during operation, the overall impact intensity is considered low. The extent of the disturbance due to clearing and fencing will be local. The duration of the impact will be short during the construction phase (10 weeks) but then long, as the loss of habitat is for the life of the Project. In applying the Determination of Importance Evaluation Grid, considering local extent, the impact result is minor. Closure of the landfill sites will have positive impacts, as nuisance animals that are drawn there will no longer have a food source.

7.3.3.3 Mitigation and Residual Impacts

In the Boreal Shield (D7) nesting zone, vegetation clearing and other activities that could disrupt nesting should be avoided from the end of May through the end of July. As construction is likely to take place during the breeding season, a bird's nest search survey will be completed by a qualified person less than seven days before the start of construction activities. If nests are found, mitigation measures will be recommended by a qualified biologist.

Enforcement of a speed limit may reduce traffic noise and collision risk. Regular waste compaction, progressive cover and a well-maintained fence will reduce nuisance animals' access to waste as a food source. The residual impact is considered minor.

Table 7-12 Terrestrial and Avian Wildlife Impact Summary Table

Sources	Vegetation clearing (▼) Traffic during construction (▼) Construction of landfill and access road (▼) Traffic during operation (▼) Landfill operations (▼) Closure of landfill site (+)
Nature of Impact (construction/operation): Negative	
Intensity	Low
Extent	Local
Duration	Short/Long
Importance of Impact: Minor	
Mitigation Measures in Addition to Project Design Features	Enforcement of speed limit Installation of fence and regular inspection/maintenance during operation Regular compaction and recovery of waste
Residual Impact: Minor	

7.4 IMPACT ON HUMAN ENVIRONMENT

In the context of the present Project and associated ESIA, the local economy was not retained as a valued component of the social environment. The assessment of impacts on the local economy generally considers subsistence activities that are part of the traditional harvesting economy, as well as job creation and losses and benefits for local companies related to the Project development and existing landfill closure.

The potential effects of the Project on traditional subsistence activities, such as harvesting for food (hunting, trapping and fishing) and medicine (berries and plant gathering), as well as on sharing between community members and selling harvested resources, are presented in Section 7.4.1 Land and Resource Use. However, assessing potential economic losses due to the loss of harvesting areas is not in the scope of the present study. It should also be noted that information concerning land and resource use in the Project area was shared by participants in the land use interviews and in consultation activities. This information gives an overview of most of the land and resource use in the LSA, but it is not considered comprehensive.

As for the effects of the Project on local workers and companies, it is anticipated that approximately 20 workers will be required to complete construction activities, which will last for 10 weeks. Most workers will be hired locally. Though operational aspects of the Project still needed to be confirmed at the time of the present ESIA report submission—for example, whether the actual operators would keep their position and work at the new landfill or new workers would be hired—a new hire was anticipated for an additional operator to help with garbage collection. Furthermore, for the new site to be properly managed, additional operators will be required.

7.4.1 Land and Resource Use

7.4.1.1 Description of Impacts

Construction Phase

The land and resource use section includes impacts on land use for subsistence and comprises aspects that fall into traditional economy, such as harvesting for food and medicine as well as sharing between community members or selling harvested resources.

Planned with a 10-week schedule in mind, the landfill site and access road construction will involve the gradual penetration by vehicles (other than ATVs and snowmobiles) and machinery inland from the Route du Nord especially for the construction of the access road. This will create some disruption in current transportation patterns in the LSA and raise safety issues.

The new landfill site construction will result in the permanent loss of hunting and trapping areas that were reported within the PDA. Species harvested in the PDA include beaver, rabbit, lynxes, small game and, on occasion, larger animals when they pass through (moose and black bears). Since the area is easily accessible by the Route du Nord, several community members use the land and resources on trapline R16 without informing the tallyman; so it is possible that berry-gathering activities are taking place in proximity to the potential landfill site and along the Route du Nord. Construction of the landfill site and

access road may therefore result in the permanent loss of berry-gathering sites located within the PDA. During field surveys conducted in the PDA, sheep-laurel and velvet-leaved blueberry were observed.

Noise, dust and increase in traffic generated by the Project construction will cause animal avoidance from the PDA and potentially parts of the LSA. Additionally, vegetation clearing within the PDA will reduce habitat for terrestrial wildlife, thus reducing the quality and quantity of hunting and trapping areas.

Operation Phase

Noise, dust and traffic during operations of the landfill could cause some animal avoidance around the PDA throughout the life of the Project, though some species might get habituated to the new conditions over time. The fence surrounding the landfill will act as a barrier to movement, causing large animals to go around. Noise, dust and traffic during operations have a potential to affect other hunting and trapping areas within the LSA.

Odours stemming from garbage trucks using the main road and access road, and odours emanating from the landfill site, though localized, will be felt throughout the life of the Project and will be stronger in summer than in winter. They can be unpleasant and cause inconvenience to some people. Unpleasant odours do not directly represent a risk to human health, as they are rarely dangerous in nature, not necessarily toxic, and generally found at low concentrations. Nevertheless, it has been recognized in past studies that exposure to odours may cause different negative effects, ranging from emotional stress to physical symptoms. In recent years, landfill gaseous emissions have been chemically characterized by reputable authors. Yet the effects of unpleasant odours are rather complex because they depend on different variables such as individual sensitivity, kind of smell, and frequency and intensity at which they are perceived, as well as topography, weather conditions, wind speed and direction. Consequently, recent literature has not yet defined a unanimous threshold for the emission of odorous substances. However, in most cases, sensitive areas involve households within a 1-kilometre radius of the landfill. No camps are located within 1 kilometre of the proposed site.

Waste disposal will attract animals, providing a new food source that will change animal populations locally. Bald eagles, crows, ravens, black bears, polar bears, wolves, dogs and foxes are present in the RSA and known to be drawn to landfills. Large animals such as bears become a safety risk once habituated (Environment and Climate Change Canada, 2017).

Another safety risk will come from new transportation patterns in the LSA: the increase in traffic on the main road and the presence of big trucks and heavy machinery on the access road, an area which is presently frequented only by ATVs and snowmobiles. The risk will be more pronounced once site operations start, but it will decrease as time passes and users of the area get used to new circulation in the area.

As for the safety issues caused by changes in transportation patterns in the LSA, these can be prevented by posting appropriate signage on the Route du Nord and access roads, enforcing speed limits, and raising safety awareness among construction workers, machinery operators, landfill operators and other users of the area. It is also recommended that shoulders be included in the access road design.

Traffic and operation of machinery will create dust that will cover plants during operation. Enforcing a speed limit and spraying the access road with calcium chloride will mitigate dust.

Closure Phase

No additional impacts on land and resource use are expected during the closure.

7.4.1.2 Evaluation of Impacts

The value of the land and resource use component is considered moderate. During construction and operation, the degree of disturbance is considered moderate, as the utilization of the landfill site will no longer be possible for land and resource use.

When both the value and degree of disturbance are moderate, the impact overall intensity is considered moderate. During construction and operation, the extent will be local. The result of the impact will be short during construction but long during operation, since habitat and populations will be altered for the life of the Project. In applying the Determination of Importance Evaluation Grid, the result of the impact is minor during construction and moderate during operation.

7.4.1.3 Mitigation and Residual Impacts

Construction is planned during the summer and will avoid important hunting periods, such as the fall moose and bear hunt. Noise-related impacts can be mitigated by enforcing speed limits and by avoiding construction and limiting operations during the main hunting periods. Enforcement of a speed limit and spraying of dust suppressant on access roads will decrease impacts related to dust.

Signage will be put in place to ensure the safe and efficient circulation of vehicles along the access road. Speed limits and signage along the main road and access road will respect regulations in order to ensure the safe circulation of operators and land users.

A waste compactor and a bulldozer will be used for regular and progressive compaction and cover of waste to ensure proper landfill operations. Proper site management will reduce unpleasant odours in the vicinity of the landfill as well as risks associated with the presence of nuisance animals. Still, the best means to prevent safety concerns is eliminating the food source (MFFP 2013). Once a bear is habituated, it is possible to relocate the animal; however, this may be complicated, as bears can travel long distances and will favour anthropogenic food sources once habituated, especially when natural food sources are scarce. As a last resort, problem bears may have to be killed to eliminate a safety risk. Fencing will act as a deterrent, keeping large nuisance animals out and eliminating the food source. A fence and a gate will be installed around the perimeter of the proposed landfill. By preventing unauthorized personnel as well as nuisance animals from entering the landfill, the fence will increase safety for operators and residents alike.

The residual impact is considered moderate and negative for the land users who will not be compensated.

Table 7-13 Land Use Impact Summary Table

Sources	Vegetation clearing (▼) Construction of landfill and access road (▼) Traffic during construction (▼) Traffic during operation (**V**) Landfill operation (**V**)
Nature of Impact (construction/operation): Negative	
Intensity	Moderate
Extent	Local
Duration	Short/Long
Importance of Impact: Moderate	
Mitigation Measures in Addition to Project Design Features	Enforcement of speed limit Spraying of calcium chloride on access roads Avoiding construction during main hunting and trapping periods Groundwater and surface water monitoring
Residual Impact: Moderate	

7.4.2 Infrastructure and Equipment

7.4.2.1 Description of Impacts

Construction Phase

There will be an increase in traffic on the Route du Nord due to construction of the access road and landfill.

Operation Phase

Regular traffic during operations will include trucks to deliver waste (six times a week), so there will be a minimal increase in traffic on the Route du Nord due to the operation and plowing of the landfill. In addition, the access road to the landfill will need to be regularly maintained.

Closure Phase

No additional impacts on infrastructure and equipment are expected during the closure.

7.4.2.2 Evaluation of Impacts

The value of the infrastructure and equipment component is low. The degree of disturbance is considered low, as the integrity and function of the Route du Nord will not be affected, and traffic will be minimal during construction and operation.

When both the value and the degree of disturbance are low, the overall intensity of the impact is considered low. The disturbance extent will be local. The duration of the impact will be short during the

construction phase (10 weeks) but long during operation, since the Route du Nord will receive additional vehicles and will need to be maintained and plowed for the life of the Project.

When the Determination of Importance Evaluation Grid is applied for this component, the result of the impact is minor.

7.4.2.3 Mitigation and Residual Impacts

The proposed landfill will provide better management of waste in a location that poses less risk to the general population. With the proposed mitigation measures in place, the residual impact on the main road is minor and negative, while the residual impact is minor.

Table 7-14 Infrastructure and Equipment Impact Summary Table

Sources	Construction of the access road (▼) Traffic during construction (▼) Traffic during operation (▼)
Nature of Impact (construction/operation): Negative	
Intensity	Low
Extent	Local
Duration	Short/Long
Importance of Impact: Minor	
Mitigation Measures in Addition to Project Design Features	Enforcement of speed limits Maintenance of signage and equipment Improved waste management practices
Residual Impact: Minor	

7.4.3 Visual Environment

7.4.3.1 Description of Impacts

Construction Phase

Vegetation will be cleared from the access road and landfill area, including a buffer on each side of the access road (6 m) and surrounding the landfill (15 m).

The landfill design includes the excavation of a trench and construction of a surrounding green berm with the excavated materials. The berm will limit visibility of landfilling operations and prevent wind-dispersed waste from spreading.

Operation Phase

Waste disposal at the landfill will provide a source of lightweight waste that could be dispersed by the wind. Waste can also be scattered by nuisance animals attracted to the landfill. As sections of the landfill are progressively filled in, operators will cover the waste with granular material on a weekly basis from April to November to prevent waste dispersion. The landfill site will be fenced, and a gate will be installed



to limit public access. The fence will also reduce wildlife prowling and scavenging, as well as waste spreading outside the landfilling area by animals and wind. The fence installed around the perimeter of the landfill, on top of the berm, will impact the visual environment. which will shift from a natural environment to a man-made development.

Impacts related to landscaping of the selected site will be offset by the site's favourable topography and location, 0.5 km from the Route du Nord and 17 km from Nemaska. The landfill is located at the top of a ridge rising some 50 to 70 metres above the surrounding land. The addition of a surrounding berm and regular and progressive cover will decrease the visibility of waste from the surrounding area. Waste filling should not exceed the height of the berm.

Lightweight waste, such as plastic bags or papers, can be easily scattered by the wind. It has a visual impact on the landscape and roadside. Pests that open and spread garbage bags contribute to wasting scattering. Regular waste compaction and progressive cover will reduce waste that is exposed to wind, animals and birds (gulls and ravens) that may scatter waste. The effects of wind-scattered waste and waste scattered by nuisance animals will be greatly minimized with the installation of the catching nets in place at the existing landfill and the construction of fencing alongside the perimeter of the landfill. Regular site maintenance, including an annual litter patrol, will reduce waste in the surrounding environment. Maintenance of the catching nets and fence will ensure its effectiveness against pests and wind.

Closure Phase

When the height of the waste deposited in the continuous trench reaches the berm height at the perimeter of the landfill area, it will be covered with a 60 cm soil layer including, in its upper portion, a 15 cm layer of organic soil suitable for vegetation. Revegetation of berms and landfill site will improve the visual aspect.

7.4.3.2 Evaluation of Impacts

The value of the Visual Environment component is considered moderate, as the proposed landfill site will be visible to the land users. A moderate degree of disturbance was attributed, since the effect of these impacts will decrease the quality of the visual environment for land users, though it will not prevent the use of the LSA. When both the value and the degree of disturbance are moderate, the overall intensity of the impacts is considered moderate. The extent of visual impacts will be local, given the topography and distance of the landfill from the main road and communities. The duration of the impact during construction will be short, since the activities will last for a maximum of 10 weeks. The impacts will last long during the operation when it comes to visual environment related to the insertion of man-made elements in a natural setting and waste disposal. When the Determination of Importance Evaluation Grid is applied for this component, the result of the impact is minor during the construction phase and moderate in operation.

There are visual impacts related to general site maintenance, since the landfill has almost reached capacity. Closure of the proposed landfill at the end of its life will have a positive impact on the visual environment, given that the site will be fully covered and revegetated, bringing it back to baseline conditions over time.

7.4.3.3 Mitigation and Residual Impacts

With the proposed mitigation measures in place, the overall residual impact remains minor and negative.

Table 7-15 Visual Environmental Impact Summary Table

Sources	Vegetation clearing (▼) Construction of the landfill and access road (▼) Landfill operations (▼) Closure of the landfill site (+)
Nature of Impact (construction/operation): Negative	
Intensity	Moderate
Extent	Local
Duration	Short/Long
Importance of Impact: Minor/Moderate	
Mitigation Measures in Addition to Project Design Features	Revegetation Weekly compaction and cover Maintenance and regular cleanup of the fence Regular site cleanup and annual patrol
Residual Impact: Minor	

8.0 CLIMATE CHANGE IMPACTS ON PROJECT

Stantec performed a high-level assessment of risks to the proposed landfill due to meteorological events, based on future climate projections in the area. The report is presented in Appendix H.

The methodology used for this assessment is inspired from Infrastructure Canada's Climate Lens Guidance (Infrastructure Canada 2019). Current climate trends were obtained from Environment Canada's weather stations in proximity to the infrastructure being assessed. Stantec used state-of-the-art analytical tools to develop trends for a wide range of climate parameters, including precipitation, temperatures, and wind.

Risks to the infrastructure were determined from current and future climate events with respect to selected performance criteria such as structural integrity, functionality, and operational issues.

The proposed infrastructure and assets assessed under the projected effects of climate change in the Nemaska area were determined to be most at risk from increases in temperature and wind gusts. There were nine infrastructure-climate interactions that were assessed as having high risk ratings.

The greatest climate change threat to the Project was determined to be the projected increase in frequency of heat waves on site attendants and operations personnel, along with the increased frequency of wind gusts on the operation of high-profile heavy equipment and on wind-blown dust and debris.

Exercising caution when working in challenging hot or windy conditions, by taking frequent water breaks and seeking shelter (megadomes) as needed, will be required to protect the workers at the site. High winds can present challenges for those operating heavy equipment with a high profile. During high wind events, the use of heavy equipment, particularly on unstable or steep ground, should be limited. Moreover, exposed waste should be covered prior to a forecasted period of high wind gusts to limit the scattering of debris and litter. Stockpiles of soil and cover material should be limited in height to reduce the blowing of dust and suspension of particulates.



9.0 ACCIDENTS, MALFUNCTIONS AND UNPLANNED EVENTS

9.1 FIRE

Waste burning will not be allowed on site. However, there are naturally occurring fire risks from forest fires.

Forest fires could occur in the summer period, ignited by lightning. Projected increases in temperature due to climate change may increase the frequency and intensity of forest fires in the future.

In order to prevent fire risks, a 15-metre buffer zone cleared of vegetation is planned around the site. Best operation practices, especially compacting waste and covering it every week with excavated soil, will also help reduce the risks. An emergency response plan in case of fire and related training for the operators is also necessary.

9.2 LEAKS AND SPILLS

No permanent storage of hazardous materials (required for mobile equipment) is anticipated at the new landfill. Mobile equipment will be fuelled using a fuel truck from the community. However, if a diesel fuel tank must be set up on site in order to provide emergency fuel for mobile equipment in the event of a temporary fuel shortage, the tank will be located at least 75 metres from any hydrous environment or sensitive area. Preventive maintenance will be performed directly on site by local personnel and/or qualified contractors. Used oil and filters will not be stored on site but will be returned to the community and disposed of appropriately in accordance with current regulations. Refuelling of mobile equipment will take place regularly using a fuel truck on site. No refuelling will be done less than 75 metres from a hydrous environment or sensitive area, and operators will stay with the equipment at all times during refuelling, in case of any mechanical problem. If there is a leak or spill during refuelling, maintenance or general operation of the equipment, steps will be taken immediately to halt and contain the spillage. Spill kits containing emergency materials and products will be available on site at strategic locations (operational sectors and traffic-prone areas) so that spills can be immediately cleaned up. All contaminated material will be collected and stored appropriately (leak-proof containers and/or membranes) so that it is not released into the environment until it can be managed accordingly.

10.0 ENVIRONMENTAL MONITORING AND FOLLOW-UP PROGRAMS

10.1 ENVIRONMENTAL MONITORING

Environmental surveillance and monitoring programs aim to ensure compliance with mitigation and corrective measures proposed in the ESIA, and all legislative and regulatory documents are respected.

These measures cover all Project phases and will be the responsibility of the CNN. The measures taken during the Project design are discussed in more detail in the Project description section and impact analysis section. Environmental supervision measures planned for the construction, operation, closure and post-closure phases following Project approval are discussed below.

10.1.1 Construction Phase

An environmental inspector will be mandated to monitor the site on a regular basis throughout the construction phase.

The specific objectives of the environmental monitoring program are as follows:

- Ensure compliance with the environmental requirements laid down in the plans and specifications;
- Ensure compliance with the environmental authorizations obtained;
- Ensure compliance with the various applicable laws and regulations related to the environment;
- Advise and support the site supervisor on all matters concerning environmental management at the site;
- Prepare an environmental surveillance report at the end of the construction phase.

10.1.2 Operation Phase

An environmental and social monitoring program is required during the site operation phase in order for the CNN to fulfill the regulatory requirements as well as operate the site according to best practices.

The landfill supervisor and operators will be provided with all guidance required to operate the landfill according to best practices and to limit impacts on the environment. An operation and maintenance manual will describe comprehensive operation procedures and specifications of the environmental monitoring program. The supervisor and operators will also follow a training course to familiarize themselves with operational, maintenance and environmental procedures before the landfill's initial activities.

10.1.2.1 Registries

For each unloading truck, the nature, origin and eligibility of incoming waste will be checked and noted in a registry, along with the name of the carrier, quantity of waste and date. No vehicle will be able to access the landfill site outside opening hours or when there is no operator on site.

A visual inspection will be carried out by the operator driving the bulldozer when waste is unloaded. If any hazardous waste is identified, it will be removed and brought to a dedicated area in the village. Information will be noted in the registry.

10.1.2.2 Annual Report

Each year, the CNN will prepare an annual report containing:

- Compilation of the data collected in the registry relating to the nature, source and quantity of residual materials landfilled, as well as the materials received for cover purposes;
- Plan and data showing the onsite progression of the landfilling operations, including filled disposal areas, areas in operation and current available landfill capacity;
- Results of the groundwater and surface water sampling programs, including monitoring point locations, methods and devices, and names of the laboratories or people taking samples;
- Certificate stating that the measurements and samples were taken in compliance with best practices and the provisions of the RRLIRM;
- Summary of the work carried out pursuant to this Regulation.

10.1.3 Closure Phase

The CNN will close the landfill site when waste reaches the height of the berm and maximum capacity is achieved. Information about closure-related works to be performed will be communicated, along with safety notices, before the start of closure activities. The location and opening date of the new landfill will also be communicated to the community as soon as they are known.

Within six months following the site closure, the CNN will have an independent expert prepare a state of closure report attesting to the following:

- Functionality, efficiency and reliability of the groundwater observation wells;
- Compliance of baseline contaminant values in groundwater samples upon closure;
- Compliance of the site regarding the final cover;
- Any deficiencies and corrective measures required in order to meet RRLIRM specifications.

Upon landfill closure, a sign will be placed at the entrance indicating that any further waste disposal is forbidden. The Administrator must be informed of the closure date as soon as possible; that is, when the operator is able to determine this date relatively precisely.

10.1.4 Post-closure Phase

The environmental monitoring program will continue during the post-closure period, in compliance with the RRLIRM. During this period, monitoring activities will include:

- Inspection of final cover, gates and fence; and their upkeep thereafter to maintain their integrity;
- Checks, maintenance and cleaning of the groundwater observation wells system;
- Water sampling and analysis campaign.

Post-closure management must be carried out as long as the landfill is likely to be a source of contamination.

10.2 ENVIRONMENTAL FOLLOW-UP PROGRAM

10.2.1 Groundwater Monitoring

In accordance with Section 65 of the RRLIRM, the groundwater monitoring program will utilize a network of observation wells dedicated to the landfilling zone. This network will be composed of four observation wells: one upstream (northwest) and three downstream (southeast). The upstream well and one of the downstream wells are already in place (set up during the site characterization studies) and respectively identified as PZ-03 and PZ-06 on the drawing available in Appendix D. The two other downstream wells (PZ-07 and PZ-08) will be drilled during the construction works.

10.2.2 Surface Water Monitoring

Surface water will also be sampled at one location downstream of the site (SW-4).

10.2.3 Sampling and Analysis Parameters

The groundwater and surface water monitoring programs will include:

- Water level measurements during each sampling campaign; in accordance with Section 69 of the RRLIRM, water samples will not undergo any filtration;
- Sample preparation and delivery to a qualified and accredited laboratory;
- Chemical analysis of water samples by a MELCC-certified laboratory, according to Section 118.6 of the LQE. All laboratory certificates will be kept for a minimum period of five years after issuance as part of the annual reporting;
- Review and compilation of laboratory results.

The monitoring points (surface and groundwater) will be sampled and analyzed three times a year. The chemical parameters to be analyzed are those presented in Sections 57 and 66 of the RRLIRM:

- Ammoniacal nitrogen
- Benzene
- Boron (B)
- Cadmium (Cd)
- Chlorides
- Chromium
- Fecal coliforms
- Total cyanides
- Ethylbenzene
- Iron
- Manganese
- Mercury
- Nickel
- Nitrates + nitrites
- Lead
- Sodium
- Total sulphates
- Total sulphides
- Toluene
- Xylene
- Zinc
- Electrical conductivity
- Phenolic compounds
- 5-day biochemical oxygen demand (BOD5)
- Chemical oxygen demand (COD).

11.0 CLOSURE OF EXISTING LANDFILL

The existing landfill will be closed after the opening of the new site. The CNN is responsible for the site closure. Closing procedures would include:

- Fence repair or installation when required;
- Installation of a sign indicating that the site is closed;
- Layering of the final cover;
- Seeding no later than one year after closure.

The final cover provides a secure barrier to keep infiltration out of the landfill. It promotes drainage, reduces erosion and provides access for post-closure activities such as monitoring and inspection. The final cover also reduces the risks of animals prowling and scavenging in the waste.

The landfill would be covered with a soil layer at least 30 cm in thickness. The material excavated and stored on site during the construction of the landfill would be reused in this final covering layer.

In order to allow the water to flow away from the landfill and to limit soil erosion, the final cover would also be graded to a slope of at least 2%. Furthermore, when required, ditches would be excavated around the landfill in order to prevent surface water from being contaminated by residual materials or from penetrating into the disposal areas.

Finally, groundwater monitoring wells would be installed for sampling and analysis of the groundwater in the site area and assessment of the contamination state and evolution.

The works related to the closure of the site will include the increasing risk of heavy rainfalls identified in the Proposed Nemaska Landfill Climate Impact Assessment (Stantec, 2023) by the 2080 horizon.

Post-closure monitoring will also include the inspection and maintenance of the final cover when required.

There is no projected use of the site. It will remain closed and under post-closure monitoring.

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APPENDIX A DIRECTIVE

DIRECTION GÉNÉRALE DE L'ÉVALUATION ENVIRONNEMENTALE ET STRATÉGIQUE

Directive pour le projet d'aménagement d'un nouveau site d'enfouissement à Nemaska par la Nation crie de Nemaska

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Ministère
de l'Environnement
et de la Lutte contre
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TABLE DES MATIÈRES

I. AVANT-PROPOS 1

NOUVEAU LIEU D'ENFOUISSEMENT EN TRANCHÉE À NEMASKA 1

LA DIRECTIVE 1

II. INTRODUCTION 2

ÉVALUATION ENVIRONNEMENTALE ET SOCIALE 2

ÉTUDE D'IMPACT 2

III. PRINCIPES DE BASE 4

INTÉGRATION DES OBJECTIFS DU DÉVELOPPEMENT DURABLE 4

PRISE EN COMPTE DES CHANGEMENTS CLIMATIQUES LORS DE L'ÉLABORATION DU PROJET ET DE LA RÉALISATION DE L'ÉTUDE D'IMPACT 4

INTÉGRATION DU SAVOIR TRADITIONNEL 5

CONSULTATIONS ET COMMUNICATIONS 5

IV. CONTENU DE L'ÉTUDE D'IMPACT 7

1. MISE EN CONTEXTE 7

1.1 Présentation du promoteur 7

1.2 Contexte d'insertion du projet 7

1.3 Raison d'être du projet 8

2. CHOIX DES VARIANTES D'EMPLACEMENT ET DE TECHNOLOGIE 9

2.1 Variantes d'emplacement 9

2.2 Variantes technologiques 10

3. DESCRIPTION DU PROJET 11

3.1 Description des travaux préparatoires 11

3.2 Description du LEET 11

3.3 Aménagement et projets connexes 13

3.4 Émission des GES 14

4. DESCRIPTION DU MILIEU 15

4.1 Délimitation de la zone d'étude 15

4.2 Description des composantes pertinentes 15

4.3 Milieu biophysique 16

4.4 Milieu social 18

5. ANALYSE DES IMPACTS DU PROJET 20

5.1 Détermination et évaluation des impacts 21
5.2 Impacts cumulatifs 22
6. MESURES D'ATTÉNUATION, IMPACTS RÉSIDUELS ET MESURES DE COMPENSATION 24
6.1 Atténuation des impacts 24
6.2 Impacts résiduels et mesures de compensation 26
7. PROGRAMMES DE SURVEILLANCE ET DE SUIVI 27
7.1 Programme de surveillance 27
7.2 Programme de suivi environnemental et social 28
8. PRÉSENTATION DE L'ÉTUDE D'IMPACT 30

Annexe I Complément d'information pour la prise en compte des changements climatiques

Annexe II Méthodologie de calcul des émissions de GES

I. AVANT-PROPOS

Nouveau lieu d'enfouissement en tranchée à Nemaska

La Nation crie de Nemaska souhaite construire un nouveau lieu d'enfouissement en tranchée (ci-après "LEET"). Le site actuel d'élimination des déchets solides, bien qu'agrandi en 2017, atteindra bientôt sa capacité maximale, et devra être fermé et le site devra être restauré. Le présent projet vise donc la construction d'un nouveau lieu d'enfouissement en tranchée, incluant l'aménagement d'un chemin d'accès, le tout sur des terres de catégorie III. Le site est localisé à environ 17 kilomètres (km) de la communauté crie de Nemaska, près du kilomètre 306 de la Route du Nord. La durée de vie des installations, en fonction du mode de gestion retenu, est estimée de 35 à 45 ans.

Par ailleurs, le site retenu pour la construction et l'exploitation du nouveau LEET est localisé à environ 50 mètres (m) d'une ligne exploitée par Hydro-Québec et à environ 6,8 km de l'aéroport de Nemiscau.

En plus des consultations initiées auprès du maître de trappe et des représentants du conseil de bande, le promoteur a contacté différents acteurs locaux afin de les informer et d'échanger sur ce projet, soit Hydro-Québec, l'aéroport de Nemiscau et la minière Nemaska Lithium inc.

En parallèle, la Nation crie de Nemaska prévoit également la construction d'un écocentre et la mise en place d'un projet-pilote de compostage des déchets.

La directive

Le ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC) a reçu, le 9 septembre 2019, les renseignements préliminaires du projet de nouveau lieu d'enfouissement en tranchée de Nemaska. Le régime de protection de l'environnement et du milieu social applicable dans la région de la Baie-James est régi par les articles 153 à 167 du titre II de la Loi sur la qualité de l'environnement.

En vertu de l'article 153 et de l'annexe A de la LQE, tout système d'enlèvement et d'élimination des matières résiduelles, à l'exclusion des résidus miniers et des matières dangereuses, est obligatoirement assujetti à la procédure d'évaluation et d'examen sur l'environnement et le milieu social. Le projet de lieu d'enfouissement en tranchée de Nemaska est donc un projet automatiquement assujetti à cette procédure.

Le présent document constitue la directive de ce projet. La directive indique au promoteur la nature, la portée et l'étendue de l'étude d'impact sur l'environnement et le milieu social qu'il doit réaliser. Elle présente une démarche visant à fournir les informations nécessaires à l'évaluation environnementale et sociale du projet. Cette directive ne doit pas être considérée comme exhaustive et le promoteur est tenu d'ajouter dans son étude d'impact tout autre élément pertinent quant à l'analyse du projet.

II. INTRODUCTION

Cette introduction précise les caractéristiques fondamentales de l'évaluation environnementale et sociale ainsi que les exigences relatives à la préparation de l'étude d'impact sur l'environnement et le milieu social.

Évaluation environnementale et sociale

L'évaluation environnementale et sociale est un instrument privilégié dans la planification du développement et de l'utilisation des ressources et du territoire. Elle vise la considération des préoccupations environnementales à toutes les phases de la réalisation d'un projet, y compris sa conception, son exploitation et sa fermeture. Elle aide le promoteur à concevoir un projet plus soucieux du milieu récepteur, sans remettre en jeu sa faisabilité technique et économique.

L'évaluation environnementale et sociale prend en compte l'ensemble des composantes des milieux biophysique et humain susceptibles d'être affectées par le projet. Elle permet d'analyser et d'interpréter les relations et interactions entre les facteurs qui exercent une influence sur les écosystèmes, les ressources et la qualité de vie des individus et des collectivités. La comparaison et la sélection de variantes de réalisation du projet sont intrinsèques à la démarche d'évaluation environnementale et sociale. L'étude d'impact fait donc ressortir clairement les objectifs et les critères de sélection de la variante privilégiée par le promoteur.

L'évaluation environnementale et sociale prend en considération les opinions, les réactions et les principales préoccupations des individus, des groupes et des collectivités. À cet égard, elle rend compte de la façon dont les diverses parties concernées ont été associées au processus de planification du projet et considère les résultats des consultations et des négociations effectuées.

L'évaluation environnementale et sociale vise à faire ressortir les enjeux associés au projet et détermine les composantes environnementales et sociales qui subiront un impact important. L'importance relative d'un impact contribue à déterminer les enjeux sur lesquels s'appuieront les choix et la prise de décision et, s'il y a lieu, à quelles conditions.

Étude d'impact

L'étude d'impact est le document qui fait état de la démarche d'évaluation environnementale et sociale du promoteur. Elle doit faire appel à des méthodes scientifiques et satisfaire aux exigences du Comité d'examen (COMEX) concernant l'analyse du projet ainsi que la consultation du public et des communautés autochtones concernées. Elle permet de comprendre globalement le processus d'élaboration du projet. Plus précisément, elle :

- présente les caractéristiques du projet et en explique la raison d'être, compte tenu du contexte de réalisation;
- trace le portrait le plus juste possible du milieu dans lequel le projet sera réalisé et de l'évolution de ce milieu pendant et après l'implantation du projet;
- démontre comment le projet s'intègre dans le milieu en présentant l'analyse comparée des impacts des diverses variantes de réalisation;

- définit les mesures destinées à minimiser ou à éliminer les impacts négatifs sur l'environnement et à maximiser ceux qui sont susceptibles de l'améliorer et, lorsque les impacts ne peuvent être suffisamment atténués, propose des mesures de compensation;
- propose des programmes de surveillance et de suivi pour assurer le respect des exigences gouvernementales et des engagements du promoteur, pour suivre l'évolution de certaines composantes du milieu affectées par la réalisation du projet et pour vérifier l'efficacité des mesures d'atténuation prévues.

III. PRINCIPES DE BASE

Les sections suivantes décrivent quatre grands principes de base qui doivent guider le promoteur dans la réalisation de son étude d'impact.

Intégration des objectifs du développement durable

Le développement durable vise à répondre aux besoins du présent sans compromettre la capacité des générations futures de répondre aux leurs. Ses trois objectifs sont le maintien de l'intégrité et des caractéristiques de l'environnement, l'amélioration de l'équité sociale et l'amélioration de l'efficacité économique. Un projet conçu dans une telle perspective doit viser l'intégration et l'équilibre de ces trois objectifs.

Il est de la responsabilité du promoteur de prendre en compte les objectifs du développement durable lors de l'élaboration de son projet et de déterminer comment les actions à mettre en œuvre doivent être adaptées au contexte environnemental et social particulier de la Baie-James. Ces objectifs peuvent être intégrés autant dans la planification et la gestion du projet que dans les mesures d'atténuation et de compensation proposées. L'étude d'impact doit d'ailleurs résumer la démarche de développement durable suivie par le promoteur et expliquer de quelle façon la conception du projet en tient compte. Le promoteur est d'ailleurs fortement encouragé à mettre en place des programmes de gestion responsable comprenant des objectifs concrets et mesurables en matière de protection de l'environnement, d'efficacité économique et d'équité sociale.

Prise en compte des changements climatiques lors de l'élaboration du projet et de la réalisation de l'étude d'impact

Pour le Comité d'évaluation et le COMEX, et particulièrement dans le contexte nordique, la lutte contre les changements climatiques constitue un enjeu aussi prioritaire que fondamental. Tant sur le plan de la réduction des émissions de gaz à effet de serre (GES) que sur celui de l'adaptation aux changements climatiques, le promoteur devra prendre en compte les changements climatiques dès l'élaboration de son projet et lors de la réalisation de l'étude d'impact. L'analyse des solutions de rechange, des différentes variantes de réalisation et des impacts du projet devra donc être effectuée en considérant le contexte des changements climatiques. Le promoteur doit notamment évaluer la contribution du projet au bilan d'émission de GES du Québec. Il doit également évaluer les effets possibles des changements climatiques sur son projet et sur le milieu d'implantation de ce dernier, notamment s'ils sont susceptibles de modifier la nature et l'importance des impacts du projet sur l'environnement, la sécurité des personnes ou la stabilité et la pérennité des infrastructures (voir méthodologie suggérée en annexe).

Afin de s'assurer de bien considérer les GES du projet pour chacune des phases de réalisation, le promoteur doit définir différents périmètres au moment de délimiter la zone d'étude. Ces périmètres doivent notamment permettre de considérer les émissions directes et indirectes de GES qui sont modulées par les choix de variantes de réalisation du projet.

Intégration du savoir traditionnel

La connaissance qu'ont les communautés concernées par le projet de leur milieu biophysique et humain est essentielle à une évaluation adéquate des impacts d'un projet de cette nature. Chaque groupe culturel possède son propre système de représentation de lui-même, des communautés voisines, de son environnement, de son passé et de son avenir. Parce qu'il détermine en partie la réaction au changement du groupe concerné, ce système de représentation et la connaissance qu'ont les communautés concernées de leur environnement doivent être connus et intégrés dans l'étude d'impact. Cela inclut leur compréhension des limites temporelles et spatiales du projet et de son aire d'influence.

L'intégration du savoir traditionnel dans l'étude d'impact est nécessaire et exige la collecte d'informations auprès des communautés concernées et des utilisateurs du territoire. L'analyse de ces données requiert également une participation de ces derniers à divers niveaux. L'ensemble de cet exercice favorise l'implication des communautés concernées et leur connaissance du projet.

Consultations et communications

Le promoteur doit mettre à profit la capacité des communautés concernées et des citoyens à faire valoir leurs points de vue et leurs préoccupations par rapport au projet. À cet effet, il est recommandé de mettre en œuvre un processus d'information et de consultation du public le plus tôt possible, en y associant les parties concernées (individus, groupes et collectivités, etc.), afin de considérer les opinions des parties intéressées lors des choix et des prises de décisions. Plus la consultation intervient tôt dans le processus qui mène à une décision, plus grande est l'influence des citoyens sur l'ensemble du projet et, nécessairement, plus le projet a des chances d'être acceptable socialement.

Une section de l'étude d'impact devra être consacrée à la présentation et à l'analyse des consultations. Le promoteur devra y décrire son programme de consultation, les séances publiques qu'il a organisées et celles qui sont prévues, et ce, à chaque étape de réalisation du projet. Il devra indiquer les dates, les lieux et la durée des séances d'information et de consultation. Il devra produire des comptes rendus de ces rencontres, lesquels feront état de la méthodologie utilisée, de la liste des participants, des commentaires, préoccupations, opinions et réactions des individus, des groupes, des organismes de la Baie-James et des utilisateurs du territoire. Il est à noter que le contenu final des comptes rendus devra être validé par les participants, une tierce partie ou un observateur indépendant. Le promoteur est invité à consulter les documents relatifs à l'information et à la consultation du public publiés sur le site du COMEX[1].

À ce sujet, le promoteur doit s'assurer d'exclure tout renseignement confidentiel ou qui pourrait porter préjudice à l'environnement ou aux personnes et transmettre cette information dans un document séparé, en demandant qu'il ne soit pas rendu public. Il est recommandé au promoteur de placer ces renseignements et données dans un document séparé de l'étude d'impact et clairement marqué comme étant jugé de nature confidentielle. Le promoteur est invité à consulter le document

[1] Consultations effectuées par le promoteur : les attentes du COMEX : http://comexqc.ca/participation-publique/consultations-par-le-promoteur/

intitulé *Caractère public ou confidentiel des informations transmises au COMEX*[2] afin d'obtenir plus de renseignements à ce sujet.

Le promoteur indiquera de quelles façons les opinions des parties intéressées ont influé sur les questions à étudier, les choix, les prises de décisions et les modifications apportées au projet. Le promoteur devra expliquer comment il tiendra compte des préoccupations recueillies dans le cadre de son projet.

Par ailleurs, le fait d'entreprendre des démarches d'information et de consultation le plus tôt possible permettra également au promoteur de sonder l'intérêt des personnes à faire partie d'un éventuel comité technique ou comité de vigilance dédié à la gestion des matières résiduelles. Dans le cas du présent projet, la formation d'un tel comité est recommandée. Le promoteur est invité à fournir, en version préliminaire, les caractéristiques dudit comité.

Enfin, le promoteur mettra en œuvre les moyens nécessaires pour que les documents essentiels au projet soient compris par les communautés concernées, rendra ces documents publics, assurera la diffusion de l'information auprès des personnes et groupes intéressés à l'aide des médias appropriés et verra à leur mise à jour.

[2] https://comexqc.ca/wp-content/uploads/Caracte%CC%80re-public-ou-confidentiel_COMEX-FR-2.0.pdf

IV. CONTENU DE L'ÉTUDE D'IMPACT

Les sections suivantes décrivent les éléments devant être présentés dans l'étude d'impact.

1. MISE EN CONTEXTE

Cette section de l'étude d'impact doit exposer les éléments à l'origine du projet. Elle comprend une courte présentation du promoteur, le contexte d'insertion et la raison d'être du projet. L'exposé du contexte et de la raison d'être du projet doit permettre de dégager les enjeux environnementaux, sociaux, économiques et techniques à l'échelle locale et régionale.

1.1 Présentation du promoteur

L'étude d'impact doit présenter le promoteur du projet et, s'il y a lieu, ses consultants. Cette présentation inclut des renseignements généraux sur ses antécédents en relation avec le projet envisagé et le secteur d'activité dans lequel se situe le projet.

L'étude doit, de plus, présenter clairement la structure administrative du promoteur qui permet d'offrir les garanties financières requises lorsque des mesures de restauration environnementale, de décontamination, de démantèlement d'infrastructures ou d'autres mesures doivent être prises.

1.2 Contexte d'insertion du projet

Le promoteur devra fournir une description du projet comprenant les coordonnées géographiques du projet et ses principales caractéristiques techniques et économiques. Il insistera sur le contexte général d'insertion du projet, les buts visés, les composantes connexes, le calendrier de construction, d'exploitation et de fermeture du projet, son coût et sur l'éventualité d'un agrandissement du projet, s'il est prévu. Le promoteur devra également détailler les principales contraintes du milieu à l'implantation du projet et dresser un portrait des activités menées par de tierces parties à proximité.

Dans la présentation du contexte et de la raison d'être du projet, le promoteur devra présenter et prendre en compte les principales caractéristiques techniques et économiques du projet. L'étude d'impact doit être basée sur ces caractéristiques et le projet ne devra pas être modifié de façon majeure au cours du processus d'évaluation environnementale. Les impacts anticipés et analysés sont ceux qui ont le potentiel de se produire lors de la réalisation du projet et qui seront présentés au public.

Le promoteur tracera ensuite un historique en faisant un rappel des principales étapes qui ont conduit à la définition du projet proposé. Il fera également état des ententes déjà établies pour l'utilisation de certains services ou de partenariat avec les communautés et/ou entreprises locales et régionales. Le cas échéant, il traitera d'ententes prises en termes de cogestion des matières résiduelles et recyclables avec des entreprises locales ou régionales (Hydro-Québec, Nemaska Lithium, etc.).

Le cadre légal d'insertion du projet devra être décrit en précisant les conventions, les lois et les règlements pertinents, pour tous les niveaux de gouvernements. De plus, le promoteur devra non seulement énumérer les lois, règlements, politiques et directives applicables à son projet, mais il devra, dans les sections appropriées de son étude d'impact, y faire référence et décrire de quelle façon il prévoit s'y conformer. En ce sens, le projet doit refléter les grandes orientations en matière de protection des milieux récepteurs et favoriser l'élimination des contaminants à la source plutôt qu'un traitement a posteriori.

Le promoteur et son consultant doivent s'assurer d'une participation importante de la communauté autochtone dans son projet et en faire la démonstration.

1.3 Raison d'être du projet

L'étude expose le contexte d'insertion et la raison d'être du projet. À cet égard, elle décrit la situation actuelle et prévisible quant à la gestion des matières résiduelles du territoire desservi par le projet, énonce les objectifs poursuivis, démontre en quoi il répond à un besoin réel compte tenu des modes de gestion des matières résiduelles implantés ou à venir sur le territoire à desservir et présente les contraintes ou les exigences liées à sa réalisation et à son exploitation.

En outre, les promoteurs de projet doivent indiquer les efforts entrepris pour inciter la population desservie à appliquer l'approche des 3RV, à adopter des habitudes visant à diminuer la production de matières résiduelles et à favoriser leur valorisation (réduction à la source, réemploi, recyclage ou autre opération de valorisation) ainsi que pour réduire la quantité à enfouir au LEET projeté.

De plus, la présentation du contexte et de la raison d'être d'un projet de LEET doit inclure les éléments suivants en utilisant les données disponibles les plus récentes :

- l'état de situation : historique du projet, besoins à combler, évolution des quantités et nature des matières résiduelles produites sur le territoire, d'où elles proviennent (secteur municipal, industries, commerces, institutions, construction, rénovation et démolition), clientèles desservies actuellement, autres usagers potentiels, inventaire des infrastructures en place et projetées visant la mise en valeur des matières résiduelles (entreposage, recyclage, réemploi, valorisation, etc.), plan de gestion des matières résiduelles, s'il y a lieu, ouverture d'un écocentre, etc.;
- la superficie, la capacité et la durée de vie actuelles du LEET, le cas échéant, et celles estimées pour le projet, doivent être mises en relation avec les phases futures de développement local, voire régional : augmentation de la population desservie, implantation de nouvelles entreprises, sensibilisation de la population à la réduction des matières résiduelles, efficacité future des programmes de réduction des matières résiduelles, etc.

2. CHOIX DES VARIANTES D'EMPLACEMENT ET DE TECHNOLOGIE

2.1 Variantes d'emplacement

Les variantes présentées porteront notamment sur le choix d'un emplacement, s'il s'agit d'un nouveau lieu, ou sur certains éléments précis du projet tels que les variantes d'imperméabilisation, les variantes d'intégration au paysage, les modes d'exploitation ou les variantes d'accès au LEET.

L'étude décrit les caractéristiques techniques des variantes en insistant sur les éléments distinctifs susceptibles d'intervenir dans le choix de la variante ou des variantes de réalisation les plus pertinentes au projet.

En tenant compte des normes, de l'information recueillie lors de l'inventaire du milieu et, le cas échéant, des commentaires reçus lors des consultations préliminaires menées auprès de la population et des communautés autochtones, le promoteur effectue le choix de l'emplacement le plus pertinent à l'implantation du projet parmi les emplacements possibles, en les comparant tant sur les plans environnemental et social que technique et économique. L'étude explique en quoi l'emplacement choisi se distingue nettement des autres emplacements envisagés et pourquoi ces derniers n'ont pas été retenus pour l'analyse détaillée des impacts. Dans le choix de l'emplacement, le promoteur tient compte, notamment :

- des contraintes physiques et hydrogéologiques (proximité d'un cours d'eau, topographie, perméabilité des sols, niveau de contamination des sols et des eaux souterraines, capacité géotechnique, risques potentiels de mouvements des sols, etc.);
- des contraintes biologiques (présence d'un habitat faunique ou d'un milieu humide ou hydrique);
- de la vulnérabilité du milieu aux impacts des changements climatiques;
- des contraintes techniques et financières (capacité d'enfouissement, tenure des terres, calendrier de réalisation, coûts, etc.);
- de l'ampleur de certains impacts anticipés (impacts sur les résidences à proximité, les milieux sensibles, les espèces menacées et les sites d'intérêt pour les communautés autochtones, risques pour la santé et la sécurité, utilisation traditionnelle du territoire, etc.);
- de la conjoncture sociale et économique (préoccupations majeures, retombées économiques, etc.);
- de l'intégration au paysage.

Cette description doit être suffisamment détaillée et illustrée pour permettre de comparer les différents emplacements envisagés et d'évaluer leurs avantages respectifs, sur les plans biophysique, social, technique et économique. Dans tous les cas, le promoteur devra démontrer son souci de réduction de l'empreinte de son projet sur le milieu. Dans l'éventualité où le choix d'un seul site est physiquement possible, le promoteur justifiera son raisonnement.

Le promoteur présentera les renseignements géographiques pertinents pour permettre de bien localiser les éléments du projet ainsi que les variantes et les infrastructures temporaires, le cas échéant, notamment en précisant les noms des plans d'eau et leur position géographique.

2.2 Variantes technologiques

Le choix des éléments à considérer dépend largement de la dimension et de la nature du projet. Toutes ces considérations devront être faites en tenant compte de la particularité du milieu nordique et de son évolution dans un contexte de changements climatiques. À ce propos, le promoteur indiquera comment il compte adapter son projet face aux changements climatiques afin d'assurer l'intégrité de ses installations et leur stabilité à long terme.

Le promoteur devra déterminer et décrire les variantes susceptibles de moduler les émissions de GES. Par exemple, le promoteur peut envisager l'utilisation de la meilleure technologie disponible, l'emploi de sources d'énergie de remplacement à faible empreinte carbone, le remplacement de carburants et le choix de trajets réduisant les distances nécessaires pour le transport des matières résiduelles. La comparaison des variantes doit, notamment, être réalisée dans le souci d'éviter, de réduire ou de limiter les émissions de GES.

Lors de son choix, il considérera également les objectifs de rejets liquides, les normes d'émission dans l'atmosphère et les règles de gestion des matières résiduelles afin d'assurer la protection des milieux aquatique, terrestre et atmosphérique. De plus, le promoteur précisera les risques associés aux deux options de profondeur pour la tranchée proposée, soit 4 mètres ou 6 mètres, considérant que la nappe phréatique est à 5 mètres de profondeur.

Par ailleurs, les solutions visant à répondre à la problématique peuvent être, par exemple, l'augmentation des efforts de récupération et de recyclage, le regroupement avec un autre gestionnaire de site ou les possibilités d'enfouissement des matières résiduelles dans un autre lieu.

3. DESCRIPTION DU PROJET

Dans cette section, le promoteur devra procéder à la description des différentes infrastructures et des technologies retenues parmi celles présentées à la section précédente. Il fournira une quantité de détails suffisante pour bien en comprendre les enjeux, notamment en précisant si certaines infrastructures devront être aménagées à proximité d'emplacements devant affecter le milieu hydrique ou des milieux humides. La conservation et la protection de la ressource en eau est un enjeu qui doit également être considéré lors de la mise en œuvre du projet.

Le promoteur devra démontrer la capacité du projet à respecter les normes, critères et exigences légales et réglementaires.

Le promoteur précisera l'échéancier de réalisation de son projet et indiquera les dates ou périodes prévues pour la réalisation des travaux et la durée anticipée de ceux-ci.

De plus, pour chaque type d'activité et à chaque étape du projet, la localisation précise des points de rejet, les bruits, les odeurs, les émissions diffuses et les autres types de nuisances ainsi que les équipements et les installations qui y sont associés (captage, épuration, traitement, réception, entreposage, manipulation, etc.) doivent être recensés.

3.1 Description des travaux préparatoires

Le promoteur décrira également les activités et travaux préparatoires requis pour l'implantation des installations, qu'il s'agisse de déboisement (en précisant les superficies et les caractéristiques des peuplements forestiers déboisés), de dynamitage, de détournement de cours d'eau, de terrassement, ou de remblayage. Il indiquera les lieux, les limites approximatives, les volumes approximatifs de même que les modes de collecte, de transport et d'élimination des matériaux déplacés, le cas échéant. Il fournira la description de la nature, des volumes approximatifs, du mode et du lieu d'entreposage du sol végétal et du mort-terrain, le cas échéant.

3.2 Description du LEET

Le promoteur présentera ainsi, de façon synthétique et cartographique, quand les informations s'y prêtent, les renseignements suivants :

- l'étendue du territoire visé et l'importance de la population à desservir;
- la clientèle visée (municipalités, institutions, industries, stations d'épuration, incinérateurs, etc.) et le territoire de desserte du projet. Pour ce dernier point, le promoteur doit indiquer s'il entend limiter la provenance des matières résiduelles à éliminer à un territoire donné;
- la nature des matières résiduelles à éliminer et leur quantité en fonction des différents clients et ententes prises avec des partenaires spécifiques (Nemaska Lithium, Hydro-Québec, etc.) ainsi que les boues de fosses septiques susceptibles d'être acheminées sur le site;
- les modes de collecte et de transport des matières résiduelles (types de véhicules, fréquence de passage, parcours, horaires, etc.);
- le mode de gestion des matériaux récupérés au centre de tri et de compostage (description des récupérateurs, destinations, mode de fonctionnement pour la récupération des matériaux par les destinataires, type de valorisation des matériaux récupérés);

- le réaménagement ou l'implantation de nouvelles infrastructures de transport ou de signalisation routière, le cas échéant;
- la localisation, la superficie, la tenure des terres, des portions de territoire devant servir à l'implantation des infrastructures nécessaires à la gestion des déchets et, si possible, une photographie aérienne récente du secteur;
- la description pédologique, hydrogéologique et géologique du terrain visé pour accueillir le lieu d'enfouissement en tranchée;
- les plans et profils des installations projetées, en situant ces profils par rapport aux plans d'eau et milieux humides jouxtant le projet;
- les dimensions du lieu d'enfouissement en tranchée et de toutes les autres structures connexes y compris la zone tampon;
- la durée de vie prévue pour l'exploitation du LEET et la possibilité d'autres phases de développement en tenant compte de la quantité des matières résiduelles en regard, notamment, des ententes prises avec des partenaires spécifiques;
- l'influence du compactage des déchets sur les surfaces requises et la durée de vie du LEET;
- les garages, ateliers d'usinage et d'entretien des équipements et entrepôts des matières dangereuses (réactifs, hydrocarbures, explosifs, etc.), le cas échéant;
- les plans préliminaires pour l'aménagement et l'exploitation du LEET, y compris tout équipement ou ouvrage destiné à réduire, à contrôler, à contenir ou à prévenir le dépôt, le dégagement, l'émission ou le rejet de contaminants dans l'environnement (ex. relevé topographique du terrain, plan préliminaire d'aménagement du terrain et des systèmes de drainage, description et localisation des points de rejet dans l'environnement, description du système d'imperméabilisation des zones de dépôt de matières résiduelles ainsi que du système de traitement du lixiviat et des eaux, le cas échéant, la description du recouvrement, etc.);
- la description des équipements et ouvrages destinés à prévenir ou à contrôler la migration dans le sol, le cas échéant;
- les modalités d'exploitation du terrain et la séquence d'aménagement des tranchées d'enfouissement;
- les mesures destinées à assurer l'entretien et la réparation de la machinerie ainsi que son remplacement, si nécessaire;
- les mesures prévues en cas de bris d'équipement ou de panne;
- les mesures de contrôle des matières résiduelles admises (nature, qualité, provenance), notamment pour les boues et les sols contaminés, et celles applicables en cas de non- admissibilité de ces matières;
- les mesures de contrôle des matériaux de recouvrement;
- les heures d'ouverture du lieu;
- les méthodes d'effarouchement pour animaux ou autre mesure destinée à éloigner les animaux qui seront utilisées;
- le programme d'inspection, d'entretien et de nettoyage des systèmes de captage des eaux de ruissellement ainsi que des systèmes de puits d'observation des eaux souterraines;
- le programme préliminaire d'assurance et de contrôle de la qualité pour les aménagements proposés visant à assurer leur conformité aux normes et exigences applicables, notamment en ce qui concerne la surveillance effectuée;
- le programme préliminaire de suivi environnemental, incluant entre autres le suivi des eaux souterraines et de surface;

– les modes de désaffectation et de restauration du site actuel et les activités liées à la gestion et au suivi post-fermeture.

3.3 Aménagement et projets connexes

Infrastructures d'accès

Le promoteur discutera des accès routiers existants et à construire dans la zone du projet et précisera l'utilisation qu'il compte en faire. Il devra décrire les activités ou travaux nécessaires pour la construction et l'exploitation d'une route d'accès au site et des autres chemins, y compris les chemins temporaires. Il précisera si, et dans quelle mesure, il sera responsable de leur entretien. Il précisera également comment il entend effectuer l'entretien, la réfection et le maintien des routes existantes liées au projet. Cette description devra inclure, sans s'y limiter, l'installation d'ouvrages de traversées de cours d'eau et les travaux ou activités prévus sous la ligne naturelle des hautes eaux.

De façon plus ciblée, afin de permettre une description adéquate et pertinente des effets du projet sur l'habitat du poisson, le promoteur devra localiser et décrire les interventions envisagées en rives et dans les cours d'eau, permanentes et intermittentes, la dimension des ouvrages (permanents et temporaires), les matériaux nécessaires, etc. Ces interventions peuvent être, sans s'y limiter, le remblai en rive, la réfection et la construction de ponceaux ou de ponts. Le promoteur devra également localiser les milieux humides présents dans la zone de construction de l'accès au LEET.

Bancs d'emprunt

Dans cette section, le promoteur devra définir précisément ce qu'il entend faire relativement à l'exploitation des bancs d'emprunt requis pour le projet, et ce, tant pour les différentes étapes de la construction et de l'exploitation du lieu d'enfouissement en tranchée que pour les accès routiers ou tout autre aspect du projet.

Il devra localiser et cartographier l'ensemble des exploitations existantes et projetées pour les besoins du projet, en précisant leur proximité par rapport à l'emplacement des routes, des cours d'eau, des milieux humides et des aires protégées projetées de façon à tenir compte de la réglementation, des particularités et des possibilités du milieu. Il évaluera les superficies et les volumes requis. Le promoteur indiquera de quelle façon s'est faite l'optimisation de l'évaluation des matériaux d'emprunt requis. Finalement, un aperçu des mesures de réaménagement, de désaffectation et de restauration de ces sites devra également être fourni.

Fermeture et restauration du site existant

Le promoteur devra indiquer les mesures prévues concernant la restauration et la fermeture du lieu d'enfouissement des matières résiduelles actuellement utilisé et le devenir du site après restauration. Le promoteur indiquera si l'ancien lieu d'enfouissement contient des matières recyclables qui pourraient être récupérées et dans quelle mesure l'ancien site sera contrôlé pour éviter que l'on continue d'y apporter des rebuts. Le promoteur devra également préciser le suivi et la surveillance envisagés après fermeture. L'échéancier de ces travaux devra également être transmis.

3.4 Émission des GES

Le promoteur devra produire un rapport d'identification et de quantification détaillé des émissions de GES annuelles attribuables à toutes les sources d'émissions du projet et aux différentes phases du projet.

Pour faciliter le travail du promoteur, les méthodes de calcul suggérées pour les principales sources mentionnées précédemment sont présentées en annexe. Les quantifications doivent être réalisées par une personne compétente dans le domaine. On entend par « personne compétente dans le domaine », toute personne physique ou morale qui a déjà démontré ses connaissances et ses compétences en matière de quantification d'émissions de GES ou de réduction d'émissions de GES. Cette personne peut provenir de l'intérieur ou de l'extérieur de l'organisation et son accréditation n'est pas obligatoire.

4. DESCRIPTION DU MILIEU

4.1 Délimitation de la zone d'étude

Le promoteur, en prenant en compte le savoir traditionnel et les valeurs culturelles autochtones, doit circonscrire une zone d'étude dont l'étendue devra pouvoir englober l'ensemble des activités projetées et leurs effets directs et indirects sur les milieux biophysique et humain susceptibles d'être affectés par le projet et ses infrastructures connexes. Le promoteur devra justifier les limites de cette aire d'étude et son étendue et devra faire part des contraintes biophysiques, techniques, économiques et sociales qui ont permis d'en établir l'étendue.

La portion du territoire couverte par la zone doit être suffisante pour englober l'ensemble des activités projetées, y compris la cueillette et le transport des matières résiduelles (origine, destination) ainsi que l'agrandissement éventuel du LEET et pour circonscrire l'ensemble des effets directs et indirects du projet sur les milieux physique, biologique et humain. La zone d'étude doit également couvrir les distances exigées par le Règlement sur l'enfouissement et l'incinération de matières résiduelles (REIMR) (chapitre Q-2, r. 19).

En plus du site accueillant le lieu d'enfouissement en tant que tel, l'aire d'étude englobera les accès, et les bancs d'emprunt, le cas échéant, et définira les patrons actuels de l'utilisation du territoire et de son développement futur. Selon les impacts étudiés, qu'ils soient d'ordre biophysique ou social, l'aire d'étude peut être composée de différentes aires délimitées. Ainsi, elle devra tenir compte du fait qu'une bonne partie des impacts directs du projet sur le milieu biophysique pourrait impliquer plus directement les lots de piégeage de la communauté crie concernée alors que les possibilités d'emploi et d'autres retombées économiques pourraient se répercuter sur d'autres communautés du territoire.

4.2 Description des composantes pertinentes

Le promoteur devra décrire l'état de l'environnement tel qu'il se présente dans la zone d'étude avant la réalisation du projet. Il devra dresser un historique des événements, des activités et des projets ayant affecté l'état de référence des composantes valorisées pertinentes afin de soutenir une évaluation des effets cumulatifs fondée sur des données probantes. À cet effet, il fournira les sources d'information qu'il aura consultées. Il doit décrire de la façon la plus factuelle possible les composantes des milieux biophysique et humain susceptibles d'être touchées par la réalisation du projet. Si les données disponibles chez les organismes gouvernementaux, municipaux, autochtones ou autres sont insuffisantes ou ne sont plus représentatives, le promoteur complétera la description du milieu par des inventaires effectués dans les règles de l'art.

Le promoteur doit indiquer la provenance de toutes les données ayant servi à la description du milieu ainsi que les fins auxquelles elles sont utilisées. De plus, il doit commenter la qualité et la fiabilité des données disponibles. Pour de nombreuses composantes du milieu, les organismes gouvernementaux ont développé des guides ou des documents de référence afin d'aider les promoteurs et leurs consultants dans la collecte et la présentation de l'information.

4.3 Milieu biophysique

En ce qui concerne les projets de LEET, les composantes suivantes doivent être présentées dans la description du milieu :

- le relief et la description de la géologie locale comprenant, pour le terrain visé par le projet :
  - une stratigraphie détaillée;
  - un relevé géologique effectué à partir d'un nombre représentatif de sondages stratigraphiques (un minimum de quatre pour les cinq premiers hectares et un sondage pour chaque tranche supplémentaire de cinq hectares ou, dans le cas d'une tranche résiduelle, de moins de cinq hectares);
  - une caractérisation de la nature des sols à partir d'un nombre représentatif d'échantillons;
  - une estimation des volumes de matériaux disponibles pour l'aménagement et l'exploitation du LEET;
- la configuration actuelle du drainage et la topographie générale du terrain dans un rayon d'un kilomètre;
- la description de l'hydrogéologie locale comprenant, pour le terrain visé par le projet, les caractéristiques des unités hydrostratigraphiques dont leur localisation, leur profondeur, leur conductivité hydraulique (déterminée à partir d'essais in situ) et pour chacune des nappes présentes, une carte piézométrique, le nivellement des puits d'observation et autres points d'eau (résurgences, ruisseaux, affleurements de la nappe libre), les caractéristiques physicochimiques des eaux souterraines, le sens d'écoulement, la vitesse de migration, la relation entre les diverses unités hydrostratigraphiques et les diverses nappes ainsi qu'avec le réseau hydrographique de surface et, enfin, leur vulnérabilité à la pollution. Cette description doit être établie à partir d'un nombre représentatif de puits d'observation ou de piézomètres (un minimum de quatre pour les cinq premiers hectares et un pour chaque tranche supplémentaire de cinq hectares ou, dans le cas d'une tranche résiduelle, de moins de cinq hectares) et, au besoin, d'essais de pompage;
- la détermination et la description des propriétés géotechniques des dépôts meubles, du roc et des matières résiduelles (masse volumique, teneur en eau, limites et indices de consistance, indices de compression, pression de préconsolidation, résistance au cisaillement, etc.) en fonction des caractéristiques propres au projet de manière à évaluer, en lien avec les conditions hydrogéologiques locales et, lorsque requis, les contraintes géotechniques associées aux travaux d'aménagement et d'exploitation du lieu, notamment la consolidation et les tassements, la stabilité des pentes des excavations et des amoncellements de matières résiduelles, la liquéfaction ainsi que le soulèvement du fond des excavations;
- la caractérisation de l'hydrologie du site incluant :
  - les débits d'étiage du cours d'eau récepteur ($Q_{2,7}$, $Q_{10,7}$ et $Q_{5,30}$ estivaux et hivernaux) au point de rejet de l'effluent, si applicable;
  - le débit $Q_{5,30}$ estival et hivernal à l'emplacement de la première prise d'eau potable en aval du rejet, si applicable;
  - la superficie du bassin versant en amont du point de rejet de l'effluent;

- une carte indiquant, dans un rayon d'un kilomètre, l'emplacement des points d'observation géologique et hydrogéologique utilisés, les affleurements rocheux et les unités de dépôts meubles, les zones sensibles à l'érosion et aux mouvements de terrain, les zones d'inondation de récurrence de 100 ans lorsque cartographiées, ainsi que les terrains où, en raison de leurs utilisations actuelles ou passées, pourraient potentiellement être présents des contaminants en concentration égale ou supérieure aux valeurs limites fixées à l'annexe I du Règlement sur la protection et la réhabilitation des terrains (chapitre Q-2, r. 37);
- la description des caractéristiques bactériologiques et la caractérisation physicochimique de l'état initial du milieu aquatique, selon le Guide de caractérisation physicochimique de l'état initial du milieu aquatique avant l'implantation d'un projet industriel;
- la description des routes et des autres infrastructures de transport, de la circulation sur les routes et du trafic actuel engendré par le transport des matières résiduelles;
- la localisation de tout aéroport dans un rayon de huit kilomètres des sites potentiels;
- la caractérisation de la qualité de l'atmosphère (concentration initiale des contaminants, récepteurs sensibles, vents dominants, etc.), selon les indications données dans le Guide de la modélisation de la dispersion atmosphérique;
- les sources d'odeurs et de contamination de l'atmosphère existantes et leurs caractéristiques (LEET existants, industries, lieux de compostage, etc.);
- la caractérisation des cours d'eau et des plans d'eau susceptibles d'être affectés par le projet, leurs caractéristiques physiques (bathymétrie, substrat, largeur, profondeur, obstacles au libre passage du poisson et niveau d'eau), leur qualité physicochimique, leur régime hydrique (débit, vitesse de courant, etc.), leurs usages notamment en aval des points de rejet, les bassins et sous-bassins versants dans lesquels ils se trouvent;
- une étude de caractérisation des milieux visés comprenant :
    - une description des milieux humides et hydriques, tels qu'ils sont définis à l'article 46.0.2 de la LQE avec les renseignements et documents exigés à l'article 46.0.3 de cette loi ainsi que la localisation des milieux dans le réseau hydrographique du bassin versant;
    - une délimitation de la portion de ces milieux dans laquelle sera réalisé le projet, y compris toute portion additionnelle susceptible d'être affectée par cette activité;
    - une description des caractéristiques écologiques de ces milieux, notamment des sols et des espèces vivantes ainsi que leur localisation, y compris des espèces menacées ou vulnérables ou susceptibles d'être ainsi désignées en vertu de la Loi sur les espèces menacées et vulnérables (chapitre E-12.01);
    - une description des fonctions écologiques des milieux qui seront affectés par le projet se référant aux différentes fonctions énumérées au deuxième alinéa de l'article 13.1 de la Loi affirmant le caractère collectif des ressources en eau et favorisant une meilleure gouvernance de l'eau et des milieux associés (chapitre C-6.2), dont la connectivité de ces milieux avec d'autres milieux humides et hydriques ou d'autres milieux naturels;
- la capacité des milieux visés à se rétablir ou la possibilité de les restaurer en tout ou en partie une fois le projet complété;
- le couvert végétal, y compris la végétation aquatique et riveraine, avec des précisions sur la présence de peuplements fragiles ou exceptionnels ou de peuplements forestiers dans la zone d'étude et leurs caractéristiques (type, âge, superficie);
- les espèces fauniques (mammifères, chiroptères, oiseaux, reptiles, amphibiens) et leurs habitats et les espèces d'intérêt pour les communautés autochtones et non autochtones, en particulier dans les plans d'eau potentiellement affectés;

- les espèces de poissons présentes ainsi que l'emplacement et les superficies de leurs habitats potentiels ou confirmés pour la reproduction, l'alevinage, la croissance, l'alimentation, la migration et la survie hivernale;
- les espèces rares, menacées ou vulnérables selon le statut de protection accordé à ces espèces par les gouvernements ou susceptibles d'être ainsi désignées, avec une description des espèces fauniques et floristiques (terrestres ou aquatiques) et des habitats de ces espèces;
- les espèces floristiques utilisées dans un contexte traditionnel;
- la situation des espèces exotiques envahissantes dans la zone d'étude;
- la présence d'aires protégées existantes ou d'aires protégées projetées;
- le contexte climatique : valeurs de températures annuelles, périodes de gel, hauteur des précipitations moyennes et maximales, estimation de l'évaporation annuelle (mm), carte des vents dominants et conditions particulières observées;
- l'historique des évènements climatiques extrêmes et les projections climatiques et hydroclimatiques propres au milieu et au bassin versant où le projet sera réalisé pour une période équivalente à la durée de vie du projet;
- les éléments du milieu qui sont sensibles aux changements climatiques, tels que les zones de contraintes existantes comme les zones à risque de glissement de terrain, d'érosion des berges, d'inondation ou de submersion;
- les aléas[3] découlant des conditions climatiques et hydrologiques (pluies abondantes, crues, étiages importants, élévation des températures ambiantes, inondations, feux de forêt, etc.) qui pourraient survenir pendant la durée de vie du projet et qui sont susceptibles d'y porter atteinte.

Plus précisément, le promoteur est invité à déposer une demande de renseignements auprès de la Direction de la gestion de la faune du Nord-du-Québec du ministère des Forêts, de la Faune et des Parcs (MFFP) afin d'obtenir les informations disponibles sur les occurrences du caribou forestier et du caribou migrateur dans le secteur du projet afin de compléter le portrait de la situation de ce mammifère. Le promoteur devra également s'enquérir auprès des utilisateurs du territoire, concernant les savoirs traditionnels.

Le promoteur doit s'assurer de caractériser les éléments du milieu physique et/ou biologique afin de connaitre l'état initial du milieu pour les paramètres qui feront l'objet d'un suivi.

Enfin, lorsque cela s'y prête, le promoteur devra illustrer les composantes décrites et les infrastructures existantes et projetées sur support cartographique.

4.4 Milieu social

Le promoteur devra traiter du milieu social touché par le projet en expliquant les limites inhérentes aux données qu'il possède et qu'il aura recueillies. La description du milieu social devra permettre une évaluation globale des transformations potentielles des modes de vie des diverses communautés affectées par le projet. Il présentera notamment :

- les profils socio-économiques des populations concernées (caractéristiques démographiques, mode de vie, etc.);

[3] Un aléa est un phénomène, une manifestation physique ou une activité humaine susceptible d'affecter négativement le fonctionnement d'un projet et d'amplifier ses impacts sur le milieu.

- l'économie locale et régionale et les perspectives de développement (taux d'activité et de chômage, les principaux secteurs d'activité, la formation, etc.);
- les préoccupations, opinions et réactions des communautés locales et plus particulièrement des collectivités directement concernées, en incluant une présentation des consultations qu'il a effectuées et les principaux éléments de son plan d'information et de participation publique;
- le niveau de bruit engendré par la réalisation du projet, en caractérisant le niveau sonore ambiant de la zone d'étude et en évaluant les niveaux de bruit attribuables aux différentes phases du projet;
- l'utilisation actuelle et prévue du territoire notamment pour les points suivants :
    - les sources d'alimentation en eau;
    - les zones de pêche, de chasse et de piégeage, les espèces visées et leur importance;
    - les zones de cueillette;
    - les cours d'eau navigables de même que ceux présentant un potentiel pour la navigation;
    - les voies de déplacement traditionnelles;
    - les périodes d'utilisation du territoire par les familles;
    - les résidences, campements, chalets, camps de chasse ou de pêche;
    - les aires protégées ou projets d'aires protégées;
    - les routes et autres infrastructures de transport;
    - les corridors de transport utilisés durant les différentes saisons;
    - les pourvoiries, activités récréatives et touristiques, baux de villégiature ou autres;
    - la localisation et la description des divers bâtiments et infrastructures (habitation, services, lignes de transport, etc.) situés à proximité;
    - les lieux de sépultures;
    - les sites et secteurs ayant une valeur particulière pour la population crie et les autres communautés concernées, le cas échéant.

Le promoteur devra également évaluer l'impact du projet sur l'accès et l'occupation des territoires de chasse, de pêche, de piégeage et de cueillette et donc sur les activités de chasse et pêche dans la zone d'étude. Le promoteur décrira notamment la zone de sécurité prévue autour du lieu d'enfouissement, où il y aura possiblement une restriction d'accès.

Enfin, le potentiel archéologique et culturel du secteur, principalement aux sites retenus pour les composantes du projet, sera décrit sans omettre les sites archéologiques connus, les zones à potentiel archéologique et les autres éléments d'intérêt patrimonial, protégés ou non par la législation (site culturel). L'évaluation du potentiel archéologique ainsi que les inventaires, le cas échéant, devront être effectués par des professionnels reconnus en la matière. Le promoteur précisera quelles approches seront mises de l'avant pour recueillir et rassembler le savoir traditionnel des Cris (aîné(e)s, maître(s) de trappe, etc.) et des autres communautés concernées, le cas échéant.

5. ANALYSE DES IMPACTS DU PROJET

L'analyse portera sur les impacts du projet à court, à moyen et à long terme, de manière à couvrir les périodes de préparation, de construction, d'installation des infrastructures et d'exploitation du lieu d'enfouissement et des projets connexes, de la fermeture et de la restauration du site. L'identification des répercussions devrait se faire en concordance avec la section Description du milieu. En précisant et en évaluant les conséquences du projet, le promoteur devra indiquer les détails importants et énoncer clairement quels éléments et quelles fonctions du milieu peuvent être affectés, à quel endroit, dans quelle mesure, pendant combien de temps et avec quel effet global. Il présentera les méthodes utilisées ainsi que leurs limites et les biais possibles.

Le promoteur devra faire une évaluation détaillée des impacts positifs et négatifs anticipés et décrire, le cas échéant, les mesures qu'il entend prendre pour minimiser les impacts négatifs et optimiser les impacts positifs. Le promoteur indiquera le degré de validité et de précision de ses prévisions. Il devra porter une attention particulière au choix et à la portée des mesures d'atténuation ainsi qu'à la détermination des composantes du milieu devant faire l'objet d'un programme de suivi environnemental et social.

L'évaluation du projet devra tenir compte des ressources renouvelables qui pourraient être touchées de façon importante. Il convient donc que la démarche d'analyse des impacts soit élaborée et conduite en prenant en compte la capacité de support du milieu afin d'assurer la pérennité des espèces floristiques et fauniques. Par ailleurs, le promoteur ciblera les changements de l'environnement pouvant entraîner des effets sur le projet et documentera ces effets et les risques qu'ils entraînent.

Les enjeux suivants doivent être considérés lors de la préparation de l'étude d'impact pour un projet de LEET :

- la conservation et la protection des ressources en eau de surface et souterraine;
- la conservation de la qualité de l'atmosphère;
- la réduction des émissions de GES;
- l'utilisation du territoire par les communautés autochtones.

En fonction des ressources du milieu, de l'occupation du territoire, de son utilisation, de la vocation des sites et de la capacité de support des différents milieux, le promoteur devra évaluer les pertes environnementales et les modifications des conditions naturelles d'équilibre. Il doit mettre de l'avant, sur le plan de la protection des habitats sensibles, le principe « éviter et minimiser », et ce, tout particulièrement pour le milieu aquatique, les zones inondables, les milieux humides ou encore en regard d'espèces à statut précaire ou d'aires protégées. De plus, il doit déterminer les seuils d'irréversibilité pour tout impact. Le promoteur accordera une attention particulière aux impacts qu'aura son projet sur l'utilisation actuelle et future du territoire.

Le promoteur devra définir les enjeux principaux de son projet, en s'inspirant de son expérience passée, et notamment à partir des consultations qu'il fera auprès des populations touchées. Dans ce processus d'analyse, il portera une attention particulière aux valeurs véhiculées lors des consultations et au savoir traditionnel. Le promoteur mettra l'accent sur ces enjeux et ceux-ci devront se refléter sur les mesures d'atténuation ou de compensation et influencer le programme de suivi, en particulier si des incertitudes demeurent sur ces enjeux.

5.1 Détermination et évaluation des impacts

Le promoteur devra déterminer les impacts du projet pendant les phases de préparation, de construction, d'exploitation et de fermeture, et en évaluer l'importance. Il considérera les impacts positifs et négatifs, directs et indirects liés à la réalisation du projet. Comme mentionné précédemment, le promoteur présentera la perspective des communautés autochtones et non autochtones relative aux effets du projet sur les composantes des milieux biophysique et humain liés aux enjeux majeurs, notamment en ce qui concerne le milieu physique.

L'étude décrira la méthode retenue pour l'évaluation des impacts. La méthode et les techniques utilisées doivent être objectives, concrètes, reproductibles et compréhensibles par tous. Le lecteur doit pouvoir suivre facilement le raisonnement du promoteur pour déterminer et évaluer les impacts.

Les impacts suivants doivent être considérés lors de la préparation de l'étude d'impact pour un projet de LEET :

- les effets sur la qualité des eaux de surface, que le promoteur doit évaluer en fonction de la description détaillée du milieu récepteur et des rejets potentiels effectuée préalablement, et ce, tant durant la période de construction, d'exploitation et de fermeture;
- les effets sur la qualité de l'eau souterraine, évalués en considérant les valeurs limites du REIMR, et le risque de contamination possible de ces eaux par le lixiviat, et ce, tant durant la période de construction, d'exploitation et de fermeture;
- les perturbations des sources d'approvisionnement en eau souterraine et de surface (qualité et disponibilité);
- les effets sur la qualité de l'atmosphère (odeurs, poussières, contaminants);
- les effets du projet sur la capacité du Québec à atteindre ses cibles de réduction des GES. Pour ce faire, le promoteur devra présenter une quantification complète des émissions de GES (voir en annexe);
- les désagréments causés aux résidents et/ou aux utilisateurs du territoire par les odeurs;
- les impacts potentiels sur la santé publique, notamment les concentrations ou charges de contaminants (dans l'eau, l'atmosphère et, le cas échéant, les sols);
- les effets sur l'environnement visuel associés à l'aménagement et à l'exploitation du LEET;
- la présence d'oiseaux ou d'autres espèces fauniques indésirables (ours noir, loup, grand corbeau, pygargue à tête blanche, etc.) et les problématiques qui peuvent en découler si un accès au site par la faune est possible, autant du point de vue de la santé des animaux, des individus qui consommeront ces animaux et des risques de conflits entre l'humain et la faune. Plus précisément, comme le projet est situé sur un lot de piégeage, il existe un risque de conflit potentiel associé à la présence accrue de prédateurs dans cette zone. De plus, compte tenu de la proximité de la route avec le site d'enfouissement projeté, un effet d'attraction de la faune pourrait augmenter les risques de collision routière;
- les effets sur les espèces migratrices durant la phase de construction;
- les effets sur les espèces floristiques, en particulier sur celles ayant un statut précaire ou un intérêt pour les Cris et les autres communautés concernées (ex. plantes médicinales);
- le drainage, l'érosion par ruissellement ou par le vent;
- les effets sur les milieux visuels par l'intrusion de nouveaux éléments dans le champ visuel et le changement de la qualité esthétique du paysage;

- les effets des changements climatiques sur le projet et sur les composantes du milieu susceptibles d'être affectées par le projet;
- les répercussions sur l'accès, l'utilisation et l'occupation des territoires de chasse, de pêche, de piégeage et de cueillette par les Cris et les autres communautés concernées.

En ce qui concerne le milieu social, le promoteur devra considérer tous les impacts sociaux négatifs et positifs du projet pour en faire ressortir les enjeux majeurs. Il s'agira d'évaluer globalement les transformations éventuelles des modes de vie des diverses communautés habitant ou utilisant le territoire visé par le projet et leur capacité à gérer les changements découlant du projet. Le promoteur devra, à ce sujet et dans la mesure du possible, se référer à d'autres projets analogues sur le territoire nord-québécois. Il abordera notamment les impacts causés par :

- l'utilisation des accès routiers, le maintien des pratiques d'utilisation des communautés locales, la sécurité des utilisateurs du territoire;
- un déversement accidentel de produit pétrolier ou de tout autre produit chimique dans le milieu;
- les risques de nuisance (bruit, poussières, vibrations) et leurs effets sur les utilisateurs du territoire à proximité;
- les modifications ou les adaptations que le(s) maître(s) de trappe devra(ont) apporter à l'exploitation du ou des lot(s) de piégeage affecté(s) par le projet;
- l'utilisation des ressources fauniques par les chasseurs et pêcheurs en regard des modifications de l'accessibilité;
- les activités récréotouristiques;
- l'aspect visuel du site après la réalisation des travaux;
- la modification des habitudes de vie en raison des craintes d'une contamination possible du milieu dans le cadre du projet.

5.2 Impacts cumulatifs

Les effets cumulatifs sont définis en termes généraux comme des changements subis par l'environnement en raison d'une action combinée avec d'autres actions passées, présentes et futures. La notion d'effets cumulatifs se base sur l'idée que chaque impact pris individuellement et indépendamment de son ampleur peut représenter un coût marginal élevé pour l'environnement.

Le promoteur présentera une justification concernant la délimitation géographique et temporelle de l'étude des impacts cumulatifs. Il est à noter que ces limites peuvent varier en fonction des composantes retenues pour évaluer les impacts cumulatifs, et ce, en fonction de leur distribution et de leurs caractéristiques propres. Il proposera et justifiera le choix des projets et des activités retenus pour l'analyse des impacts cumulatifs, lesquels devront comprendre les activités ou projets passés, en cours et futurs (dont la probabilité de réalisation est grande).

Les méthodes utilisées pour prédire les impacts environnementaux cumulatifs devront être clairement décrites afin de bien expliquer la façon dont l'analyse a été réalisée et la logique des conclusions présentées. Il est entendu que le savoir traditionnel des communautés concernées devra être intégré dans l'évaluation des impacts environnementaux cumulatifs. Cette évaluation des impacts environnementaux cumulatifs devra notamment :

- prendre en compte les actions et effets en combinaison avec d'autres actions passées (dont les travaux de mise en valeur qui ont eu lieu), présentes et futures;

- prendre en compte les perturbations naturelles;
- établir des composantes valorisées[4] avec les communautés concernées;
- établir des limites spatiales basées sur les caractéristiques des composantes valorisées;
- distinguer ou cartographier des caractéristiques, des impacts et d'autres utilisations des terres en conditions de référence;
- établir des tendances ou des changements dans l'état des composantes valorisées dans le temps.

Ainsi, le promoteur devra définir les composantes valorisées sur lesquelles portera l'évaluation des effets cumulatifs. Les composantes du milieu pour cette analyse devront être celles liées aux enjeux du projet, entre autres : l'utilisation du territoire par les autochtones, le contexte socio-économique de la région, la fréquentation du secteur par la communauté à des fins culturelles, les activités récréotouristiques, notamment la chasse et la pêche sportives, les espèces fauniques et floristiques en péril, la faune et son habitat ainsi que les changements climatiques. De plus, il considérera l'impact de la présence des travailleurs sur la ressource faunique et la pratique traditionnelle de pêche et de chasse pour les Cris.

Le promoteur doit documenter et évaluer les impacts cumulatifs du lieu d'enfouissement sur l'environnement et le milieu social en lien avec les activités présentes et à venir dans la zone d'étude, s'il y a lieu.

[4] Les composantes valorisées sont des aspects ou des caractéristiques de l'environnement établis comme étant importants pour les populations autochtones, les agences gouvernementales, le promoteur ou le public et pouvant être affectés directement ou indirectement par un projet.

6. MESURES D'ATTÉNUATION, IMPACTS RÉSIDUELS ET MESURES DE COMPENSATION

6.1 Atténuation des impacts

Le promoteur décrira les mesures qu'il mettra en vigueur pour accentuer au maximum les effets favorables sur l'environnement et le milieu social ainsi que les mesures correctrices qu'il compte mettre de l'avant afin de réduire les impacts négatifs du projet (dont les effets cumulatifs). Le promoteur devra privilégier les mesures permettant d'éviter les impacts négatifs, puis celles visant à réduire l'importance des impacts et, pour les impacts résiduels qu'il n'aura pas pu atténuer, proposer des mesures de compensation ou de restauration.

Une attention particulière devra être accordée à l'insertion des mesures suivantes, si elles s'appliquent :

- clauses spécifiques de protection de l'environnement dans les différents contrats octroyés;
- choix des périodes de travaux lors de la construction des infrastructures;
- méthodes proposées pour la construction d'infrastructures près des plans d'eau et des zones humides;
- méthodes pour empêcher l'accès au site à toute faune sauvage, particulièrement par l'ours noir et le loup. Certains paramètres devraient être respectés quant à la hauteur minimale de la clôture entourant le site, la solidité de la clôture, la profondeur et la distance que la clôture devrait faire sous le sol. L'installation d'une clôture électrique en supplément à la clôture initiale pourrait également être envisagée;
- planification de la phase de construction du projet en fonction de la période de migration des espèces migratrices observées dans la zone du projet;
- précautions prises pour limiter l'introduction et la propagation d'espèces exotiques envahissantes;
- protection des milieux humides, des milieux aquatiques et de l'habitat du poisson afin d'éviter ou de réduire la détérioration, la destruction ou la perturbation de ceux-ci;
- adaptation des ouvrages et infrastructures aux impacts potentiels des changements climatiques (voir références en annexe);
- plan de mesures d'atténuation des impacts du projet sur l'ensemble des émissions de GES ou sur les puits de carbone décrivant notamment de quelles façons les possibilités de réduction des émissions de GES sont incorporées dans la conception ou dans les opérations subséquentes du projet avec l'impact chiffré des réductions d'émissions de GES, lorsque possible;
- plan de gestion des émissions atmosphériques (comprenant notamment les mesures d'atténuation courantes et particulières en phase de construction et d'exploitation et un programme préliminaire de suivi), lorsque possible;
- restauration progressive pendant l'exploitation;
- modalités d'aménagement des bermes ou digues dans le but de lutter contre l'érosion, lorsqu'applicable;
- réduction de l'empreinte du projet, le cas échéant;
- mise en valeur des installations désaffectées;
- modes de restauration de certains tronçons de route existants ou de traversées de cours d'eau sujets à problèmes, le cas échéant;

- modes de restauration possibles après exploitation afin de valoriser une restauration progressive de l'ensemble du site et une réappropriation par les utilisateurs locaux;
- normes de restauration et réhabilitation des bancs d'emprunt et, le cas échéant, des portions de routes désaffectées et des sites perturbés;
- modalités de démantèlement des infrastructures requises pour le projet;
- mesures particulières envisagées afin de réduire la pression potentielle sur les activités traditionnelles de chasse et de pêche, le cas échéant;
- protection de la saison de nidification des oiseaux migrateurs, le cas échéant;
- protection des espèces à statut précaire au sens des législations provinciales et fédérales ou de toute espèce d'intérêt pour les communautés;
- protection des sites archéologiques et des sites d'intérêt culturel;
- participation de la main-d'œuvre crie à la force ouvrière ou comme contractants lors de la construction du projet et de son exploitation;
- signalisation routière et autres programmes mis en place pour atténuer les impacts d'accidents de la route causés par une augmentation de la circulation routière, le cas échéant;
- transmission de l'information aux personnes intéressées (communautés touchées et familles directement affectées par le projet);
- politique concernant la formation au travail pour les employés amenés à opérer les infrastructures et équipements construits;
- mise en place de mesures visant à préserver la qualité de vie de la population environnante, notamment par l'utilisation de techniques éprouvées qui réduisent les odeurs;
- choix des itinéraires de transport, la réduction de la vitesse de circulation à proximité et sur le site, l'entretien des camions (par exemple les silencieux), le choix des équipements d'exploitation les moins bruyants sur le site, des horaires qui permettent d'éviter les accidents et les nuisances;
- mise en place de mesures visant le maintien et la restauration du couvert végétal et l'ajout d'aménagements ou d'équipements préservant ou améliorant les aspects paysagers, visuels et esthétiques des installations et des zones adjacentes dans le but d'assurer leur intégration au paysage.

En ce qui a trait aux mesures d'atténuation relatives au projet, le promoteur différenciera les mesures prises en cours d'exploitation de celles applicables lors de la désaffectation du lieu d'enfouissement en tranchée. En particulier, il décrira :

- le programme de restauration progressive et le programme de restauration finale incluant la restauration des accès et la sécurisation des lieux à la fin du projet;
- les modalités de réaménagement et leur stabilisation afin de lutter contre l'érosion éolienne ou par ruissellement;
- la récupération de certains équipements et aménagements.

S'il y a lieu, des mesures d'atténuation propres à la construction de routes, à l'exploitation de bancs d'emprunt ou à d'autres projets connexes au projet de LEET devront être proposées dans l'étude d'impact.

6.2 Impacts résiduels et mesures de compensation

Finalement, le promoteur indiquera la nature et l'envergure des impacts résiduels susceptibles de demeurer après l'application des mesures d'atténuation. Des aménagements, des engagements et des mesures compensatoires pour suppléer à la perte d'habitats devront être proposés; le cas échéant. On traitera également des mesures de compensation pour des modifications ou des pertes liées à la pratique des activités traditionnelles. On devra également faire part de toutes garanties financières ou autres de nature environnementale pouvant être utilisées au cours des phases de construction, d'exploitation et de fermeture du projet.

Enfin, le promoteur devra fournir une liste récapitulative reprenant l'ensemble des mesures d'atténuation, des mesures de compensation spécifiques et des engagements proposés dans le cadre de son projet.

7. PROGRAMMES DE SURVEILLANCE ET DE SUIVI

Les sections suivantes visent à établir les modalités de conception et de réalisation des programmes de surveillance, d'une part, et de suivi, d'autre part, reliés au projet. Les programmes devront être conçus avec suffisamment de souplesse pour pouvoir être modifiés en fonction de nouveaux renseignements et d'évènements imprévus.

7.1 Programme de surveillance

La surveillance environnementale sera réalisée par le promoteur et elle aura pour but d'assurer la mise en œuvre :

- des exigences relatives aux lois et règlements pertinents;
- des mesures proposées dans l'étude d'impact, y compris les mesures d'atténuation ou de compensation;
- des engagements du promoteur prévus aux autorisations ministérielles;
- des conditions fixées dans le certificat d'autorisation.

La surveillance environnementale concernera aussi bien la phase de construction que les phases d'exploitation, de fermeture ou de démantèlement du projet. Le promoteur devra proposer dans l'étude d'impact un programme préliminaire de surveillance environnementale. Ce programme préliminaire sera bonifié lorsque tous les éléments du projet seront mieux définis. Il sera complété, le cas échéant, à la suite de l'autorisation du projet. Ce programme décrira les moyens et les mécanismes mis en place pour assurer le respect des exigences légales et environnementales. Il permettra de vérifier le bon fonctionnement des travaux, des équipements et des installations et de surveiller toute perturbation de l'environnement causée par la réalisation, l'exploitation, la fermeture ou le démantèlement du projet. Le programme de surveillance pourra permettre, si nécessaire, de réorienter les travaux et éventuellement d'améliorer le déroulement de la construction et de la mise en place des différents éléments du projet.

Le programme de surveillance environnementale devra notamment comprendre :

- la liste des éléments nécessitant une surveillance environnementale;
- l'ensemble des mesures et des moyens envisagés pour protéger l'environnement;
- les caractéristiques du programme de surveillance (pour chacun des milieux : eau de surface, atmosphère, sols, etc.), lorsque celles-ci sont prévisibles (ex. localisation des interventions, protocoles prévus, liste des paramètres mesurés, méthodes d'analyse utilisées, échéancier de réalisation, ressources humaines et financières affectées au programme, participation des communautés visées, le cas échéant);
- un mécanisme d'intervention en cas de non-respect des exigences légales et environnementales ou des engagements du promoteur;
- les engagements du promoteur quant au dépôt des rapports de surveillance (nombre, fréquence, contenu et distribution);
- les engagements du promoteur quant à la diffusion des résultats de la surveillance environnementale à la population concernée.

- Le programme de surveillance devra également inclure les émissions de GES. De façon générale, ce programme inclura les éléments qui sont requis dès la conception du projet pour pouvoir quantifier les émissions de GES engendrées par le projet et suivre leur évolution à travers le temps. Étant donné le grand nombre de cas de figure possibles, il n'existe pas de modèle (chaque cas étant unique) de suivi et de surveillance des émissions de GES. À cet effet, un exemple de données à inclure est présenté en annexe. Le plan de suivi et de surveillance des GES est en général très succinct et vise surtout à faciliter le travail du promoteur pour la quantification des émissions de GES. Ce plan peut évoluer selon la durée de vie du projet.
- Le programme de surveillance devra comprendre les activités d'inspection et d'entretien du lieu. Ces activités incluent notamment la vérification de l'état des éléments suivants, si applicable, la barrière limitant l'accès au lieu et les modalités d'affichage; les clôtures limitant l'accès au lieu d'enfouissement, les chemins d'accès au lieu et à ses composantes; les fossés de drainage et le bassin de sédimentation des eaux superficielles; le recouvrement du lieu, y compris le couvert végétal; les bermes et les talus.
  Elle comprend aussi l'inspection des éléments des divers systèmes tels que les puits d'observation des eaux souterraines.
  L'entretien vise à maintenir en bon état le lieu et à assurer le fonctionnement des divers systèmes et équipements dont il est pourvu. Cela comprend les entretiens réguliers planifiés, les réparations et les remplacements.

7.2 Programme de suivi environnemental et social

Le suivi environnemental et social sera effectué par le promoteur et il aura pour but de vérifier, par l'expérience sur le terrain, la justesse de l'évaluation de certains impacts et l'efficacité de certaines mesures d'atténuation ou de compensation prévues à l'étude d'impact et pour lesquelles subsiste une incertitude.

Les connaissances acquises lors des programmes de suivi environnemental et social pourront être utilisées non seulement pour améliorer les prévisions et les évaluations relatives aux impacts des nouveaux projets de même nature, mais aussi pour mettre au point des mesures d'atténuation et éventuellement réviser les normes, directives ou principes directeurs relatifs à la protection de l'environnement.

Le promoteur devra proposer dans l'étude d'impact un programme préliminaire de suivi environnemental et social. Ce programme couvre notamment la réalisation de l'ensemble des activités du programme de suivi environnemental (eaux superficielles, eaux souterraines, etc.) et détaille le nombre de points d'échantillonnage ou de mesure, la fréquence des prélèvements ou des mesures et les paramètres à analyser.

Ce programme préliminaire sera complété, le cas échéant, à la suite de l'autorisation du projet. Ce programme devra notamment comprendre les éléments suivants :

- les raisons d'être du suivi, incluant une liste des éléments nécessitant un suivi environnemental (entre autres les composantes valorisées);
- la durée minimale du programme de suivi, ses objectifs et les composantes visées par le programme (ex. valider l'évaluation des impacts, apprécier l'efficacité des mesures d'atténuation pour les composantes suivantes : eau, air, sol, etc.);

- le nombre d'études de suivi prévues ainsi que leurs caractéristiques principales (liste des paramètres à mesurer, échéancier de réalisation projeté, participation des Cris et d'autres communautés visées au suivi, le cas échéant);
- les modalités concernant la production des rapports de suivi (nombre, fréquence, format et distribution);
- le mécanisme d'intervention mis en œuvre en cas d'observation d'une dégradation imprévue de l'environnement;
- le mécanisme d'intervention mis en œuvre en cas d'observation d'un impact imprévu sur le milieu humain;
- le programme de communication des résultats des suivis aux populations concernées dans un format adapté.

8. PRÉSENTATION DE L'ÉTUDE D'IMPACT

L'étude d'impact devra être présentée d'une façon claire et concise et se limiter aux éléments nécessaires à la bonne compréhension du projet et de ses impacts. Pour assurer la compréhension de tous, un glossaire définissant les termes techniques, les acronymes et les abréviations devra être inclus. Les éléments d'information plus techniques ne devront pas être incorporés au document principal, à moins qu'ils ne soient indispensables pour la compréhension du lecteur. Ce qui peut être schématisé ou cartographié devra l'être, et ce, à des échelles appropriées. Les composantes du projet devront figurer autant sur des cartes thématiques que sur des cartes synthèses.

Le promoteur devra illustrer, à l'aide de graphiques, de cartes et de photographies, les points saillants de son étude. Les cartes devront être présentées à des échelles et avec des données de référence communes pour permettre la comparaison et la superposition des éléments cartographiés. La disponibilité et la qualité des données utilisées devront également être évaluées par le promoteur. Toutes les sources de renseignements devront être données en référence. De plus, les méthodes utilisées au cours de la réalisation de l'étude d'impact (inventaires, enquêtes, entrevues, analyses comparatives, etc.) devront être présentées, explicitées et validées sur le plan scientifique.

Le promoteur devra également préparer un résumé de l'étude d'impact. Ce résumé devra s'adresser au grand public et inclura des illustrations ainsi que des cartes permettant une compréhension rapide des travaux prévus dans le cadre du projet. Le résumé devra être suffisamment détaillé pour permettre au lecteur de prendre connaissance du projet et de comprendre les enjeux, les principaux impacts appréhendés, les mesures d'atténuation proposées, les impacts résiduels et les conclusions sur l'importance de ces effets. Il est à noter que d'autres initiatives du promoteur favorisant la participation publique, telles que la production de vidéos, de capsules pour la radio, de maquettes, de feuillets d'informations, etc., sont également fortement encouragées. Il est fortement suggéré au promoteur de présenter l'intégralité de son étude d'impact en anglais, ainsi que de traduire le résumé en cri afin de permettre aux communautés affectées par le projet, le cas échéant, d'accéder à l'information.

Sur autorisation du promoteur, tous les documents transmis par celui-ci seront déposés sur le site Internet du COMEX[5] et sur le Registre des évaluations environnementales[6] du MELCC afin de favoriser la participation du public au sein des communautés touchées.

Si le promoteur juge que des renseignements ou des données concernant des procédés industriels sont de nature confidentielle, il devra s'assurer d'exclure ces renseignements et données (et tous ceux qui peuvent porter préjudice à l'environnement ou aux personnes) et de les transmettre dans un document séparé de l'étude d'impact et clairement marqué comme étant jugé de nature confidentielle. Le promoteur est invité à consulter le document intitulé *Caractère public ou confidentiel des informations transmises au COMEX*[7] afin d'obtenir plus de renseignements à ce sujet.

[5] https://comexqc.ca/
[6] http://www.ree.environnement.gouv.qc.ca/index.asp
[7] https://comexqc.ca/wp-content/uploads/Caracte%CC%80re-public-ou-confidentiel_COMEX-FR-2.0.pdf

ANNEXE I : COMPLÉMENT D'INFORMATION
POUR LA PRISE EN COMPTE DES CHANGEMENTS CLIMATIQUES

Cette annexe vise à présenter les renseignements que le promoteur doit fournir pour le traitement de l'enjeu de la lutte contre les changements climatiques. Ces renseignements doivent être considérés pour adapter le projet aux effets des changements climatiques et présentés dans les sections de l'étude d'impact correspondantes.

Éléments à ajouter à la description du milieu récepteur

Cette étape a pour objectif de préciser les interactions actuelles et futures entre le projet, le climat et le milieu. À cette fin, les renseignements suivants doivent être présentés lorsqu'ils sont susceptibles d'avoir une interaction avec l'une des composantes du projet :

- les conditions climatiques et hydrologiques récentes, l'historique des évènements climatiques extrêmes et les projections climatiques et hydroclimatiques futures propres au milieu et au bassin versant où le projet sera réalisé sur une période équivalente à la durée de vie du projet;
- les éléments du milieu qui sont sensibles aux changements climatiques, tels que les zones de contraintes existantes comme les zones potentiellement exposées aux glissements de terrain, à risque d'érosion des berges, d'inondation ou de submersion ou de pergélisol;
- les aléas[1] découlant des conditions climatiques et hydrologiques (pluies abondantes, crues, étiages importants augmentation du niveau de la mer ou des températures ambiantes, inondations, feux de forêt, etc.) qui pourraient survenir pendant la durée de vie du projet et qui sont susceptibles d'y porter atteinte.

Éléments à ajouter à la description du projet

Pour chacune des phases du projet (construction, exploitation et fermeture), les composantes (routes, digues, bâtiments d'élevage, etc.) sensibles aux aléas identifiés, et les impacts potentiels du projet sur celles-ci, doivent être précisés.

Par la suite, l'étude doit indiquer de quelle façon les aléas climatiques anticipés sur le milieu récepteur et les impacts potentiels sur le projet ont été pris en compte dans la détermination et l'analyse des variantes. Par exemple, cette section de l'étude d'impact peut indiquer que l'emplacement d'une infrastructure prévue a été modifié pour éviter une zone inondable, réduisant ainsi le risque[2] associé à des inondations susceptibles de devenir plus fréquentes.

Éléments à ajouter à la description de la variante sélectionnée

L'étude d'impact doit expliquer comment les aléas identifiés sont pris en compte dans la localisation du projet, ainsi que dans les critères de conception des ouvrages et des infrastructures projetés. Par exemple, elle peut indiquer que la conception des ouvrages de retenue prévoit un

[1] Un aléa est un phénomène, une manifestation physique ou une activité humaine susceptible d'affecter négativement le fonctionnement d'un projet et d'amplifier ses impacts sur le milieu.

[2] Le risque exprime l'effet de l'incertitude sur l'atteinte des objectifs du projet, y compris ses objectifs environnementaux. Le niveau de risque dépend de la probabilité d'occurrence d'un aléa et des conséquences susceptibles d'en résulter sur les composantes vulnérables du projet et du milieu.

facteur de majoration qui tient compte de la probabilité d'augmentation des débits causée par une augmentation des événements de précipitations abondantes.

Éléments à ajouter à la description des impacts

Pour la ou les variantes sélectionnées, l'initiateur doit, en tenant compte des aléas identifiés et des composantes du projet susceptibles d'en subir les effets, décrire les impacts et évaluer les risques pour le projet et pour le milieu récepteur. La probabilité d'occurrence de l'aléa pendant la durée de vie de la composante considérée, ainsi que la gravité de ses conséquences sur le projet et son milieu, doivent être considérées dans l'évaluation de chacun des risques identifiés. L'initiateur doit aussi décrire les effets cumulés des changements climatiques et du projet lorsque les changements climatiques peuvent exacerber les impacts du projet sur le milieu ou encore lorsque le projet peut augmenter la vulnérabilité[3] du milieu aux changements climatiques.

Ensuite, en fonction de l'importance des impacts et des risques anticipés, l'étude d'impact doit présenter les mesures d'atténuation prévues pour adapter le projet aux conditions climatiques actuelles et futures pour une durée équivalente à celle du projet. Par exemple, l'initiateur peut prévoir d'augmenter la fréquence d'entretien des infrastructures dans les zones où certaines conditions météorologiques sont plus probables, de cesser les rejets dans un cours d'eau en période d'étiage, de mettre en place des bassins de rétention, ou tout autre aménagement permettant une meilleure gestion des eaux pluviales. Les mesures d'atténuation proposées doivent être modulées suivant l'évolution des conditions climatiques anticipées, et ce, pendant toute la durée de vie du projet.

Éléments à ajouter au programme de suivi environnemental

Dans le cas où il subsiste une incertitude quant aux impacts résiduels du projet cumulés aux effets des changements climatiques, l'initiateur doit présenter un programme préliminaire de suivi permettant de vérifier l'efficacité des mesures d'atténuation qui seront mises en œuvre. Le suivi peut également être utile pour identifier de nouveaux risques qui pourraient survenir pendant la durée de vie du projet, ou pour mettre à profit de nouvelles informations qui seraient disponibles sur les effets des changements climatiques. Dans le cas où l'initiateur juge que la mise en œuvre d'un tel programme n'est pas nécessaire, il doit le justifier.

Références utiles pour la préparation des renseignements en lien avec l'élaboration du volet « Adaptation aux changements climatiques » de l'étude d'impact :

- Le document Synthèse des connaissances sur les changements climatiques au Québec, publié par Ouranos en 2015, présente notamment un état des lieux sur les changements climatiques au Québec, leurs impacts dans différentes régions, les types de milieux, les secteurs d'activité ainsi que les stratégies d'adaptation possibles. Il peut être utile pour identifier les impacts éventuels des changements climatiques qui sont propres à la région où le projet sera réalisé (https://www.ouranos.ca/synthese-2015/);

- Les changements climatiques auront des impacts importants au Québec, lesquels ne seront pas uniformes sur l'ensemble du territoire. Le site Web de scénarios climatiques d'Ouranos offre une plateforme où les usagers peuvent visualiser une information climatique

[3] La vulnérabilité est une condition résultant de facteurs physiques, sociaux, économiques ou environnementaux qui prédispose les éléments exposés à la manifestation d'un aléa à subir des préjudices ou des dommages.

spatialisée, afin de mieux évaluer l'ampleur des changements attendus dans leur région d'intérêt (https://www.ouranos.ca/portraitsclimatiques/#/);

- Le document Guide sur les scénarios climatiques : utilisation de l'information climatique pour guider la recherche et la prise de décision en matière d'adaptation permet de se familiariser avec l'information climatique future. Dans le cas où l'information requise n'est pas disponible, il permet de préciser les besoins et de s'outiller pour interagir avec des fournisseurs d'information climatique (https://www.ouranos.ca/publication-scientifique/GuideScenarios2016_FR.pdf);

- Le rapport d'Ouranos publié en 2017 et intitulé « *État des connaissances relatives aux changements climatiques et à l'adaptation dans le territoire Eeyou Istchee Baie-James* ». Il a été produit pour le Comité consultatif pour l'environnement de la Baie James. (www.ouranos.ca/publication-scientifique/RapportEeyouIstchee_FR.pdf);

La documentation générale portant la gestion des eaux pluviales et la conception des ouvrages municipaux de gestion des eaux pluviales traite également de la question des changements climatiques et suggère une approche pour tenir compte des changements climatiques dans la conception des réseaux de drainage.

ANNEXE B : MÉTHODOLOGIE DE CALCUL DES ÉMISSIONS DE GES

La présente annexe vise à apporter des précisions supplémentaires au regard des émissions de gaz à effet de serre (GES) du projet, en considérant que le promoteur a déjà intégré les éléments inclus à l'Annexe A « *Complément d'information pour la prise en compte des changements climatiques* ». L'annexe comporte les deux sections suivantes : la méthodologie générale pour la quantification des émissions de GES (section A) et les formules de calcul des émissions de GES (section B).

A) Méthodologie générale pour la quantification des émissions de GES

A.1) Sources d'émission de GES à considérer (non limitatives)

À titre indicatif, des sources spécifiques d'émission de GES à considérer dans l'étude d'impact sont présentées ci-dessous. Il est à noter que cette liste est non exhaustive et qu'il est de la responsabilité de l'initiateur du projet d'établir la liste complète des sources potentielles d'émission de GES.

Phase de construction

- Systèmes de combustion fixes (tels que les génératrices);
- Systèmes de combustion mobiles (tels que la machinerie sur le chantier);
- Transport des matériaux de construction, des matériaux d'excavation et de remblais;
- Déboisement lors de la construction (si applicable).

Phase d'exploitation

- Systèmes de combustion fixes;
- Systèmes de combustion mobiles;
- Transport d'amendement et autres matériaux;
- Enfouissement des matières organiques.

A.2) Plan des mesures d'atténuation des émissions de GES

Le plan de réduction des émissions de GES présenté par le promoteur doit décrire comment les possibilités de réduction des émissions de GES sont incorporées dans la conception ou dans les opérations subséquentes du projet, et il peut inclure aussi des mesures applicables aux puits de carbone associés ou affectés par le projet. Ces réductions doivent être quantifiées pour toutes les phases du projet. La quantification du potentiel de réduction d'une mesure se calcule par la différence entre les émissions de GES du scénario de référence et les émissions de GES du projet avec la mesure. Le scénario de référence est défini comme le scénario le plus susceptible de se réaliser en l'absence de mesures de réduction. En règle générale, le scénario de référence représente ordinairement le cours normal des affaires.

A.3) Plan de surveillance des émissions de GES

Typiquement, un plan de surveillance permet de quantifier les émissions et les réductions d'émissions de GES engendrées par le projet et de suivre leur évolution à travers le temps. Il vise surtout à faciliter le travail d'un initiateur dans la mise en place de bonnes pratiques. Le plan de surveillance qui peut s'inspirer de la norme ISO 14 064 ou du Mitigation Goal Standard du GHG Protocol (World Ressources Institute, 2018) peut inclure le type de données à recueillir (ex. : la consommation de carburant d'un équipement), le processus et

les méthodes pour recueillir ces données, la fréquence, etc. Étant donné le grand nombre de cas de figure possibles, un exemple de plan de surveillance et de suivi des émissions de GES est présenté ci-après.

Exemple de plan de surveillance et de suivi des émissions de GES				
Catégorie	**Types de données**	**Unités**	**Source des données**	**Fréquence**
Équipements motorisés	Consommation de carburant de chacun des véhicules	Litres	Factures	Mensuelle/ annuelle
	Kilométrage de chacun des véhicules	km	Odomètres	Mensuelle/ annuelle
	Heures d'utilisation des véhicules hors route	h	Registre des opérations	Mensuelle/ annuelle
	Acquisition de nouveaux véhicules	Litres/100 km	Factures	Annuelle
Bâtiments et procédés	Consommation de gaz naturel	m3	Factures	Mensuelle
	Consommation d'électricité	kWh	Factures	Mensuelle
	Consommation de mazout	litres	Factures	Mensuelle

B) Formules de calcul des émissions de GES

B.1) Calcul des émissions des systèmes de combustion fixes

Les sources visées sont tous les équipements fixes sur le site du lieu d'enfouissement tels qu'une génératrice ou un convoyeur, lors de toutes les phases du projet.

Les émissions des activités de combustion fixes sont estimées à partir de l'équation suivante, pour chaque type de combustible (i) :

$$\text{Émissions de gaz à effet de serre} = \sum_{i=1}^{i=n} \text{Quantité de combustible i consommée} \times \text{Facteur d'émission}_i$$

Cette équation peut être employée pour tous les types de combustibles ainsi que pour estimer les émissions biogéniques de CO_2, lors de l'utilisation de combustibles tels que la biomasse résiduelle, le biogaz ou les granules de bois. Toutefois, les émissions biogéniques de CO_2 (carboneutres) doivent être présentées à part des émissions de CH_4 et de N_2O (non carboneutres) dans les tableaux de résultats.

Pour ce qui est des facteurs d'émission de GES des différents types de combustibles, se référer aux tableaux 1-1 à 1-8 de l'annexe A.2 du Règlement sur la déclaration obligatoire de certaines émissions de contaminants dans l'atmosphère.

B.2) Calcul des émissions des systèmes de combustion mobiles

Les sources visées sont tous les équipements mobiles sur le site du lieu d'enfouissement, lors de toutes les phases du projet.

Les émissions des activités de combustion mobiles sont estimées à partir de l'équation suivante, pour chaque type de combustible (i) :

$$Émissions\ de\ gaz\ à\ effet\ de\ serre = \sum_{i=1}^{i=n} Quantité\ de\ carburant\ i\ consommée \times Facteur\ d'émission_i$$

Pour ce qui est des facteurs d'émission de GES des carburants, veuillez vous référer aux tableaux ci-après.

Facteurs d'émission des carburants ou des combustibles, en équivalents CO_2					
Carburants et combustibles liquides	gCO_2/litre	gCH_4/litre	gN_2O/litre	gCO_2e/litre	Référence
Essence automobile	2 307	0,14	0,022	2 317	*
Carburants diesel	2 681	0,11	0,151	2 729	*
Propane	1 515	0,64	0,028	1 539	*
Véhicules hors route à essence	2 307	10,61	0,013	2 576	*
Véhicules hors route au diesel	2 681	0,073	0,022	2 689	*
Véhicules au gaz naturel	1,9	0,009	0,00006	2,143	*, ***
Essence d'aviation	2 365	2,2	0,23	2 489	*
Carburéacteur	2 560	0,029	0,071	2 582	*
Trains alimentés au diesel	2 681	0,15	1	2 983	*
Bateaux à essence	2 307	0,22	0,063	2 331	*
Navires à moteur diesel	2 681	0,25	0,072	2 709	*
Navires au mazout léger	2 753	0,26	0,073	2 781	*

Facteurs d'émission des carburants ou des combustibles, en équivalents CO_2					
Carburants et combustibles liquides	gCO_2/litre	gCH_4/litre	gN_2O/litre	gCO_2e/litre	Référence
Navires au mazout lourd	3 156	0,29	0,082	3 188	*

Facteurs d'émission des biocarburants, en équivalents CO_2				
Biocarburants liquides	Émissions biogéniques	Émissions non biogéniques		Référence
	Facteur d'émission (gCO_2/litre)	Facteur d'émission (gCH_4/litre)	Facteur d'émission (gN_2O/litre)	
Éthanol (100 %)	1 508	0,14	0,022	*
Biodiesel (100 %)	2 474	0,11	0,151	*
Biocarburants gazeux	Émissions biogéniques	Émissions non biogéniques		Référence
	Facteur d'émission (gCO_2/m^3)	Facteur d'émission (gCH_4/m^3)	Facteur d'émission (gN_2O/m^3)	
Biogaz	1 887	0,037	0,033	**

* *Rapport d'inventaire national* (RIN) 1990-2016. Partie II. Tableau A6-12 – *Emission Factors for Energy Mobile Combustion Sources*.
** RIN 1990-2016. Partie II. Tableaux A6-1 et A6-2.
*** Aux conditions standards de température et pression.

Pour ce qui est des émissions de GES attribuables à l'utilisation d'équipements mobiles hors route, l'initiateur a aussi la possibilité d'estimer la consommation de combustible à partir du facteur BSFC[1] qui représente la consommation du diesel des équipements par puissance (HP) et par heure d'utilisation. Ce facteur est exprimé en livres de diesel par HP et par heure, et peut être déterminé à partir des tableaux A4, C1 et C2 du document « Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling-Compression-Ignition in MOVES201X », publié par l'United States Environmental Protection Agency[2].

B.3) Calcul des émissions de GES attribuables au transport

Les émissions attribuables au transport des matériaux (de construction, d'excavation et de recouvrement), d'amendement ou des remblais doivent être calculées en utilisant la méthodologie présentée à la section sur les systèmes de combustion mobiles (B.2).

[1] Brake-Specific Fuel Consumption.

[2] *https://nepis.epa.gov/EPA/html/DLwait.htm?url=/Exe/ZyPDF.cgi/P10005BI.PDF?Dockey=P10005BI.PDF*

B.4) Calcul des émissions de GES attribuables aux activités de déboisement

Les activités de déboisement peuvent avoir des impacts importants sur les changements climatiques, lesquels sont documentés notamment par le Groupe d'experts intergouvernemental sur l'évolution du climat (GIEC), sous le vocable « changement d'affectation des terres ». Le secteur forestier a la capacité de séquestrer le carbone atmosphérique dans la biomasse et, par conséquent, de réduire sa concentration atmosphérique. Selon la documentation scientifique, les écosystèmes forestiers constituent des réservoirs de carbone et certains projets de grande envergure spatiale (ex. : construction de routes, exploitation d'une mine, construction d'un lieu d'enfouissement technique, exploitation des hydrocarbures, etc.) peuvent affecter ces réservoirs.

Si des activités de déboisement sont réalisées (surtout en phase de construction), un calcul des émissions de GES qui lui sont attribuables doit être effectué. Si des activités de déboisement sont anticipées, lors d'autres phases du projet, elles devront aussi être considérées.

Pour calculer les émissions de GES reliées au déboisement, le document du GIEC 2019 « Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 : Agriculture, Forestry and Other Land Use »[3] est recommandé. Ces émissions peuvent être calculées en réalisant un bilan de la quantité de carbone présente dans un réservoir de carbone avant et après le projet, à partir de l'équation plus bas[4].

Les émissions de CO_2 attribuables au déboisement peuvent être calculées à partir de l'équation :

$$Émissions\ de\ GES\ (tonnes_{CO2}) = N_H \times t_{MSh} \times (1 + T_x) \times CC \times \frac{44}{12}$$

Où :

NH = Nombre d'hectares déboisés;

tMSh = Tonnes de matières sèches par hectare;

Tx = Taux de biomasse souterraine par rapport à la biomasse aérienne;

CC = Contenu en carbone du bois, en tonnes de carbone par tonne de matières sèches;

44/12 = Ratio masse moléculaire de CO_2 par rapport à la masse moléculaire de C.

Étant donné les particularités propres à un projet et qu'il n'est pas possible de toutes les présenter dans ce guide, le tableau suivant présente les références suggérées pour déterminer les valeurs des variables de l'équation.

[3] https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html

[4] http://www.ipcc-nggip.iges.or.jp/public/2006gl/french/pdf/4_Volume4/V4_04_Ch4_Forest_Land.pdf.

Paramètres de l'équation pour déterminer les émissions de CO_2 reliées aux activités de déboisement	
Paramètre	Référence
t_{MSh}	Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 : Agriculture, Forestry and Other Land Use. Tableau 4.7
Tx	Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 : Agriculture, Forestry and Other Land Use. Tableau 4.4
CC	Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 : Agriculture, Forestry and Other Land Use. Valeur par défaut = 0,47.

Il importe de mentionner que l'initiateur de projet doit également quantifier les émissions de GES dues à la consommation de combustibles ou de carburants des équipements fixes ou mobiles utilisés lors des activités de déboisement, à l'aide des méthodologies présentées à la section sur les systèmes de combustion mobiles.

De plus, le cas échéant, le promoteur devra quantifier les émissions (ou réductions d'émissions) de GES dues à l'utilisation du bois coupé ou à la décomposition des résidus de coupe laissés sur place.

B.5) Calcul des émissions fugitives de CH_4 attribuables à l'enfouissement en tranchée des matières résiduelles

Pour les lieux d'enfouissement en tranchée, le Règlement sur l'enfouissement et l'incinération de matières résiduelles (chapitre Q-2, r. 19) précise les territoires où ce type de lieu d'enfouissement est permis (article 87) et y prescrit les normes d'aménagement et d'exploitation (articles 88 à 93). Il est à noter qu'il n'y a pas de mesure obligatoire concernant le captage des biogaz pour ces lieux d'enfouissement, compte tenu de la géographie et des limites où ce type de gestion est permis.

Les contextes géographique et réglementaire font en sorte que la quantification des émissions de GES et la détermination de mesures d'atténuation pour les lieux d'enfouissement en tranchée sont complètement différentes que pour les lieux d'enfouissement technique, dans la partie méridionale du Québec.

Nos recherches ne nous ont pas permis de trouver de méthodologie de calcul des émissions de méthane pour les dépôts en tranchée, tant du côté du GIEC que d'Environnement et Changement climatique Canada. Cependant, le fait que les déchets sont davantage exposés à l'air libre (aérobie) rend moins propice la génération de méthane, si on fait abstraction des autres enjeux environnementaux.

Compte tenu de ce contexte, la Direction de l'expertise climatique n'a pas d'exigences particulières à formuler quant à la quantification des émissions fugitives de méthane attribuables à l'enfouissement en tranchée des matières résiduelles.

B.6) Autres calculs potentiels

Si l'initiateur apporte des modifications à son projet, il est de sa responsabilité de mettre à jour et d'évaluer les émissions de GES qui pourraient en découler, le cas échéant. Le ministère est disponible pour toute question et pourra fournir les équations de calcul des émissions de GES, au besoin.

APPENDIX B SITE SELECTION STUDY

Site Selection and Baseline Study for a New Landfill Site in Nemaska

Final Report



Prepared for:
Cree Nation of Nemaska

Prepared by:
Stantec Consulting Ltd.

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Sign-off Sheet

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Table of Contents

1.0 INTRODUCTION 2.1
1.1 MANDATE AND OBJECTIVES 2.1
1.2 METHODOLOGY 2.1
1.3 CURRENT SITE 2.2

2.0 DETERMINATION OF THE NEEDS AND SELECTION CRITERIA 2.1
2.1 REGULATORY FRAMEWORK 2.1
2.1.1 General Land Management 2.1
2.1.2 Zoning By-law and Road Distance 2.1
2.1.3 Transport Canada – Federal Guidelines 2.1
2.1.4 Waste Management – Provincial Regulation 2.2
2.1.5 Summary of Applicable Regulations 2.4
2.2 POPULATION AND WASTE PROJECTION 2.4
2.2.1 Population Growth 2.4
2.2.2 Waste Generation Projection 2.5
2.3 LANDFILL TYPES 2.6
2.3.1 Annual Trenches 2.6
2.3.2 Continuous Trenches 2.7
2.4 SITE SELECTION REQUIREMENTS 2.7
2.4.1 Land Area 2.7
2.4.2 Environment and topography 2.7
2.4.3 Culture and Nature 2.9
2.4.4 Infrastructure and Development 2.10

3.0 IDENTIFICATION OF POTENTIAL SITES 3.1
3.1 PRESENTATION AND ANALYSIS OF POTENTIAL SITES 3.1
3.1.1 Selection Criteria 3.1
3.1.2 Site 1 ..... 3.1
3.1.3 Site 2 ..... 3.1
3.1.4 Site 3 ..... 3.2
3.1.5 Site 4 ..... 3.2
3.1.6 Site 5 ..... 3.2
3.1.7 Site 6 ..... 3.2
3.1.8 Site 7 ..... 3.2
3.1.9 Site 8 ..... 3.2
3.1.10 Site 9 ..... 3.2
3.2 SITES CHOSEN FOR FURTHER ANALYSIS 3.3
3.3 RESULTS OF THE SITE VISITS 3.3

4.0 GEOTECHNICAL AND GEOMORPHOLOGICAL FIELD WORK 4.1
4.1 FIELD WORK PLAN AND METHODOLOGY 4.1
4.2 RESULTS 4.1
4.3 STRATIGRAPHIC DESCRIPTION 4.3

4.3.1 Site 4 ..... 4.3
4.3.2 Site 7 ..... 4.3
4.3.3 Site 8 ..... 4.3
4.4 ANALYSIS AND SITE SELECTION 4.3

5.0 PRELIMINARY HYDROGEOLOGICAL STUDY 5.1
5.1 WORK PLAN AND METHODOLOGY 5.1
5.1.1 Field Program 5.1
5.1.2 Laboratory Program 5.1
5.1.3 Installation of Monitoring Wells. 5.1
5.2 NATURE AND PROPERTIES OF MATERIALS 5.2
5.2.1 Subsurface information 5.2
5.2.2 Topsoil 5.3
5.2.3 Till 5.3
5.2.4 Groundwater and Bedrock Depth 5.3
5.2.5 Poly-Géo Geotechnical and Geomorphological Fieldwork 5.4
5.3 EXCAVATION AND GROUNDWATER CONTROL 5.4
5.4 SITE LAY-OUT AND POTENTIAL LIFESPAN 5.4

6.0 COMPLETE DESCRIPTION OF THE RECOMMENDED SITE 6.1
6.1 LAND AREA 6.1
6.2 ENVIRONMENT AND TOPOGRAPHY 6.1
6.3 CULTURE AND NATURE 6.2
6.4 INFRASTRUCTURE AND DEVELOPMENT 6.2
6.5 CAPITAL COSTS 6.3

7.0 NEXT STEPS AND SCHEDULE 7.1

8.0 CONCLUSIONS AND RECOMMENDATIONS 8.1

LIST OF TABLES

Table 1 Requirements for Trench Landfills Contained in the RRLIRM 2.3
Table 2 Population Growth Rates 2.4
Table 3 Estimated volume of Wastes to be Buried in the New Nemaska Trench Landfill (Including 10% of Soil for Weekly Cover) 2.6
Table 4 Minimum Dimension of the Landfill Site as a Function of the Trench Depth 2.7
Table 5 Environmental and Topographical Factors to Consider during Site Selection 2.8
Table 6 Items to Consider for Culture and Nature 2.9
Table 7 Items to Consider for Infrastructure and Development 2.10
Table 8 Test Pit Program Results 4.2
Table 9 Comparative Analysis for Final Site Selection 4.5
Table 10 Summary of stratigraphy in the boreholes 5.2
Table 11 Sieve analysis 5.3
Table 12 Estimated Lifespan of Site 4 ..... 5.5
Table 13 Cost Estimates for the Implementation of the New Landfill 6.3
Table 14 Subsequent Project Steps and Associated Schedule 7.1

LIST OF FIGURES

Figure 1 Example of annual trench 2.6
Figure 2 Example of continuous trench 2.7
Figure 3 Continuous trench in excavation 5.5
Figure 4 Continuous trench in excavation with a surrounding berm 5.5
Figure 5 Extract from POLY-GEO final report: Site 4 ..... 6.1
Figure 6 Mean major wind directions 6.2

LIST OF APPENDICES

APPENDIX A MAP OF THE 9 POTENTIAL SITES A.1

APPENDIX B ANALYSIS MATRIX B.1

APPENDIX C PHOTO REPORT C.1

APPENDIX D POLY-GEO FIELDWORK FINAL REPORT D.1

APPENDIX E PLANS E.2

APPENDIX F LABORATORY TESTING RECORDS F.1

APPENDIX G BOREHOLE RECORDS G.1

APPENDIX H LANDFILL COST ESTIMATES H.1

Summary and Conclusion

In 2012, the Cree Nation of Nemaska (CNN) prepared a Waste Management Master Plan study in order to evaluate the possible options and the landfilling needs for the next 30 years. The existing landfill lifespan was estimated to be less than 2 or 3 years.

In 2014, Stantec prepared a Landfill Action Plan that detailed several options for the existing landfill to increase its lifespan. The short-term option chosen was to build a continuous trench landfill above the already filled areas. A Certificate of Authorization was issued in June 2017 by the Quebec Ministry of Sustainable Development, Environment and the Fight against Climate Change (MDDELCC) and the continuous trench was constructed in September 2017. The lifespan of the existing landfill was therefore extended 5 to 6 years.

The CNN must now prepare a mid-term option, which is to establish a new solid waste disposal site. The New Landfill Site Study was started in 2016 and included the following steps.

Step 1 - Determination of the needs and selection criteria

The CNN population 30-year growth forecast indicates that roughly 130,000 m^3 of residual materials (including 10% soil cover) will have to be disposed within the new landfill.

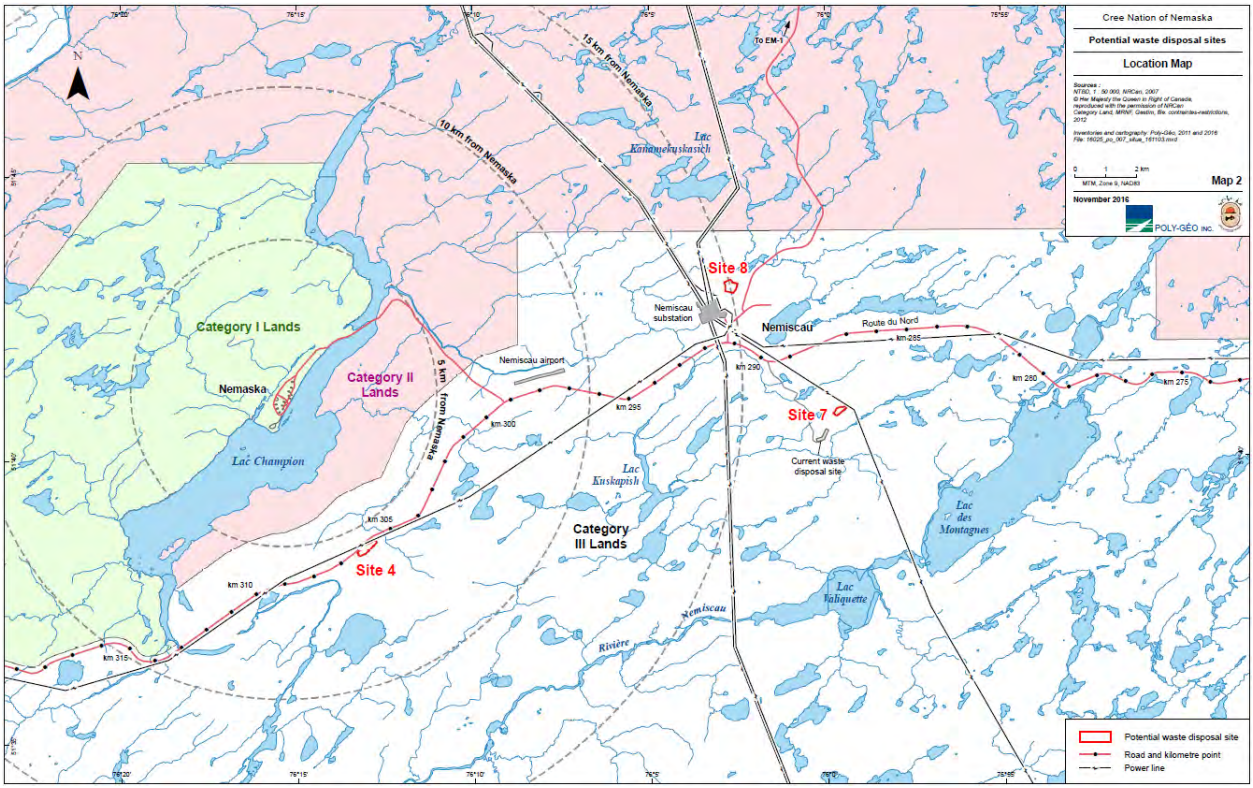
Selection criteria used for the identification of potential sites using air photo interpretation included the distance from the community, the distance from water courses and bodies, the depth of bedrock and groundwater, as well as the type of soil and local topography.

Step 2 - Identification of potential sites

Aerial photo interpretations identified nine potential sites meeting the landfill site selection requirements. The nine sites were assessed as per the agreed selection requirements. Sites 4, 7 and 8 (see the map below) were identified as being the best potential sites and were selected for further analysis.

Step 3 – Geotechnical and geomorphological field works.

Site visits were organized at each of the three sites and geotechnical and geomorphological field work was carried out.



Location of potential sites

In October 2016, the available information was used by Stantec and POLY-GEO to complete a selection matrix comparing the three sites. Site 8 had the best score (38), followed by Site 4 (34) and Site 7 (28). Site 7 has only 64,000 m^2 in available surface area. As a result, it does not meet the minimum requirement of 25-year capacity lifespan. Site 8 was recommended and approved by the Council in November 2016.

However, subsequently additional information was obtained, and further constraints were identified that made Site 8 unacceptable as a possible site for the development of the future landfill. These included the following:

- Hydro-Québec objected to the location of the proposed landfill, which was close to the flight path of landing airplanes and would cause major operational constraints
- The presence of a Hydro-Québec drinking water well at Poste Nemiscau near the proposed landfill
- The planned construction of a new powerline during the summer of 2017 would limit the amount of land available for development at Site 8
- Additional topographic information indicated that the eastern and southern sections of the proposed landfill site would be visible from the road, which is not acceptable
- Detailed topographical analysis of Site 8 as well as the stratigraphy of the soil present indicated that a potential risk for the contamination of the groundwater as well as the nearby river

- The Tallyman (Charles Cheezo) had concerns about the risk of contamination of the river located north of Site 8

After revising the rating based on the information obtained from the field investigations, Site 4 was rated the highest for the following reasons:

- The available land area (215,000 m^2) is sufficient, even when compared to the estimated land area required for a 4 m deep trench (89,000 m^2)
- Proximity of the access road
- Good drainage and adequate type of soil
- The depth of the groundwater is greater than 5.0 metres below the ground surface (mbgs) and the depth of the bedrock is greater than 4.4 mbgs
- No known archeological or cultural areas of interest
- Accepted by local authorities (main road, airport and zoning by-law)

In summary, Site 4 meets all the selection requirements including land area, environment and topography, culture and nature, infrastructure and development, regulatory requirements especially those of the *Regulation respecting the landfilling and incineration of residual materials* (RRLIRM) and the Zoning By-Law of the Eeyou Istchee James Bay Regional Government. The Zoning By-Law indicates there are no special requirements for the property. As a result, Site 4 was recommended and approved by the Band Council in November 2017.

The installation of groundwater wells at Site 4 was recommended in order to determine more precisely the bedrock and groundwater depth, and to confirm that it is suitable for the development of a new landfill.

Step 4 – Preliminary Hydrogeological Study

To evaluate the nature of the soil and the depth to groundwater within the project area, five (5) monitoring wells were installed in December 2017. The observed groundwater depth varied from between 5 and 10 m in the project area (consistent with the results of previous field investigations). As a result, it was concluded that the nature of the soil and depth of groundwater are suitable for the development of an in-trench landfill.

Step 5 – Report and Recommendations

Based on the results of the Hydrogeological Study, it was concluded that a continuous trench could be excavated to a depth between 4 and 9 m. A berm could also be constructed around the perimeter of the excavated trench to increase landfill capacity. The following table presents the estimated lifespan for the two trench depths based on an excavation slope of 3.0H:1.0V.

Trench Depth	4 m	6 m
Usable area (m2)	45,000 m2	45,000 m2
Capacity	160,000 m3	225,000 m3
Minimum lifespan	35 years	45 years

The estimated lifespan is more than 30 years and could be increased by 30% with a trench depth of 6 m. Therefore, Site 4 is suitable for the development of an in-trench landfill.

Next Steps

As indicated in the following table, the next steps include carrying out an Environmental and Social Impact Assessment Study, and preparing preliminary plans and specifications required to submit a comprehensive document to the COMEX. Funding for this work has already been approved.

Project Item	Schedule
Preliminary Information to the Environmental and Social Impact Review Committee (COMEX)	September 2018
Land Survey	September 2018
Environmental and Social Impact Assessment Study	Sept. 2018 – Dec. 2018
Preliminary Plans and Specifications	Sept. 2018 – Dec. 2018
Analysis by COMEX (Supplementary Studies, Questions, Discussions, Communications, etc.)	Jan. 2019 – Jan. 2020
Preparation of the Request for a Certificate of Authorization	Jan. 2020 – Feb. 2020
Final Plans and Specifications and Tender Documents	Jan. 2020 – March 2020
Call for Proposals	April 2020
Land Clearing Permit	July 2020
Construction (General and Trenches 1 and 2)	August – Oct. 2020
Beginning of the Operation and Training Sessions	2021 – 2022
Closure of the Existing Site	2022 – 2023

1.0 INTRODUCTION

1.1 MANDATE AND OBJECTIVES

The Cree Nation of Nemaska (CNN) currently operates a trench landfill that provides waste disposal services for its residents, institutions and businesses. In 2012, the CNN conducted a Waste Management Master Plan Study to evaluate potential options as well as the landfilling needs for the next 30 years. The study determined that the current landfill lifespan was only a few years with an end-of-life forecasted for 2017–2018 if there was no operation improvement.

In 2014, Stantec prepared a Landfill Action Plan that detailed short and long-term options. The long-term option was to build a new landfill. The opening of a new landfill will take several years. As a result, it was necessary to increase the lifespan of the existing landfill.

Stantec was therefore mandated in March 2016 by the CNN to undertake a study that would identify a location for a new waste disposal site for the community. POLY-GEO was involved as a subcontractor to facilitate the identification of potential sites and the selection process.

The main objective of this study was to identify a new waste disposal site that will meet the current and future needs of the population to be served while conforming to all applicable regulations and best practice guidelines and ensuring that no community land of importance is disturbed.

1.2 METHODOLOGY

To achieve its mandate, the following services were planned:

- Identification of the selection criteria: regulatory, technical, economical, cultural and environmental
- Review of available information: reports, maps, existing constraints, etc.
- Determination of the needs (population and waste generation projection)
- Identification of potential sites
- Data analysis and identification of most feasible sites
- Geotechnical and geomorphological field work
- Selection of the best site(s)
- Hydrogeological field work
- Production of conclusions and recommendations

1.3 CURRENT SITE

The current landfill site is located 22 km by road from Nemaska community, off the Route du Nord. This landfill has been in operation since 2000 and is located on Category III land. In 2010, a Certificate of Authorization was issued by the Ministry of Sustainable Development, Environment and the Fight against Climate Change (MDDELCC) for the conversion of the Nemaska trench landfill, which was constructed to meet the requirements of the now superseded *Regulation respecting solid waste*, into one that conforms to the *Regulation respecting the landfilling and incineration of residual materials* (RRLIRM).

As detailed in the 2014 Landfill Action Plan, there was a need to increase the lifespan of the current landfill. The solution identified was to develop a continuous trench above the already filled areas of the western section of the landfill, requiring excavation of soil and the construction of a berm. An application for a Certificate of Authorization was sent to the MDDELCC in May 2017 to modify the design of the existing landfill and thereby increase its lifespan by 6 to 7 years.

2.0 DETERMINATION OF THE NEEDS AND SELECTION CRITERIA

2.1 REGULATORY FRAMEWORK

As per Section 22.2.3 of the James Bay Northern Quebec Agreement (JBNQA), waste disposal sites are subject to all federal and provincial laws respecting environmental and social protection.

2.1.1 General Land Management

Three categories of lands are considered to be present within the James Bay Territory according to the JBNQA, categories I, II and III.

Category I (A and B) lands belong to the indigenous communities, including about 3 250 square miles allocated to the Cree communities. On these lands the administrative council of each community (band council) is responsible for implementing local laws and overseeing their application.

On categories II and III lands, provincial and federal laws are applicable. Within Category II lands, indigenous communities have exclusive hunting, fishing and trapping rights but they do not have any special right of occupancy.

Within Category III lands, which represent most of the territory, indigenous communities can pursue their hunting, fishing and trapping activities but they only have exclusive rights for some selected species.

The Community of Nemaska is entirely located on Category IA land.

2.1.2 Zoning By-law and Road Distance

The applicable zoning by-law (51-06-R) was also reviewed. No special requirements are contained in this by-law, which was developed by the Eeyou Istchee James Bay Regional Government (previously James Bay Municipality). The main access road belongs to Hydro-Quebec and is operated by the James Bay Development Society, who have not placed any constraints on its use.

2.1.3 Transport Canada – Federal Guidelines

Federal agencies and guidelines (e.g., Transport Canada, *Aviation Industry Guide to the Management of Wildlife Hazards* TP13549, March 2004) recommend that landfill sites should be more than 8 km from airports to limit the potential impact of the landfill on airport activities. Indeed, landfill sites usually attract a lot of birds that could interfere with plane trajectories.

2.1.4 Waste Management – Provincial Regulation

If the chosen site is located on categories II or III land, the new landfill will have to comply with applicable provincial regulations, including obtaining any permits that are required.

2.1.4.1 Regulation Respecting the Landfilling and Incineration of Residual Materials

The RRLIRM (Q-2, r.6.02) was introduced by the Government of Quebec on May 12, 2005 and came into effect on January 19, 2006. The RRLIRM applies to the establishment of all new solid waste disposal installations, as well as to the extension or enlargement of existing installations. There are several types of landfill sites:

- Engineered landfills
- Trench landfills
- Northern landfills
- Construction or demolition waste landfills
- Remote landfills

Regulatory requirements are lower for trench landfills than for engineered landfills, but only the following territories are allowed to have a trench landfill:

- Territories located north of the 55 parallel
- Municipalité de Côte-Nord-du-Golfe-du-Saint-Laurent, the municipalities of Blanc-Sablon, Bonne-Espérance, Gros-Mécatina and Saint-Augustin, Ville de Schefferville and the territory within a radius of 10 km from the limits of that town, the Naskapi Village of Kawawachikamach and any other municipality constituted under the Act respecting the municipal reorganization of the Territory of Municipalité de Côte-Nord-du-Golfe-du-Saint-Laurent (1988, chapter 55 ; 1996, chapter 2)
- Any part of territory that is not organized into a local municipality and that is situated more than 100 km by a road open year-round from an engineered landfill site that is not reserved exclusively for the use of an industrial, commercial or other establishment
- Territory of the James Bay region, as described in the schedule to the James Bay Region Development and Municipal Organization Act (chapter D-8.2), excluding the towns of Chibougamau and Chapais
- Any territory inaccessible by a road open year-round, including every island that is not connected to the mainland by a bridge or a boat service operational year-round
- Regional county municipalities of Minganie and Caniapiscau
- Part of the territory of Ville de La Tuque situated west of the 73rd meridian

Trench landfill requirements outlined in the RRLIRM are summarized in Table 1.

Table 1 Requirements for Trench Landfills Contained in the RRLIRM

Requirements	Trench landfills
Distance between trench area and water course or body of water	150 m
Distance between trench area and catch point of water for human consumption	500 m
Distance between bottom of trenches and groundwater level	1 m
Distance between bottom of trenches and bedrock	1 m
Buffer zone	50 m
Weekly cover	Yes, from May to October
Material containing asbestos, animal carcasses or animal parts must be covered as soon as they are deposited	Yes
Burning of combustible material once a week	No
Soil layer for closure	60 cm (including 15 cm suitable for vegetation)
Soil layer for closure must respect a slope of 2% or the natural slope	Yes
Surface water collection	Yes
Groundwater monitoring wells	Yes

2.1.4.2 Required Authorizations

A Certificate of Authorization needs to be obtained from the MDDELCC if the chosen site is subject to provincial regulations. An application for a Certificate of Authorization will need to include plans and specifications; the characteristics of the chosen site; the results of a social and environmental impact study; the planned capacity and lifespan of the landfill; results of water analysis; operating procedures; and other relevant information. This information will have to be sent to the MDDELCC at least 75 working days before the beginning of the construction work schedule.

In addition, if the selected site is on provincial land, the community will have to obtain a land lease from the Ministry of Energy and Natural Resources (MERN) to be able to build and operate a landfill on this land. A request will have to be sent to the MERN with all relevant information about the chosen site (maps, coordinates, land area needed, environmental studies, planned lifespan, etc.). If it is accepted, the MERN will prepare a lease offer. The renting rate is based on the surface area of the land required. The expected delay to obtain a lease offer is usually less than 30 work days if all the required relevant information is compliant.

2.1.5 Summary of Applicable Regulations

If the selected site is outside the reserve (outside Category I land) the following requirements will have to be met:

- The CNN will need to obtain an occupational lease from the MERN and/or transfer the land management from provincial to the federal jurisdiction
- The site will have to be located at a safe distance from the airport and validated with the Nemiscau airport security
- If the site is located on a family territory, an information letter will have to be sent to the family describing the community's intentions with the site
- An environmental and social impact study will have to be carried out
- The CNN will need to obtain a Certificate of Authorization from the MDDELCC
- The landfill site will have to comply with the RRLIRM

2.2 POPULATION AND WASTE PROJECTION

Population growth and waste generation were estimated in the Waste Management Plan in 2012. These projections were updated to consider new population data available for 2016.

2.2.1 Population Growth

The population of the Community of Nemaska was estimated to consist of 775 residents in 2016. The projected growth rates were calculated from the projections of Quebec Statistical Institute for Eeyou Istchee from 2016 to 2036 in proportion to the actual growth rate of Nemaska from 2011 to 2016, as presented in the Table 2. As there is no projection data available after 2036, the population increase is considered to be stable after 2036.

Table 2 Population Growth Rates

Period	Eeyou Istchee growth rate	Nemaska growth rate
2011 to 2016[1]	1.73% per year (real)	2.56% per year (real)
2016 to 2021	1.62% per year (projection)	2.40% per year (projection)
2021 to 2026	1.43% per year (projection)	2.11% per year (projection)
2026 to 2031	1.25% per year (projection)	1.85% per year (projection)
2031 to 2036	1.08% per year (projection)	1.61% per year (projection)
After 2036	1.08% per year (projection)	1.61% per year (projection)

[1]Population of 775 residents in 2016 is based on the information found at the following website: http://www.mamot.gouv.qc.ca/organisation-municipale/decret-de-population

2.2.2 Waste Generation Projection

Currently, all residual household waste, bulky waste and construction waste are buried at the trench landfill site. An ecocentre was built in the summer of 2017 that allowed waste diversion from the landfill. However, in order to be ready for the worst-case scenario (zero diversion), it was decided to consider that 100% of household waste and construction & demolition waste produced by the community will go to the landfill.

The buried volumes were calculated in 2013, 2014 and 2015 for the annual report. An average of these results divided by the number of residents was chosen as the generated waste volume for 2016. The following hypotheses of the Waste Management Master Plan prepared in 2012 were then incorporated:

- It assumed an increase of generated waste of 2% in 2013 and 1% in 2042 with a progressive decrease of 0.05% per year. For example, 1.8% of waste generation increase in 2017; and an increase of 0.5% from 2054 to 2069
- It assumed that the proportion of construction waste and bulky waste will be 38.9% (this was documented during the characterization study carried out in 2012)
- It was also considered that 10% of the waste buried will be soil utilized for daily cover

The current landfill site could accept waste for the next two to three years (first option, if the MDDELCC does not accept the project) or for the next six to seven years (second option, if the Certificate of Authorization for the new design is received). It was decided to take into account the second option (conservative scenario regarding the needs for the new landfill).

Table 3 summarizes the annual waste volume to be buried during the next 30 years following the closure of the current landfill, that is to say between 2025 and 2054, taking into account all the above data. Based on these estimates, a landfill site that can accept about 130 000 m^3 of waste is required.

Table 3 Estimated volume of Wastes to be Buried in the New Nemaska Trench Landfill (Including 10% of Soil for Weekly Cover)

Year	Annual volume (m3)	Cumulative volume (m3)
2025	3 313	3 313
2030	3 631	20 837
2035	3 936	39 910
2040	4 262	60 557
2045	4 616	82 917
2050	4 998	107 131
2055	5 386	133 327
2060	5 833	161 583
2065	6 316	192 182
2070	6 840	225 318

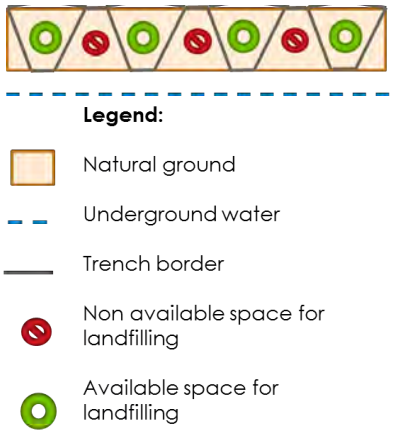
2.3 LANDFILL TYPES

Since the coming into effect of the RRLIRM in 2009, it has been permitted to design a landfill site using what are called “continuous trenches”. The following sections present the advantages of this operation mode compared to “annual trenches”. The biggest advantage of continuous trenches is the ability to increase the landfill lifespan by 30% for the same land area. For this reason, the “continuous trenches” operation mode was chosen for the new landfill site.

2.3.1 Annual Trenches

An annual trench involves excavating every year a trench that can accept the volume of waste produced in one year. The excavation materials (soil) are accumulated along the trench and are used for the weekly and final cover of the trench. Trenches should be as close as possible to each other to reduce the land surface used. However, a considerable volume is lost between each trench. Moreover, this operation mode limits the possible use of machines for compaction.

Figure 1 Example of annual trench



2.3.2 Continuous Trenches

In the case of a continuous trench, a volume of soil is excavated for all or a part of the site. The excavation is performed according to plans on which the slopes are designed to optimize the operation and the lifespan of the landfill. The excavated soil will be used for the weekly cover as well as the intermediate and final covers. There is more space for the machines to place and compact waste.

Figure 2 Example of continuous trench



2.4 SITE SELECTION REQUIREMENTS

2.4.1 Land Area

As described in Section 2.2.2, the volume of waste that will be buried between 2025 and 2055 (30 years) was estimated to be around 130 000 m^3.

Prior to searching for potential sites, it is important to define the required land surface to build the landfill, which should include a 50 m protective buffer zone. Table 4 presents the potential dimensions for the landfill site as a function of the various potential trench depths.

Table 4 Minimum Dimension of the Landfill Site as a Function of the Trench Depth

Trench depth	4 m	6 m	8 m	10 m
Length at soil level	305 m	219 m	179 m	155 m
Width at soil level	120 m	120 m	120 m	120 m
Length at bottom of excavation	285 m	189 m	139 m	105 m
Width at bottom of excavation	100 m	90 m	80 m	70 m
Buffer zone	50 m	50 m	50 m	50 m
Required area with buffer	89 000 m^2	70 225 m^2	61 270 m^2	56 158 m^2

2.4.2 Environment and topography

Concerning the natural characteristics and topography of the location where the landfill is to be built, several items must be considered in order to effectively minimize the environmental and social impacts of the landfill. Table 5 lists the environment and topography items to consider during site selection.

Table 5 Environmental and Topographical Factors to Consider during Site Selection

Category	Items of analysis
Topography	Relief
Drainage	Catchments
	Waterways
	Flood response
Climatology	Wind patterns
	Precipitation
	Fire
Geology	Lithology
	Geomorphology
	Tectonics
	Sedimentology
Hydrogeology	Aquifers and wells
	Groundwater level
	Catchments
	Protection areas
Physical Constraints	Slopes and erosion areas
	Landslides
Environment	Groundwater contamination
	Soil contamination

Topography and Drainage

Site relief is analyzed based on height above sea level, uniformity and the presence of natural depressions. For the protection of water resources, it is important to locate any water catchments and catchment boundaries present at or near the potential site. It is also necessary to identify waterways, determine their size and form, and determine if there is potential for the path of the waterway to change over time. Potential sites also need to be assessed to determine flood risks in response to excessive rainfall or snowmelt.

Climatology

Climatological criteria taken into consideration as part of the analysis include the dominant wind directions, precipitation patterns, areas of high snow accumulation, and risk of forest fires. In terms of wind direction, the selected site should be located downwind of the community (meaning that wind from the community would blow towards the selected site). If the landfill site is located upwind of the community, odour issues may be expected.

Geology

In order to verify if the geology is suitable for the establishment of a landfill, the bedrock lithology, source, spacial distribution and condition must be documented and analyzed. The site geomorphology regarding the type and form of surficial deposits of

unconsolidated materials and topographic considerations also need to be studied. It is also necessary to verify that the territory is not situated within an area of high tectonic activity, extensive fracturing, faults or fault zones. Finally, information regarding soil types, source distribution and stratigraphy must be considered.

Hydrogeology

The RRLIRM specifies that the minimum distance between a landfill (either trench or northern) and any catchment installation for surface or groundwater intended for human consumption must be at least 500 m. However, RRLIRM goes on to state that this requirement may not apply if the presence of the landfill is unlikely to alter the quality of the water (if confirmed by a hydrogeological study). It is important to understand the depth of the water table (and its variation during freezing conditions), in order to confirm that the depth of the trenches is not deeper than the groundwater level at anytime. Also, catchment boundaries and characteristics, around the studied area, must be evaluated. Finally, it must be verified that the studied area is not located within a protected area, specifically: zones with high potential aquifers, future clean sources, conservation or any protection areas.

Physical Constraints

It is important to measure the slope and to identify areas of erosion in order to determine if an area is suitable for a landfill. This will include determining the degree and the direction of the slope, the type of surface materials, type of vegetation and the recurrence of erosion.

Environment

In order to assess environmental constraints, existing issues and sensitivities regarding groundwater and soil contamination need to be considered.

2.4.3 Culture and Nature

Table 6 lists the items to be analyzed regarding culture and natural elements.

Table 6 Items to Consider for Culture and Nature

Category	Items of analysis
Flora	Location of sensitive species
	Forests
Fauna	Location of sensitive species
	Hunting and Fishing
	Pests
Geography	Administrative boundary
	Exceptional natural sites
Heritage	Areas of cultural significance
	Areas of archaeological significance
Community	Site preferences

Flora and Fauna

In order to prevent the destruction of flora and fauna, it is necessary to locate all sensitive, threatened and/or species of cultural significance. It is also important to review and integrate all aspects that are important to the local habitat and to locate any traditional hunting and fishing grounds. Finally, the presence of wild animals on the territory should be considered, such as the activity of bears, vermin and birds.

Geography

It is important to locate the administrative boundaries of the territory analyzed in order to understand the applicable regulations as well as population concerns and characteristics. Cree land boundaries, boundaries of category I, II and III lands and the presence of exceptional natural sites such as lookouts and pristine environments need to be identified and assessed.

Heritage

The territory must be analyzed in order to identify any areas of cultural or archaeological significance such as cultural and ceremonial grounds, ancient cultural or ceremonial grounds and burial sites.

Community

The site preferences of the community representatives must be known and considered in order to represent the interests of the community.

2.4.4 Infrastructure and Development

Table 7 lists the items to analyze regarding infrastructure and development elements.

Table 7 Items to Consider for Infrastructure and Development

Category	Items of analysis
Land use	Current land use
	Future land use
Infrastructures	Water distribution
	Road network
Geotechnical	Soil characteristics
Capacity	Site capacity restrictions
Regulations	Federal and Provincial requirements

Land use and Infrastructure

It is important to consider the current as well as potential future land uses by local communities. This includes evaluating the proximity of the proposed site to existing communities, infrastructure and hunting camps that are within the subject territory. Concerning the existing infrastructure, it is necessary to consider the location of potable water supply wells, road networks and to consider site accessibility during the winter. Finally, the study of the site must take into account the future residential and infrastructure planning of the community.

Geotechnical Tests

To verify that the design of the landfill and other connected infrastructure is appropriate, soil characteristics must be assessed, including soil type, slope-bearing capacity and any structural restrictions for buildings.

Capacity and Regulations

The site capacity limit must meet the community's waste management needs for the next 30 years. As a result, a calculation of the required surface area for the landfill must be performed. Also, the possibility for effective mitigation of the site must be analyzed. Finally, the site must satisfy federal and provincial standards and guidelines for the landfill development, especially the *RRLIRM*.

3.0 IDENTIFICATION OF POTENTIAL SITES

3.1 PRESENTATION AND ANALYSIS OF POTENTIAL SITES

3.1.1 Selection Criteria

The site selection process involved two steps:

- The first step was based on an air photo interpretation with the following selection criteria being used:
  - Site area
  - Distance from the community (maximum 30 km)
  - Minimum distance from water courses and bodies (150 m)
  - Estimated depth of rock and groundwater
  - Minimum distance from drinking water wells (1 km)
  - Buffer zone without any activities and roads (50 m)
  - Type of soil
  - Slope
  - Length of the access road to build (high capital costs and maintenance costs in winter to remove the snow)

As a result of this analysis, nine potential landfill sites were identified (see map in Appendix A) for further assessment (see matrix in Appendix B).

- The second step consisted of a review of the selected sites with CNN representatives in order to select some sites for further investigation

Sites visits were organized at this time to aid in the selection of three preferred sites for detailed field work.

3.1.2 Site 1

Site 1 is located near the community, on Category I land. A long access road (2.1 km) would need to be built that would cross some soft and wet terrain. This site is very close to the community and as a result could create odour problems for the community.

3.1.3 Site 2

Site 2 is located near km 310 of the Route du Nord, on the southern side of the community on the opposite side of Lake Champion, within Category III land. An access road (0.9 km) would need to be built. There is a significant decrease in elevation, of between 10 and 15 m, between the top of the site and its southern/northern sides.

3.1.4 Site 3

Site 3 is located near km 306 of the Route du Nord, on the southern side of the community on the opposite side of lake Champion, on category II land. A long access road (1.8km) would need to be constructed.

3.1.5 Site 4

Site 4 is located near km 306 of the Route du Nord, on the southern side of the community on the opposite side of Lake Champion, within Category III land. Well drained, it is also close to the road so only a short access road (100 m) would need to be constructed. It is situated near a powerline.

3.1.6 Site 5

Site 5 is located between km 306 and km 303 of the Route du Nord, on the southern side of the community on the opposite side of Lake Champion, within Category III land. A long access road (between 1.9 km and 2.0 km depending on the direction) would need to be constructed. This site is narrow, which could create difficulties for site preparation and operation.

3.1.7 Site 6

Site 6 is located near km 292 of the Route du Nord, on the eastern side of the community, within Category III land. A long access road (1.5 km) that would cross some steep slopes and two small brooks would need to be constructed.

3.1.8 Site 7

Site 7 is located near a road with access to the Route du Nord, on the eastern side of the community, within Category III land. An access road (800 m) would need to be constructed. A powerline is located along the eastern boundary of the Site. The potential for extension of the landfill is limited.

3.1.9 Site 8

Site 8 is located near a road with access to the Route du Nord, on the eastern side of the community, within Category III land. An access road (400 m) would need to be constructed. It is located only 1.2 km from Hydro-Quebec residences and less than 500 m from the Nemiscau substation. The high permeability of the sand present could result in drainage and groundwater contamination problems.

3.1.10 Site 9

Site 9 is located near a road with access to the Route du Nord, on the eastern side of the community, within Category III land. A short access road (200 m) would need to be constructed. It is very far from the community. The water table could be close to the surface.

3.2 SITES CHOSEN FOR FURTHER ANALYSIS

The nine sites were assessed and discussed with CNN representatives. The CNN decided to rule out Site 1 as it is too close to the community and this land could be used in the future for community expansion.

As the community must collect the waste generated at the Nemiscau camp seven days a week and in the future, the Nemaska Lithium Mine (at km 275), the western sites are preferred (Sites 6, 7, 8 and 9). Site 6 was eliminated as the access road would have to cross steep slopes as well as two small brooks. As a result, it would be difficult to build and to maintain the access road.

The sites in the east are also promising. However, some need a long access road (Sites 3, 5) and the elders mentioned that bear dens are present in the vicinity of Site 2.
Site 7 was (at this time) considered one of the best options as it is in an already disturbed area, and close to the existing and Hydro-Quebec landfills.

Sites 4, 7, 8 and 9 were therefore chosen for further investigation. Site visits were organized in July 2016 with the help of the Tallyman (Charles Cheezo).

3.3 RESULTS OF THE SITE VISITS

As a result of the site visits, it was possible to gather more visual information concerning the lands under consideration (see photograph report in Appendix C). The Tallyman considered that all sites were acceptable but that a preference should be given to already disturbed sites (7 and 8). POLY-GEO also gathered information regarding land topography (that is also described in this section).

Site 4: The surface topography is very flat and drainage is excellent. The Jack Pines are mature and have a thick diameter. Some boulders were observed; however, their presence should not impact the project.

Site 7: Although the underlying unconsolidated material is till, very few boulders were observed at the surface of the site; however, a potential outcrop (bedrock) was observed on the southern part of the northwestern slope. A subsequent aerial photo review indicated that it is unlikely that this would affect the potential depth of this site and limit the excavation of trenches. The surface topography is relatively flat and there is a general downward slope towards the south-west. The terrain is very well drained, and no puddles or wet areas were observed on the site. The vegetation is essentially young Jack Pines that range from being 12 to 15 feet high. There were many bear trails observed within this site. At the foot of the southeastern slope the terrain is flat, and the drainage is poor. Some remaining puddles of rain were observed in lower terrain, but they did not appear to drain to any creek or river.

Site 8: This site includes part of an old sand quarry that was used to build the road that leads to the EM-1 road. Alder and Jack Pine were planted within the quarry following the exploitation period (2006 -2007) in order to prevent erosion. The unconsolidated deposits observed at the surface consisted mostly of sand with some gravel; however, till was also observed at the surface (60 m north of the site), mixed in with some sand and gravel. This may indicate the presence of till under the gravel in this area. A previous study (POLY-GEO, 2011) that included the excavation of test pits to a depth of between 4.0 to 4.5 m indicates that the unconsolidated deposits present mostly consist of sand with variable proportions of gravel, ranging from 5% to> 20%. A few small boulders (300 to 400 mm) were also observed at the site. Surface topography is relatively flat considering that the site was used as an active quarry for a while; however, some levelling would be required. The drainage is excellent, and the terrain seems to have a downward slope towards the north-northeast. There may be a visibility issue since the site would be clearly visible from several Hydro-Quebec residences. The site is about 350 m from the road. There is what seems to be a forested peatland, which is located about 75 m south-south-west of the site.

Site 9: The site is located at a lower elevation than the other potential sites. The boulder density on the slopes suggests that it is a partially outwashed drumlin. The slopes are gentle compared to the other sites. Although the surface drainage seems good, the surrounding topography is flat and flowing water has been seen under the moss less than 60 meters north of the southwestern extremity of the site. This site is also the furthest from Nemaska (> 25 km) and it is just 165 m from the EM-1 road, which may be dangerous as a lot of animals will likely be attracted by the presence of a landfill.

Following these visits, **Sites 4, 7 and 8** were chosen for detailed characterization work.

4.0 GEOTECHNICAL AND GEOMORPHOLOGICAL FIELD WORK

4.1 FIELD WORK PLAN AND METHODOLOGY

To evaluate the nature of the soil in the project area, an assessment strategy employing test pits was implemented. Soil samples were collected and submitted for testing at a geotechnical laboratory.

A total of thirty (30) test pits (PU) were excavated using a mechanical shovel (Volvo EC250E) in September 2016 at sites 4, 7 and 8, and in March 2017 at Site 4 (for additional information). To obtain a more accurate measurement of the depth of the water table, the test pits were left open at least 24 hours to allow the water level to equilibrate (Sites 4 and 7 only). Only one sample was collected from Site 8, because geotechnical tests had already been carried out during five previous granulometric studies.

The test pits were dug to a depth of 5 m unless rocky outcrops or significant amounts of groundwater were encountered. Each test pit was described in detail (type of material, visual evaluation of the percentage of boulders, cobbles or gravel, depth of the groundwater, photos were taken, GPS coordinates determined, soil samples were submitted for granulometric analysis and their water content).

The samples collected were sent to the Qualitas Laboratory in Val-d'Or for testing (granulometric analysis and water content).

The weather was cloudy and fairly rainy before and during the September surveys, which may have slightly influenced the measured water table depth.

The field work performed is described in detail in the POLY-GEO report (see Appendix D).

4.2 RESULTS

The results of the test pit program are summarized in Table 8, which also presents the geomorphological and topographical context for each site.

Table 8 Test Pit Program Results

Site	Centre Coordinates	Geomorphological and Topographical Context	Test Pits Identification	Measured Depth of Water Table
Site 4 (23 test pits)	415 745 m 5 712 796 m	Located on a drumlin forming a broad ridge that rises some 20 m above the surrounding land, this site is about 850 m long and some 240 m wide. Ground surface is mostly flat, with some sparse boulders. From the centre of the site, the terrain slopes gently towards the NE and the SW, resulting in a 4–5 m difference in elevation. The surface is very well drained, and vegetation is sparse.	PU-04-01	4.5 m
			PU-04-02 to PU-04-11	Not reached
			PU-04-12	2.3 m
			PU-04-13 to PU-04-15	Not reached
			PU-04-16	1.6 m
			PU-04-17 to PU-04-23	Not reached
Site 7 (6 test pits)	431 238 m 5 725 969 m	Located less than 300 m NE of the Hydro-Quebec waste disposal site and is located on the northeastern portion of a drumlin. The broad ridge rises 25 to 30 m above the surrounding land. This site is about 430 m long and 80 to 180 m wide. The northwestern edge of the site is delimited by a stream located at the base of the ridge. Bedrock is close to the surface in the southwestern portion of Site 7.	PU-01-7	2.6 m
			PU-02-7 to PU-05-7	Not reached
			PU-06-7	3.2 m
Site 8 (1 test pit in 2016 + 10 test pits in 2011)	427 928 m 5 730 063 m	Located about 500 m NE of the Nemiscau substation and less than 400 m NW of the EM-1 road, this site measures about 280 m x 300 m. It forms part of a big, sandy deposit associated with the Sakami Moraine. It is about 10 metres higher than the surrounding land. The surface is slightly corrugated but there are no major variations in elevation. Materials are mostly sand and gravelly sand. The underlaying till was not reached.	PU-01-8	Not reached
			PG-20-06 PG-20-08 to PG-20-11 PG-21-01 to PG-21-02 PG-21-06 to PG-21-08	Not reached

4.3 STRATIGRAPHIC DESCRIPTION

4.3.1 Site 4

The twenty-three (23) test pits excavated at Site 4 indicate that the till matrix at this site is generally sandy, containing 32% to 34% silt and clay, <10% gravel, <10% cobbles and <10% boulders (see Technical description of Test Pits and Grain Size Analysis; Appendix 3 of the POLY-GEO final report). Within the till, boulders range up to 1,500 mm in diameter (see Technical description of test pits and Grain size analysis; Appendix 4 of the POLY-GEO final report). Some sparse boulders were observed on the surface, but their presence is unlikely to cause complications should the site be developed as a waste disposal area.

4.3.2 Site 7

The six (6) test pits excavated at Site 7 indicate that the till matrix at this site is generally composed of silty sand (24% to 28% silt and clay, <10% gravel, <10% cobbles and <10% boulders). Within the till, boulders range up to 2,000 mm in diameter (see Technical description of test pits and Grain size analysis; Appendix 4 of the POLY-GEO final report).

4.3.3 Site 8

Only one test pit was excavated at Site 8 in September 2016. Results from a previous POLY-GEO study carried out in 2011 were also evaluated (10 test pits). The observed thickness of the unconsolidated deposits reached 6.5 m (PU-01-8). They mainly consist of sand with varying proportions of gravel, sand and gravel, and some layers of silty sand. These soil types are generally characterized by a high hydraulic conductivity. As a result, the water level reaches equilibrium quickly, and it is usually not necessary to leave the test pit open for more than a few hours to obtain a representative water table depth.

4.4 ANALYSIS AND SITE SELECTION

Since all three sites are close to power lines, additional contacts were made with Hydro-Quebec representatives in order to identify any potential constraints and distance limits that would place limitations on the design of the new landfill.

In October 2016, using the data collected and other available information, Stantec and POLY-GEO filled out a selection matrix in order to compare the three sites. Site 8 had the highest score (38), followed by Site 4 (34) and Site 7, which had the lowest score (28). As Site 7 has only 64,000 m^2 in available surface area, it does not meet the minimum requirement for a 25-year capacity. As a result, Site 8 was recommended and accepted by the Band Council in November 2016.

However, some important additional information was not available at that time and additional constraints have also been identified since then that made Site 8 no longer recommended for the development of the future landfill. These are summarized below:

- **Operations at the airport:** Although the future landfill will be small and located more than 6 km from the airport, the person in charge of operations at the airport had significant concerns because of the possible presence of birds attracted by the landfill along the aircraft's trajectory. Major operational constraints would probably result.
- **Hydro-Quebec's drinking water well at Poste Nemiscau:** This water supply well was not previously identified. Although the minimal distance required by RRLIRM is respected, the presence of this well can be considered as a potential additional risk for the operation.
- **Hydro-Quebec's future powerline location**: Hydro-Quebec sent the exact location of a new powerline. Site 8 would only be located 300 m from the future 69 kV powerline to be constructed in 2017, which could limit the development of the site.
- **Visibility of the site from the road:** Based on additional topographic information received, it appears that the eastern and southern sections of the landfill would be visible from the road, which is not acceptable according to the RRLIRM. This constraint limits the development of the site to its western section.
- **Potential risk of river contamination**: The Tallyman expressed concerns about the nearby river, as he sets traps for beavers in this watercourse and was concerned regarding risk for the potential seepage of contamination into the river, which will impact its water quality. A more detailed analysis of the topography of the site as well as the stratigraphy of the soil indicated that there is a potential risk of contamination of groundwater and the river.

As a result, a new comparative analysis was performed for the three sites, which considered the results of the field work and the other available information. The results of this analysis are summarized below in Table 9. Each criterion was rated from 1 (worst rating) to 5 (highest rating).

Table 9 Comparative Analysis for Final Site Selection

Criteria	Site 4		Site 7		Site 8	
Distance from the Community	17 km	4	23 km	3	20 km	3
Distance from HQ Camp	15 km	3	5 km	4	1 km	5
Available Area	215,000 m^2	5	64,000 m^2	1	120,000 m^2 but partially visible from the road so reduced to 80,000 m^2	3
Distance to Access Road	100 m	5	830 m	1	370 – 730 m	3
Depth of Bedrock or Groundwater	> 5.0 m Presence of bedrock 4.4m northeast of the site	4	1.5 to> 5.0 m Presence of bedrock and groundwater north and southwest of the site	2	> 5 m	5
Type of Soil and Drainage	Till	4	Till	4	Mainly medium to fine sand, silty sand and gravelly sand Potential contamination risk for river	2
Slope	Broad ridge rises 20 m above the surrounding land	4	Broad ridge rises 25–30 m above the surrounding land	4	It lies about 10 m higher than the surrounding land	4
Already Disturbed Area	No	1	Yes, proximity to 2 existing waste disposal sites	4	Yes, former sand pit	5
Distance from the Airport	6.8 km. Accepted by the airport	4	8.7 km	5	5.8 km. Operation of a landfill at this site could disturb the airport operations.	1
Other Considerations	Proximity of the road Electric line (>50m)	4	Electric line (>130m)	4	Proximity of HQ camp & water well Future electric line	2
Total score		38		32		33

The results of this analysis indicate that **Site 4** should be subject to further investigation including hydrogeological field work to determine more precisely the depth of the bedrock and the water table.

5.0 PRELIMINARY HYDROGEOLOGICAL STUDY

5.1 WORK PLAN AND METHODOLOGY

In order to evaluate the nature of the soil and the groundwater at Site 4, an exploratory borehole drilling program was performed, which included the collection of soil samples for geotechnical tests. The boreholes were then converted into monitoring wells.

5.1.1 Field Program

The field work was carried out between November 22 and December 7, 2017 by Stantec personnel. A total of six (6) exploratory boreholes were drilled using a Geoprobe 7822 DT drill rig. The soil samples were collected using a 1.22m long plastic tube inserted in a 100-millimetre diameter metal protector tube. Soil samples were collected for testing from each stratigraphic horizon. The goal of these boreholes was to locate the water table and to install groundwater monitoring wells that will eventually be used to monitor groundwater conditions at the site during landfill operation. All the field work was carried out under the full-time supervision of an experienced Stantec technician.

The locations of the six (6) boreholes and monitoring wells as well as their GPS coordinates are presented in Table 10 and illustrated in the plans presented in Appendix E.

5.1.2 Laboratory Program

All the recovered soil samples from the exploratory boreholes were sent to a geotechnical laboratory (Stantec) for identification and classification purposes. An attentive visual examination by a geotechnical technician was performed, and twelve (12) soil samples were characterized via sieve analyses. The results of these analyses are presented in Appendix F.

5.1.3 Installation of Monitoring Wells.

Well construction details for the five (5) monitoring wells are presented in the exploratory borehole records included in Appendix G. No monitoring well was installed in borehole PZ-04 as the water table was not reached.

The monitoring wells were constructed according to the following specifications:

- 51 mm internal diameter (ID) 10-slot PVC screen
- Threaded or slip-on bottom cap
- 51 mm ID # 10 PVC casing
- #1 silica sand (filter pack) from approximately 0.3 metres above the screen down to the bottom of the well
- 9.5 mm (3/8-inch) bentonite pellets above the filter pack
- Lockable cap

5.2 NATURE AND PROPERTIES OF MATERIALS

5.2.1 Subsurface information

The soil classification method utilized was based on the procedures described in ASTM D2487 (Standard Practice for Classification of Soils for Engineering purposes (Unified Soil Classification System)) and ASTM D2488 (Standard Practice for Description and Identification of Soils, Visual-Manual Procedure).

The subsurface conditions and results of laboratory tests performed on the soil samples are presented in detail in the exploratory borehole records provided in Appendix G.

In a general manner, the subsurface profile at Site 4 consisted of a thin layer of topsoil over a silty sand or sand and silt layer with traces or some gravel. Cobbles and boulders were also encountered at various depths in the boreholes within the sand layers. Refusal on bedrock was not encountered during the on-site borehole campaign. A summary of the observed stratigraphy is presented in Table 10 below.

Table 10 Summary of stratigraphy in the boreholes

DESCRIPTION		PZ-01	PZ-02	PZ-03	PZ-04	PZ-05	PZ-06
GPS locations (Nad 83 UTM 18)	X	415 616	415 763	415 630	415 832	415 949	415 935
	Y	5 721 599	5 721 671	5 721 769	5 721 813	5 721 955	5 821 676
Depth in metres							
Topsoil		0.08	0.18	0.10	0.13	0.06	0.18
Silty sand/Sand and Silt, presence of gravel, cobbles		0.08 – 9.14	0.18 – 2.40	0.10 – 12.37	0.13 -7.60	0.06 – 16.87	0.18 – 11.23
Alternating layers of boulders/cobbles and grey sand with traces of silt and gravel		9.14-17.68	2.40-20.04	-		4.42-16.87	-
End of drilling		17.68	20.04	12.37	7.60	16.87	11.23
Refusal		No	No	No	No	No	No
Groundwater		5.5	7.7	7.7	Not reached	7.9	0.2

5.2.2 Topsoil

A thin layer of topsoil was encountered in all boreholes, which ranged in thickness from 60 to 180 mm.

5.2.3 Till

Underlying the topsoil, a layer of till was encountered at all the exploratory boreholes. The thickness of this layer is at least 20.0 m. Based on the results of the sieve analyses shown in Table 11, this layer varied from a brown poorly graded sand to sand with gravel (SP). Cobbles and boulders were also noted to be present within this layer. All the samples contained a significant proportion of fine particles, which varied from between 19.2 to 48.0%

Table 11 Sieve analysis

Sample N°	Average Depth (m)	Fine - Silt and clay (%)	Sand (%)	Gravel (%)
PZ-01 CC -02	2.5	31.6	56.9	11.5
PZ-01 SS-05	7.6	38.5	56.8	4.7
PZ-01 SS-08	14.0	46.5	46.7	6.8
PZ-02 SS-03	2.7	29.3	52.2	18.5
PZ-02 SS-08	11.0	28.1	62.8	9.1
PZ-03 CC -02	1.8	19.2	63.7	17.1
PZ-03 SS-06	9.6	27.1	62.3	10.6
PZ-04 SS-03	2.0	30.9	61.6	7.5
PZ-04 SS-05	3.3	31.6	54.3	14.1
PZ-05 SS-03	3.3	48.0	43.7	8.3
PZ-06 CC -04	4.6	30.8	51.7	17.5
PZ-06 CC -07	10.4	25	61.1	13.9

5.2.4 Groundwater and Bedrock Depth

The groundwater level in the boreholes was encountered at depths varying between approximately 5.5 and 7.9 m in the central and western sections of Site 4 (monitoring wells PZ-01, PZ-02, PZ-03 and PZ-05). In the eastern section, which is located below the ridge, the water table was encountered at a depth of 0.2 m in monitoring well PZ-06. Groundwater was not encountered in borehole PZ-04, which was 7.6 m deep.

The above results must be interpreted with caution due to the short period between the drilling of the exploratory boreholes and the water level measurements. It is also important

to mention that several factors can influence the level of groundwater, including precipitation, snowmelt and modifications made to the physical environment and thus, it can vary with the seasons and over the years.

Although many boulders were encountered, the depth of the bedrock could not be confirmed in the six (6) exploratory boreholes.

5.2.5 Poly-Géo Geotechnical and Geomorphological Fieldwork

The fieldwork performed by Poly-Géo within Site 4 indicates that the till at the Site is made-up of 32 to 34% silt and clay, less than 10% gravel, less than 10% cobbles and less than 10% boulders. It was mentioned that the boulders ranged up to 1.5 metres in diameter. While groundwater and bedrock were reached during the geotechnical and geomorphological fieldwork, this only happened at test pits that were located outside of the proposed landfill area. Groundwater was encountered at three (3) test pits: PU-04-01 (4.5m), PU-04-12 (2.3m) and PU-04-16 (1,6m). Bedrock was encountered at four (4) test pits though three were located outside the limits of Site 4: PU-04-05 (4.4m), PU-04-08, PU-04-09 and PU-04-11.

5.3 EXCAVATION AND GROUNDWATER CONTROL

Groundwater is not anticipated to be encountered during any excavation work associated with the construction of the landfill at Site 4, but if so, the excavation work must be immediately stopped. Surface run-off water must be drained/diverted to avoid entering the landfill trenches.

Based on a geotechnical assessment, it was concluded that a 3.0H:1.0V slope (or flatter) would be stable during permanent excavation of the dry soil.

5.4 SITE LAY-OUT AND POTENTIAL LIFESPAN

As shown on Plan 1 in Appendix E, groundwater depth varied between approximately 5 and 12 m in the project area. The nature of the soil would allow sufficient drainage and is suitable for the development of an in-trench landfill.

In accordance with these results, the continuous trench could be excavated to a depth of 4 to 11 metres. A berm could also be constructed along the perimeter of the excavated trench to increase landfill capacity. Figures 3 and 4 illustrate the different concepts, that is with or without a berm.

Plan 2 in Appendix E presents the maximum landfill depth (1.0 m above the groundwater or bedrock).

Figure 3 Continuous trench in excavation

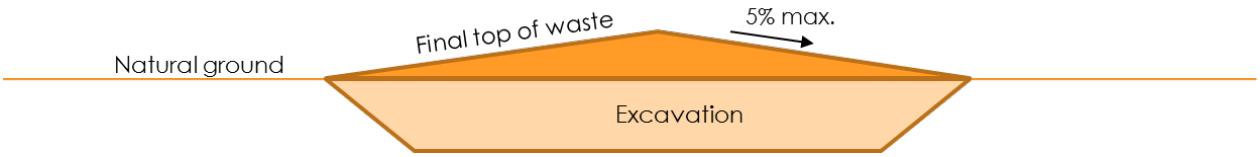


Figure 4 Continuous trench in excavation with a surrounding berm

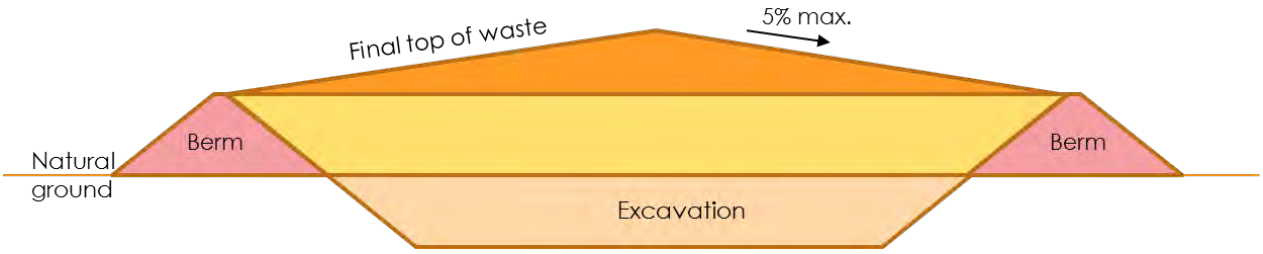


Table 12 presents the estimated parameters for the two (2) trench depths based on an excavation slope of 3.0H:1.0V.

Table 12 Estimated Lifespan of Site 4

Trench Depth	4 m	6 m
Usable area (m^2)	45,000 m^2	45,000 m^2
Capacity	160,000 m^3	225,000 m^3
Minimum lifespan	35 years	45 years

The estimated lifespan is more than 30 years and could be increased by 30% with a trench depth of 6 metres. Therefore, Site 4 is suitable for the development of an in-trench landfill.

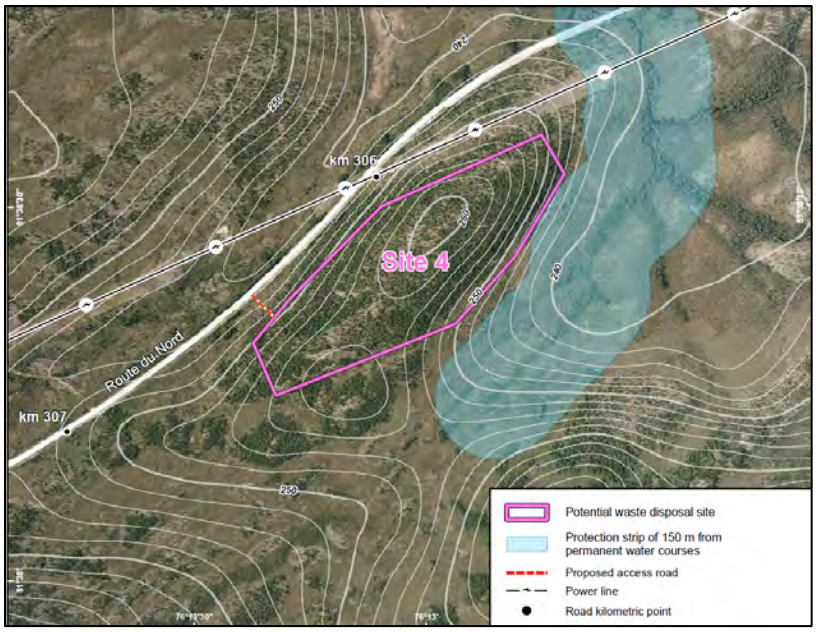
6.0 COMPLETE DESCRIPTION OF THE RECOMMENDED SITE

After analyzing all the available information, Site 4 is recommended to be the location of the new landfill site.

6.1 LAND AREA

Site 4 has ample land area available (215 000 m²) as illustrated in Figure 1, which would be enough even when compared to the estimated required land area for a 4 m deep trench (89 000 m²) as noted in Table 4.

Figure 5 Extract from POLY-GEO final report: Site 4

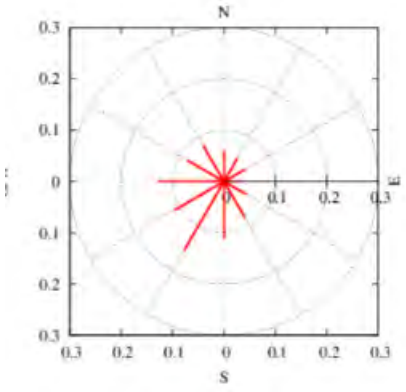


6.2 ENVIRONMENT AND TOPOGRAPHY

Site 4 meets all the requirements regarding environment and topography.
Topography: Site 4 has sufficient drainage and it is located behind a hill, away from flood response areas.
Drainage Site 4 is located more than 150 m from the permanent creek situated to the southeast.

Climatology: According to the Canadian Wind Energy Atlas (see wind rose), the mean major wind directions during the year in the Nemaska area blows towards the east and north-east. As Site 4 is located far from the village and is located on the east side of a hillock, wind is not a concern. However, the operation of the site may have to cope with an accumulation of snow in the winter.

Figure 6 Mean major wind directions



Geology: Site 4 is located on a sandy deposit containing around 33% of silt and clay, with sparse boulders that should not create complications.

Hydrogeology: No nearby drinking water well have been identified to be present in the vicinity of Site 4. Groundwater was only encountered at three (3) out of twenty-three (23) test pits, where the water table depth ranged from 1.6 m to 4.5 m. However, the test pits where the water table depths of 1.6 m and 2.3 m were encountered are in a low-lying, poorly drained area that would not be used for waste disposal and therefore not representative of the water table depth across Site 4.

Physical constraints: Site 4 is not located where issues with slopes, erosion or landslides are expected.

Environment: No potential environmental concerns that could have resulted in soil or groundwater contamination at Site 4 have been identified.

6.3 CULTURE AND NATURE

Site 4 meets all requirements regarding cultural and natural settings, based on the information available (from site visits, Tallyman, and Band Council), as described below.

Flora: to our knowledge, Site 4 is not located in an area of sensitive flora species or forests.

Fauna: to our knowledge, Site 4 is not located in an area of sensitive fauna species or in an area commonly used for hunting or fishing. Pests are not considered to be a concern for this site specifically, although fencing will be recommended in order to secure the site.

Geography: Site 4 is located 17 km from the community, on Category III land. To our knowledge, the site has not been identified as an exceptional natural site.

Heritage: The Tallyman visited Site 4 with POLY-GEO during their field work. According to the Tallyman, Site 4 is not located in an area of cultural or archaeological significance.

Community: Site 4 is the preferred location of the representatives of the CNN band council.

6.4 INFRASTRUCTURE AND DEVELOPMENT

Land use and Infrastructures: Site 4 does not interfere with any current or future land use plans, as it is located approximately 17 km from the community boundaries. Site 4 is located at least 65 metres from the access road, which is acceptable according to Hydro-Quebec who owns the road and according to the SDBJ (who operate the road). The Ministère des Transports, de la Mobilité durable et de l'Électrification des transports

(MTMDET) does not have any specific requirements. Site 4 is bounded to the north by a power line right-of-way (it is at least 50 m from the power line, which is adequate for Hydro-Quebec). According to those responsible for airport security, the location is far enough away from the airport that it should not impact its operations.
Geotechnical: The site's geotechnical characteristics are discussed in sections 4 and 5. They are suitable for the installation of a waste disposal site.
Capacity: According to the available land area, Site 4 is significantly large enough to install a trench landfill that will have enough capacity for at least 30 years.
Regulation: All the requirements of the RRLIRM were respected during the selection and investigation process for all sites. Site 4 meets the requirements of the RRLIRM. Site 4 is located within zone 51-06-R of the Eeyou Istchee James Bay Regional Government Zoning by-law and no special requirements apply.

6.5 CAPITAL COSTS

The capital costs were estimated for the implementation of the new landfill at Site 4 with the continuous trench concept. These are presented in Table 13. A contingency of 25% was also considered for unforeseen construction events.
The detailed costs are presented in Appendix H.

Table 13 Cost Estimates for the Implementation of the New Landfill

Period	Phase	Total	Funding	Status
2016–2018	Site selection study	$148,000	Approved	Completed
2018–2019	Studies: environmental and social impact assessment study and preliminary plans and specifications	$104,000	Approved	To be started
2019–2020	Final plans and specifications and obtaining a Certificate of Authorization	$75,000	To be approved	Not started
2020–2021	Tender Management and construction supervision General items (fence, signs, access road) Trenches 1 and 2 opening (lifespan 5 years)	$1,900,000	To be approved	Not started
2021–2022	Opening of the new site (assistance, training)	$27,000	To be approved	Not started
Total for the new landfill 2016–2022		$2,254,000		

It should be noted that the current landfill site will also have to be closed when the new site opens. The closure costs for the current landfill were estimated to be around **$365,000**.

7.0 NEXT STEPS AND SCHEDULE

Table 14 generally outlines the subsequent project steps and corresponding schedule.

Table 14 Subsequent Project Steps and Associated Schedule

Project Item	Schedule
Preliminary information to the Environmental and Social Impact Review Committee (COMEX)	September 2018
Land Survey	September 2018
Environmental and Social Impact Assessment Study	Sept. – Dec. 2018
Preliminary Plans and Specifications	Sept. – Dec. 2018
Analysis by COMEX	Jan. 2019– Jan. 2020
Preparation of the Request for a Certificate of Authorization	Jan. – Feb. 2020
Final Plans and Specifications and Tender Documents	Jan. – March. 2020
Call for Proposals	April. 2020
Land Clearing Permit	July 2020
Construction (General and Trenches 1 and 2)	August – Oct. 2020
Beginning of the Operations and Training	2021–2022
Closure of the Existing Landfill	2022–2023

The Environmental and Social Impact Assessment Study and the preliminary plans and specifications will have to be prepared simultaneously in order to submit a comprehensive document to the COMEX. The request for a Certificate of Authorization will have to be sent to the MDDELCC with the plans and specifications as well as the results of an environmental and social impact study.

The construction of the landfill includes the access road construction, trench excavation, fence installation, gate construction and sign implementation as well as the site preparation, if needed.

Finally, prior to commencing the operation of the landfill, a manual will need to be prepared and delivered to train the people responsible for operating the landfill in compliance with the Certificate of Authorization.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the CNN population and waste generation projections, it is estimated that the community may need to bury around 130 000 m^3 of waste (including 10% soil cover) in the 30 years following the closure of the current landfill.

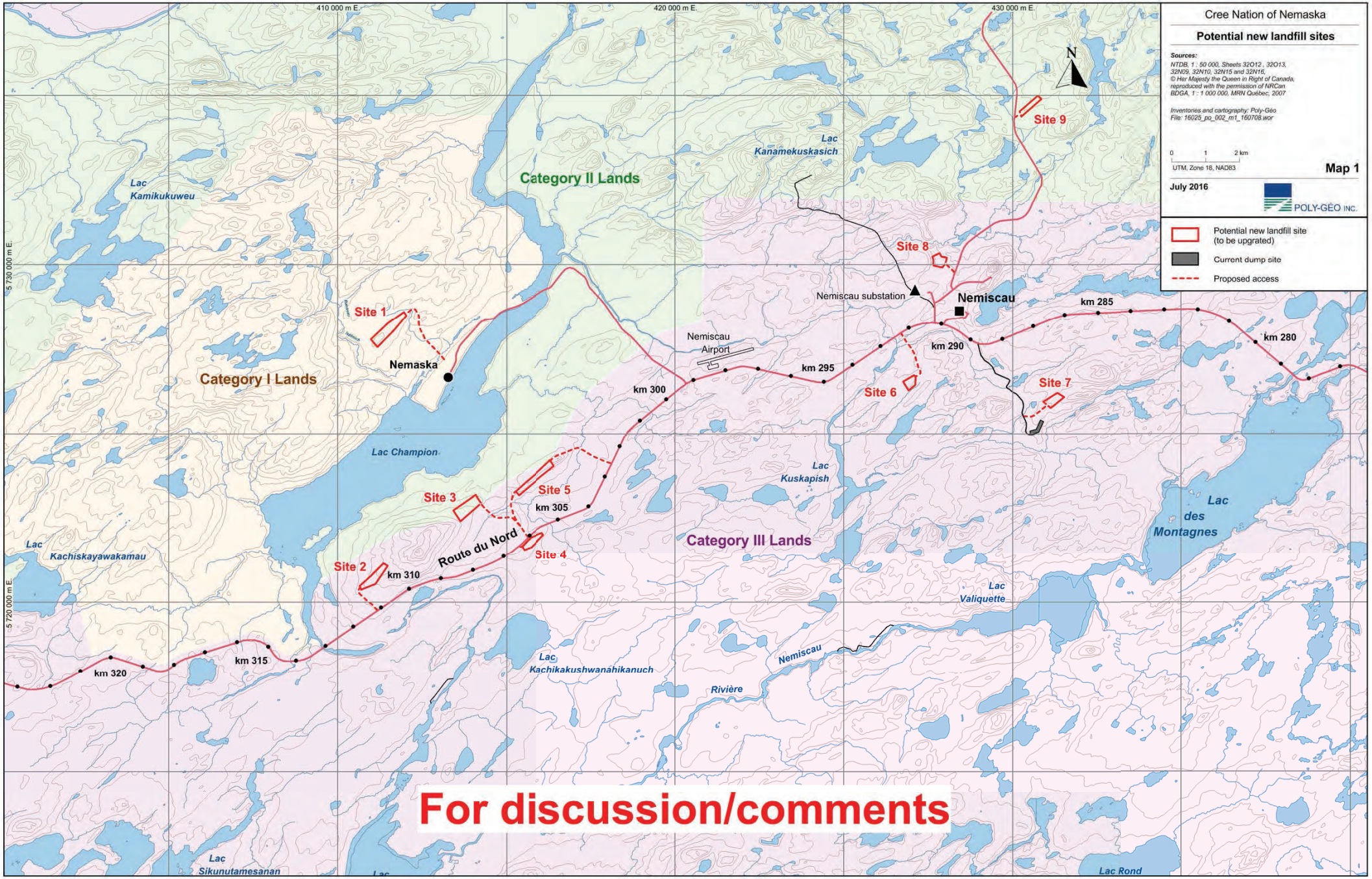
Selection criteria implemented with an air photo interpretation led to select nine sites to assess. After reviewing them with CNN representatives, four sites were chosen for further analysis. Sites visits were organized, and three sites were selected for geotechnical and geomorphological field works (Sites 4, 7 and 8).

After considering all the results and information, Site 4 obtained the best rate compared to Sites 7 and 8:

- Land area available (215 000 m^2) is enough compared to the estimated required land area even for a 4 m deep trench (89 000 m^2)
- Groundwater depth between 5 to 10 m in the project area
- Lifespan higher than 30 years
- Proximity of the road
- Good drainage and adequate type of soil
- No known archeological or cultural areas of interest
- Accepted by local authorities (main road, airport and zoning by-law)

Site 4 is recommended to develop a new landfill and conduct the environmental and social impact study and plans and specifications.

Appendix A MAP OF THE 9 POTENTIAL SITES


Cree Nation of Nemaska
Potential new landfill sites
Sources:
NTDB, 1 : 50 000, Sheets 32O12 , 32O13, 32N09, 32N10, 32N15 and 32N16, © Her Majesty the Queen in Right of Canada, reproduced with the permission of NRCan
BDGA, 1 : 1 000 000, MRN Québec, 2007
Inventories and cartography: Poly-Géo
File: 16025_po_002_m1_160708.wor
0 1 2 km
UTM, Zone 18, NAD83
Map 1
July 2016
POLY-GÉO INC.
Potential new landfill site (to be upgrated)
Current dump site
Proposed access
410 000 m E.
420 000 m E.
430 000 m E.
5 730 000 m E.
5 720 000 m E.
N
Category I Lands
Category II Lands
Category III Lands
Nemaska
Nemiscau
Nemiscau substation
Nemiscau Airport
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
Site 7
Site 8
Site 9
Route du Nord
km 280
km 285
km 290
km 295
km 300
km 305
km 310
km 315
km 320
Lac Kamikukuweu
Lac Champion
Lac Kachiskayawakamau
Lac Kanamekuskasich
Lac Kuskapish
Lac des Montagnes
Lac Valiquette
Lac Kachikakushwanahikanuch
Lac Sikunutamesanan
Lac Rond
Nemiscau Rivière
For discussion/comments

Appendix B ANALYSIS MATRIX

NEMASKA NEW WASTE DISPOSAL SITE

TABLE 1: POTENTIAL NEW LANDFILL SITES IDENTIFIED BY PHOTO-INTERPRETATION

TABLE SUBMITTED
JULY 8, 2016

Name	Site Area (m²)	Site Length (m)	Site Average width (m)	Surficial material	Estimated depth of water table (m)	Approximate length of the access road to build (km)	Average distance from Nemaska by road (including new access road) (km)	Average distance from Nemiscau Airport (km)	Site characteristics	Constraints / limitations
Site1	310 000	1 250	250	Thin discontinuous layer of sand and gravel with boulders overlying the till	> 3	2,1	2,1	8,8	- Drumlin - Denivelation of 15-18 m between the top of the site and the terrain on the south side. - Denivelation of only 5 to 7 m on the north side. - Permanent brook on the north-east side.	- Very close from the community. - Proposed access road will cross some soft and humid terrains (peat bog) on the first 600 m.
Site2	200 000	980	180	Till	> 4	0,9	22,4	11,3	- Drumlin - Very good site. No water course at less than 150 m. - Denivelation of 10-15 m between the top of the site and the south and north sides. - Access road easy to build (terrain with good bearing capacity, dry and borrow pit available less than 1 km west).	- Some concerns about the water table depth.
Site3	270 000	800	320	Thin layer of sand overlying the till	> 4	1,8	18.1	7,9	- Drumlin with gentle slopes. - Easy to develop.	- Some concerns about the water table depth. - Long access road to build and costly maintenance in winter.
Site4	215 000	850	240	Till	> 4	0,1	16,3	6,8	- Drumlin - Site bordered by the Route du Nord and a powerline on the north side - Well drained and short access road to build (100 m)	- Close to the Route du Nord and the powerline.
Site5	235 000	1 300	180	Till	> 6	2 (east side) 1,9 (west side)	18,2	5,4	'- Very long and narrow drumlin (1250 m x 150 m) - Steep slopes on north and south sides - Well drained - The nearest creek is more than 250 m away.	- Long access road to build and costly maintenance in winter. - Some concerns about the preparation and operation site (narrow).
Site6	95 000	360	250	Till	> 5	1,5	17,9	4,5	- Drumlin - Site easy to develop (flat surface). Can be expanded significantly westward. - The access road will cross terrains with good bearing capacity, but there is some steep slopes and two small brooks to cross.	- The creek shown on the map, near the south side of the site, doesn't exist. '- Some concerns about the water table depth because the surface of the drumlin is flat or in gentle slope. - Costs for access road construction and maintenance in winter could be high.
Site7	120 000	490	240	Till	> 4	0,8	22,5	8,7	- Drumlin located only 450 m north-east of current dump site of Nemaska. - Domed surface and relatively steep slopes on the north and south side of the site. - Well drained - A powerline marks the eastern boundary of the site.	- Limited potential for expansion. - Permanent stream on the NW side (< 150 m).
Site8	120 000	380	310	Sand, sand and gravel	> 6	0,4	19,7	5,8	- Sakami Moraine. Former borrow pit, partly exploited for the construction of EM-1 access road. - Thick sand (> 5m) - Very well drained and deep water table.	- Only at 1.2 km from Hydro-Québec résidances and less than 500 m from Nemiscau substation (maybe water well). - Located in the northeast extension of the airstrip (6 km). - The high permeablilty of sand could be a problem.
Site9	110 000	720	150	Till	> 4	0,2	25,6	10,4	- Drumlin - Site easy to develop. - Short access road. Low costs for construction and maintenance.	- Far from Nemaska Community - The water table could be close to the surface (3-4m) due to gentle slopes.

Appendix C PHOTO REPORT

Site 4



Photo no 1 : Site 4



Photo no 2 : Site 4



Photo no 3 : Site 4



Photo no 4 : Site 4



Photo no 5: Site 4



Photo nº 6 : Site 4

Site 7



Photo nº 7 : Site 7



Photo nº 8 : Site 7



Photo no 9 : Site 7



Photo no 10 : Site 7



Photo no 11 : Site 7



Photo no 12 : Site 7

Site 8



Photo no 13 : Site 8



Photo no 14 : Site 8



Photo no 15 : Site 8



Photo no 16 : Site 8



Photo no 17 : Site 8



Photo no 18 : Site 8

Site 9



Photo no 19 : Site 9



Photo no 20 : Site 9



Photo no 21 : Site 9



Photo no 22 : Site 9



Photo no 23 : Site 9



Photo no 24 : Site 9

Appendix D POLY-GEO FIELDWORK FINAL REPORT

NEMASKA NEW WASTE DISPOSAL SITE



Photo-interpretation and field investigations

Final technical report presented to the Cree Nation of Nemaska

April 2017

POLY-GÉO INC.

SUMMARY

Authors and title (for referencing purposes):

Poly-Géo Inc. 2017. – **NEMASKA NEW WASTE DISPOSAL SITE**. Photo-interpretation and field investigations. Technical report presented to the Cree Nation of Nemaska. 6 pages and 5 appendices.

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Geomorphologist

Richard Lévesque, M.Sc.
Senior Geomorphologist

Version: Final
Date: April 10th, 2017

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Report editing:
Sylvie Pomerleau

Poly-Géo Inc. ref. number: 16025

TABLE OF CONTENTS

1. INTRODUCTION 1

2. SITES DESCRIPTION AND FIELD STUDIES 3

Site 4 3

Site 7 4

Site 8 4

3. CONCLUSION 6

LIST OF TABLES

TABLE 1 : Potential new landfill sites identified by photo-interpretation ..... Appendix 1

TABLE 2 : Main characteristics of sites validated ..... Appendix 2

LIST OF MAPS

MAP 1 : Potential new landfill sites ..... Appendix 1

MAP 2 : Location map 2

MAP 3A : Site 4 (general view) ..... Appendix 3

MAP 3B : Site 4 (close-up with location of test pits) ..... Appendix 3

MAP 4 : Site 7 ..... Appendix 4

MAP 5 : Site 8 ..... Appendix 5

LIST OF APPENDICES

APPENDIX 1 : PRELIMINARY STUDY BY PHOTO-INTERPRETATION

- Map 1 : Potential new landfill sites
- Table 1 : Potential new landfill sites identified by photo-interpretation

APPENDIX 2 : Table 2 : Main characteristics of sites validated in the field

APPENDIX 3 : SITE 4

- Maps 3A and 3B : Site 4
- Technical description of test pits
- Grain size analysis

APPENDIX 4 : SITE 7

- Map 4 : Site 7
- Technical description of test pits
- Grain size analysis

APPENDIX 5 : SITE 8

- Map 5 : Site 8
- Technical description of test pits (this study and Poly-Géo, 2011)
- Grain size analysis (Poly-Géo, 2011)

INTRODUCTION 1

As part of the study for a new waste disposal site for the Cree Nation of Nemaska, Poly-Géo conducted a field study from September 19 to 23, 2016 and March 20 to 23, 2017, to collect additional data, mainly on stratigraphy and water table depth. Fieldwork focused on the sites chosen by photo-interpretation earlier in the summer and briefly validated during a short visit by Poly-Géo (July 26-27, 2016). The preliminary map of the nine locations previously identified and the preliminary table providing the main sites characteristics are provided in Appendix 1 (Map 1; Table 1).

Sites 4, 7 and 8 (Map 2) were chosen for detailed characterization. A total of 12 test pits (PU) were excavated with a mechanical shovel (Volvo EC250E) in September 2016 and 18 additional test pits in March 2017 at Site 4. For more accurate reading of water table depth, the test pits were left open at least 24 hours to allow the water level to settle (Sites 4 and 7 only). It should be noted that the weather was cloudy and fairly rainy before and during the September surveys, which may have slightly affected the measured water table depth.

Cree Nation of Nemaska

Potential waste disposal sites

Location Map

Sources :
NTBD, 1 : 50 000, NRCan, 2007
© Her Majesty the Queen in Right of Canada, reproduced with the permission of NRCan
Category Land, MRNF, Gestim, file: contraintes-restrictions, 2012

Inventories and cartography: Poly-Géo, 2011 and 2016
File: 16025_po_007_situa_161103.mxd

0 1 2 km
MTM, Zone 9, NAD83

Map 2

November 2016

POLY-GÉO INC.

N

76°20' 76°15' 76°10' 76°5' 76°0' 75°55'

51°45' 51°40' 51°35'

15 km from Nemaska

10 km from Nemaska

5 km from Nemaska

To EM-1

Lac Kanamekuskasich

Lac Champion

Lac Kuskapish

Lac des Montagnes

Lac Valiquette

Rivière Nemiscau

Category I Lands

Category II Lands

Category III Lands

Nemaska

Nemiscau airport

Nemiscau substation

Nemiscau

Route du Nord

km 275 km 280 km 285 km 290 km 295 km 300 km 305 km 310 km 315

Site 4

Site 7

Site 8

Current waste disposal site

Potential waste disposal site
Road and kilometre point
Power line

Site 4

Site 4 covers an area of about 21.5 ha on the south side of the Route du Nord, on a broad ridge of till (drumlin) aligned along a NE-SW axis (Map 3A; Appendix 3). Site 4 is 17 km from Nemaska, and as such is the site nearest to the town. It is bounded to the northwest by the road and to the north by the power line right-of-way. There are lowlands with peat bog along the southeastern boundary of the site and a rocky, partially till-covered area at its southern end. Tree cover (mostly jack pine with some black spruce) is scattered at the top of the site and a little denser on the northwest and southeast slopes.

The site boundaries (Map 3B, Appendix 3) comply with the minimum distances prescribed by law, as well as those required by Hydro-Québec and the Quebec Ministry of Transport in relation to the power line and the Route du Nord, respectively. The buffer strips used were as follows: > 150 m from the permanent creek southeast of the site, > 65 m from the power line, and > 65 m from the Route du Nord.

The site should be accessed from the southwestern side, where the slope is gentle and there is no power line. The surface layer of organic matter is generally thin at the site (< 0.35 m), but on the northwest slope, where the proposed access road would be built, it is 0.5 to 0.6 m thick. The access road would be about 65 m long and must ascend a slope with an average grade of 8%.

A total of 23 test pits were excavated (5 in September 2016 and 18 in March 2017). The till thickness observed ranged from 3.1 m to more than 5.3 m (Table 2; Appendix 2 and Technical Description of Test Pits; Appendix 3). Although it rained for two days during the September surveys, surficial drainage on the site was excellent, and no excess water was observed on surface. At the time, the water table was only reached in one test pit (PU-04-01), in the southwestern portion of the site, at a depth of 4.5 m. Bedrock was also only observed in one test pit (PU-04-05), in the northeastern portion of the site, at a depth of 4.4 m. The investigation and characterization of Site 4 was completed by the test pits excavated in March 2017, during the winter low-water. Bedrock was reached in three of those test pits, all located outside the site boundaries. All the other test pits, which were 3.1 to 5.1 m deep, failed to reach the bedrock underlying the till. The water table was only observed in two test pits (PU-04-12 and PU-04-16), at depths of 2.3 and 1.6 m, respectively. Those test pits were excavated in a low-lying, poorly-drained area that would not be used for waste disposal, and were therefore not representative of the site.

The till matrix is generally sandy, containing 32% to 34% silt and clay, < 10% gravel, < 10% cobbles and < 10% boulders (Technical description of Test Pits and Grain Size Analysis; Appendix 3). Within the till, boulders can be up to 1,500 mm in diameter. Some sparse boulders were observed on the surface, but their presence is unlikely to cause complications should the site be developed into a waste disposal area (Appendix 1).

Site 7

Site 7 is located near the current Nemaska and Hydro-Québec waste disposal sites, about 23 km from Nemaska. Like Site 4, it sits on top of a drumlin ridge, aligned along a NE-SW axis (Map 4; Appendix 4). Accessing Site 7 may prove difficult, as both of the existing waste disposal sites are fenced and the Hydro-Québec septic waste sedimentation pools are contiguous. The access road should run along the northern edge of the Hydro-Québec waste disposal site and should ideally use part of the same entry point.

The vegetation on Site 7 is mainly characterized by young jack pine regeneration rarely higher than 3 m.

A total of six test pits were excavated on this site, showing a till thickness of 1.5 m to more than 5.5 m (Table 2, Appendix 2). The water table was only reached in two test pits, PU-01-7 and PU-06-7, both located in the southwestern portion of the site, at depths of 2.6 and 3.2 m, respectively. Bedrock was reached in three test pits, PU-02-7, PU-03-7 and PU-06-7, at depths of 1.5 m, 3.7 m and 4.6 m, respectively. These last three test pits are located in the central and western part of the site.

Just like at Site 4, the till matrix is generally silty sand (24 to 28% silt and clay, < 10% gravel, < 10% cobbles and < 10% boulders (Appendix 1). Within the till, boulders can reach a diameter of 2,000 mm (Technical description of test pits and Grain size analysis; Appendix 4).

A small stream flowing towards the SW was mapped in the bottom of the valley, about 150 m NW of the site. Due to the shallow water table depth and bedrock observations, as well as the presence of the stream, the site surface area was reduced from what was initially proposed, prior to the field study. This allowed for the creation of a 150 m buffer zone between the stream and the waste disposal site. The total area available for the development of a waste disposal site is now 6.4 ha.

Site 8

Site 8 is located less than 400 m NW from the EM-1 road and about 500 m NE from the Nemiscau substation. It sits on a big, sandy deposit associated with a segment of the Sakami Moraine that was partly used as a borrow pit for the construction of the EM-1 road. This site is already accessible via an old access road (Option A) that branches off the Nemiscau / EM-1 road at Kilometre 1.1 (Map 5; Appendix 5). This narrow road with relatively steep slopes would require significant upgrading, however, to accommodate loaded trucks. Photo interpretation and our field surveys indicate that it would be better to build a new road from Kilometer 0.6 of the Nemiscau/EM-1 road (Option B). This route would be half as long as Option A (370 m vs 730 m), and therefore less costly to build and maintain. However, considerable excavation work would be required to reduce the slope in the central part of the route, as well as at the intersection with the existing road, where there is a slope of loose material 4-5 m high. The leftover materials in the former borrow pit should facilitate access road construction.

Stratigraphic data is from a total of 11 test pits, with one (PU-01-8) excavated during this field study (Table 2, Appendix 2) and the other 10 excavated during a previous study of Poly-Géo[1] (Table 2, Appendix 2; Technical description of test pits and Grain size analysis; Appendix 5). The observed material thickness reached 6.5 m (PU-01-8). The water table was not reached in any of the test pits, but it is important to mention that none of the pits were left open at least 24 h to allow the water to settle. However, the material is mainly sand with varying proportions of gravel, sand and gravel, and some layers of silty sand. In this type of material, the water level adjusts quickly, and it is usually not necessary to leave a pit open more than a few hours to observe it. Bedrock was not reached in any of the test pits, and the geomorphological setting suggests that the surficial material in this area is more than 10 m thick. The vegetation on the site is characterized by jack pine in the undeveloped area and green alder in the old borrow pit area.

[1] ***POLY-GÉO INC. (2011).*** Potential granular borrow sources in the Nemaska area. Mechanical shovel exploration. Final report presented to the Cree Nation of Nemaska.12 p., 2 appendices.

CONCLUSION 3

Site 7 is probably the least interesting of the three sites. Although it is located in an already disturbed area, the proximity of a stream and the shallow bedrock and water table act as major constraints on the available surface area. Also, building a > 800 m access road north of the Hydro-Québec waste disposal site will be relatively difficult due to the uneven terrain, possible wetlands and sideward slope.

Sites 4 and 8 both have good potential. At Site 4, which is closest to Nemaska (17 km), the average thickness of the till materials is > 5 m, the water table is low and bedrock was only observed in four test pits, at a depth of 4.4 m in the northeastern part of the site and near surface in the three test pits located outside the southern boundary. Site 4 is also the closest site to the road, and would require the construction of a 65 m access road. Keeping a 65 m buffer strip between the southern edge of the site and the Route du Nord would prevent Site 4 from being seen from the road, which lies 6 to 10 m lower down. The entire site is suitable for use as a waste dump, but its northeastern half, which has rougher terrain and likely better drainage, seems slightly more favourable.

Site 8 is farther from Nemaska (20 km) but closer than the current waste disposal site. Since some of the site surface is already disturbed by the old borrow pit, it could be easily developed. The access road would also be easy to build as the materials in place could likely be used. The bed of materials is thick; neither the water table nor bedrock was reached in any of the test pits. Soil drainage could be fast within the sandy material, in the first 4 to 5 m, and possibly deeper. Drilling of a few deep boreholes (10-15 m) would provide information on the stratigraphy at depth and allow a few piezometers to be installed to monitor the water table. However, despite its favourable features, this site does not qualify due to its proximity of the Nemiscau substation and its drinking water well, and because it lies in the axis of the Nemiscau landing strip, which is less than 6 km away. Moreover, the opening of a waste disposal site at this location would have a slight visual impact on the Hydro-Québec residences located 1.2 km southeast.

Because of the good quality of the materials, the acceptable depth of the water table and the low environmental and physical constraints associated with its development, Site 4 appears to be the most favourable site for the new waste disposal site. More field investigations are required to clearly determine whether this site complies with all the legal requirements and can meet the community of Nemaska's needs. For instance, piezometers will have to be installed to determine the depth of the water table and monitor it over a sufficiently long period of time to see how it changes.

APPENDIX 1

- Map 1: Potential new landfill sites
- Table 1: Potential new landfill sites identified by photo-interpretation

(first part of the study)

410 000 m E.

420 000 m E.

430 000 m E.

5 730 000 m E.

5 720 000 m E.

N

Lac Kamikukuweu

Lac Kanamekuskasich

Category II Lands

Category I Lands

Category III Lands

Site 1

Site 2

Site 3

Site 4

Site 5

Site 6

Site 7

Site 8

Site 9

Nemaska

Nemiscau Airport

Nemiscau substation

Nemiscau

Route du Nord

km 280

km 285

km 290

km 295

km 300

km 305

km 310

km 315

km 320

Lac Champion

Lac Kachiskayawakamau

Lac Sikunutamesanan

Lac Kuskapish

Lac des Montagnes

Lac Valiquette

Lac Kachikakushwanahikanuch

Nemiscau Rivière

Lac Rond

For discussion/comments

Cree Nation of Nemaska

Potential new landfill sites

Sources:

NTDB, 1 : 50 000, Sheets 32O12 , 32O13, 32N09, 32N10, 32N15 and 32N16, © Her Majesty the Queen in Right of Canada, reproduced with the permission of NRCan
BDGA, 1 : 1 000 000, MRN Québec, 2007

Inventories and cartography: Poly-Géo
File: 16025_po_002_m1_160708.wor

0 1 2 km

UTM, Zone 18, NAD83

Map 1

July 2016

POLY-GÉO INC.

Potential new landfill site (to be upgrated)

Current dump site

Proposed access

NEMASKA NEW WASTE DISPOSAL SITE

TABLE 1: POTENTIAL NEW LANDFILL SITES IDENTIFIED BY PHOTO-INTERPRETATION

TABLE SUBMITTED
JULY 8, 2016

Name	Site Area	Site Length	Site Average width	Surficial material	Estimated depth of water table	Approximate length of the access road to build	Average distance from Nemaska by road (including new access road)	Average distance from Nemiscau Airport	Site characteristics	Constraints / limitations
	(m^2)	(m)	(m)		(m)	(km)	(km)	(km)		
Site 1	310 000	1 250	250	Thin discontinuous layer of sand and gravel with boulders overlying the till	> 3	2,1	2,1	8,8	- Drumlin - Denivelation of 15-18 m between the top of the site and the terrain on the south side. - Denivelation of only 5 to 7 m on the north side. - Permanent brook on the north-east side.	- Very close from the community. - Proposed access road will cross some soft and humid terrains (peat bog) on the first 600 m.
Site 2	200 000	980	180	Till	> 4	0,9	22,4	11,3	- Drumlin - Very good site. No water course at less than 150 m. - Denivelation of 10-15 m between the top of the site and the south and north sides. - Access road easy to build (terrain with good bearing capacity, dry and borrow pit available less than 1 km west).	- Some concerns about the water table depth.
Site 3	270 000	800	320	Thin layer of sand overlying the till	> 4	1,8	18.1	7,9	- Drumlin with gentle slopes. - Easy to develop.	- Some concerns about the water table depth. - Long access road to build and costly maintenance in winter.
Site 4	215 000	850	240	Till	> 4	0,1	16,3	6,8	- Drumlin - Site bordered by the Route du Nord and a powerline on the north side - Well drained and short access road to build (100 m)	- Close to the Route du Nord and the powerline.
Site 5	235 000	1 300	180	Till	> 6	2 (east side) 1,9 (west side)	18,2	5,4	'- Very long and narrow drumlin (1250 m x 150 m) - Steep slopes on north and south sides - Well drained - The nearest creek is more than 250 m away.	- Long access road to build and costly maintenance in winter. - Some concerns about the preparation and operation site (narrow).
Site 6	95 000	360	250	Till	> 5	1,5	17,9	4,5	- Drumlin - Site easy to develop (flat surface). Can be expanded significantly westward. - The access road will cross terrains with good bearing capacity, but there is some steep slopes and two small brooks to cross.	- The creek shown on the map, near the south side of the site, doesn't exist. '- Some concerns about the water table depth because the surface of the drumlin is flat or in gentle slope. - Costs for access road construction and maintenance in winter could be high.
Site 7	120 000	490	240	Till	> 4	0,8	22,5	8,7	- Drumlin located only 450 m north-east of current dump site of Nemaska. - Domed surface and relatively steep slopes on the north and south side of the site. - Well drained - A powerline marks the eastern boundary of the site.	- Limited potential for expansion. - Permanent stream on the NW side (< 150 m).
Site 8	120 000	380	310	Sand, sand and gravel	> 6	0,4	19,7	5,8	- Sakami Moraine. Former borrow pit, partly exploited for the construction of EM-1 access road. - Thick sand (> 5m) - Very well drained and deep water table.	- Only at 1.2 km from Hydro-Québec résidances and less than 500 m from Nemiscau substation (maybe water well). - Located in the northeast extension of the airstrip (6 km). - The high permeablilty of sand could be a problem.
Site 9	110 000	720	150	Till	> 4	0,2	25,6	10,4	- Drumlin - Site easy to develop. - Short access road. Low costs for construction and maintenance.	- Far from Nemaska Community - The water table could be close to the surface (3-4m) due to gentle slopes.

APPENDIX 2

- Table 2: Main characteristics of sites validated in the field

Nemaska new waste disposal site

TABLE 2 : Main characteristics of sites validated in the field

Sites	Total distance from Nemaska (including new access roads)	Total area available	Centre coordinates of optimal subarea	Land characteristics				Evaluation of work	
				Geomorphological and topographical context	Material			Access road	Comments
					Test pit	Thickness and stratigraphy[1]	Measured depth of water table	to build / refurbish	
	(km)	(ha)	(UTM, Nad 83, Zone 18)					(m)	
Site 4	17	21.5	415 745 m 5 721 796 m	Located on a drumlin forming a broad ridge that rises some 20 m above the surrounding land, this site is about 850 m long and some 240 m wide. Ground surface is moslty flat, with some sparse boulders. From the centre of the site, the terrain slopes gently towards the NE and the SW, creating a 4-5 m difference in altitude. The surface is very well drained and vegetation is sparse.	PU-04-01	Till: > 5.2 m	4.5 m	100	- Access to this site is very short. - A buffer area of 65 m will be maintained between the road, the powerline and the site.
					PU-04-02	Till: > 5.3 m	Not reached		
					PU-04-03	Till: > 5.0 m	Not reached		
					PU-04-04	Till: > 5.0 m	Not reached		
					PU-04-05	Till: 4.4 m / Bedrock	Not reached		
					PU-04-06	Till: > 4.5 m	Not reached		
					PU-04-07	Till: > 5.0 m	Not reached		
					PU-04-08	Bedrock (out of bound)	Not reached		
					PU-04-09	Bedrock (out of bound)	Not reached		
					PU-04-10	Till: > 4.1 m	Not reached		
					PU-04-11	Bedrock (out of bound)	Not reached		
					PU-04-12	Silty sand with gravel and cobbles : > 4.1 m	2.3 m		

Nemaska new waste disposal site

TABLE 2 : Main characteristics of sites validated in the field

Sites	Total distance from Nemaska (including new access roads)	Total area available	Centre coordinates of optimal subarea	Land characteristics				Evaluation of work	
				Geomorphological and topographical context	Material			Access road	Comments
					Test pit	Thickness and stratigraphy[1]	Measured depth of water table	to build / refurbish	
	(km)	(ha)	(UTM, Nad 83, Zone 18)					(m)	
Site 4 (continued)	17	21.5	415 745 m 5 721 796 m	See previous page	PU-04-13	Till: > 5.1 m	Not reached	100	See previous page
					PU-04-14	Till: > 5.1m	Not reached		
					PU-04-15	Till: > 4.9 m	Not reached		
					PU-04-16	Till: > 4.5 m	1,6 m		
					PU-04-17	Till: > 4.6 m	Not reached		
					PU-04-18	Till: > 5.1 m	Not reached		
					PU-04-19	Till: 0 - 3.1 m Bed of boulders: > 3.1 m	Not reached		
					PU-04-20	Till: > 4.7 m	Not reached		
					PU-04-21	Till: > 5.0 m	Not reached		
					PU-04-22	Till: > 4.8 m	Not reached		
					PU-04-23	Till: > 5.0 m	Not reached		

Nemaska new waste disposal site

TABLE 2 : Main characteristics of sites validated in the field

Sites	Total distance from Nemaska (including new access roads)	Total area available	Centre coordinates of optimal subarea	Land characteristics				Evaluation of work	
				Geomorphological and topographical context	Material			Access road	Comments
					Test pit	Thickness and stratigraphy[1]	Measured depth of water table	to build / refurbish	
	(km)	(ha)	(UTM, Nad 83, Zone 18)					(m)	
Site 7	23	6.4	431 238 m 5 725 969 m	Site 7 is located less than 300 m NE of the Hydro-Québec waste disposal site on the northeastern portion of a drumlin. The broad ridge rises 25 to 30 m above the surrounding land. The site is about 430 m long and 80 to 180 m wide. The northwestern edge of the site is constrained by a stream located at the bottom of the slope. Bedrock is closer to the surface in the southwestern portion of the site.	PU-01-7	Till: > 5.5 m	2.6 m	830	- The surface area has been reduced from the original proposition (see table 1) because a 150 m buffer zone requirement must be applied along the stream to the NW of the site. - The low depth of the bedrock and water table has also reduced the surface area in the southwestern portion of the site. - Access to Site 7 will be complicated by the presence of the Nemaska and Hydro-Québec waste disposal sites and the sedimentation pools to the southwest.
					PU-02-7	Till: 1.5 m / Bedrock	Not reached		
					PU-03-7	Till: 3.7 m / Bedrock	Not reached		
					PU-04-7	Till: > 5.2 m	Not reached		
					PU-05-7	Till: > 5.0 m	Not reached		
					PU-06-7	Till: 4.6 m / Bedrock	3.2 m		
Site 8	20	12.0	427 928 m 5 730 063 m	Located about 500 m NE of the Nemiscau substation and less than 400 m NW of the EM-1 road, this site measures about 280 m x 300 m and is part of a big, sandy deposit associated with the Sakami Moraine. It lies about 10 metres higher than the surrounding land. The surface is slightly corrugate but there are no major variations in elevation. Materials are mostly sand and gravelly sand. The underlaying till was not reached.	PU-01-8	Sand / silty sand: > 6.5 m	Not reached	Option A: 370 Option B: 730	- Access to the site should be relatively easy to built given the amount of material already in place. - Material thickness is > 5 m, drainage should be fast within the first 4-5 metres due to the lack of fine sediments. - There might be a visibility issue for the nearby Hydro-Québec residences.
					Data from Poly-Géo, 2011 [2]				
					PG-20-06	Gravelly sand: > 4.5	Not reached		
					PG-20-08	Sand and gravel / silty sand: > 4.0 m	Not reached		
					PG-20-09	Sand: > 4.3 m	Not reached		
					PG-20-10	Gravelly sand / silty sand: > 5.0 m	Not reached		
					PG-20-11	Sand: > 4.5 m	Not reached		

TABLE 2 : MAIN CHARACTERISTICS OF SITES VALIDATED IN THE FIELD

Sites	Total distance from Nemaska (including new access roads)	Total area available	Centre coordinates of optimal subarea	Land characteristics				Evaluation of work	
				Geomorphological and topographical context	Material			Access road	Comments
					Test pit	Thickness and stratigraphy[1]	Measured depth of water table	to build / refurbish	
	(km)	(ha)	(UTM, Nad 83, Zone 18)					(m)	
Site 8 (continued)	20	12.0	427 928 m 5 730 063 m	See previous page	*PG-21-01*	Till: > 2.5 m	Not reached		See previous page
					PG-21-02	Sand: > 4.3 m	Not reached		
					PG-21-06	Gravelly sand: > 4.7	Not reached		
					PG-21-07	Sand / silty sand: > 5.0 m	Not reached		
					PG-21-08	Sand / sand and gravel: > 4.0 m	Not reached		

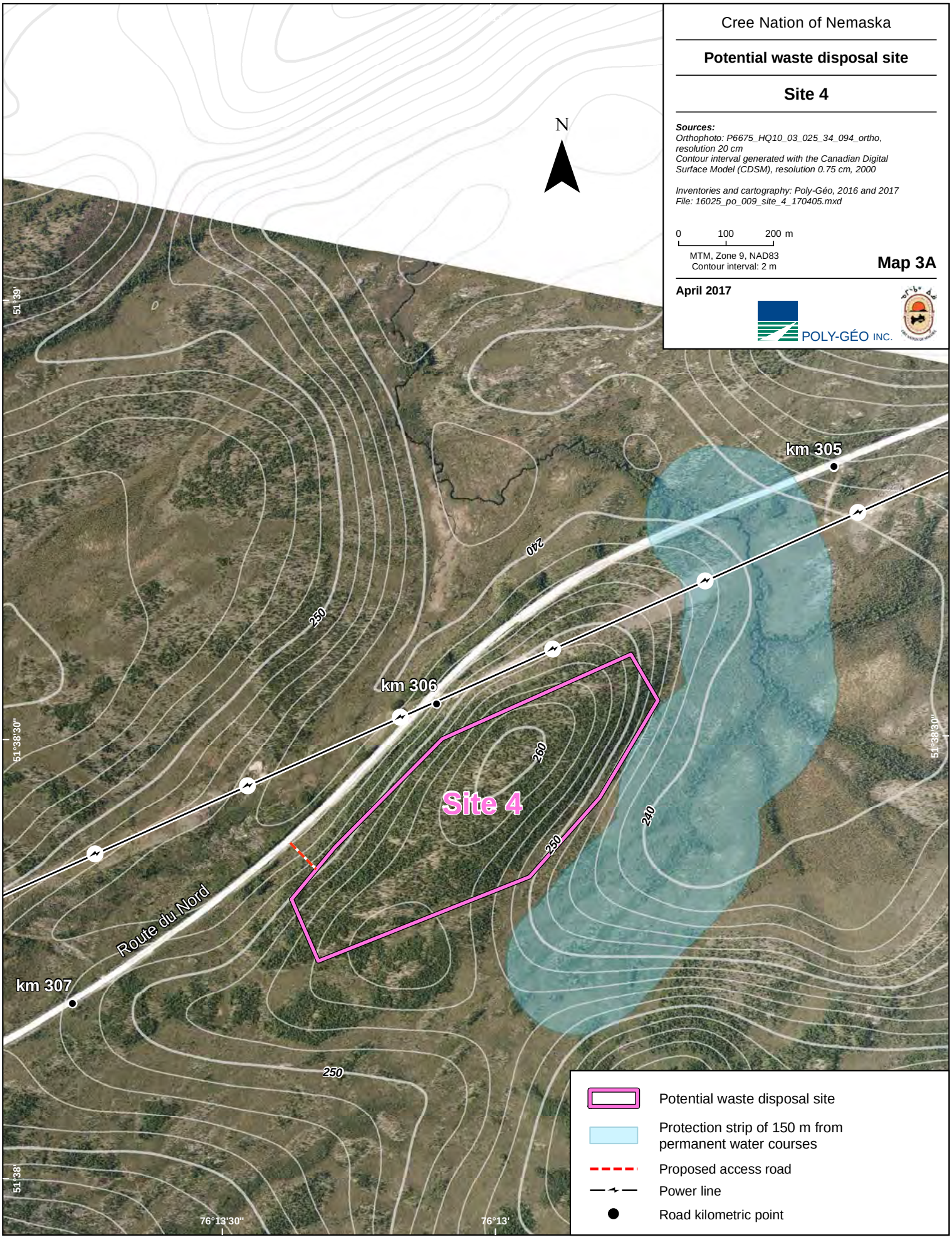
[1] See technical description sheets and granulometric spread sheets for more detailed data (Appendix).

* Test pits were excavated in a previous study (Poly-Géo, 2011).

APPENDIX 3

SITE 4

- Maps 3A and 3B : Site 4
- Technical description of test pits
- Grain size analysis



Cree Nation of Nemaska

Potential waste disposal site

Site 4

Sources:
Orthophoto: P6675_HQ10_03_025_34_094_ortho, resolution 20 cm
Contour interval generated with the Canadian Digital Surface Model (CDSM), resolution 0.75 cm, 2000

Inventories and cartography: Poly-Géo, 2016 and 2017
File: 16025_po_009_site_4_170405.mxd

0 100 200 m

MTM, Zone 9, NAD83
Contour interval: 2 m

Map 3A

April 2017

POLY-GÉO INC.

- Potential waste disposal site
- Protection strip of 150 m from permanent water courses
- Proposed access road
- Power line
- Road kilometric point

Cree Nation of Nemaska

Potential waste disposal sites

Site 4

Sources:

Orthophoto: P6675_HQ10_03_025_34_094_ortho, resolution 20 cm
Contour interval generated with the Canadian Digital Surface Model (CDSM), resolution 0.75 cm, 2000

Inventories and cartography: Poly-Géo, 2016 and 2017
File: 16025_po_011_site_4_170407.mxd

0 40 80 m

MTM, Zone 9, NAD83
Contour interval: 2 m

Map 3B

April 2017

POLY-GÉO INC.

76°13'40" 76°13'20" 76°13'

51°38'20" 51°38'40"

km 306

PU-04-01 PU-04-02 PU-04-03 PU-04-04 PU-04-05 PU-04-06 PU-04-07 PU-04-08 PU-04-09 PU-04-10 PU-04-11 PU-04-12 PU-04-13 PU-04-14 PU-04-15 PU-04-16 PU-04-17 PU-04-18 PU-04-19 PU-04-20 PU-04-21 PU-04-22 PU-04-23

246 250 254 256 258 260 242 240

Potential waste disposal site

PU-04-06 Test pit (*Poly-Géo, March 2017*)

PU-04-01 Test pit (*Poly-Géo, September 2016*)

Water course

Protection strip of 150 m from permanent water course

Proposed access road

Power line

Road kilometric point

51°38' 51°38'20" 76°13' 76°12'40" 51°38'20"

Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4

Test pit: **PU-04-01**

Date: September 21th 2016

Coordinates: UTM zone 18, NAD 83
X: 415 555 m. E.
Y: 5 721 668 m. N.

Approximated altitude : 257 m
Described by : Daniel Brosseau
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.35	**Organic matter**	4,5 m	- Relatively difficult excavation under 2 m of depth. Very stable walls. **- *Sample # 16-SG-08612 taken at 3 m depth (grain size analysis)** - Water content at 3.0 m : 6.7 %
0.35 - 1.0	**Silty sand or sandy silt**		
1.0 - 5.2	**Till* :** sand with 32 % of silt and clay, < 10% gravel, < 10% cobbles, < 10% boulders, Boulder: Ø max. 1500 mm		

Total depth: 5.2 m (no evidence of bedrock)





SNC·LAVALIN

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SOLS ET GRANULATS
SOMMAIRE DES ESSAIS

Soumis à : M. Daniel Brosseau , M.Sc.
Poly-Géo Inc.
624, Avenue Notre-Dame
St-Lambert, Québec, J4P 2L1

Entrepreneur : -

Projet : Poly-Géo - Analyses granulométriques et teneurs en eau

Localisation : Val-d'Or

Dossier N° : 641911

Date : 2016-10-26

Vos références

Réf. Client : 16025 - 16026

Bon de comma : 5065

RENSEIGNEMENTS GÉNÉRAUX

Numéro échantillon : 16-SG-08612
Type de matériau : Till
Calibre du matériau : Non spécifié
Usage proposé : Divers
Lieu de prélèvement : Site 4, Puit 01-4 (PU-04-01)
Date de prélèvement : 2016-09-21

Prélevé par : Client
Source : En place
Date de l'essai : 2016-10-13
Date de réception : 2016-10-05

GRANULOMÉTRIE (LC 21-040)

Tamis	% Passant	Exigences min.	Exigences max.
112 mm	100		
80 mm	100		
56 mm	100		
40 mm	97		
31,5 mm	96		
20 mm	93		
14 mm	91		
10 mm	89		
5 mm	84		
2,5 mm	80		
1,25 mm	73		
630 µm	64		
315 µm	53		
160 µm	42		
80 µm	31,6		

MODULE DE FINESSE : -

ESSAIS DIVERS		Résultats	Exigences min.	Exigences max.
Micro-Deval %	(LC 21-070)	-		
Micro-Deval (fin) %	(LC 21-101)	-		
Los Angeles %	(LC 21-400)	-		
MD + LA %	(NQ 2560-114)	-		
Densité brute >5mm	(LC 21-067)	-		
Densité SSS >5mm	(LC 21-067)	-		
Densité app. >5mm	(LC 21-067)	-		
Absorption >5mm %	(LC 21-067)	-		
Densité brute <5mm	(LC 21-065)	-		
Densité SSS <5mm		-		
Densité app. <5mm	(LC 21-065)	-		
Absorption <5mm %	(LC 21-065)	-		
Teneur en eau %	(LC 21-201)	6,7		

PROCTOR **Méthode** : -
Masse volumique sèche maximale : - kg/m³
Teneur en eau optimale : - %

REMARQUE : * Un astérisque accompagne tout résultat individuel non conforme lorsque les exigences sont spécifiées.

c.c. M. Richard Lévesque , géomorphologue, M.Sc. Poly-Géo Inc. (1)

Approuvé par : David Lettre, ing. Junior

Chargé de projet : Daniel Cockburn, ing., M.Sc.

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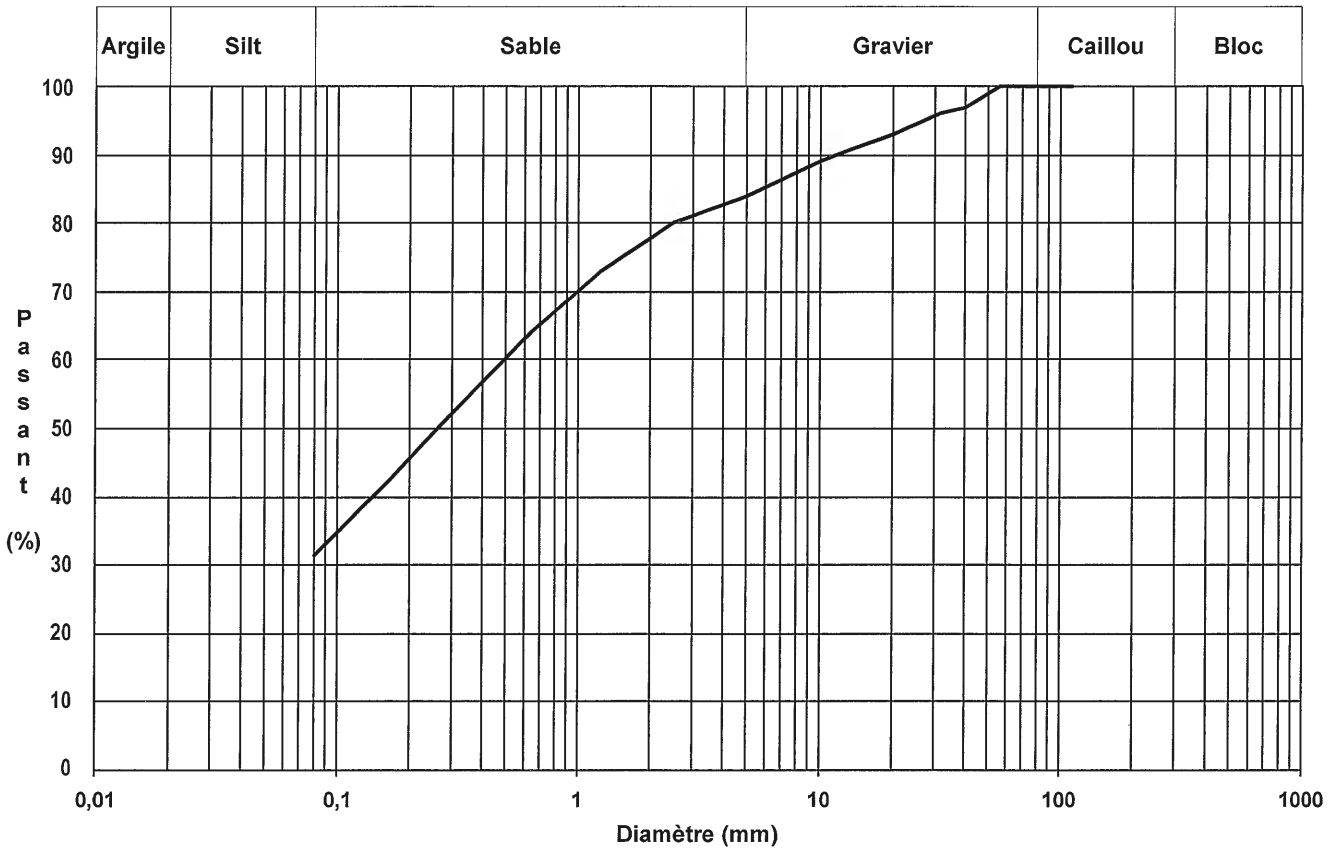
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ANALYSE GRANULOMÉTRIQUE

Soumis à	: M. Daniel Brosseau , M.Sc. Poly-Géo Inc. 624, Avenue Notre-Dame St-Lambert, Québec, J4P 2L1	**Dossier N°**	: 641911
		Date	: 2016-10-26
			Vos références
		Réf. Client	: 16025 - 16026
Entrepreneur	: -	**Bon de comma**	: 5065
Projet	: Poly-Géo - Analyses granulométriques et teneurs en eau		
Localisation	: Val-d'Or		

RENSEIGNEMENTS GÉNÉRAUX

Numéro échantillon	: 16-SG-08612	**Prélevé par**	: Client
Type de matériau	: Till	**Source**	: En place
Calibre du matériau	: Non spécifié	**Date de l'essai**	: 2016-10-13
Usage proposé	: Divers		
Lieu de prélèvement	: Site 4, Puit 01-4 (PU-04-01)		
Date de prélèvement	: 2016-09-21	**Date de réception**	: 2016-10-05

ANALYSE GRANULOMÉTRIQUE



Cu = -	Cc = -	D10 =	D30 =	D60 =

c.c. M. Richard Lévesque , géomorphologue, M.Sc. Poly-Géo Inc. (1)

Approuvé par : David Lettre, ing. Junior

Chargé de projet : Daniel Cockburn, ing., M.Sc.

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Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4

Test pit: **PU-04-02**

Date: September 21th 2016

Coordinates: UTM zone 18, NAD 83
X: 415 688 m. E.
Y: 5 721 672 m. N.

Approximated altitude : 259 m
Described by : Daniel Brosseau
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.3	**Organic matter**	Not reached	- Materials are very compact but well drained. The walls are very stable. **- *Sample # 16-SG-08611 taken at 3 m depth (grain size analysis)** - Water content at 2.0 m : 6.1 %
0.3 - 5.3	**Till* :** sand with 34 % silt and clay, < 10% gravel, < 10% cobbles, < 10% boulders, Boulder: Ø max. 800 mm		

Total depth: 5.3 m (no evidence of bedrock)





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SOMMAIRE DES ESSAIS

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Entrepreneur : -

Projet : Poly-Géo - Analyses granulométriques et teneurs en eau

Localisation : Val-d'Or

Dossier N° : 641911

Date : 2016-11-03

Vos références

Réf. Client : 16025 - 16026

Bon de comma : 5065

RENSEIGNEMENTS GÉNÉRAUX

Numéro échantillon : 15-SG-08611
Type de matériau : Till
Calibre du matériau : Non spécifié
Usage proposé : Divers
Lieu de prélèvement : Site 4, Puit 02-4 (PU-04-02)
Date de prélèvement : 2016-09-21

Prélevé par : Client
Source : En place.
Date de l'essai : 2016-10-13
Date de réception : 2016-10-05

GRANULOMÉTRIE (LC 21-040)

Tamis	% Passant	Exigences min.	Exigences max.
112 mm	100		
80 mm	100		
56 mm	99		
40 mm	96		
31,5 mm	94		
20 mm	92		
14 mm	90		
10 mm	89		
5 mm	85		
2,5 mm	82		
1,25 mm	76		
630 µm	67		
315 µm	57		
160 µm	45		
80 µm	33,7		

MODULE DE FINESSE : -

ESSAIS DIVERS		Résultats	Exigences min.	Exigences max.
Micro-Deval %	(LC 21-070)	-		
Micro-Deval (fin) %	(LC 21-101)	-		
Los Angeles %	(LC 21-400)	-		
MD + LA %	(NQ 2560-114)	-		
Densité brute >5mm	(LC 21-067)	-		
Densité SSS >5mm	(LC 21-067)	-		
Densité app. >5mm	(LC 21-067)	-		
Absorption >5mm %	(LC 21-067)	-		
Densité brute <5mm	(LC 21-065)	-		
Densité SSS <5mm		-		
Densité app. <5mm	(LC 21-065)	-		
Absorption <5mm %	(LC 21-065)	-		
Teneur en eau %	(LC 21-201)	6,1		

PROCTOR **Méthode** : -
Masse volumique sèche maximale : - kg/m³
Teneur en eau optimale : - %

REMARQUE : * Un astérisque accompagne tout résultat individuel non conforme lorsque les exigences sont spécifiées.

c.c. M. Richard Lévesque , géomorphologue, M.Sc. Poly-Géo Inc. (1)

Approuvé par : David Lettre, ing. Junior

Chargé de projet : Daniel Cockburn, ing., M.Sc.

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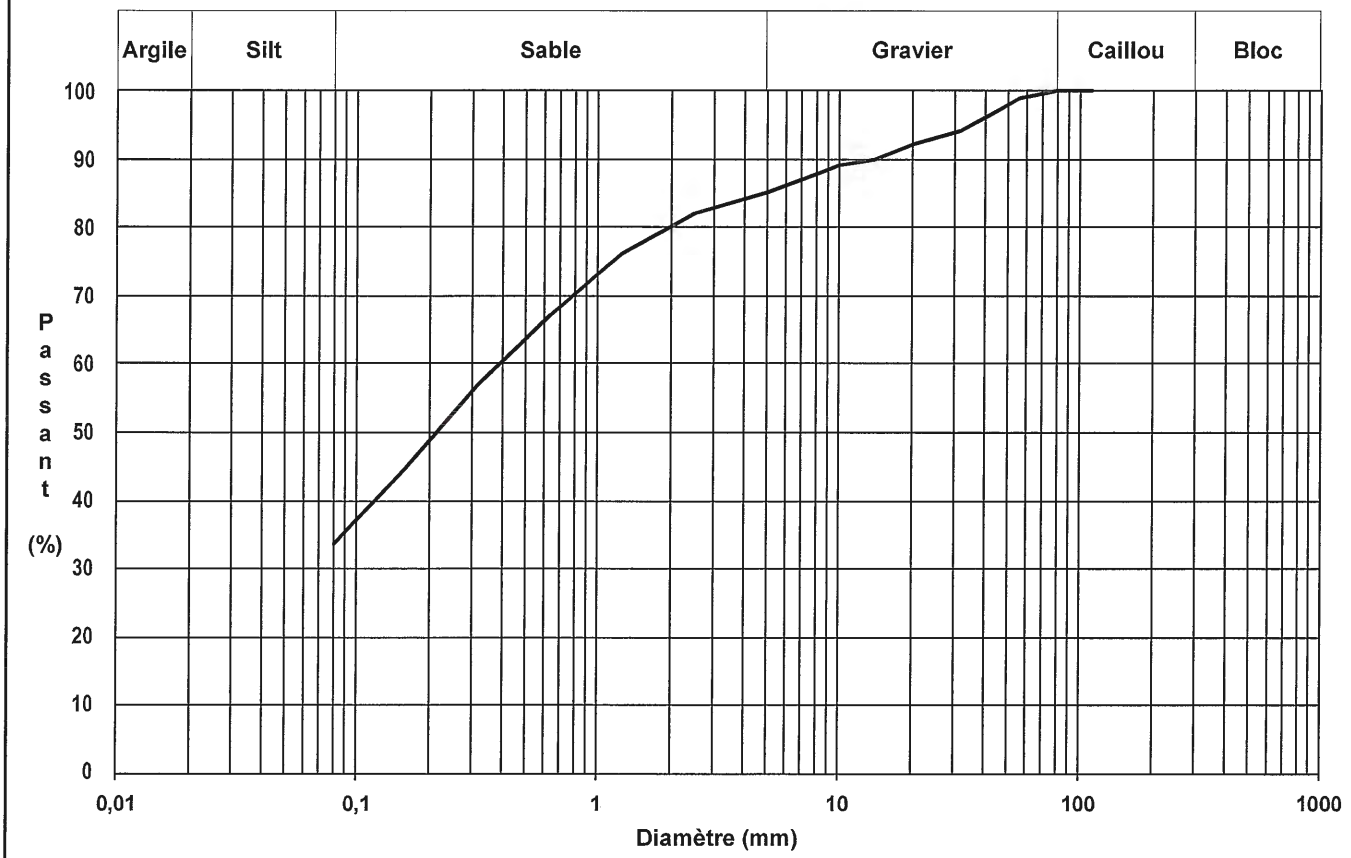
SOLS ET GRANULATS
ANALYSE GRANULOMÉTRIQUE

Soumis à	: M. Daniel Brosseau , M.Sc. Poly-Géo Inc. 624, Avenue Notre-Dame St-Lambert, Québec, J4P 2L1	**Dossier N°**	: 641911
		Date	: 2016-11-03
			Vos références
		Réf. Client	: 16025 - 16026
Entrepreneur	: -	**Bon de comma**	: 5065
Projet	: Poly-Géo - Analyses granulométriques et teneurs en eau		
Localisation	: Val-d'Or		

RENSEIGNEMENTS GÉNÉRAUX

Numéro échantillon	: 15-SG-08611	**Prélevé par**	: Client
Type de matériau	: Till	**Source**	: En place.
Calibre du matériau	: Non spécifié	**Date de l'essai**	: 2016-10-13
Usage proposé	: Divers		
Lieu de prélèvement	: Site 4, Puit 02-4 (PU-04-02)		
Date de prélèvement	: 2016-09-21	**Date de réception**	: 2016-10-05

ANALYSE GRANULOMÉTRIQUE



Cu = - **Cc = -** **D10 =** **D30 =** **D60 =**

c.c. M. Richard Lévesque , géomorphologue, M.Sc. Poly-Géo Inc. (1)

Approuvé par : David Lettre, ing. Junior

Chargé de projet : Daniel Cockburn, ing., M.Sc.

Le rapport d'essai ne doit pas être reproduit, sinon en entier, sans l'autorisation écrite de SNC-Lavalin GEM Québec inc.

Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4

Test pit: **PU-04-03**

Date: September 21th 2016

Coordinates: UTM zone 18, NAD 83
X: 415 656 m. E.
Y: 5 721 801 m. N.

Approximated altitude : 251 m
Described by : Daniel Brosseau
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.3	**Organic matter**	Not reached	- Excavation was moderate to difficult because of big boulders (>1000 mm of diameter) - Materials very compact but well drained. Walls stable.
0.3 - 5.0	**Till :** **s**and with 25 to 35% of silt and clay, < 10% gravel, < 10% cobbles, < 10% boulders, Boulder: Ø max. 1400 mm		

Total depth: 5.0 m (no evidence of bedrock)





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4

Test pit: **PU-04-04**

Date: September 21th 2016

Coordinates: UTM zone 18, NAD 83
X: 415 803 m. E.
Y: 5 721 836 m. N.

Approximated altitude : 252 m
Described by : Daniel Brosseau
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.3	**Organic matter**	Not reached	- The materials in the first 1.8 m of depth show almost no gravel, cobble or boulder. - Materials are well drained until 2.5 m where they begin to show a certain dampness. This may be due to a higher silt content. - Walls very stable.
0.3 - 5.0	**Till :** **s**and with 25 to 35 % of silt and clay, < 10% gravel, < 10% cobbles, < 10% boulders, Boulder: Ø max. 700 mm		

Total depth: 5.0 m (no evidence of bedrock)





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4
Test pit: **PU-04-05**
Date: September 21th 2016

Coordinates: UTM zone 18, NAD 83
X: 415 942 m. E.
Y: 5 721 919 m. N.

Approximated altitude : 255 m
Described by : Daniel Brosseau
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.2	**Organic matter**	Not reached	- Materials well drained. - Walls very stable.
0.2 - 4.4	**Till :** sand with 25 to 35 % of silt and clay, < 10% gravel, < 10% cobbles, < 10% boulders Boulder: Ø max. 800 mm		
4.4	**Bedrock**		

Total depth: 4.4 m (bedrock)





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4
Test pit: **PU-04-06**
Date: March 21th 2017

Coordinates: UTM zone 18, NAD 83
X: 415 443 m. E.
Y: 5 721 551 m. N.

Approximated altitude : 259 m
Described by : Richard Lévesque
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.1	**Organic matter**	Not reached	- Materials well drained. - Walls very stable.
0.1 - 4.5	**Till :** sand with 25 to 35 % of silt and clay, < 10% gravel, < 5% cobbles, < 5% boulders Boulder: Ø max. 400 mm		

Total depth: 4.5 m





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4
Test pit: **PU-04-07**
Date: March 21th 2017

Coordinates: UTM zone 18, NAD 83
X: 415 443 m. E.
Y: 5 721 447 m. N.

Approximated altitude : 266 m
Described by : Richard Lévesque
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.1	**Organic matter**	Not reached	- Materials well drained. - Walls very stable.
0.1 - 3.5	**Till :** sand with 25 to 30 % of silt and clay, < 10% gravel, < 5% cobbles, 25-30% boulders Boulder: Ø max. 800 mm		
3.5 - 5.0	**Till :** sand with 25 to 35 % of silt and clay, < 10% gravel, < 5% cobbles and		

Total depth: 5.0 m





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4
Test pit: **PU-04-08**
Date: March 21th 2017

Coordinates: UTM zone 18, NAD 83
X: 415 434 m. E.
Y: 5 721 398 m. N.

Approximated altitude : 264 m
Described by : Richard Lévesque
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.3	**Organic matter**	Not reached	
> 0.3	**Bedrock**		

Total depth: 0.3 m





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4
Test pit: **PU-04-09**
Date: March 21th 2017

Coordinates: UTM zone 18, NAD 83
X: 415 495 m. E.
Y: 5 721 365 m. N.

Approximated altitude : 265 m
Described by : Richard Lévesque
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.4	**Organic matter**	Not reached	
> 0.4	**Bedrock**		

Total depth: 0.4 m





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4
Test pit: **PU-04-10**
Date: March 21th 2017

Coordinates: UTM zone 18, NAD 83
X: 415 617 m. E.
Y: 5 721 393 m. N.

Approximated altitude : 270 m
Described by : Richard Lévesque
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.1	**Organic matter**	Not reached	- Materials well drained. - Walls very stable.
0.1 - 4.1	**Till :** sand with 25 to 35 % of silt and clay, < 10% gravel, < 5% cobbles, < 5% boulders Boulder: Ø max. 400 mm		

Total depth: 4.1 m





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4
Test pit: **PU-04-11**
Date: March 22th 2017

Coordinates: UTM zone 18, NAD 83
X: 415 676 m. E.
Y: 5 721 479 m. N.

Approximated altitude : 267 m
Described by : Richard Lévesque
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.4	**Organic matter**	Not reached	
> 0.4	**Bedrock**		

Total depth: 0.4 m





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4
Test pit: **PU-04-12**
Date: March 22th 2017

Coordinates: UTM zone 18, NAD 83
X: 415 700 m. E.
Y: 5 721 531 m. N.

Approximated altitude : 260 m
Described by : Richard Lévesque
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.2	**Organic matter**		- Some water infiltrations have been observed during the excavation between 2.5 and 4 m. - Unstable walls. Can not continue excavation beyond 4.1 m.
0.2 - 4.1	**Silty sand** < 10% gravel. < 5% cobbles	2.3 m	

Total depth: 4.1 m



Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4
Test pit: **PU-04-13**
Date: March 22th 2017

Coordinates: UTM zone 18, NAD 83
X: 415 633 m. E.
Y: 5 721 556 m. N.

Approximated altitude : 263 m
Described by : Richard Lévesque
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.2	**Organic matter**	Not reached	- Materials well drained. - Walls very stable.
0.2 - 5.1	**Till :** sand with 25 to 35 % of silt and clay, < 10% gravel, < 5% cobbles, ≠ boulders		

Total depth: 5.1 m





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4
Test pit: **PU-04-14**
Date: March 22th 2017

Coordinates: UTM zone 18, NAD 83
X: 415 544 m. E.
Y: 5 721 531 m. N.

Approximated altitude : 263 m
Described by : Richard Lévesque
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.2	**Organic matter**	Not reached	- Materials well drained. - Walls very stable.
0.2 - 5.1	**Till :** sand with 25 to 35 % of silt and clay, < 10% gravel, < 5% cobbles, ≠ boulders		

Total depth: 5.1 m





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4
Test pit: **PU-04-15**
Date: March 22th 2017

Coordinates: UTM zone 18, NAD 83
X: 415 771 m. E.
Y: 5 721 621 m. N.

Approximated altitude : 262 m
Described by : Richard Lévesque
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.2	**Organic matter**	Not reached	- Materials well drained. - Walls very stable.
0.2 - 4.9	**Till :** sand with 25 to 35 % of silt and clay, < 10% gravel, < 5% cobbles, ≠ boulders		

Total depth: 4.9 m





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4
Test pit: **PU-04-16**
Date: March 22th 2017

Coordinates: UTM zone 18, NAD 83
X: 415 877 m. E.
Y: 5 721 627 m. N.

Approximated altitude : 254 m
Described by : Richard Lévesque
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.5	**Organic matter**	1.6 m	- Many water infiltrations troughout the walls. - Walls are very unstable. Materials are completely saturated with water.
0.5 - 4.5	**Till :** sand with 30 to 40 % of silt and clay, < 10% gravel, < 5% cobbles, < 1% boulders		

Total depth: 4.5 m





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4
Test pit: **PU-04-17**
Date: March 22th 2017

Coordinates: UTM zone 18, NAD 83
X: 415 769 m. E.
Y: 5 721 727 m. N.

Approximated altitude : 266 m
Described by : Richard Lévesque
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.4	**Organic matter**	Not reached	- Materials well drained. - Walls very stable.
0.4 - 4.6	**Till :** sand with 25 to 35 % of silt and clay, < 10% gravel, < 5% cobbles, < 1% boulders		

Total depth: 4.6 m





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4
Test pit: **PU-04-18**
Date: March 22th 2017

Coordinates: UTM zone 18, NAD 83
X: 415 848 m. E.
Y: 5 721 764 m. N.

Approximated altitude : 265 m
Described by : Richard Lévesque
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.2	**Organic matter**	Not reached	- Materials well drained. - Walls very stable.
0.2 - 5.1	**Till :** sand with 25 to 35 % of silt and clay, < 10% gravel, < 5% cobbles, < 1% boulders		

Total depth: 5.1 m





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4
Test pit: **PU-04-19**
Date: March 22th 2017

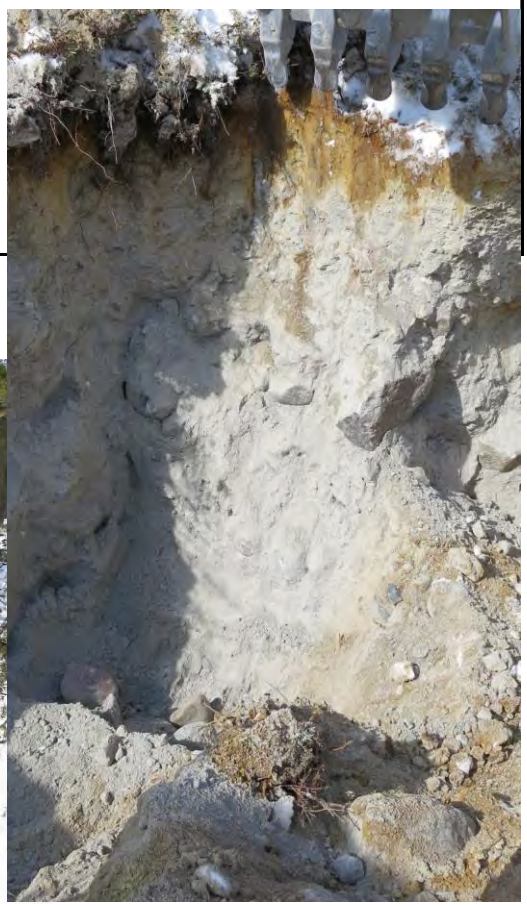
Coordinates: UTM zone 18, NAD 83
X: 415 927 m. E.
Y: 5 721 747 m. N.

Approximated altitude : 259 m
Described by : Richard Lévesque
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.2	**Organic matter**	Not reached	- Materials well drained. - Walls very stable. - Unable to continue excavation due to the presence of boulders.
0.2 - 3.1	**Till :** sand with 25 to 35 % of silt and clay, < 10% gravel, < 5% cobbles, < 1% boulders		
> 3.1	**Bed of boulders**		

Total depth: 3.1 m





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4
Test pit: **PU-04-20**
Date: March 22th 2017

Coordinates: UTM zone 18, NAD 83
X: 416 001 m. E.
Y: 5 721 832 m. N.

Approximated altitude : 259 m
Described by : Richard Lévesque
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.3	**Organic matter**	Not reached	- Materials well drained. - Walls very stable.
0.3 - 4.7	**Till :** sand with 25 to 35 % of silt and clay, < 10% gravel, < 5% cobbles, < 1% boulders		

Total depth: 4.7 m





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4
Test pit: **PU-04-21**
Date: March 22th 2017

Coordinates: UTM zone 18, NAD 83
X: 416 036 m. E.
Y: 5 721 965 m. N.

Approximated altitude : 261 m
Described by : Richard Lévesque
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.2	**Organic matter**	Not reached	- Materials well drained. - Walls very stable.
0.2 - 4.7	**Till :** sand with 25 to 35 % of silt and clay, < 10% gravel, < 5% cobbles, < 1% boulders		

Total depth: 4.7 m





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4
Test pit: **PU-04-22**
Date: March 22th 2017

Coordinates: UTM zone 18, NAD 83
X: 415 821 m. E.
Y: 5 721 926 m. N.

Approximated altitude : 265 m
Described by : Richard Lévesque
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.2	**Organic matter**	Not reached	- Materials well drained. - Walls very stable.
0.2 - 4.8	**Till :** sand with 25 to 35 % of silt and clay, < 10% gravel, < 10% cobbles, < 5% boulders		

Total depth: 4.8 m





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 4
Test pit: **PU-04-23**
Date: March 22th 2017

Coordinates: UTM zone 18, NAD 83
X: 415 894 m. E.
Y: 5 721 854 m. N.

Approximated altitude : 267 m
Described by : Richard Lévesque
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.2	**Organic matter**	Not reached	- Materials well drained. - Walls very stable.
0.2 - 5.0	**Till :** sand with 25 to 35 % of silt and clay, < 10% gravel, < 10% cobbles, < 5% boulders		

Total depth: 5.0 m

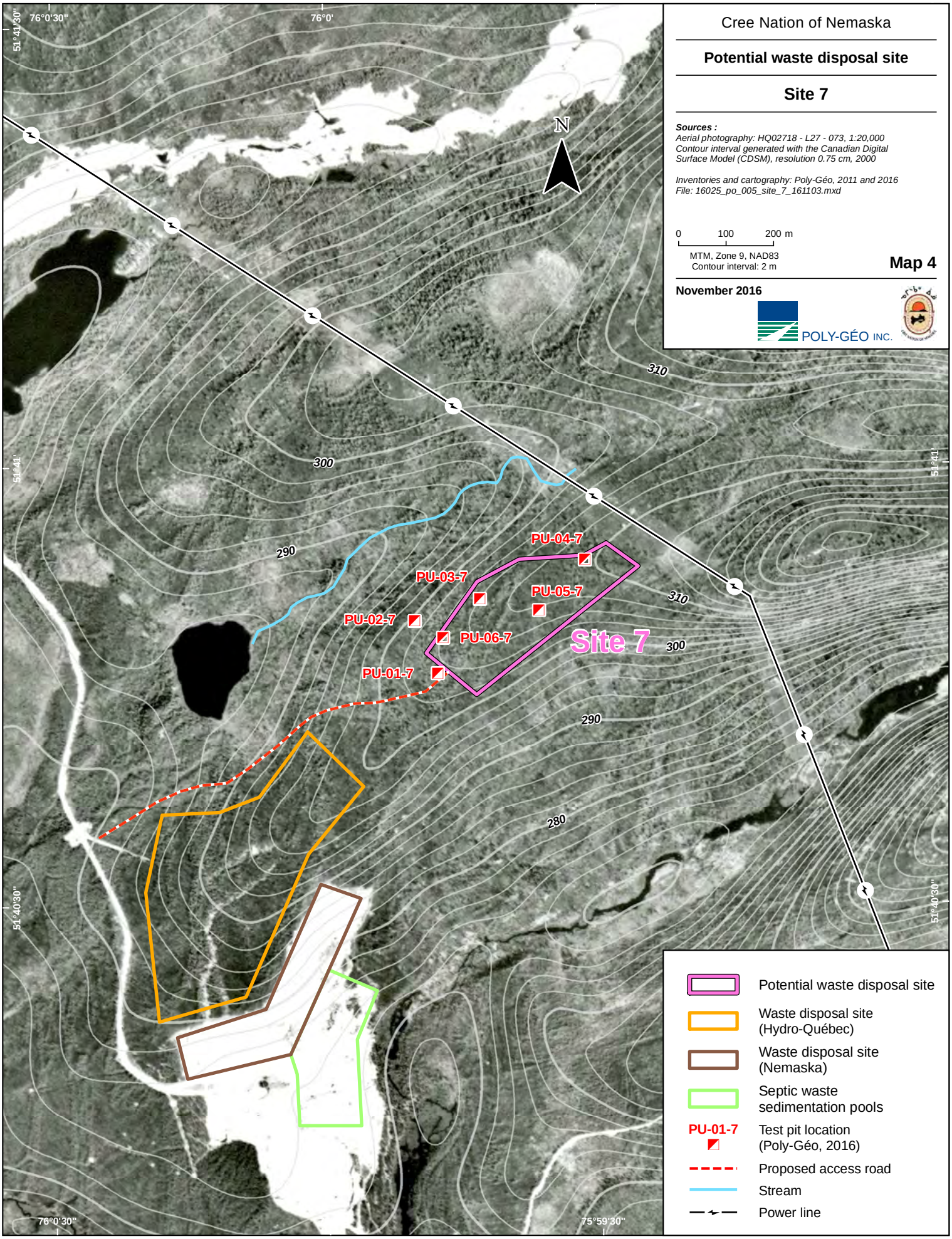




APPENDIX 4

SITE 7

- Map 4: Site 7
- Technical description of test pits
- Grain size analysis



Cree Nation of Nemaska

Potential waste disposal site

Site 7

Sources :
Aerial photography: HQ02718 - L27 - 073, 1:20,000
Contour interval generated with the Canadian Digital Surface Model (CDSM), resolution 0.75 cm, 2000

Inventories and cartography: Poly-Géo, 2011 and 2016
File: 16025_po_005_site_7_161103.mxd

0 100 200 m

MTM, Zone 9, NAD83
Contour interval: 2 m

Map 4

November 2016

POLY-GÉO INC.

- Potential waste disposal site
- Waste disposal site (Hydro-Québec)
- Waste disposal site (Nemaska)
- Septic waste sedimentation pools
- PU-01-7 Test pit location (Poly-Géo, 2016)
- Proposed access road
- Stream
- Power line

Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 7

Test pit: **PU-01-7**

Date: September 20th 2016

Coordinates: UTM zone 18, NAD 83
X: 431 093 m. E.
Y: 5 725 852 m. N.

Approximated altitude : 304 m
Described by : Daniel Brosseau
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.3	**Organic matter**	2,6 m	- Relatively easy excavation with moderatly stable walls. - Some water infiltrations have been observed during the excavation, at depths of 2,5 and 3,8 m. - Some boulders reaching a diameter of 1000 mm have been observed on the surface. **- *Sample # 16-SG-08613 taken at 4.2 m depth (grain size analysis)** - Water content at 4.2 m : 8.5 %
0.3 - 5.5	**Till* :** sand with 25 % of silt and clay, < 10% gravel, < 10% cobbles, < 10% boulders, Boulder: Ø max. 800 mm		

Total depth: 5.5 m (no evidence of bedrock)





SNC·LAVALIN

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Fax : (819) 824-3762

SOLS ET GRANULATS
SOMMAIRE DES ESSAIS

Soumis à : M. Daniel Brosseau , M.Sc.
Poly-Géo Inc.
624, Avenue Notre-Dame
St-Lambert, Québec, J4P 2L1

Entrepreneur : -

Projet : Poly-Géo - Analyses granulométriques et teneurs en eau

Localisation : Val-d'Or

Dossier N° : 641911

Date : 2016-10-26

Vos références

Réf. Client : 16025 - 16026

Bon de comma : 5065

RENSEIGNEMENTS GÉNÉRAUX

Numéro échantillon : 16-SG-08613
Type de matériau : Till
Calibre du matériau : Non spécifié
Usage proposé : Divers
Lieu de prélèvement : Site 7, Puit 01-7
Date de prélèvement : 2016-09-20

Prélevé par : Client
Source : En place.
Date de l'essai : 2016-10-13
Date de réception : 2016-10-05

GRANULOMÉTRIE (LC 21-040)

Tamis	% Passant	Exigences min.	Exigences max.
112 mm	100		
80 mm	100		
56 mm	100		
40 mm	98		
31,5 mm	96		
20 mm	91		
14 mm	88		
10 mm	85		
5 mm	79		
2,5 mm	74		
1,25 mm	67		
630 µm	59		
315 µm	48		
160 µm	36		
80 µm	24,9		

MODULE DE FINESSE : -

ESSAIS DIVERS		Résultats	Exigences min.	Exigences max.
Micro-Deval %	(LC 21-070)	-		
Micro-Deval (fin) %	(LC 21-101)	-		
Los Angeles %	(LC 21-400)	-		
MD + LA %	(NQ 2560-114)	-		
Densité brute >5mm	(LC 21-067)	-		
Densité SSS >5mm	(LC 21-067)	-		
Densité app. >5mm	(LC 21-067)	-		
Absorption >5mm %	(LC 21-067)	-		
Densité brute <5mm	(LC 21-065)	-		
Densité SSS <5mm		-		
Densité app. <5mm	(LC 21-065)	-		
Absorption <5mm %	(LC 21-065)	-		
Teneur en eau %	(LC 21-201)	8,5		

PROCTOR **Méthode** : -
Masse volumique sèche maximale : - kg/m³
Teneur en eau optimale : - %

REMARQUE : * Un astérisque accompagne tout résultat individuel non conforme lorsque les exigences sont spécifiées.

c.c. M. Richard Lévesque , géomorphologue, M.Sc. Poly-Géo Inc. (1)

Approuvé par : David Lettre, ing. Junior

Chargé de projet : Daniel Cockburn, ing., M.Sc.

Le rapport d'essai ne doit pas être reproduit, sinon en entier, sans l'autorisation écrite de SNC-Lavalin GEM Québec inc.
Ces résultats ne se rapportent qu'aux échantillons soumis pour analyses

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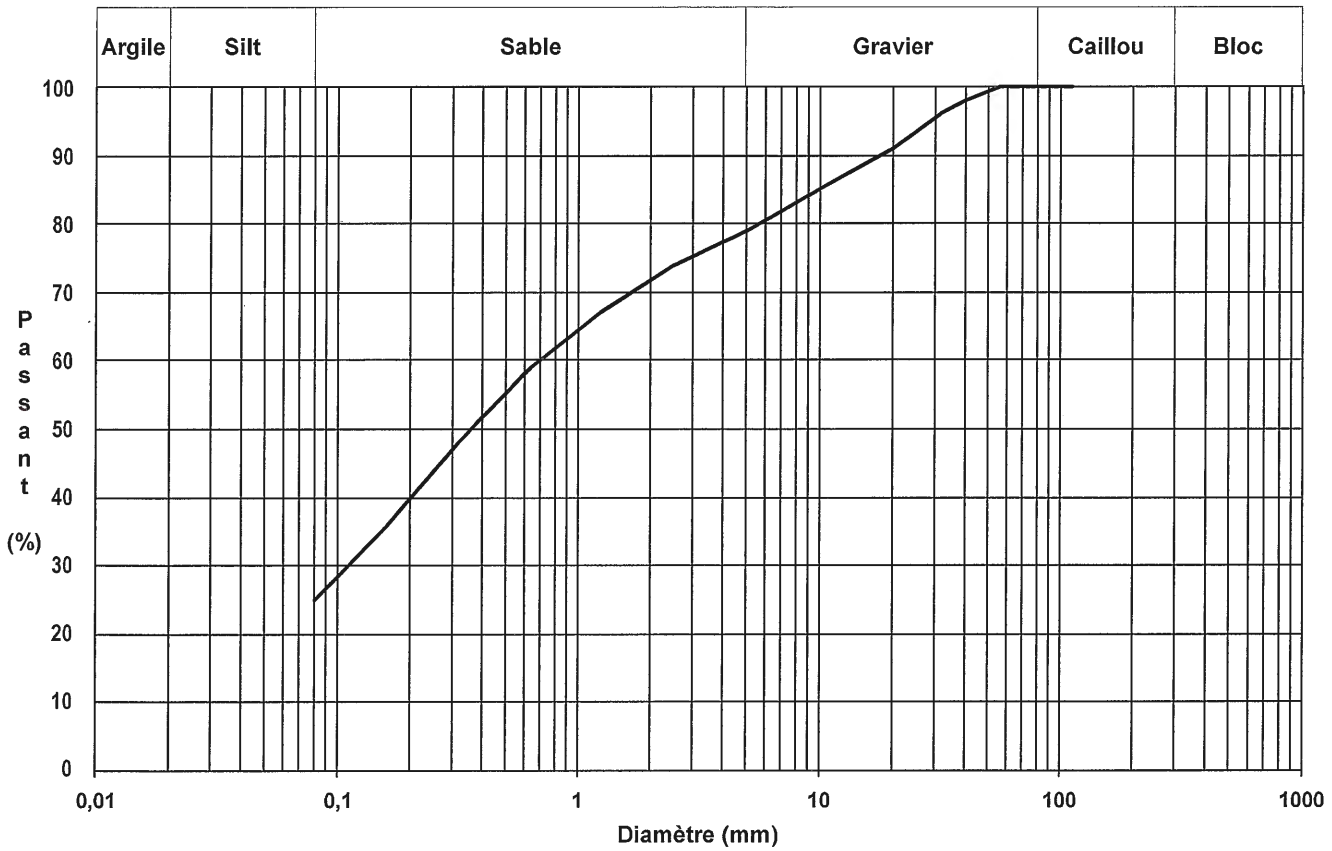
SOLS ET GRANULATS
ANALYSE GRANULOMÉTRIQUE

Soumis à	: M. Daniel Brosseau , M.Sc. Poly-Géo Inc. 624, Avenue Notre-Dame St-Lambert, Québec, J4P 2L1	**Dossier N°**	: 641911
		Date	: 2016-10-26
		Vos références	
		Réf. Client	: 16025 - 16026
Entrepreneur	: -	**Bon de comma**	: 5065
Projet	: Poly-Géo - Analyses granulométriques et teneurs en eau		
Localisation	: Val-d'Or		

RENSEIGNEMENTS GÉNÉRAUX

Numéro échantillon	: 16-SG-08613	**Prélevé par**	: Client
Type de matériau	: Till	**Source**	: En place.
Calibre du matériau	: Non spécifié	**Date de l'essai**	: 2016-10-13
Usage proposé	: Divers		
Lieu de prélèvement	: Site 7, Puit 01-7		
Date de prélèvement	: 2016-09-20	**Date de réception**	: 2016-10-05

ANALYSE GRANULOMÉTRIQUE



Cu = -	Cc = -	D10 =	D30 =	D60 =

c.c. M. Richard Lévesque , géomorphologue, M.Sc. Poly-Géo Inc. (1)

Approuvé par : David Lettre, ing. Junior

Chargé de projet : Daniel Cockburn, ing., M.Sc.

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Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 7

Test pit: **PU-02-7**

Date: September 20th 2016

Coordinates: UTM zone 18, NAD 83
X: 431 047 m. E.
Y: 5 725 963 m. N.

Approximated altitude : 302 m
Described by : Daniel Brosseau
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.3	**Organic matter**	Not reached	- Bedrock has a smooth surface and seems to be sloping down towards the NE.
0.3 - 1.5	**Till :** **s**and with 25 to 35 % of silt and clay, < 10% gravel, < 10% cobbles, < 10% boulders		
1.5	**Bedrock**		

Total depth: 1.5 m (bedrock)





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 7

Test pit: **PU-03-7**

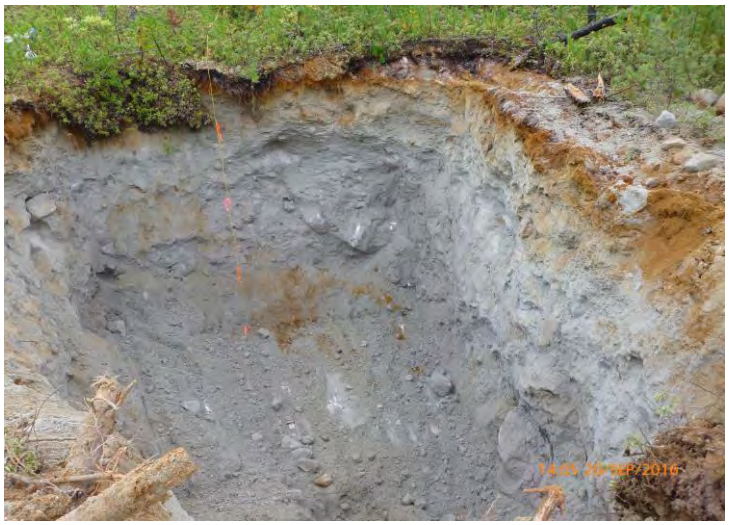
Date: September 20th 2016

Coordinates: UTM zone 18, NAD 83
X: 431 185 m. E.
Y: 5 726 007 m. N.

Approximated altitude : 303 m
Described by : Daniel Brosseau
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0,0 - 0.3	**Organic matter**	Not reached	- Relatively easy excavation above 3.2 m of depth and the walls show a great stability. - Some boulders observed below 3.5 m have very angular edges. This usually suggest the proximity of bedrock. **- *Sample # 16-SG-08599 taken at 3.5 m depth (grain size analysis)** - Water content at 3.5 m : 6.2%
0.3 - 3.7	**Till* :** sand with 28% of silt and clay, < 10% gravel, < 10% cobbles, < 10% boulders, Boulder: Ø max. 2000 mm		
> 3.7 m	**Probable bedrock**		

Total depth: 3.7 m (probable bedrock)





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SOLS ET GRANULATS
SOMMAIRE DES ESSAIS

Soumis à : M. Daniel Brosseau , M.Sc.
Poly-Géo Inc.
624, Avenue Notre-Dame
St-Lambert, Québec, J4P 2L1

Entrepreneur : -

Projet : Poly-Géo - Analyses granulométriques et teneurs en eau

Localisation : Val-d'Or

Dossier N° : 641911

Date : 2016-10-26

Vos références

Réf. Client : 16025 - 16026

Bon de comma : 5065

RENSEIGNEMENTS GÉNÉRAUX

Numéro échantillon	: 16-SG-08599	**Prélevé par**	: Client
Type de matériau	: Till	**Source**	: En place
Calibre du matériau	: Non spécifié	**Date de l'essai**	: 2016-10-05
Usage proposé	: Divers		
Lieu de prélèvement	: Site 7, Puit 03-7		
Date de prélèvement	: 2016-09-20	**Date de réception**	: 2016-10-05

ANALYSE GRANULOMÉTRIQUE

Tamis	% Passant	Exigences min.	Exigences max.
112 mm	100		
80 mm	100		
56 mm	100		
40 mm	97		
31,5 mm	97		
20 mm	97		
14 mm	95		
10 mm	91		
5 mm	85		
2,5 mm	79		
1,25 mm	72		
630 µm	63		
315 µm	51		
160 µm	39		
80 µm	27,6		

MODULE DE FINESSE : -

ESSAIS DIVERS		Résultats	Exigences min.	Exigences max.
Micro-Deval %	(LC 21-070)	-		
Micro-Deval (fin) %	(LC 21-101)	-		
Los Angeles %	(LC 21-400)	-		
MD + LA %	(NQ 2560-114)	-		
Densité brute >5mm	(LC 21-067)	-		
Densité SSS >5mm	(LC 21-067)	-		
Densité app. >5mm	(LC 21-067)	-		
Absorption >5mm %	(LC 21-067)	-		
Densité brute <5mm	(LC 21-065)	-		
Densité SSS <5mm		-		
Densité app. <5mm	(LC 21-065)	-		
Absorption <5mm %	(LC 21-065)	-		
Teneur en eau %	(LC 21-201)	6,2		

PROCTOR **Méthode** : -

Masse volumique sèche maximale : - kg/m³

Teneur en eau optimale : - %

REMARQUE : * Un astérisque accompagne tout résultat individuel non conforme lorsque les exigences sont spécifiées.

c.c. M. Richard Lévesque , géomorphologue, M.Sc. Poly-Géo Inc. (1)

Approuvé par : David Lettre, ing. Junior

Chargé de projet : Daniel Cockburn, ing., M.Sc.

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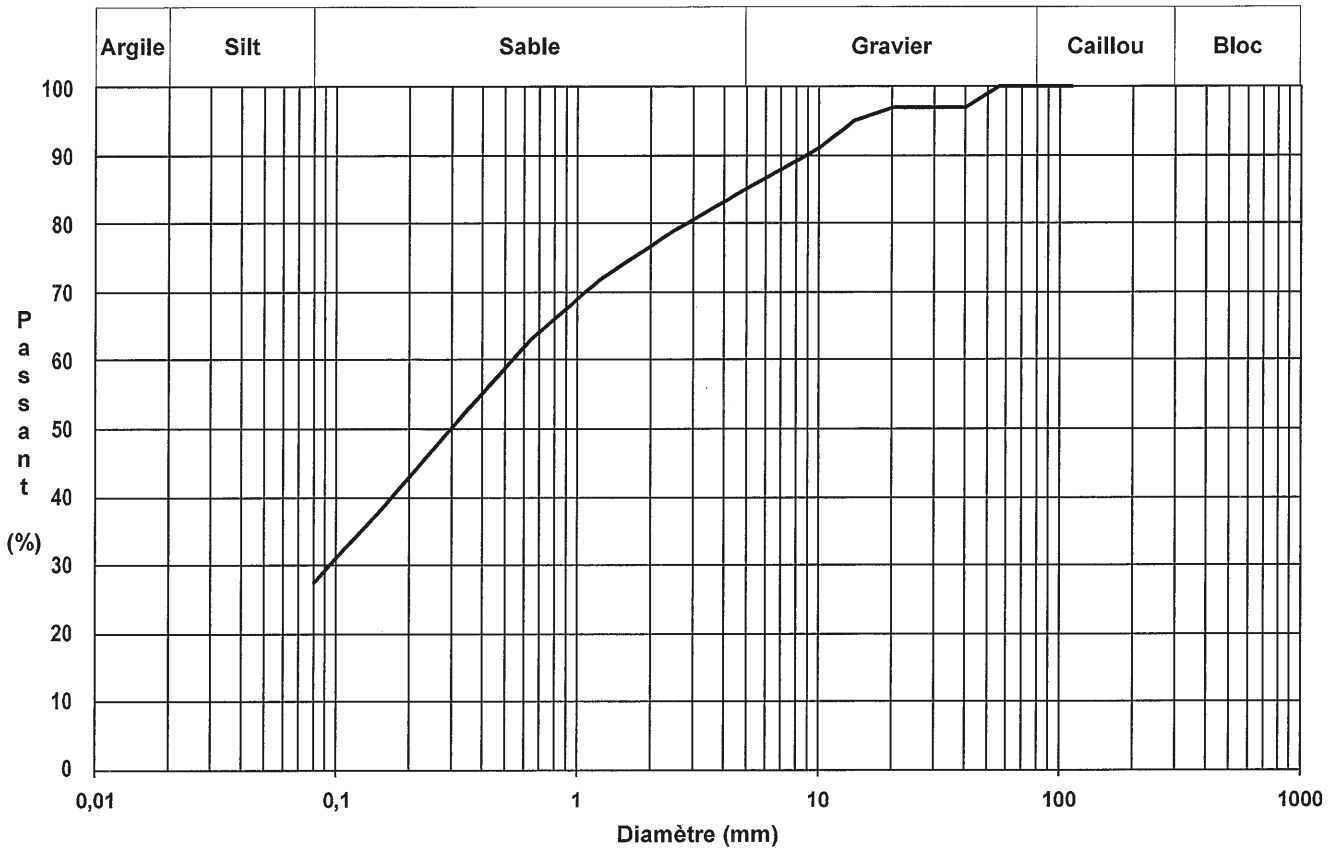
SOLS ET GRANULATS
ANALYSE GRANULOMÉTRIQUE

Soumis à	: M. Daniel Brosseau , M.Sc. Poly-Géo Inc. 624, Avenue Notre-Dame St-Lambert, Québec, J4P 2L1	**Dossier N°**	: 641911
		Date	: 2016-10-26
			Vos références
		Réf. Client	: 16025 - 16026
Entrepreneur	: -	**Bon de comma**	: 5065
Projet	: Poly-Géo - Analyses granulométriques et teneurs en eau		
Localisation	: Val-d'Or		

RENSEIGNEMENTS GÉNÉRAUX

Numéro échantillon	: 16-SG-08599	**Prélevé par**	: Client
Type de matériau	: Till	**Source**	: En place
Calibre du matériau	: Non spécifié	**Date de l'essai**	: 2016-10-05
Usage proposé	: Divers		
Lieu de prélèvement	: Site 7, Puit 03-7		
Date de prélèvement	: 2016-09-20	**Date de réception**	: 2016-10-05

ANALYSE GRANULOMÉTRIQUE



Cu = -	Cc = -	D10 =	D30 =	D60 =

c.c. M. Richard Lévesque , géomorphologue, M.Sc. Poly-Géo Inc. (1)

Approuvé par : David Lettre, ing. Junior

Chargé de projet : Daniel Cockburn, ing., M.Sc.

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Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 7
Test pit: **PU-04-7**
Date: September 20th 2016

Coordinates: UTM zone 18, NAD 83
X: 431 409 m. E.
Y: 5 726 085 m. N.

Approximated altitude : 307 m
Described by : Daniel Brosseau
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.3	**Organic matter**	Not reached	- Materials are very well drained.
0.3 - 5.2	**Till* :** sand with 24 % of silt and clay, < 10% gravel, < 10% cobbles, < 10% boulders, Boulder: Ø max. 500 mm		**- *Sample # 16-SG-08614 taken at 3.3 m depth (grain size analysis)** - Water content at 2.3 m : 4.8 %

Total depth: 5.2 m (no evidence of bedrock)





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SOMMAIRE DES ESSAIS

Soumis à : M. Daniel Brosseau , M.Sc.
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624, Avenue Notre-Dame
St-Lambert, Québec, J4P 2L1

Entrepreneur : -

Projet : Poly-Géo - Analyses granulométriques et teneurs en eau

Localisation : Val-d'Or

Dossier N° : 641911

Date : 2016-10-26

Vos références

Réf. Client : 16025 - 16026

Bon de comma : 5065

RENSEIGNEMENTS GÉNÉRAUX

Numéro échantillon	: 16-SG-08614	**Prélevé par**	: Client
Type de matériau	: Till	**Source**	: En place
Calibre du matériau	: Non spécifié	**Date de l'essai**	: 2016-10-13
Usage proposé	: Divers		
Lieu de prélèvement	: Site 7, Puit 04-7		
Date de prélèvement	: 2016-09-20	**Date de réception**	: 2016-10-05

GRANULOMÉTRIE (LC 21-040)

Tamis	% Passant	Exigences min.	Exigences max.
112 mm	100		
80 mm	100		
56 mm	100		
40 mm	99		
31,5 mm	97		
20 mm	93		
14 mm	90		
10 mm	87		
5 mm	81		
2,5 mm	76		
1,25 mm	70		
630 µm	61		
315 µm	49		
160 µm	36		
80 µm	23,8		

MODULE DE FINESSE : -

ESSAIS DIVERS		Résultats	Exigences min.	Exigences max.
Micro-Deval %	(LC 21-070)	-		
Micro-Deval (fin) %	(LC 21-101)	-		
Los Angeles %	(LC 21-400)	-		
MD + LA %	(NQ 2560-114)	-		
Densité brute >5mm	(LC 21-067)	-		
Densité SSS >5mm	(LC 21-067)	-		
Densité app. >5mm	(LC 21-067)	-		
Absorption >5mm %	(LC 21-067)	-		
Densité brute <5mm	(LC 21-065)	-		
Densité SSS <5mm		-		
Densité app. <5mm	(LC 21-065)	-		
Absorption <5mm %	(LC 21-065)	-		
Teneur en eau %	(LC 21-201)	4,8		

PROCTOR **Méthode** : -

Masse volumique sèche maximale : - kg/m³

Teneur en eau optimale : - %

REMARQUE : * Un astérisque accompagne tout résultat individuel non conforme lorsque les exigences sont spécifiées.

c.c. M. Richard Lévesque , géomorphologue, M.Sc. Poly-Géo Inc. (1)

Approuvé par : David Lettre, ing. Junior

Chargé de projet : Daniel Cockburn, ing., M.Sc.

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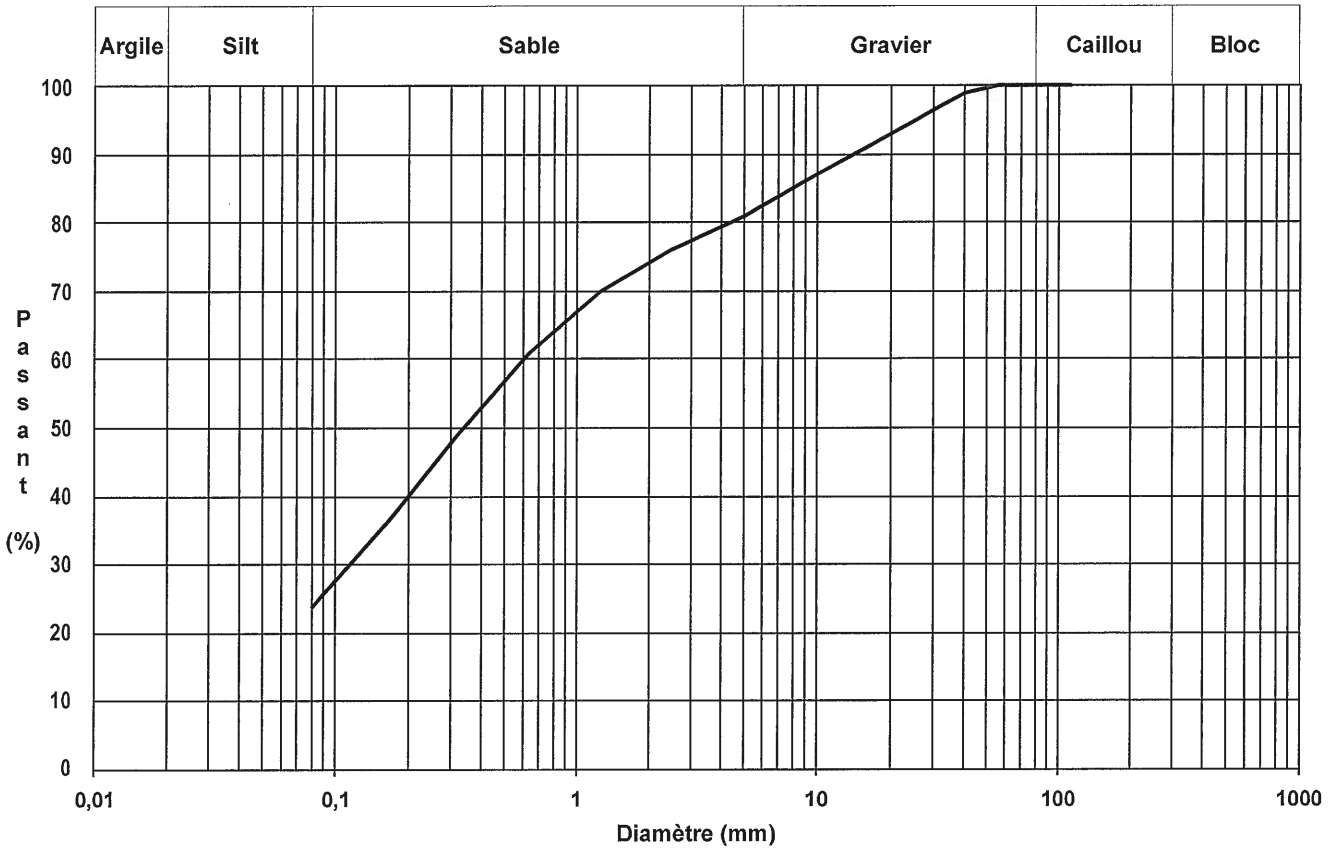
SOLS ET GRANULATS
ANALYSE GRANULOMÉTRIQUE

Soumis à	: M. Daniel Brosseau , M.Sc. Poly-Géo Inc. 624, Avenue Notre-Dame St-Lambert, Québec, J4P 2L1	**Dossier N°**	: 641911
		Date	: 2016-10-26
		Vos références	
		Réf. Client	: 16025 - 16026
Entrepreneur	: -	**Bon de comma**	: 5065
Projet	: Poly-Géo - Analyses granulométriques et teneurs en eau		
Localisation	: Val-d'Or		

RENSEIGNEMENTS GÉNÉRAUX

Numéro échantillon	: 16-SG-08614	**Prélevé par**	: Client
Type de matériau	: Till	**Source**	: En place
Calibre du matériau	: Non spécifié	**Date de l'essai**	: 2016-10-13
Usage proposé	: Divers		
Lieu de prélèvement	: Site 7, Puit 04-7		
Date de prélèvement	: 2016-09-20	**Date de réception**	: 2016-10-05

ANALYSE GRANULOMÉTRIQUE



Cu = -	Cc = -	D10 =	D30 =	D60 =

c.c. M. Richard Lévesque , géomorphologue, M.Sc. Poly-Géo Inc. (1)

Approuvé par : David Lettre, ing. Junior

Chargé de projet : Daniel Cockburn, ing., M.Sc.

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Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 7

Test pit: **PU-05-7**

Date: September 20th 2016

Coordinates: UTM zone 18, NAD 83
X: 431 309 m. E.
Y: 5 725 981 m. N.

Approximated altitude : 310 m
Described by : Daniel Brosseau
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.3	**Organic matter**	Not reached	- Excavation is moderate to difficult. - Materials are relatively well drained but slightly humid in the bottom of the hole.
0.3 - 5.0	**Till :** **s**and with 25 to 30 % of silt and clay, < 10% gravel, < 10% cobbles, < 10% boulders, Boulder: Ø max. 2000 mm		

Total depth: 5.0 m (no evidence of bedrock)





Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 7

Test pit: **PU-06-7**

Date: September 20th 2016

Coordinates: UTM zone 18, NAD 83
X: 431 106 m. E.
Y: 5 725 927 m. N.

Approximated altitude : 304 m
Described by : Daniel Brosseau
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 0.2	**Organic matter**	3,2 m	- Excavation is difficult below 3,4 m of depth. - Moderate water infiltration at a depth of 3.5 m and important at a depth of 4.4 m.
0.2 - 4.6	**Till :** sand with 25 to 30 % of silt and clay, < 10% gravel, < 10% cobbles, < 10% boulders, Boulder: Ø max. 700 mm		
4.6	**Bedrock**		

Total depth: 4.6 m (bedrock)

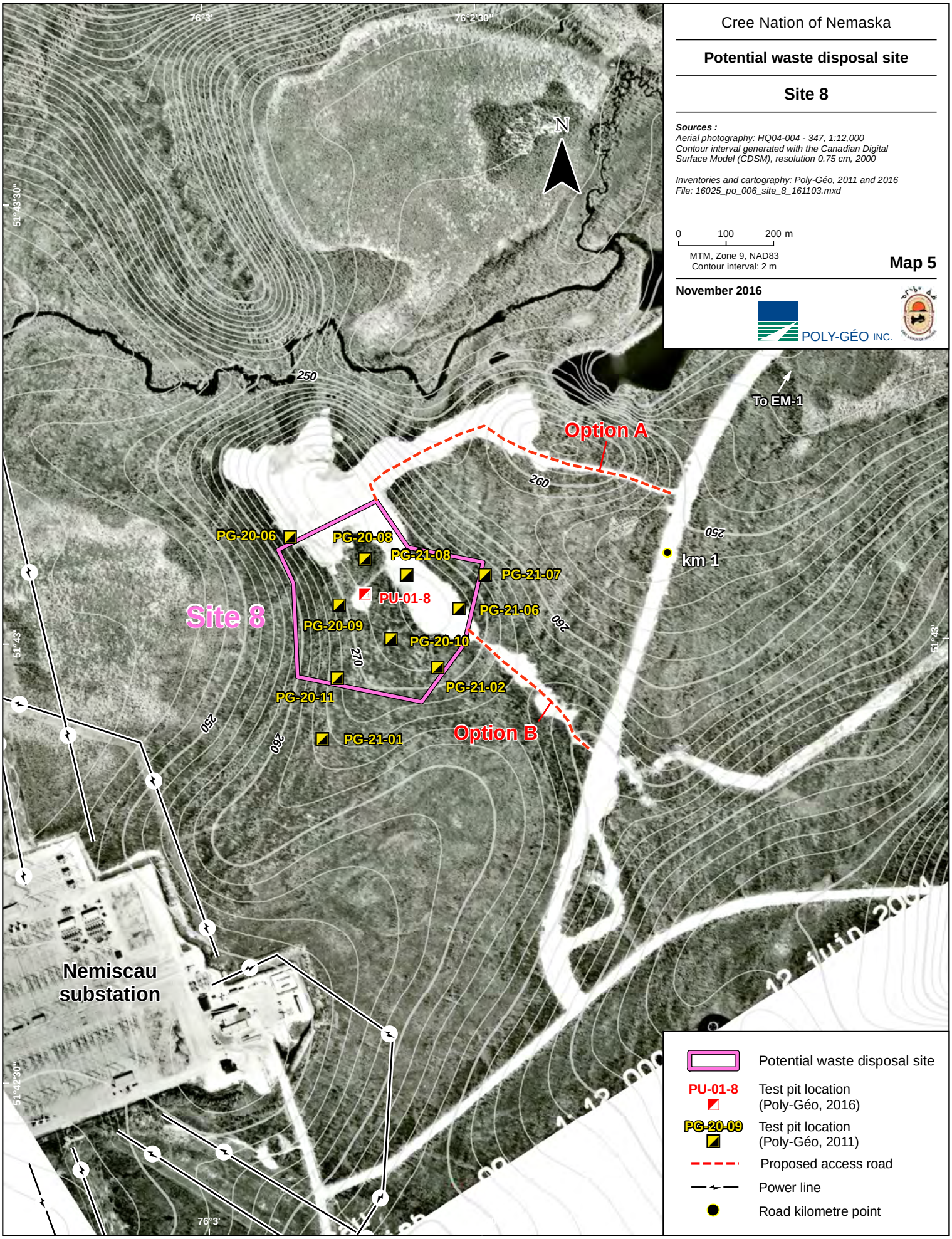




APPENDIX 5

SITE 8

- Map 5: Site 8
- Technical description of test pits *(this study and Poly-Géo, 2011)*
- Grain size analysis *(Poly-Géo, 2011)*



Cree Nation of Nemaska

Potential waste disposal site

Site 8

Sources :
Aerial photography: HQ04-004 - 347, 1:12,000
Contour interval generated with the Canadian Digital Surface Model (CDSM), resolution 0.75 cm, 2000

Inventories and cartography: Poly-Géo, 2011 and 2016
File: 16025_po_006_site_8_161103.mxd

0 100 200 m

MTM, Zone 9, NAD83
Contour interval: 2 m

Map 5

November 2016

POLY-GÉO INC.

Project: 16025 - CREE NATION OF NEMASKA : Exploration of potential sites for a new waste disposal site

Technical description of test pits

SITE 8

Test pit: **PU-01-8**

Date: September 22th 2016

Coordinates: UTM zone 18, NAD 83
X: 427 800 m. E.
Y: 5 730 145 m. N.

Approximated altitude : 266 m
Described by : Daniel Brosseau
Equipement: Volvo EC250E L

Depth (m)	Material	Water table	Comments
0.0 - 1.0	**Organic matter**	Not reached	- Relatively easy excavation but the walls were not stable. - Overall, the materials are very well drained but the silty sands below 4.5 m are sightly humid.
1.0 - 4.2	**Alternating beds of fine to medium sand and silty sand,** <10% of gravel		
4.2 - 6.5	**Silty sand**		

Total depth: 6.5 m (no evidence of bedrock)





Data obtained from the study :

POLY-GÉO INC. (2011). POTENTIAL GRANULAR BORROW SOURCES IN THE NEMASKA AREA – Mechanical shovel exploration. Final report present to the Cree Nation of Nemaska. 12 p., 2 appendices

NOTE: *SITE 8 is a portion of the former deposit GD-5B*

POLY-GÉO INC.

Test pit description

No and Poly-Géo project : 11819 - Potential borrow sources for the Cree nation of Nemaska

Site : Deposit GD-05B

Test pit : PG-20-06

Location : 0.3 km west of km 1 of the Nemiscau / Eastmain-1 Road

SNRC sheet : 32N/09

Equipment : Komatsu PC 200

Logged by : Frédéric Vinet

Coordonnates : (UTM, z18, nad 83) 427 645 m E 5 730 267 m N

Test pit depth : 4.5 m

Test pit date : 03/20/2011 (mm/dd/yyyy)

Depth (m)	Description	Level (m)	Sample	Water table	Remarks
	Organic matter	0.0 - 0.1			
1	Sand with a small amount of gravel	0.1 - 1.2			- Reforested sector
	Sand and gravel with a small amount of cobbles and few boulders	1.2 - 1.7			
2					
3	Gravelly sand with few cobbles and boulders (Average diameter of boulders is 0.3 m)	1.7 - 4.5	20-06		
4					
5	End of test pit at 4.5 m				
6					



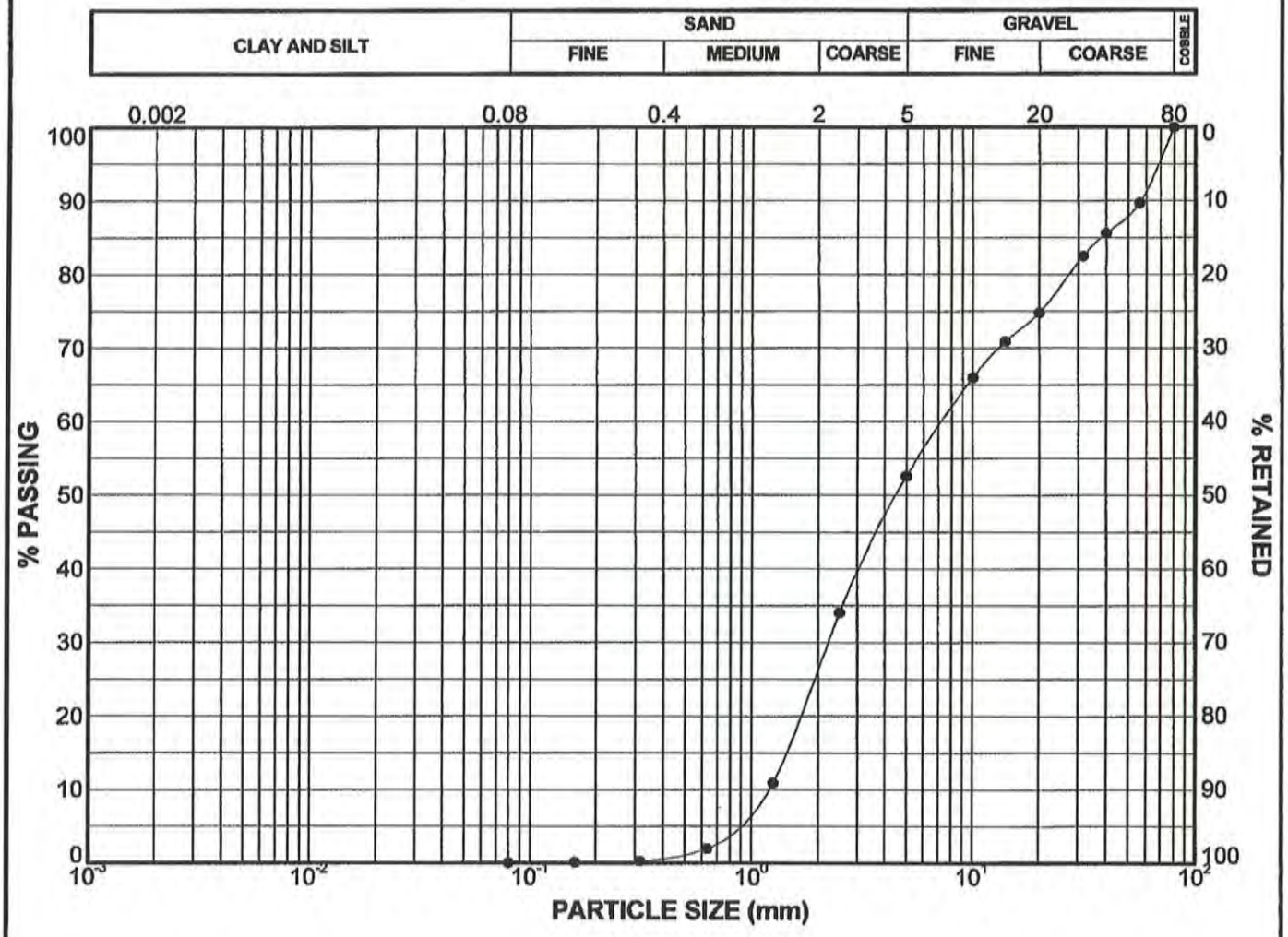


Qualitas

PARTICLE SIZE DISTRIBUTION

Figure 1

CLIENT : Poly-Géo Inc.
PROJECT : Granular research in Nemaska
LOCATION : GD-5B
FILE : 2014-01S



	Sounding	Sample	Depth (m)	Gravel (%)	Sand (%)	Silt and Clay (%)	Description
●	20-06	VR-26	0.00 to 5.00	47	53	0	Sand and gravel

REMARKS:

POLY-GÉO INC.

Test pit description

No and Poly-Géo project : 11819 - Potential borrow sources for the Cree nation of Nemaska

Site : Deposit GD-05B

Test pit : PG-20-08

Location : 0.3 km west of km 1 of the Nemiscau / Eastmain-1 Road

SNRC sheet : 32N/09

Equipment : Komatsu PC 200

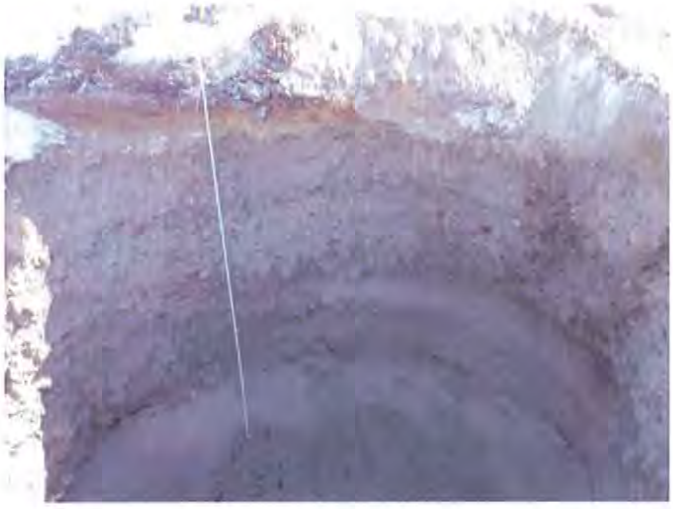
Logged by : Frédéric Vinet

Coordonnates : (UTM, z18, nad 83) 427 802 m E 5 730 217 m N

Test pit depth : 4.0 m

Test pit date : 03/20/2011 (mm/dd/yyyy)

Depth (m)	Description	Level (m)	Sample	Water table	Remarks
	Organic matter	0.0 - 0.1			
	Oxidized silty sand	0.1 - 0.4			
1	Sand and gravel with few cobbles	0.4 - 1.6			
2	Sand and gravel with a small amount of cobbles and few boulders (Average diameter of boulders is 0.3 m)	1.6 - 2.8			
3	Stratifications of sand and sand with a small amount of silt	2.8 - 4.0			
4					
	End of test pit at 4.0 m				
5					
6					





POLY-GÉO INC.

Test pit description

No and Poly-Géo project : 11819 - Potential borrow sources for the Cree nation of Nemaska

Site : Deposit GD-05B

Test pit : PG-20-09

Location : 0.3 km west of km 1 of the Nemiscau / Eastmain-1 Road

SNRC sheet : 32N/09

Equipment : Komatsu PC 200

Logged by : Frédéric Vinet

Coordonnates : (UTM, z18, nad 83) 427 746 m E 5 730 121 m N

Test pit depth : 4.3 m

Test pit date : 03/20/2011 (mm/dd/yyyy)

Depth (m)	Description	Level (m)	Sample	Water table	Remarks
	Organic matter	0.0 - 0.1			
	Oxidized sand with a small amount of gravel	0.1 - 0.7			
1	Sand with few beds of silty sand	0.7 - 1.5			
2					
3	Sand with traces of gravel and traces of silt	1.5 - 4.3	20-09		
4					
5	End of test pit at 4.3 m				
6					



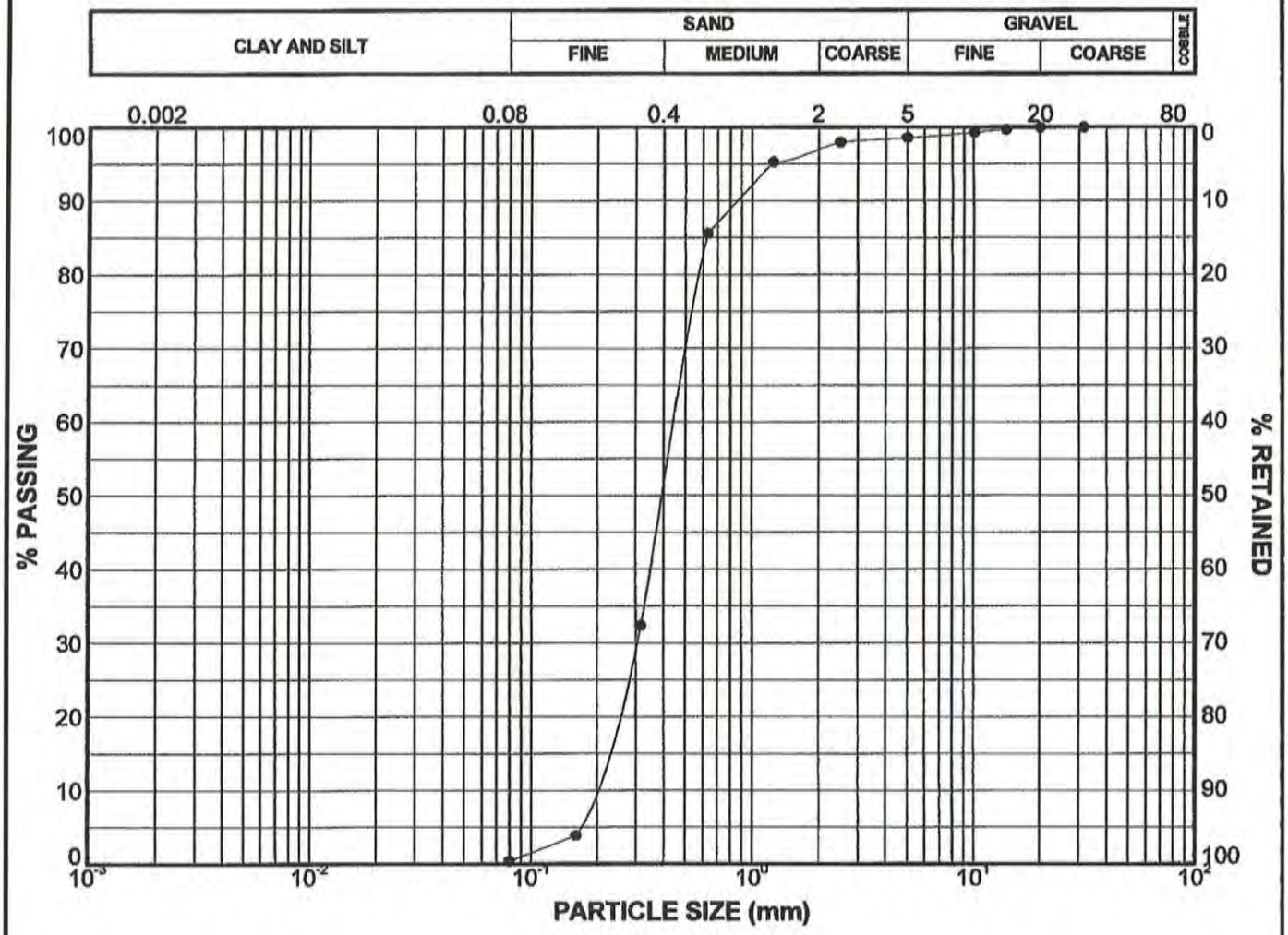


Qualitas

PARTICLE SIZE DISTRIBUTION

Figure 1

CLIENT : Poly-Géo Inc.
PROJECT : Granular research in Nemaska
LOCATION : GD-5B
FILE : 2014-01S



	Sounding	Sample	Depth (m)	Gravel (%)	Sand (%)	Silt and Clay (%)	Description
●	20-09	VR-27	0.00 to 5.00	1	98	0	Sand with gravel trace

REMARKS:

POLY-GÉO INC.

Test pit description

No and Poly-Géo project : 11819 - Potential borrow sources for the Cree nation of Nemaska

Site : Deposit GD-05B

Test pit : PG-20-10

Location : 0.3 km west of km 1 of the Nemiscau / Eastmain-1 Road

SNRC sheet : 32N/09

Equipment : Komatsu PC 200

Logged by : Frédéric Vinet

Coordonnates : (UTM, z18, nad 83) 427 854 m E 5 730 047 m N

Test pit depth : 5.0 m

Test pit date : 03/20/2011 (mm/dd/yyyy)

Depth (m)	Description	Level (m)	Sample	Water table	Remarks
	Organic matter	0.0 - 0.1			
1	Sand and gravel with few cobbles	0.1 - 1.2			
2	Stratifications of sand with a small amount of gravel and gravel with a small amount of cobbles	1.2 - 4.4	20-10		
3					
4					
5	Silty fine sand	4.4 - 5.0			
6	End of test pit at 5.0 m				



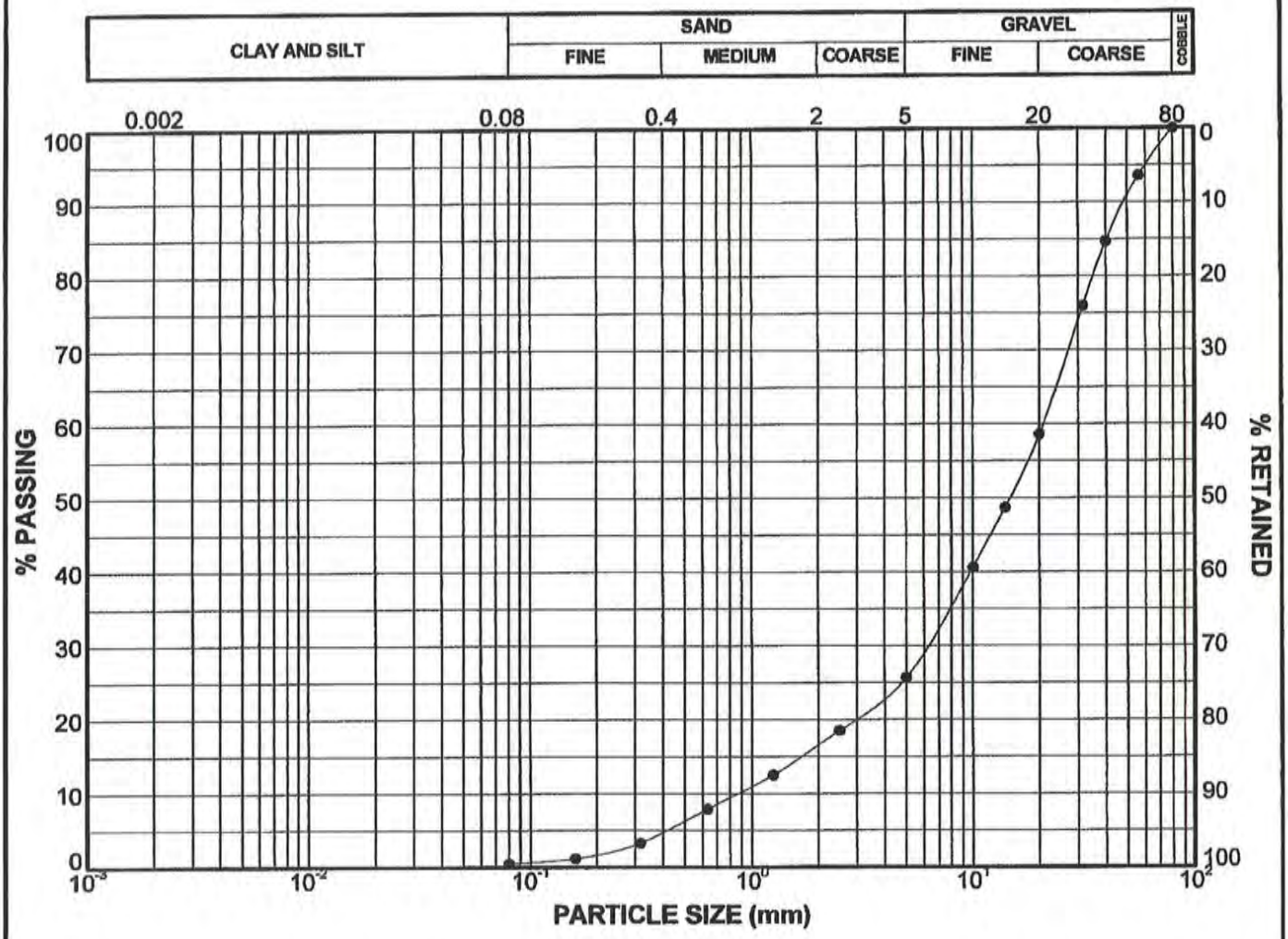


Qualitas

PARTICLE SIZE DISTRIBUTION

Figure 1

CLIENT : Poly-Géo Inc.
PROJECT : Granular research in Nemaska
LOCATION : GD-5B
FILE : 2014-01S



	Sounding	Sample	Depth (m)	Gravel (%)	Sand (%)	Silt and Clay (%)	Description
●	20-10	VR-28	0.00 to 5.00	74	25	1	Sandy gravel with silt trace

REMARKS:

POLY-GÉO INC.

Test pit description

No and Poly-Géo project : 11819 - Potential borrow sources for the Cree nation of Nemaska

Site : Deposit GD-05B

Test pit : PG-20-11

Location : 0.3 km west of km 1 of the Nemiscau / Eastmain-1 Road

SNRC sheet : 32N/09

Equipment : Komatsu PC 200

Logged by : Frédéric Vinet

Coordonnates : (UTM, z18, nad 83) 427 739 m E 5 729 966 m N

Test pit depth : 4.5 m

Test pit date : 03/20/2011 (mm/dd/yyyy)

Depth (m)	Description	Level (m)	Sample	Water table	Remarks
	Organic matter	0.0 - 0.1			
1	Oxidized sand with a small amount of gravel	0.1 - 1.0			
	Stratifications of fine sand and silty sand	1.0 - 1.6			
2	Sand with traces of gravel	1.6 - 2.7			
3	Sand with traces of silt	2.7 - 4.5			
4					
5	End of test pit at 4.5 m				
6					





POLY-GÉO INC.

Test pit description

No and Poly-Géo project : 11819 - Potential borrow sources for the Cree nation of Nemaska **Site :** Deposit GD-05B **Test pit :** PG-21-01

Location : 0.3 km west of km 1 of the Nemiscau / Eastmain-1 Road

SNRC sheet : 32N/09 **Equipment :** Komatsu PC 200 **Logged by :** Frédéric Vinet

Coordonnates : (UTM, z18, nad 83) 427 704 m E 5 729 839 m N **Test pit depth :** 2.5 m **Test pit date :** 03/21/2011 (mm/dd/yyyy)

Depth (m)	Description	Level (m)	Sample	Water table	Remarks
	Organic matter	0.0 - 0.1			
	Sand with a small amount of gravel and few cobbles	0.1 - 0.6			- Sector already exploited
1	Till	0.6 - 2.5			
2					
3	End of test pit at 2.5 m				
4					
5					
6					



POLY-GÉO INC.

Test pit description

No and Poly-Géo project : 11819 - Potential borrow sources for the Cree nation of Nemaska

Site : Deposit GD-05B

Test pit : PG-21-02

Location : 0.3 km west of km 1 of the Nemiscau / Eastmain-1 Road

SNRC sheet : 32N/09

Equipment : Komatsu PC 200

Logged by : Frédéric Vinet

Coordonnates : (UTM, z18, nad 83) 427 951 m E 5 729 985 m N

Test pit depth : 4.3 m

Test pit date : 03/21/2011 (mm/dd/yyyy)

Depth (m)	Description	Level (m)	Sample	Water table	Remarks
	Organic matter	0.0 - 0.1			
1	Stratifications of sand and gravelly sand	0.1 - 1.2			
2	Sand with traces of gravel and few cobbles	1.2 - 2.9			
3					
4	Sand with traces of gravel and traces of silt	2.9 - 4.3	21-02		
5	End of test pit at 4.3 m				
6					



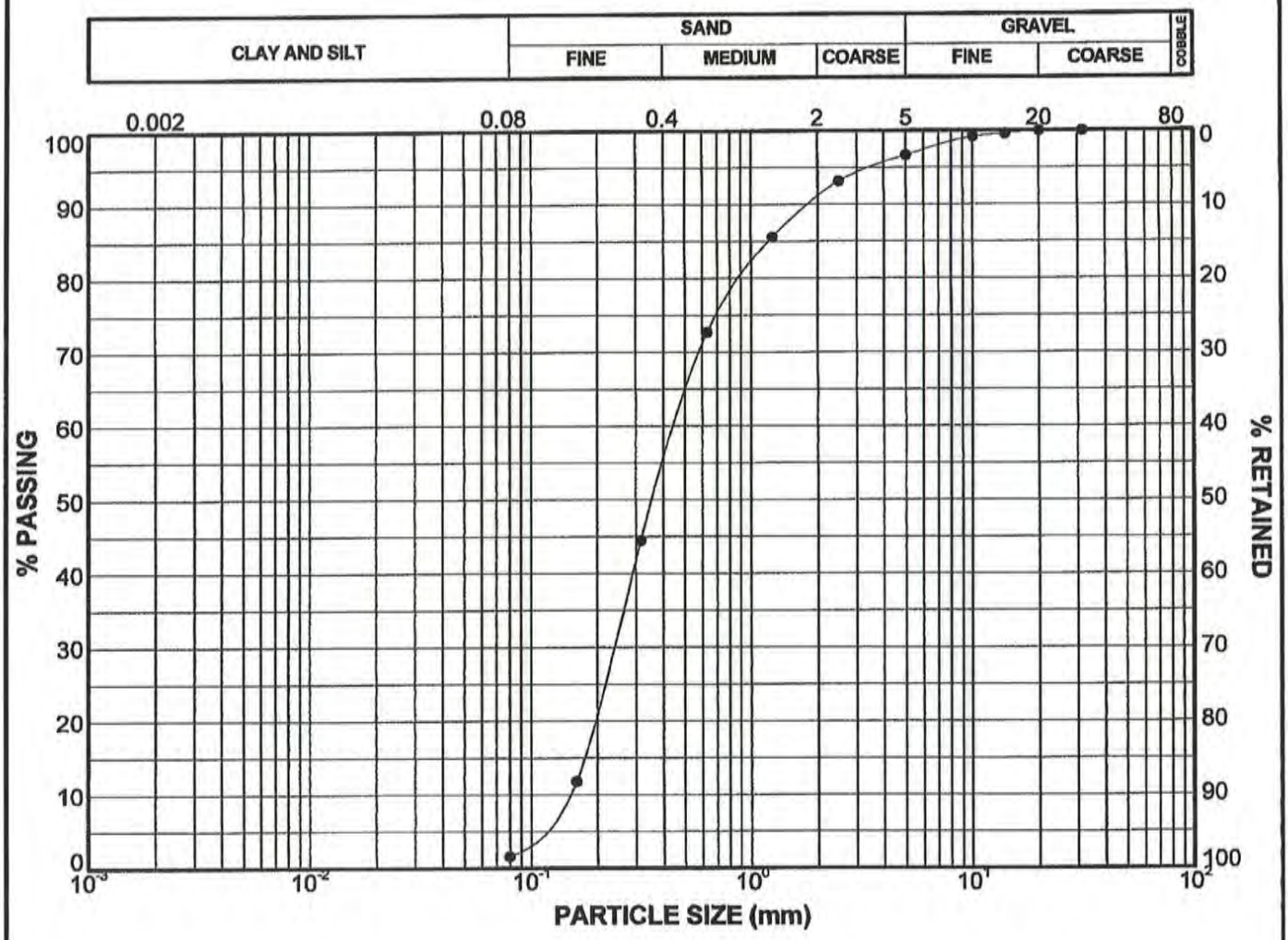


Qualitas

PARTICLE SIZE DISTRIBUTION

Figure 1

CLIENT : Poly-Géo Inc.
PROJECT : Granular research in Nemaska
LOCATION : GD-5B
FILE : 2014-01S



	Sounding	Sample	Depth (m)	Gravel (%)	Sand (%)	Silt and Clay (%)	Description
●	21-02	VR-29	0.00 to 5.00	3	95	2	Sand with gravel trace, with silt trace

REMARKS:

POLY-GÉO INC.

Test pit description

No and Poly-Géo project : 11819 - Potential borrow sources for the Cree nation of Nemaska

Site : Deposit GD-05B

Test pit : PG-21-06

Location : 0.3 km west of km 1 of the Nemiscau / Eastmain-1 Road

SNRC sheet : 32N/09

Equipment : Komatsu PC 200

Logged by : Frédéric Vinet

Coordonnates : (UTM, z18, nad 83) 427 999 m E 5 730 108 m N

Test pit depth : 4.7 m

Test pit date : 03/21/2011 (mm/dd/yyyy)

Depth (m)	Description	Level (m)	Sample	Water table	Remarks
	Organic matter	0.0 - 0.1			
	Sand with a small amount of fine gravel (Presence of a silt bed about 5 cm thick)	0.1 - 0.9			- Stripped and partially exploited
1					
2	Sand with traces of gravel and few cobbles and boulders (Average diameter of boulders is 0.3 m)	0.9 - 2.7			
3					
4	Gravelly sand with traces of cobbles and boulders	2.7 - 4.7	21-06		
5	End of test pit at 4.7 m				
6					



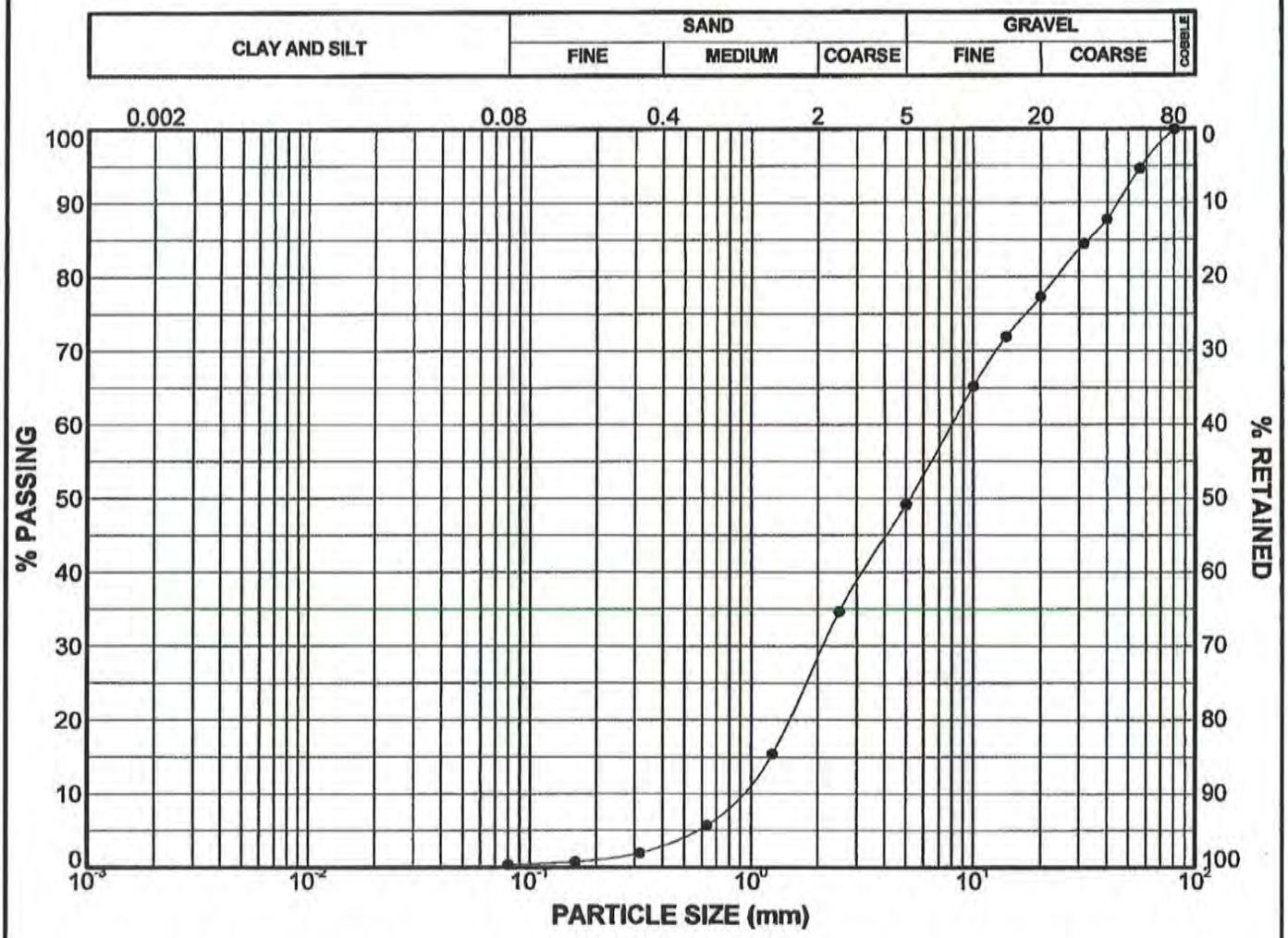


Qualitas

PARTICLE SIZE DISTRIBUTION

Figure 1

CLIENT : Poly-Géo Inc.
PROJECT : Granular research in Nemaska
LOCATION : GD-5B
FILE : 2014-01S



	Sounding	Sample	Depth (m)	Gravel (%)	Sand (%)	Silt and Clay (%)	Description
●	21-06	VR-31	0.00 to 5.00	51	49	0	Gravel and sand

REMARKS:

POLY-GÉO INC.

Test pit description

No and Poly-Géo project : 11819 - Potential borrow sources for the Cree nation of Nemaska **Site :** Deposit GD-05B **Test pit :** PG-21-07

Location : 0.3 km west of km 1 of the Nemiscau / Eastmain-1 Road

SNRC sheet : 32N/09 **Equipment :** Komatsu PC 200 **Logged by :** Frédéric Vinet

Coordonnates : (UTM, z18, nad 83) 428 055 m E 5 730 179 m N **Test pit depth :** 5.0 m **Test pit date :** 03/21/2011 (mm/dd/yyyy)

Depth (m)	Description	Level (m)	Sample	Water table	Remarks
	Organic matter	0.0 - 0.1			
	Coarse to medium sand	0.1 - 0.4			
1					
2	Stratifications of fine sand and silty sand	0.4 - 5.0			
3					
4					
5					
	End of test pit at 5.0 m				
6					





POLY-GÉO INC.

Test pit description

No and Poly-Géo project : 11819 - Potential borrow sources for the Cree nation of Nemaska

Site : Deposit GD-05B

Test pit : PG-21-08

Location : 0.3 km west of km 1 of the Nemiscau / Eastmain-1 Road

SNRC sheet : 32N/09

Equipment : Komatsu PC 200

Logged by : Frédéric Vinet

Coordonnates : (UTM, z18, nad 83) 427 890 m E 5 730 183 m N

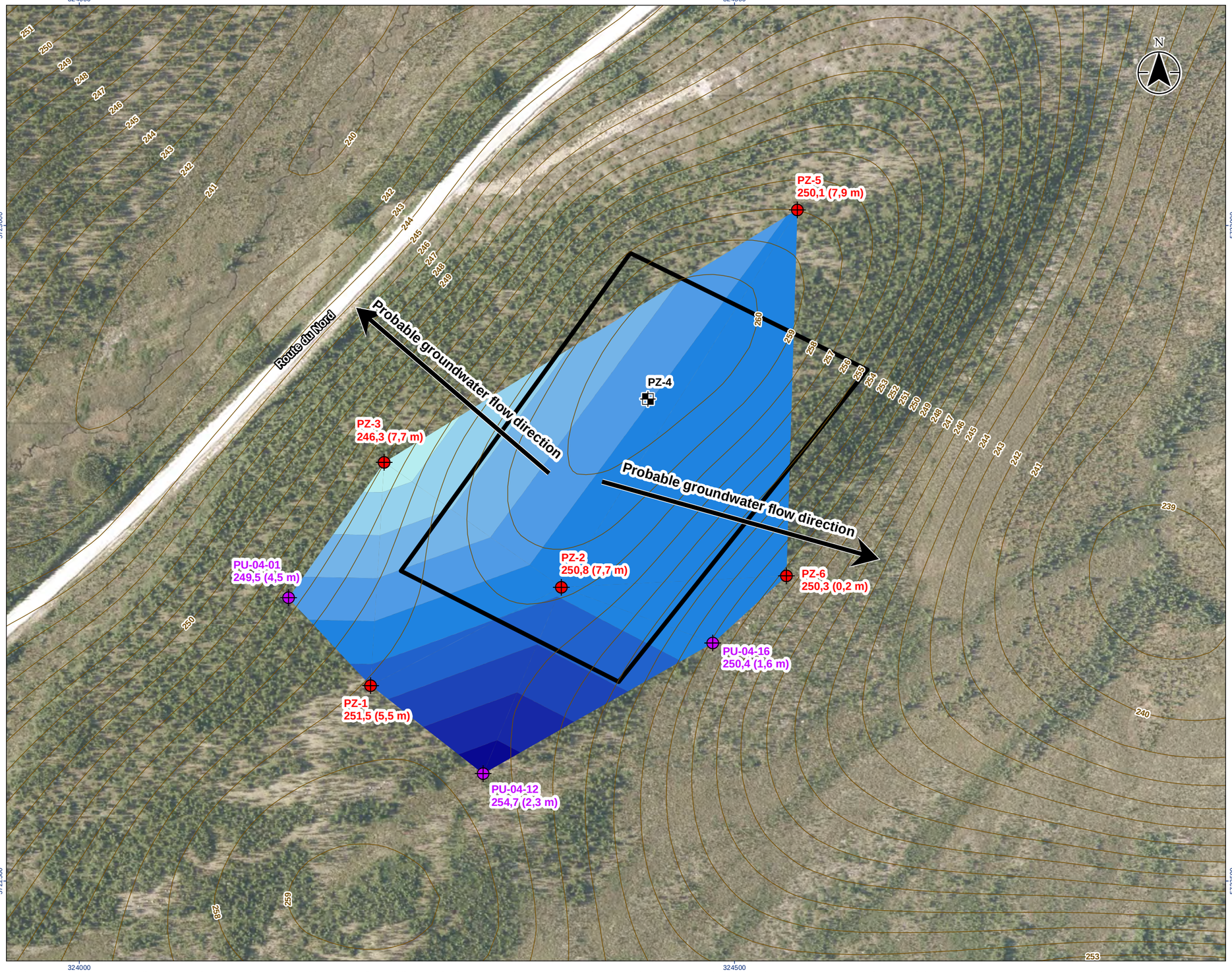
Test pit depth : 4.0 m

Test pit date : 03/21/2011 (mm/dd/yyyy)

Depth (m)	Description	Level (m)	Sample	Water table	Remarks
	Organic matter	0.0 - 0.2			
1	Coarse to medium sand with traces of gravel (Presence of a silt bed about 0.3 m thick)	0.2 - 3.0			
2					
3					
4	Sand and gravel with a small amount of cobbles and a small amount of boulders (Maximum diameter of boulders is 0.5 m and average diameter is 0.3 m)	3.0 - 4.0			
5	End of test pit at 4.0 m				
6					



Appendix E PLANS



Stantec

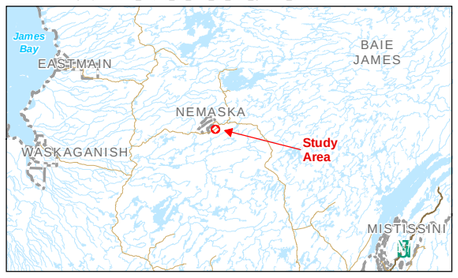
- Potential landfill site
- Contour (m)
- Monitoring Well
- PZ-1 Monitoring Well Identification
- 5,5 m Monitoring Well Groundwater Elevation (Depth)
- Test pit
- PU-04-01 Test Pit Identification
- 4,5 m Test Pit Groundwater Elevation (Depth)
- Borehole
- PZ-4 Borehole Identification

Groundwater Elevation (m)

- 246 - 247
- 247 - 248
- 248 - 249
- 249 - 250
- 250 - 251
- 251 - 252
- 252 - 253
- 253 - 254
- 254 - 255

0 50 100 metres
1:3 000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 MTM 9
2. Monitoring well location and potential landfill site : Poly-Geo, 2017
3. Groundwater depth in the monitoring well : Stantec, December 2017
4. Test pit location and groundwater depth of the test pit : Poly-Geo, September 2016 and March 2017
5. Contour interval generated with the Canadian Digital Surface Model (CDSM), resolution 0.75cm, 2000, Poly-Geo
6. Orthoimagery : P6675_HQ10_03_025_34_094_geotiff_50cm.tif



Project Location
Nemaska, Quebec

167020077-0001 REVA
Prepared by Geneviève Lemay on 2018-07-06
Technical Review by Julien Rosset on 2018-03-07
Independent Review by Graeme Wallacei on 2018-08-02

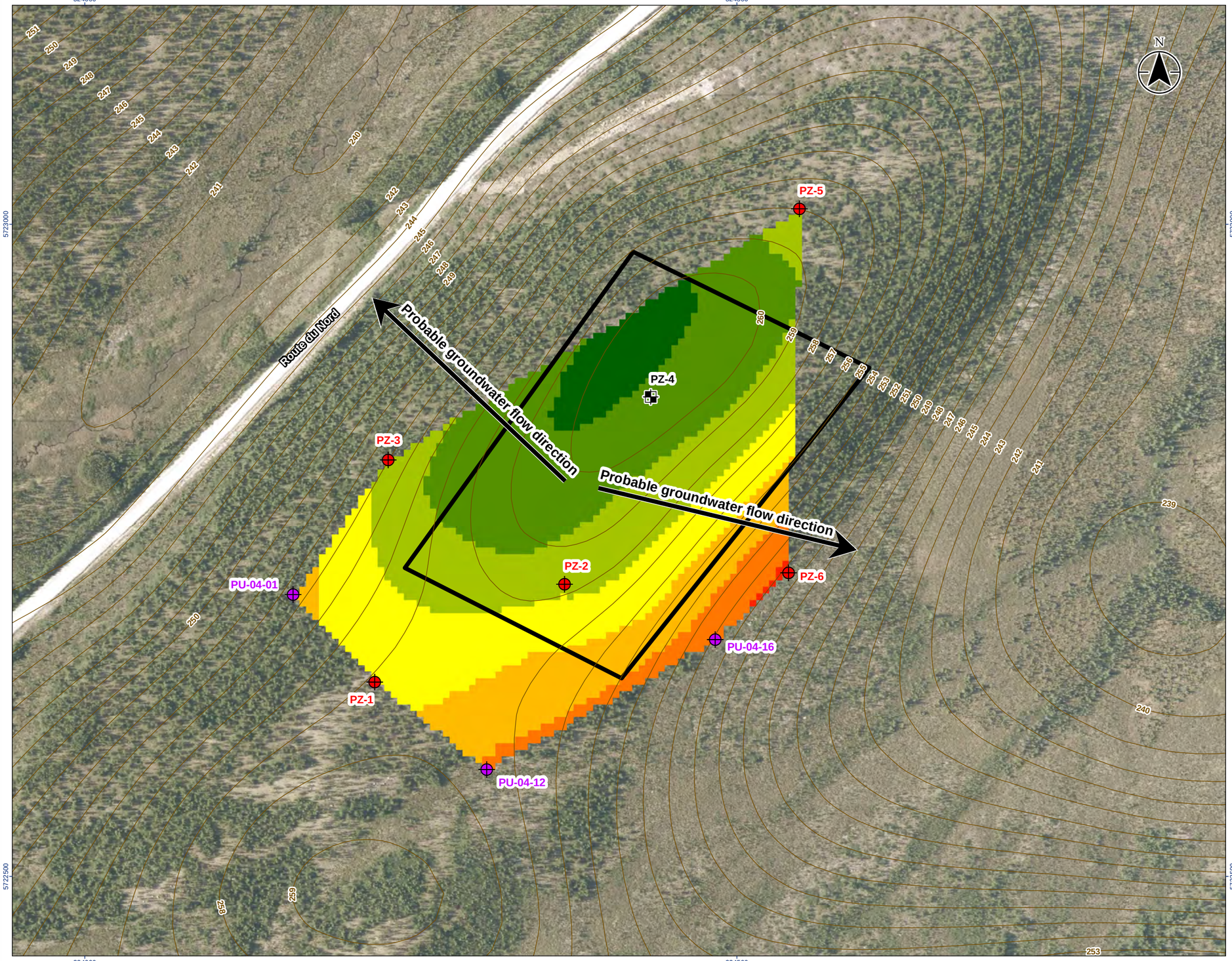
Client/Project
Cree Nation of Nemaska
New Landfill Site Selection Study

Figure No.
1

Title
Site 4
Groundwater Depth (2017)

\\cd1182-f01\Shared Projects\167020077\GIS\2 Doc\Proj\Concept\6 Geomatique\2 Carto\1 MXD\167020077-215-D001-0A_NEMWater-20180801.mxd Revised: 2018-08-01 By: bnissen

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.



Stantec

- Potential landfill site
- Contour (m)
- Monitoring Well
- PZ-1 Monitoring Well Identification
- Test pit
- PU-04-01 Test Pit Identification
- Borehole
- PZ-4 Borehole Identification

Maximum Landfill Depth (m)

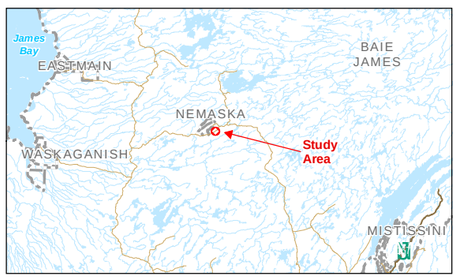
- 0 - 2
- 2 - 4
- 4 - 6
- 6 - 8
- 8 - 10
- 10 - 12
- 12 - 14

0 50 100 metres

1:3 000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 MTM 9
2. Monitoring well location and potential landfill site : Poly-Geo, 2017
3. Test pit location : Poly-Geo, September 2016 and March 2017
4. Maximum depth : Stantec, 2018
5. Orthoimagery : P6675_HQ10_03_025_34_094_geotiff_50cm.tif



Project Location
Nemaska, Quebec

167020077-0002 REVA

Prepared by Geneviève Lemay on 2018-07-06
Technical Review by Julien Rosset on 2018-03-07
Independent Review by Graeme Wallace on 2018-08-02

Client/Project

Cree Nation of Nemaska
New Landfill Site Selection Study

Figure No.
2

Title
Site 4
Maximum Landfill Depth

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

\\cd1182-f01\Shared Projects\167020077\GIS\2_Doc\ProjConcept\6_Geomatique\2_Carto\1_MXD\167020077-215-0002-0A_NEMMaxDepth-20180803_.mxd Revised: 2018-08-01 By: bnisen

Appendix F LABORATORY TESTING RECORDS

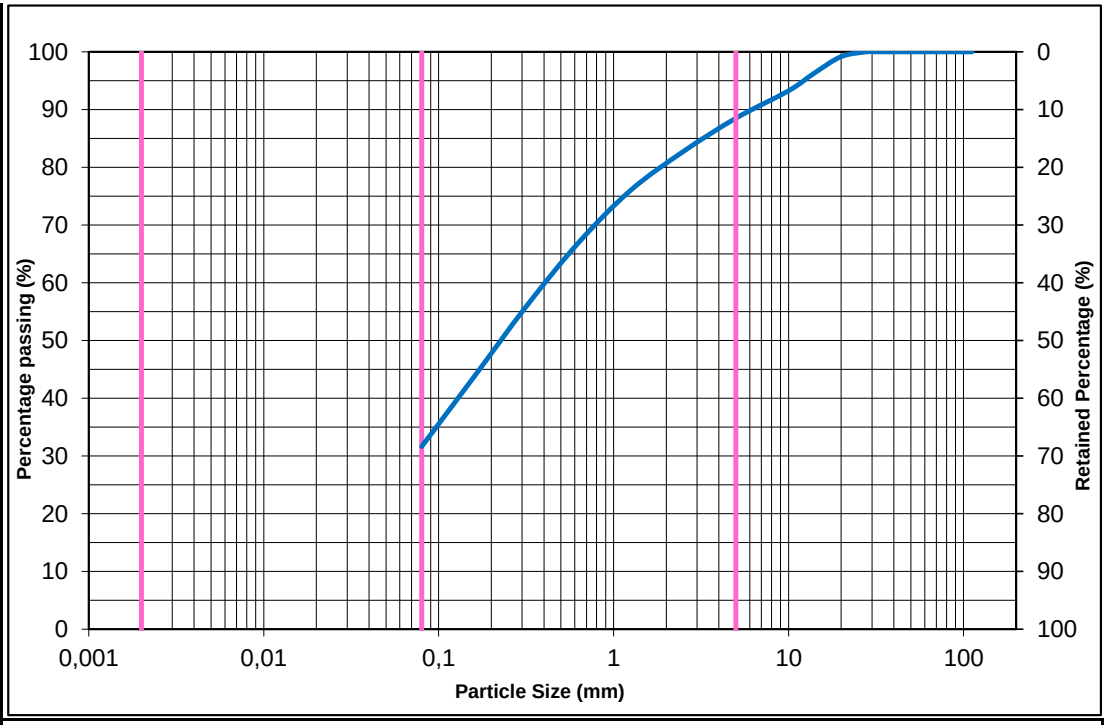
Stantec
2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client :	Cree Nation of Nemaska	Sampled by :	Philip Binette
Project :	New Landfill Study	Sampling Date :	November 24, 2017
	Site 4		
Project No :	167020077.215		
Sample No :	PZ-01 CC-02	Material Description :	Silty Sand, some Gravel
Depth :	2,2 - 2,8m		

Grain Size Analysis (BNQ 2501-025)

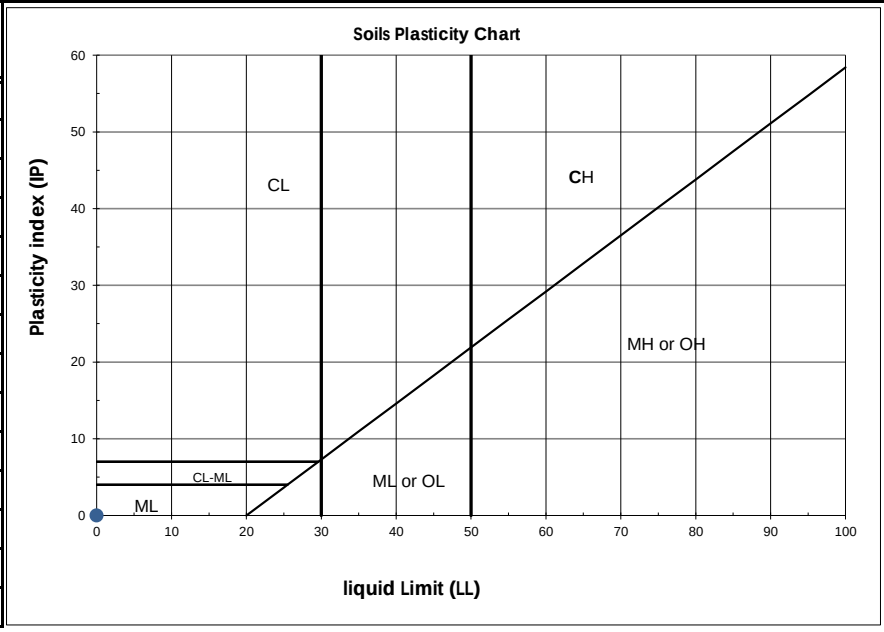
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	99
14,0	96
10,0	93
5,00	89
2,50	83
1,25	76
0,630	67
0,315	56
0,160	44
0,080	31,6



% Gravel: 11,5 % Sand : 56,9 % Silt: 31,6

Other tests

Test / Standard	Results



Remarks :

Prepared by : Benoit Cyr, geo. **Date :** March 26, 2018

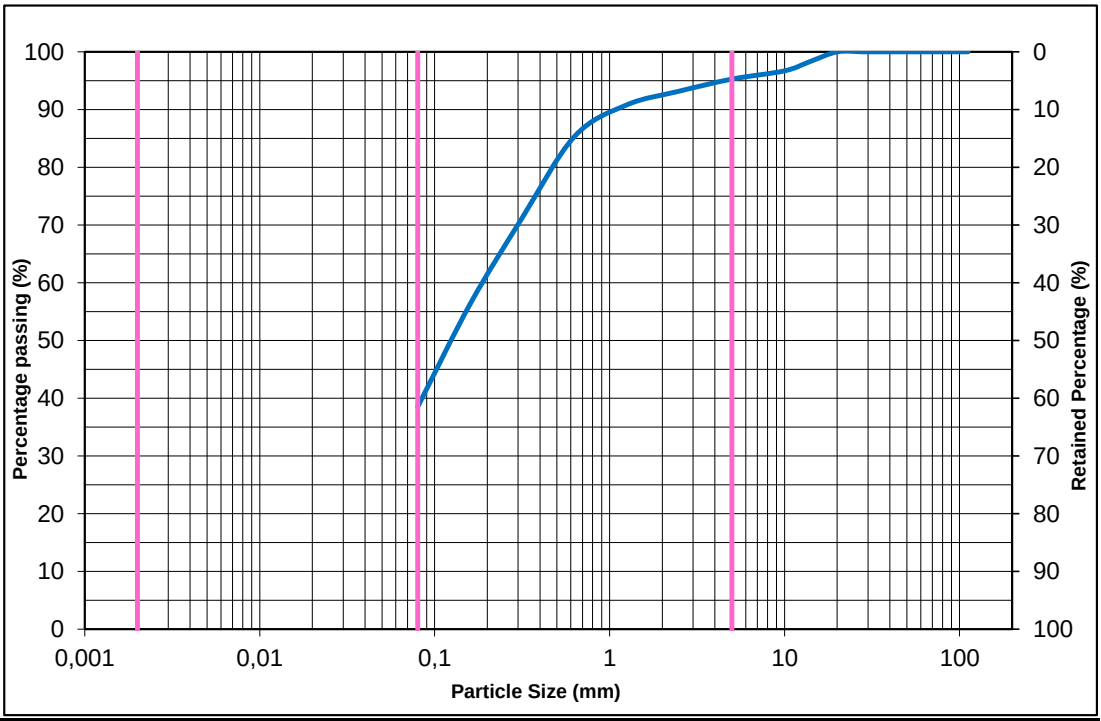
Stantec
2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client :	Cree Nation of Nemaska	Sampled by :	Philip Binette
Project :	New Landfill Study	Sampling Date :	November 25, 2017
	Site 4		
Project No :	167020077.215		
Sample No :	PZ-01 SS-05	Material Description :	Sand and Silt, traces of Gravel
Depth :	7,3 - 7,9m		

Grain Size Analysis (BNQ 2501-025)

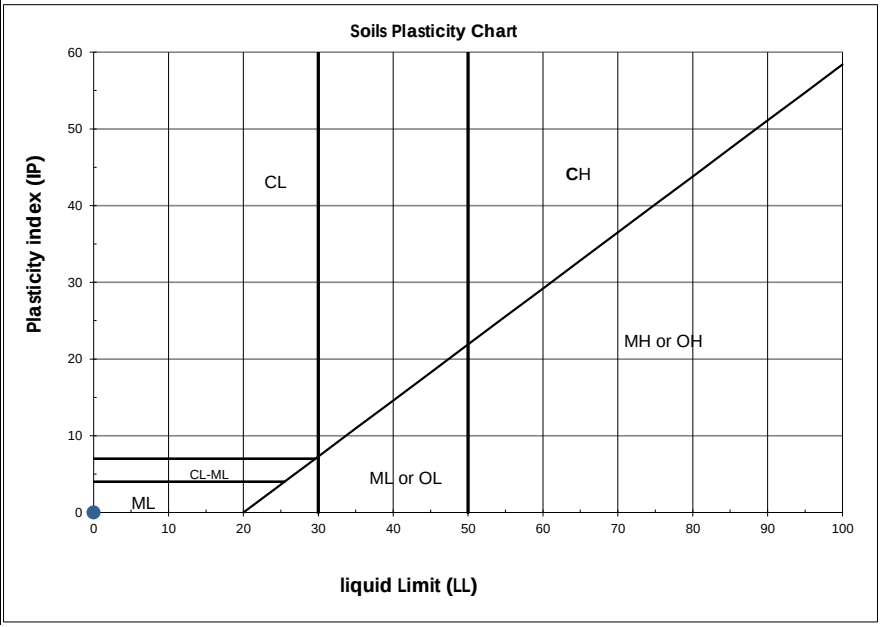
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	98
10,0	97
5,00	95
2,50	93
1,25	91
0,630	85
0,315	71
0,160	56
0,080	38,5



% Gravel: 4,7 % Sand : 56,8 % Silt: 38,5

Other tests

Test / Standard	Results



Remarks :

Prepared by : Benoit Cyr, geo. **Date :** March 26, 2018

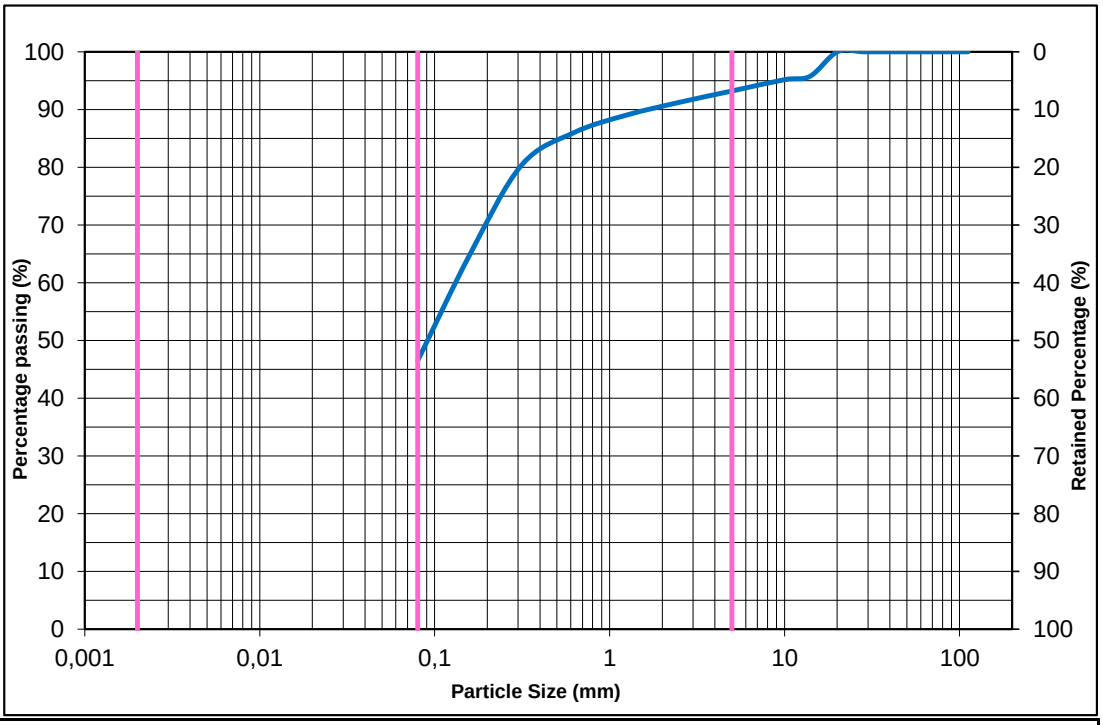
Stantec
2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client :	Cree Nation of Nemaska	Sampled by :	Philip Binette
Project :	New Landfill Study	Sampling Date :	November 27, 2017
	Site 4		
Project No :	167020077.215		
Sample No :	PZ-01 SS-08	Material Description :	Sand and Silt, traces of Gravel
Depth :	13,7 - 14,3m		

Grain Size Analysis (BNQ 2501-025)

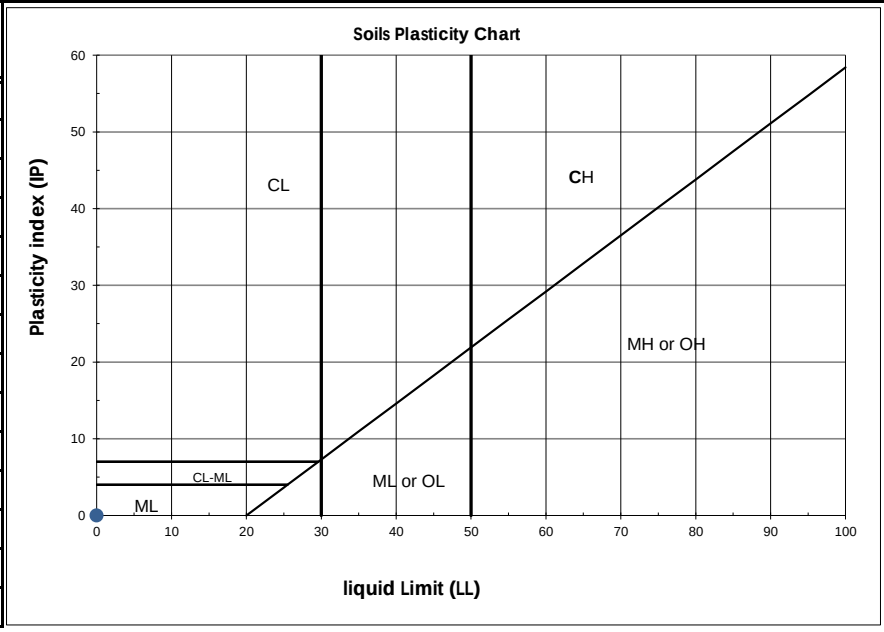
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	96
10,0	95
5,00	93
2,50	91
1,25	89
0,630	86
0,315	80
0,160	65
0,080	46,5



% Gravel: 6,8 % Sand : 46,7 % Silt: 46,5

Other tests

Test / Standard	Results



Remarks :

Prepared by : Benoit Cyr, geo. **Date :** March 26, 2018

Stantec

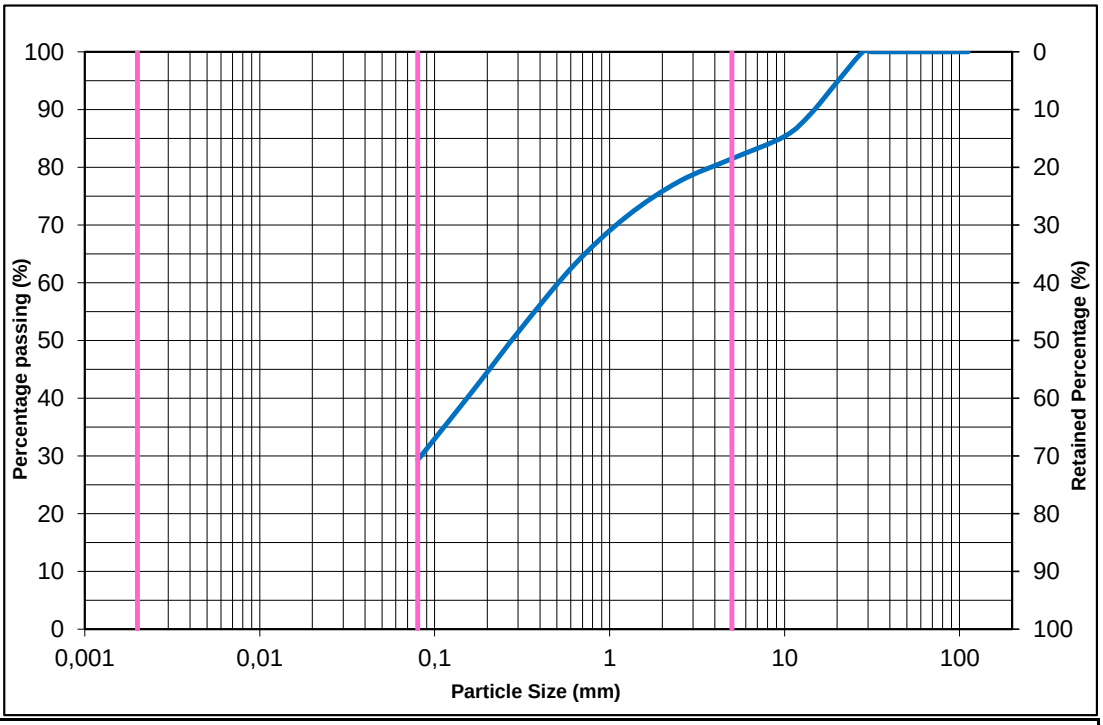
2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client :	Cree Nation of Nemaska	Sampled by :	Philip Binette
Project :	New Landfill Study	Sampling Date :	November 29, 2017
	Site 4		
Project No :	167020077.215		
Sample No :	PZ-02 SS-03	Material Description :	Silty Sand, some Gravel
Depth :	2,4 - 3,0m		

Grain Size Analysis (BNQ 2501-025)

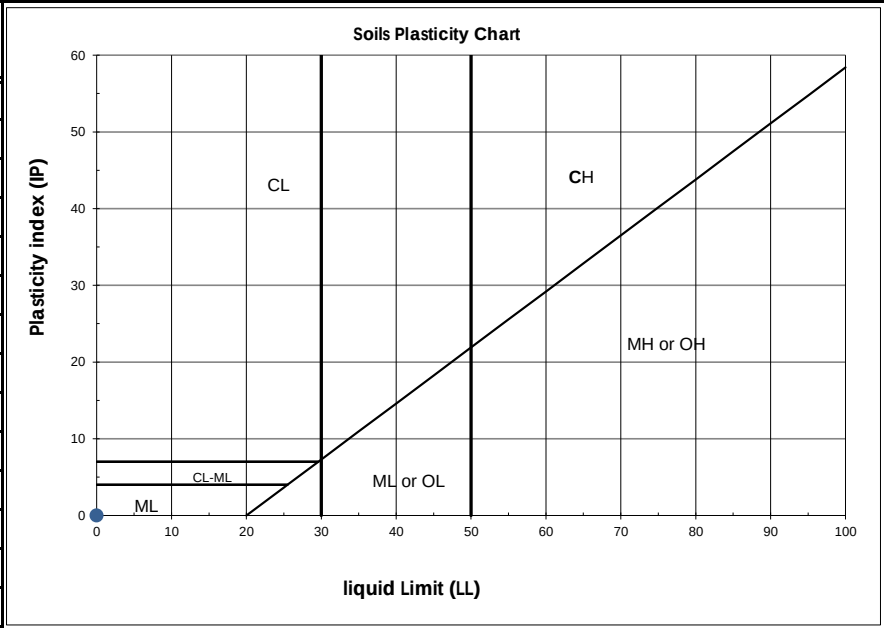
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	95
14,0	89
10,0	85
5,00	81
2,50	78
1,25	71
0,630	63
0,315	52
0,160	41
0,080	29,3



% Gravel: 18,5 % Sand : 52,2 % Silt: 29,3

Other tests

Test / Standard	Results



Remarks :

Prepared by : Benoit Cyr, geo. **Date :** March 26, 2018

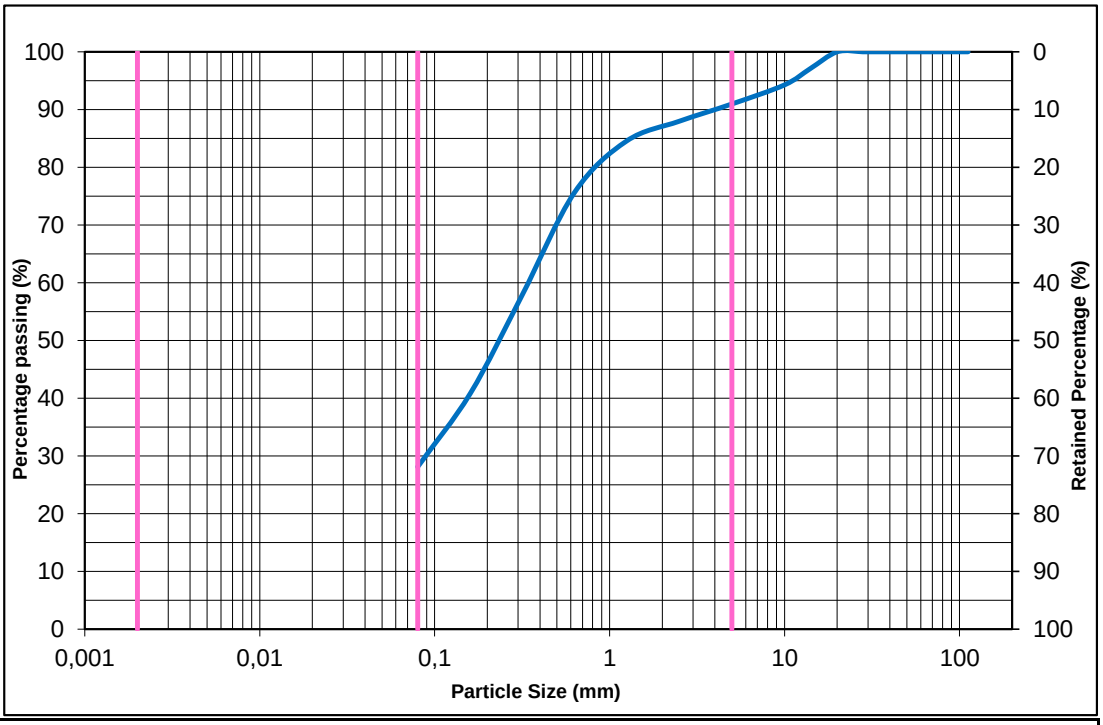
Stantec
2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client :	Cree Nation of Nemaska	Sampled by :	Philip Binette
Project :	New Landfill Study	Sampling Date :	November 30, 2017
	Site 4		
Project No :	167020077.215		
Sample No :	PZ-02 SS-08	Material Description :	Silty Sand, traces of Gravel
Depth :	10,8 - 11,2m		

Grain Size Analysis (BNQ 2501-025)

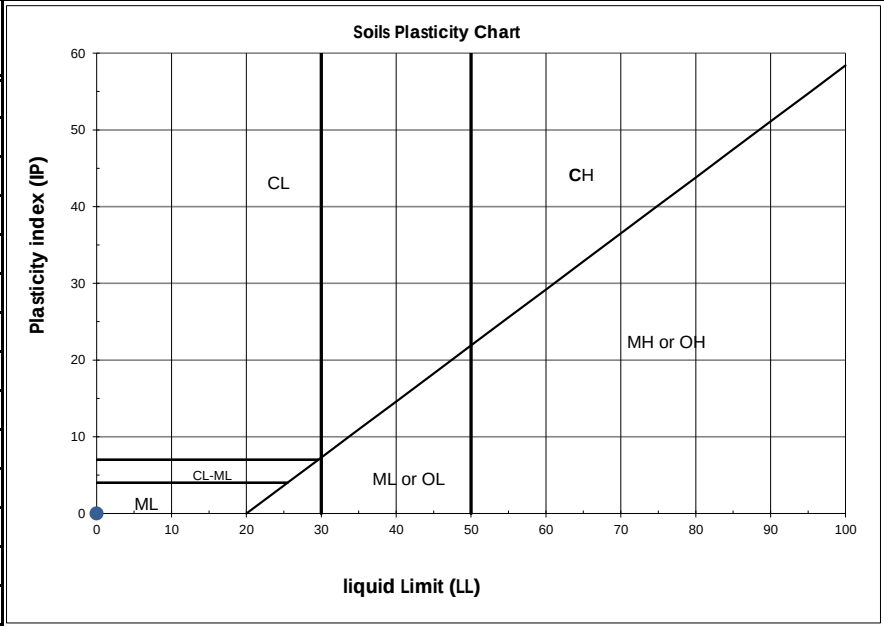
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	97
10,0	94
5,00	91
2,50	88
1,25	85
0,630	76
0,315	58
0,160	41
0,080	28,1



% Gravel: 9,1 % Sand : 62,8 % Silt: 28,1

Other tests

Test / Standard	Results



Remarks :

Prepared by : Benoit Cyr, geo. **Date :** March 26, 2018

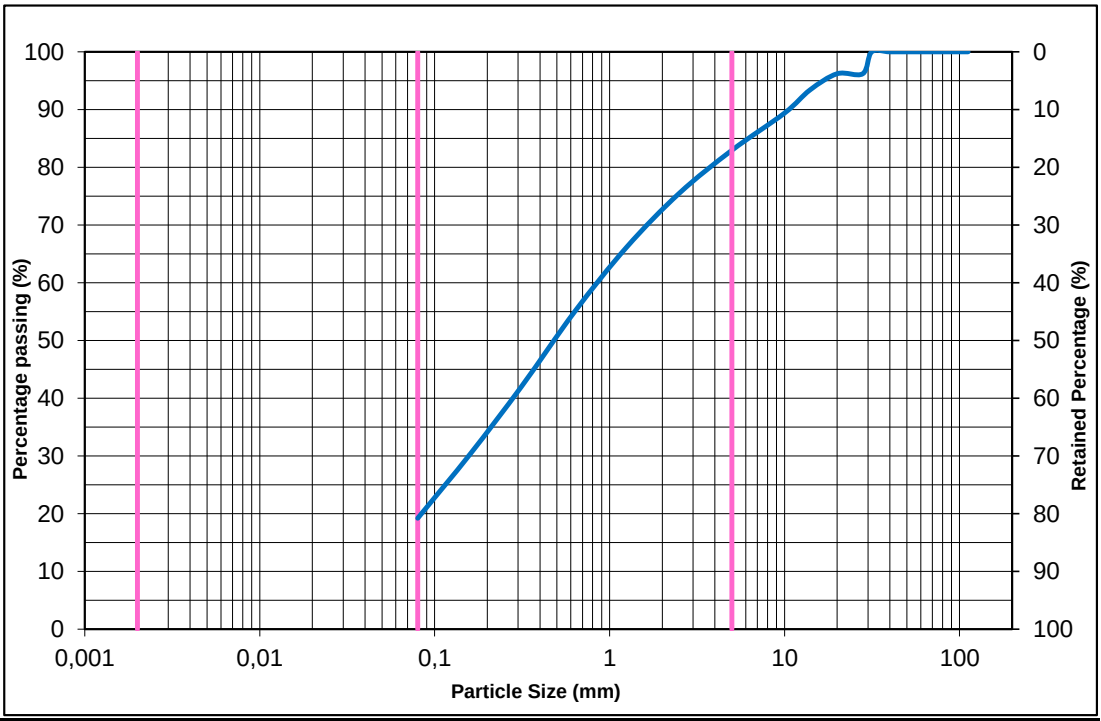
Stantec
2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client :	Cree Nation of Nemaska	Sampled by :	Philip Binette
Project :	New Landfill Study	Sampling Date :	December 07, 2017
	Site 4		
Project No :	167020077.215		
Sample No :	PZ-03 CC-02	Material Description :	Sand, some Silt, Some Gravel
Depth :	1,2 - 2,4m		

Grain Size Analysis (BNQ 2501-025)

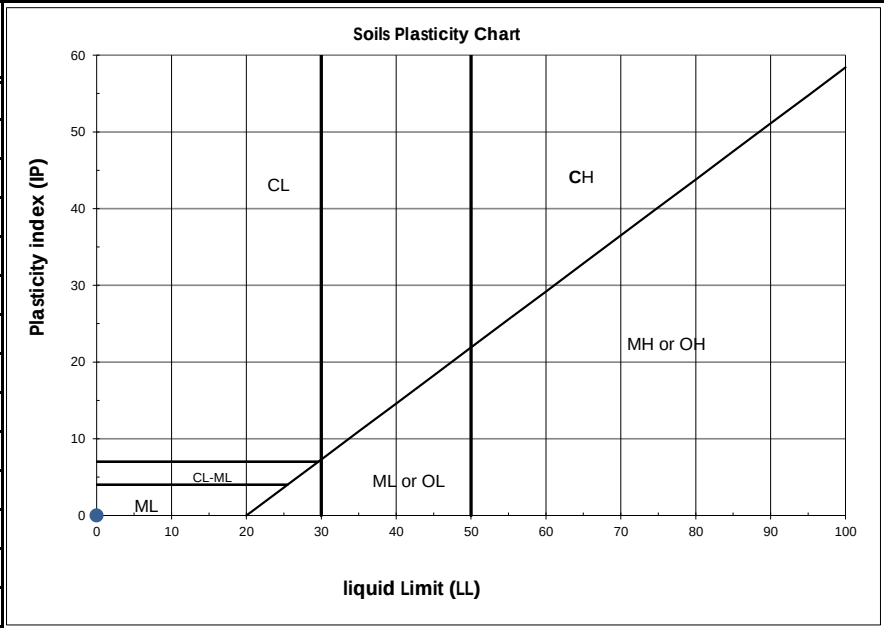
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	96
20,0	96
14,0	93
10,0	89
5,00	83
2,50	75
1,25	66
0,630	55
0,315	42
0,160	30
0,080	19,2



% Gravel: 17,1 % Sand : 63,7 % Silt: 19,2

Other tests

Test / Standard	Results



Remarks :

Prepared by : Benoit Cyr, geo. **Date :** March 26, 2018

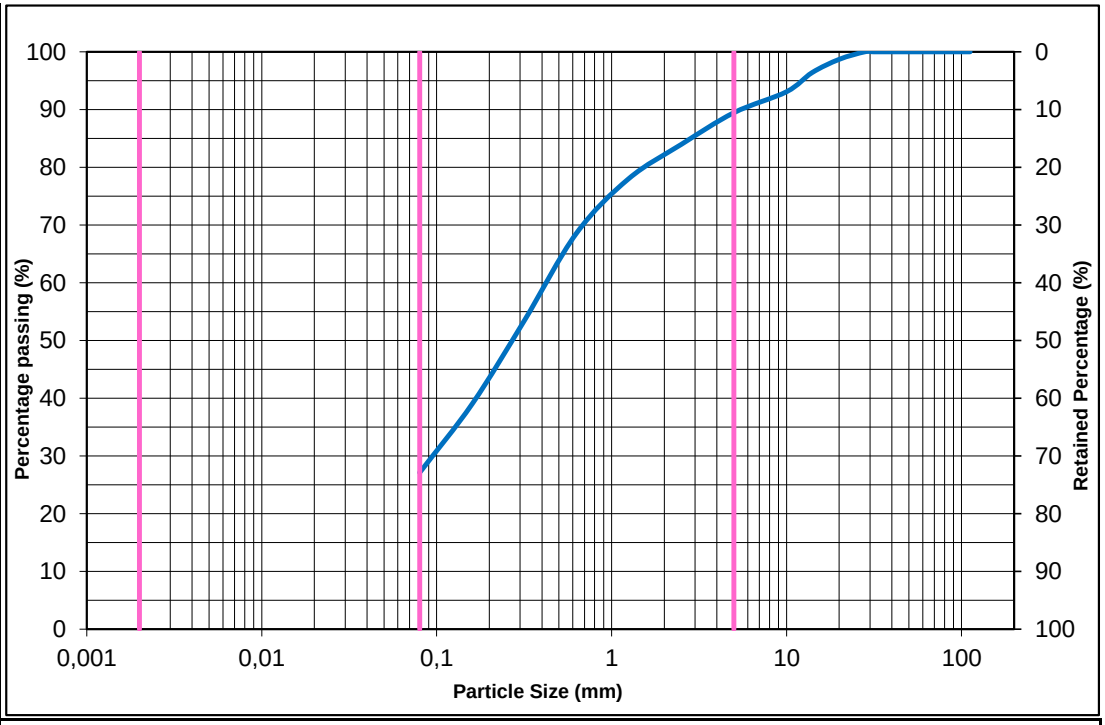
Stantec
2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client :	Cree Nation of Nemaska	Sampled by :	Philip Binette
Project :	New Landfill Study	Sampling Date :	December 07, 2017
	Site 4		
Project No :	167020077.215		
Sample No :	PZ-03 SS-06	Material Description :	Silty Sand, Some Gravel
Depth :	9,3 - 9,9m		

Grain Size Analysis (BNQ 2501-025)

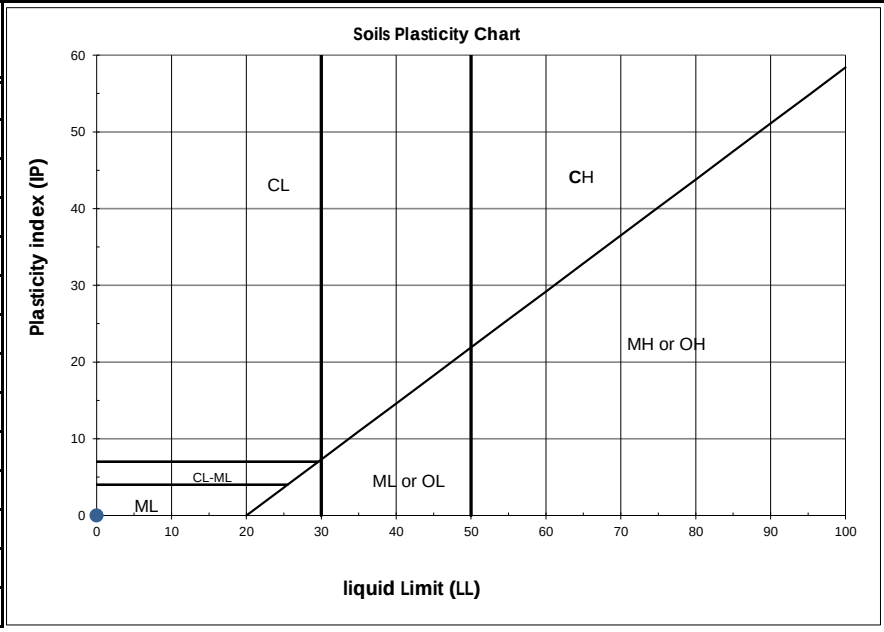
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	99
14,0	96
10,0	93
5,00	89
2,50	84
1,25	78
0,630	69
0,315	53
0,160	39
0,080	27,1



% Gravel: 10,6 % Sand : 62,3 % Silt: 27,1

Other tests

Test / Standard	Results



Remarks :

Prepared by : Benoit Cyr, geo. **Date :** March 26, 2018

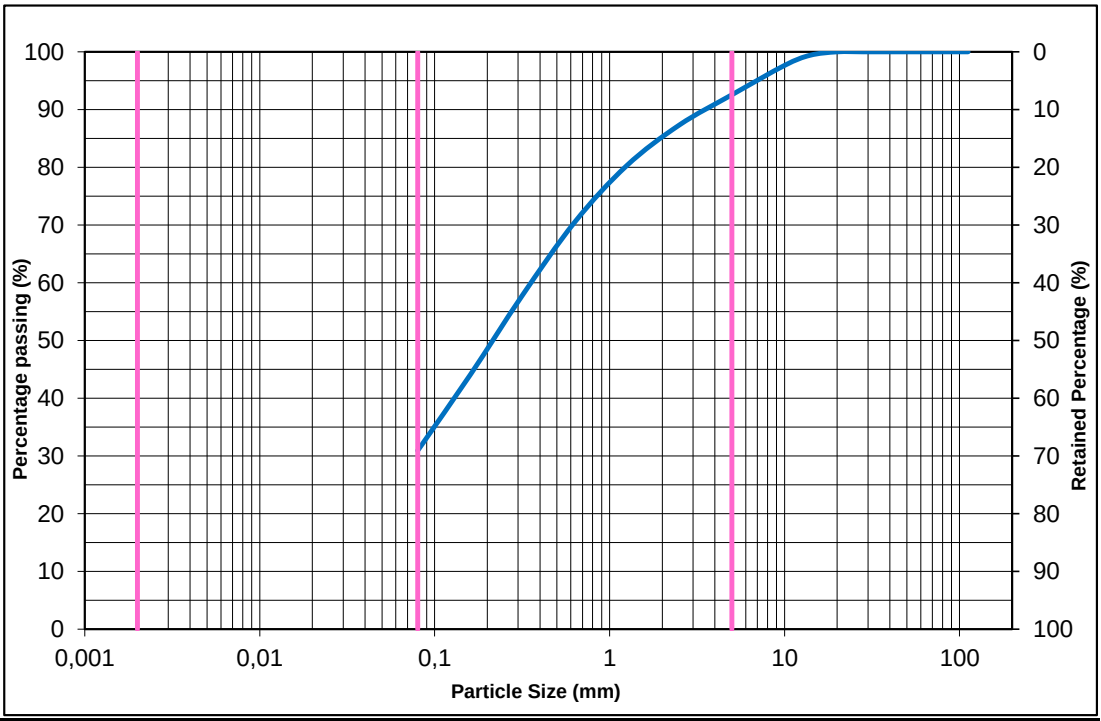
Stantec
2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client :	Cree Nation of Nemaska	Sampled by :	Philip Binette
Project :	New Landfill Study	Sampling Date :	December 05, 2017
	Site 4		
Project No :	167020077.215		
Sample No :	PZ-04 SS-03	Material Description :	Silty Sand, traces of Gravel
Depth :	1,8 - 2,2m		

Grain Size Analysis (BNQ 2501-025)

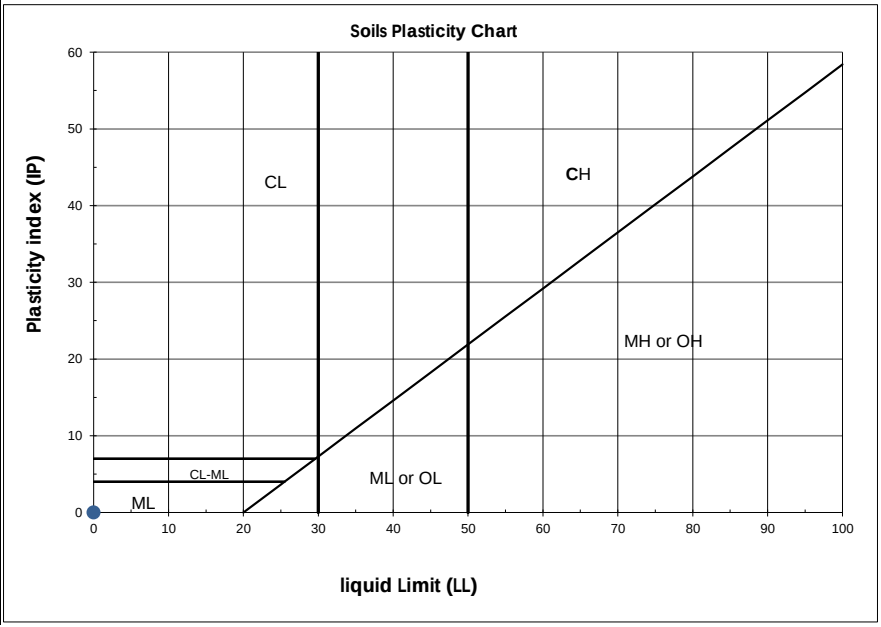
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	99
10,0	98
5,00	93
2,50	87
1,25	80
0,630	70
0,315	58
0,160	44
0,080	30,9



% Gravel: 7,5 % Sand : 61,6 % Silt: 30,9

Other tests

Test / Standard	Results



Remarks :

Prepared by : Benoit Cyr, geo. **Date :** March 26, 2018

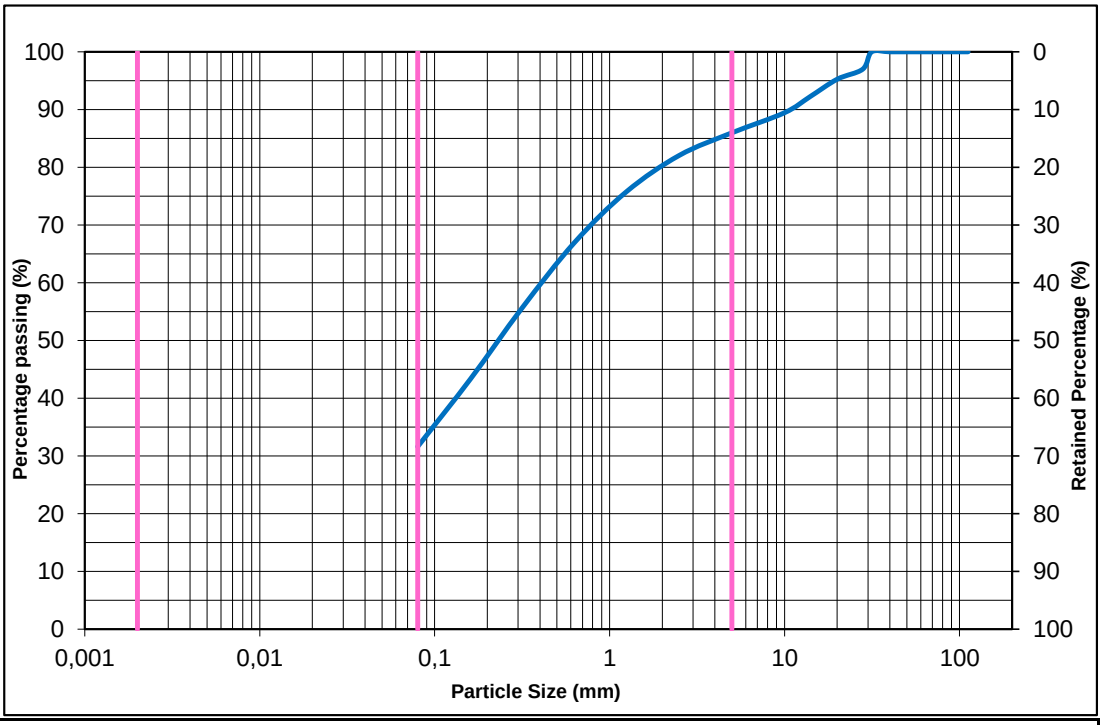
Stantec
2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client :	Cree Nation of Nemaska	Sampled by :	Philip Binette
Project :	New Landfill Study	Sampling Date :	December 05, 2017
	Site 4		
Project No :	167020077.215		
Sample No :	PZ-04 SS-05	Material Description :	Silty Sand, traces of Gravel
Depth :	3,0 - 3,6m		

Grain Size Analysis (BNQ 2501-025)

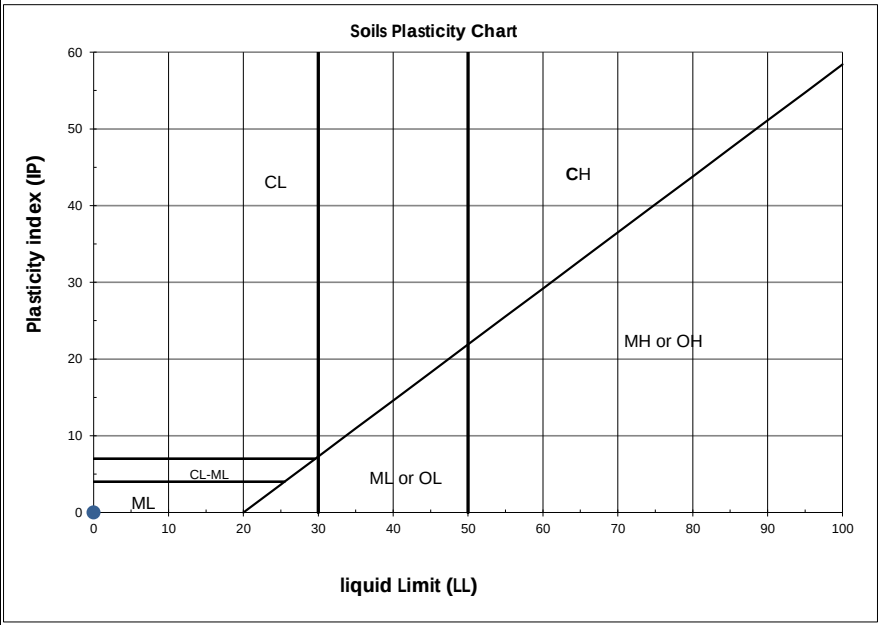
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	97
20,0	95
14,0	92
10,0	89
5,00	86
2,50	82
1,25	76
0,630	67
0,315	56
0,160	43
0,080	31,6



% Gravel: 14,1 % Sand : 54,3 % Silt: 31,6

Other tests

Test / Standard	Results



Remarks :

Prepared by : Benoit Cyr, geo. **Date :** March 26, 2018

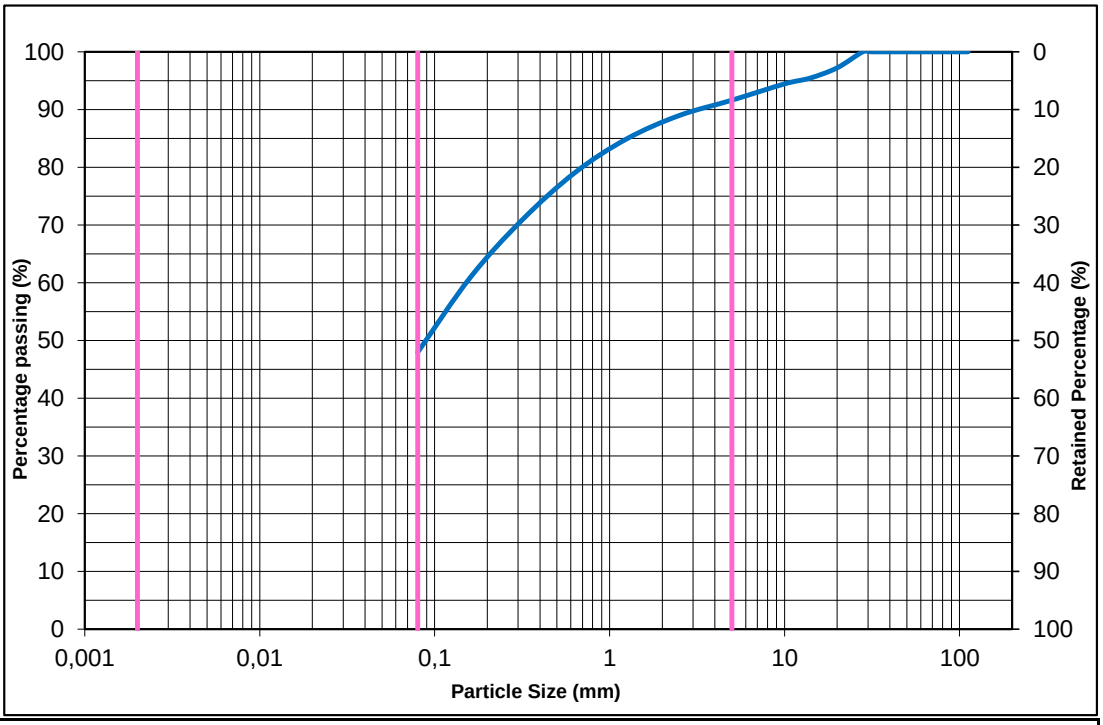
Stantec
2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client :	Cree Nation of Nemaska	Sampled by :	Philip Binette
Project :	New Landfill Study	Sampling Date :	December 01, 2017
	Site 4		
Project No :	167020077.215		
Sample No :	PZ-05 SS-03	Material Description :	Silt and Sand, some Gravel
Depth :	3,0 - 3,6m		

Grain Size Analysis (BNQ 2501-025)

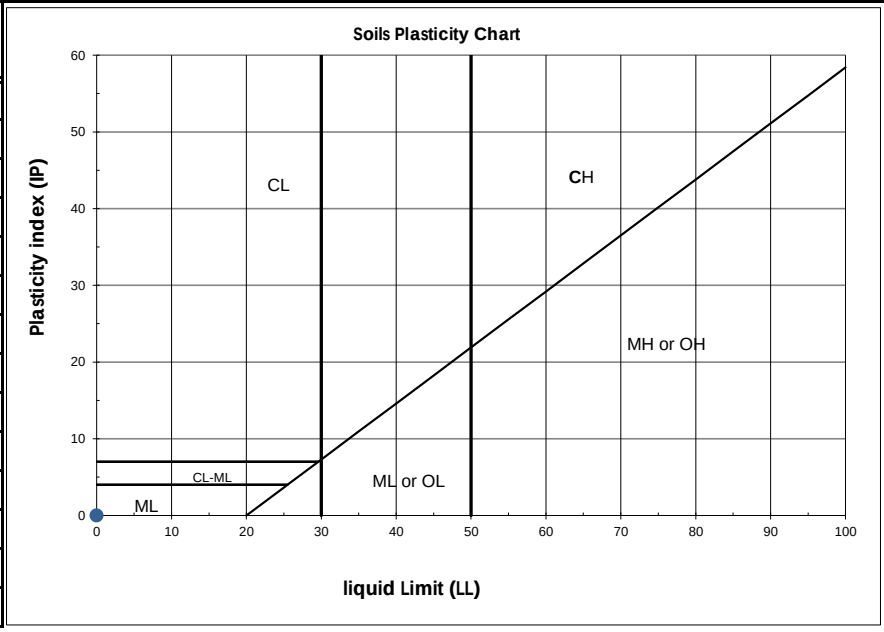
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	97
14,0	95
10,0	94
5,00	92
2,50	89
1,25	85
0,630	79
0,315	71
0,160	61
0,080	48,0



% Gravel: 8,3 % Sand : 43,7 % Silt: 48,0

Other tests

Test / Standard	Results



Remarks :

Prepared by : Benoit Cyr, geo. **Date :** March 26, 2018

Stantec

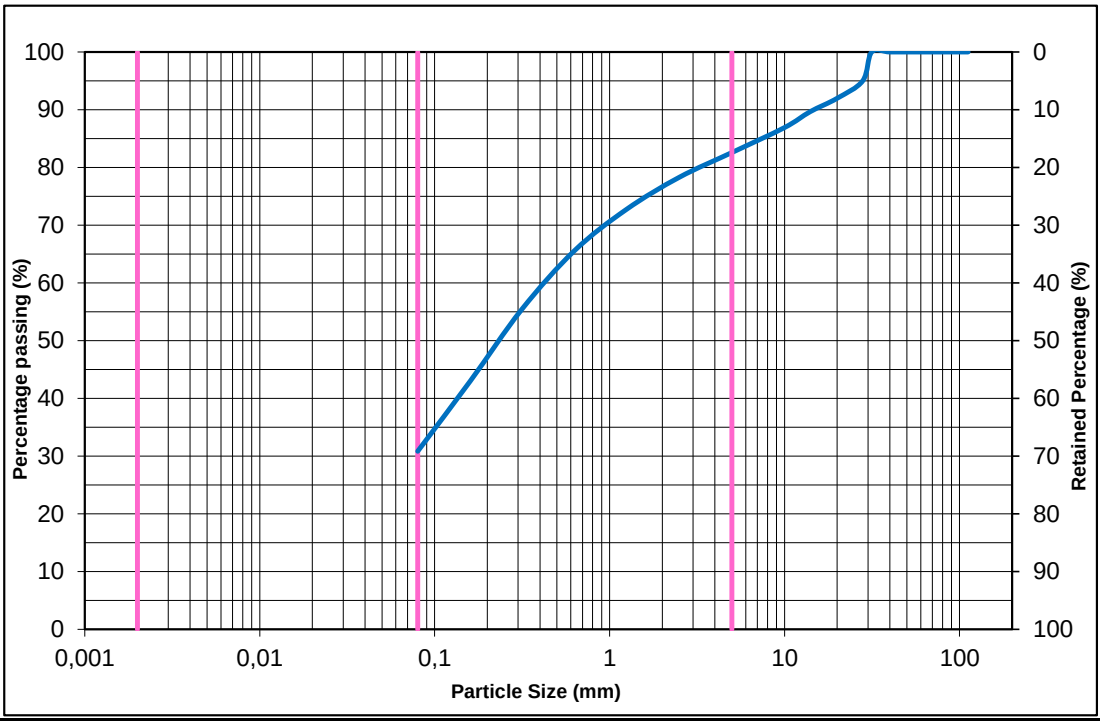
2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client :	Cree Nation of Nemaska	Sampled by :	Philip Binette
Project :	New Landfill Study	Sampling Date :	December 03, 2017
	Site 4		
Project No :	167020077.215		
Sample No :	PZ-06 CC-04	Material Description :	Silty Sand, traces of Gravel
Depth :	4,3 - 4,9m		

Grain Size Analysis (BNQ 2501-025)

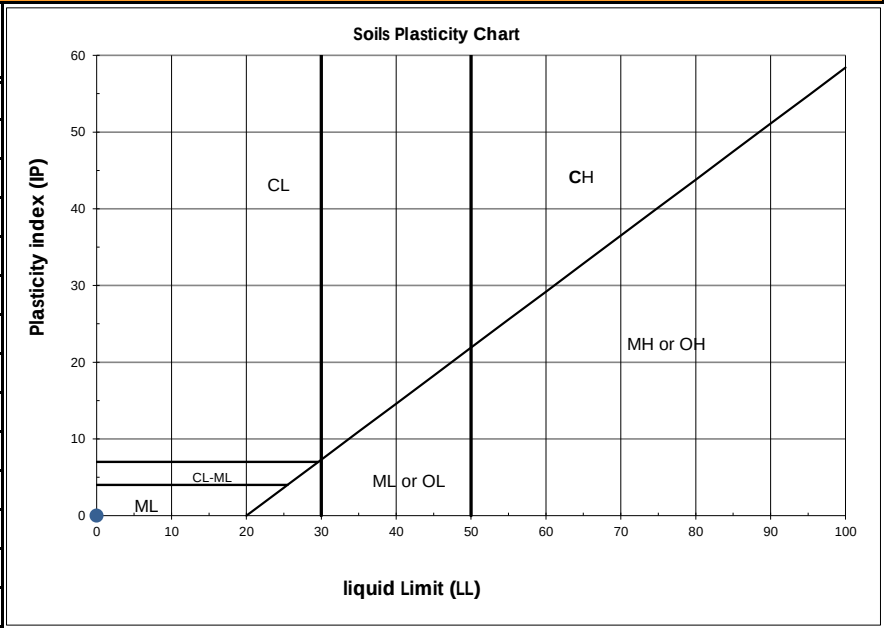
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	95
20,0	92
14,0	90
10,0	87
5,00	83
2,50	78
1,25	73
0,630	66
0,315	55
0,160	43
0,080	30,8



% Gravel: 17,5 % Sand : 51,7 % Silt: 30,8

Other tests

Test / Standard	Results



Remarks :

Prepared by : Benoit Cyr, geo. **Date :** March 26, 2018

Stantec

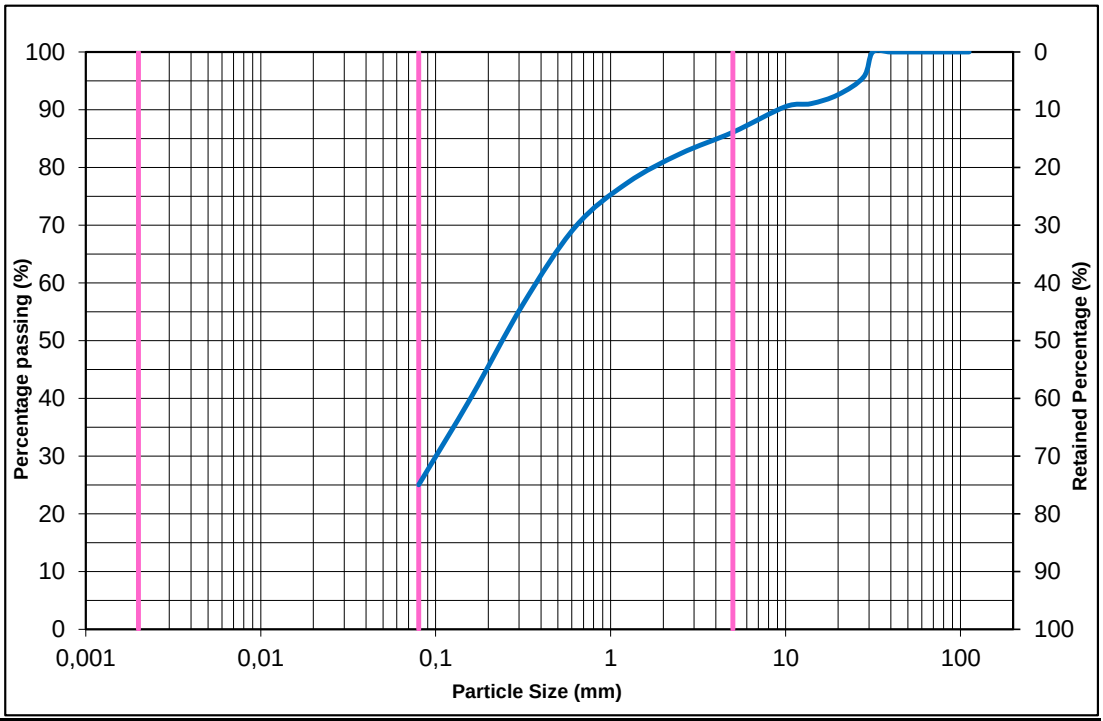
2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client :	Cree Nation of Nemaska	Sampled by :	Philip Binette
Project :	New Landfill Study	Sampling Date :	December 05, 2017
	Site 4		
Project No :	167020077.215		
Sample No :	PZ-06 CC-07	Material Description :	Silty Sand, some Gravel
Depth :	10,1 - 10,7m		

Grain Size Analysis (BNQ 2501-025)

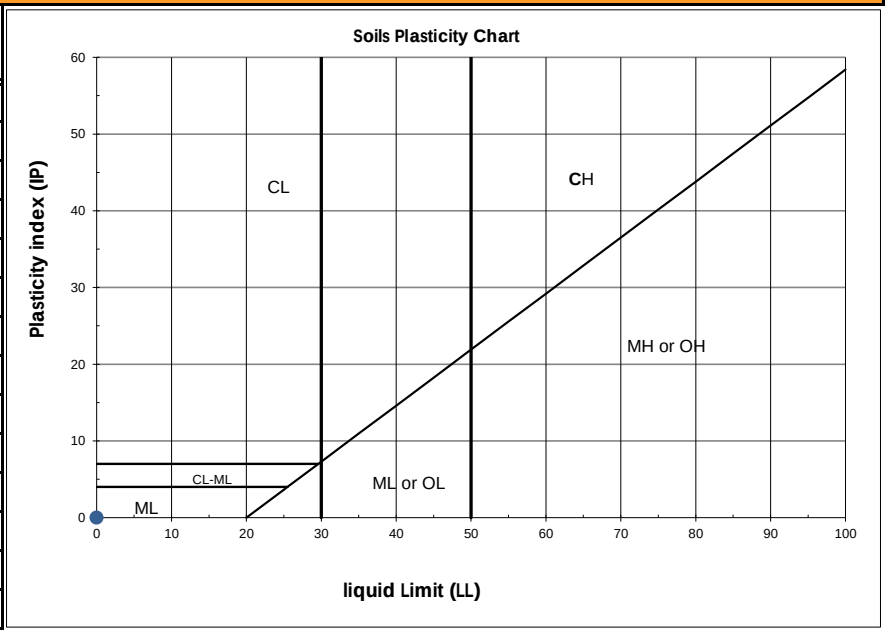
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	96
20,0	93
14,0	91
10,0	91
5,00	86
2,50	82
1,25	77
0,630	70
0,315	56
0,160	40
0,080	25,0



% Gravel: 13,9 % Sand : 61,1 % Silt: 25,0

Other tests

Test / Standard	Results



Remarks :

Prepared by : Benoit Cyr, geo. **Date :** March 26, 2018

Appendix G BOREHOLE RECORDS

SOUNDING LOG

NO. **PZ-01**

PROJECT: **New landfill site study** FILE NO: **167020077** DATE: **2017-11-24**

LOCATION: **New landfill, Site 4** CLIENT: **The Cree Nation of Nemaska**

Sounding Type: | **From** | **To**

Rotational drilling | 0,00 | 17,68

Sample Type

SS Split Spoon: 51 mm O.D.
ST Shelby Tube:
TS Piston Tube:
CR Core sample, Caliper:
PW Core sample Fondatec
GS Grab Sample
AU Manual Auger
WS Wash Sample
TU PVC Tubing (Geoprobe)

State of Sample

Disturbed Intact Lost Core

Tests and Measurement in Field

N: Standard Penetration Test
RQD: Rock Quality Designation
R: Refusal
GA: Grain Size Analysis
Kt: Triaxial Permeability Test
VOC: Volatils organic compounds

Analytics Parameters and Tests in Laboratory

MET: Metals
PAH: Polycyclic aromatic hydrocarbon
MAH: Monocyclics aromatic hydrocarbon
THH: Total halogeneted hydrocarbon
BTEX: Benzene, toluene, ethylbenzene, xylenes (totals)
PH: Petroleum hydrocarbon C10-C50
LEA: Leachate test

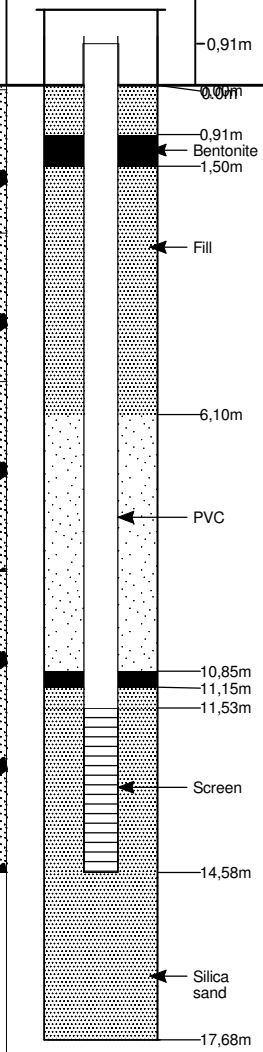
Coordinates: Nad 83 UTM 18
X: 5.721.599,000
Y: 415.616,000
Bench Mark:

Groundwater Level
Elevation: 251,49m Date: 17-12-02

Free Phase Level
Elevation Date

Depth (m)	Elevation (m)	Soil Profile	Sample Type and Number	State	Recovery (%)	N / RQD	Others	VOC (ppm)	Depth (ft)
0	257,00 / 256,92	Natural soil: brown sand. 0,08m							0
2		Grey sand with traces of gravel, presence of cobbles at a depth of 2,44 meters. * (Probable till)	CC-1		52				
			1,22m						
			CC-2		60		GA		
	254,26	Grey sand and cobbles, with traces of gravel. 2,74m * (Probable till)	2,84m						10
4			CC-3		52				
			3,66m						
	251,51 ▽ 5.51	Grey silty sand with boulders of pink granite, presence of gravel. 5,49m * (Probable till)	SS-4		54	34			20
6			6,10m						
			SS-5		58	84	GA		
8			7,93m						
	248,00	Granite Boulders 9,00m	CO-6		70				30
10			10,67m						
			CO-7						40
12			13,72m						
14	242,42	Grey sand, traces of silt and gravel 14,58m * (Probable till)	SS-8		50	58	GA		
			14,33m						50
16									
18		End of drilling at a depth of 17,68 meters.							60
20									

Well Construction



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FIELD TECHNICIAN: **Philip Binette, tech.** APPROVED BY: **Patrick L-Distefano, Eng.**

SOUNDING LOG

NO. **PZ-02**

PROJECT: **New landfill site study** FILE NO: **167020077** DATE: **2017-11-29**

LOCATION: **New landfill, Site 4** CLIENT: **The Cree Nation of Nemaska**

Sounding Type: | **From** | **To**
Rotational drilling | 0,00 | 20,04

Sample Type

SS Split Spoon: 51 mm O.D.
ST Shelby Tube:
TS Piston Tube:
CR Core sample, Caliper:
PW Core sample Fondatec
GS Grab Sample
AU Manual Auger
WS Wash Sample
TU PVC Tubing (Geoprobe)

State of Sample

Disturbed Intact Lost Core

Tests and Measurement in Field

N: Standard Penetration Test
RQD: Rock Quality Designation
R: Refusal
GA: Grain Size Analysis
Kt: Triaxial Permeability Test
VOC: Volatils organic compounds

Analytics Parameters and Tests in Laboratory

MET: Metals
PAH: Polycyclic aromatic hydrocarbon
MAH: Monocyclics aromatic hydrocarbon
THH: Total halogeneted hydrocarbon
BTEX: Benzene, toluene, ethylbenzene, xylenes (totals)
PH: Petroleum hydrocarbon C10-C50
LEA: Leachate test

Coordinates: Nad 83 UTM 18
X: 5.721.671,000
Y: 415.763,000
Bench Mark:

Groundwater Level
Elevation: 250,79m Date: 17-12-01

Free Phase Level
Elevation Date

Depth (m)	Elevation (m)	Soil Profile	Sample Type and Number	State	Recovery (%)	N / RQD	Others	VOC (ppm)	Depth (ft)
0	258,50								0
	258,32	Top soil: Organic material. 0,18m	CC-1		50				
		Grey sand, with traces of silt and gravel, cobbles. * (Probable till)							
2	256,70	Boulder. 1,80m	CC-2		4				
	256,06	Grey sand with traces of silt and gravel, cobbles. 2,44m	SS-3		46	Refu	GA		10
	255,25	* (Probable till) 3,25m	CO-4		42				
4		Alterations layers of boulders and grey sand with traces of silt and gravel with cobbles * (Probable till)	CO-5		15				
6			CO-6		26				20
8		▽ 7.71							
			CO-7		17				30
10			SS-8		50	Refu	GA		
12									40
14			CO-9		27				
16									50
18									60
			CO-10		0				
20	238,46	End of drilling at a depth of 20,04 meters. 20,04m							

Well Construction

Diagram	Description
	0,00m
	bentonite
	1,17m
	1,50m
	PVC
	13,36m
	Silica sand
	Screen
	16,41m
	fill
	20,04m

1,22m
2,44m
3,05m
4,57m
5,79m
7,77m
10,85m
11,15m
15,49m
20,04m

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FIELD TECHNICIAN: **Philip Binette, tech.** APPROVED BY: **Patrick L-Distefano, Eng.**

SOUNDING LOG

NO. **PZ-03**

PROJECT: **New landfill site study** FILE NO: **167020077** DATE: **2017-12-06**

LOCATION: **New landfill, Site 4** CLIENT: **The Cree Nation of Nemaska**

Sounding Type: | **From** | **To**
Rotational drilling | 0,00 | 12,37

Sample Type

SS Split Spoon: 51 mm O.D.
ST Shelby Tube:
TS Piston Tube:
CR Core sample, Caliper:
PW Core sample Fondatec
GS Grab Sample
AU Manual Auger
WS Wash Sample
TU PVC Tubing (Geoprobe)

State of Sample

Disturbed Intact Lost Core

Tests and Measurement in Field

N: Standard Penetration Test
RQD: Rock Quality Designation
R: Refusal
GA: Grain Size Analysis
Kt: Triaxial Permeability Test
VOC: Volatils organic compounds

Analytics Parameters and Tests in Laboratory

MET: Metals
PAH: Polycyclic aromatic hydrocarbon
MAH: Monocyclics aromatic hydrocarbon
THH: Total halogeneted hydrocarbon
BTEX: Benzene, toluene, ethylbenzene, xylenes (totals)
PH: Petroleum hydrocarbon C10-C50
LEA: Leachate test

Coordinates: Nad 83 UTM 18
X: 5.721.769,000
Y: 415.630,000
Bench Mark:

Groundwater Level
Elevation: 246,27m Date: 17-12-08

Free Phase Level
Elevation Date

Depth (m)	Elevation (m)	Soil Profile	Sample Type and Number	State	Recovery (%)	N / RQD	Others	VOC (ppm)	Depth (ft)
0	254,00 / 253,90	Top soil: Organic material. 0,10m							0
		Grey sand with traces of silt and gravel with boulders. * (Probable till)	CC-1		58				
1,22m			CC-2		79		GA		
2	251,56	Boulders with cobbles (pink granite) 2,44m							10
2,44m			CO-3		71				
3,96m			CO-4		50				
4	249,43	Grey sand with traces of silt, presence of boulders (pink granite) and cobbles. * (Probable till) 4,57m							
4,57m									
6									20
7,62m			CO-5		54				
8		▽ 7.73							
9,65m			SS-6		66	47	GA		30
10									
12	241,81	12,19m End of drilling at a depth of 12,37 meters.							40
14									
16									50
18									60
20									

Well Construction

Diagram: 0,00m Bentonite; 0,91m; PVC; Fill; 8,64m; 8,94m; 9,32m; Silica sand; Screen; 12,37m

Description: 0,99m

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FIELD TECHNICIAN: **Philip Binette, tech.** APPROVED BY: **Patrick L-Distefano, Eng.**

SOUNDING LOG

NO. **PZ-04**

PROJECT: **New landfill site study** FILE NO: **167020077** DATE: **2017-12-05**

LOCATION: **New landfill, Site 4** CLIENT: **The Cree Nation of Nemaska**

Sounding Type: | **From** | **To**
Rotational drilling | 0,00 | 7,60

Sample Type

SS Split Spoon: 51 mm O.D.
ST Shelby Tube:
TS Piston Tube:
CR Core sample, Caliper:
PW Core sample Fondatec
GS Grab Sample
AU Manual Auger
WS Wash Sample
TU PVC Tubing (Geoprobe)

State of Sample

Disturbed Intact Lost Core

Tests and Measurement in Field

N: Standard Penetration Test
RQD: Rock Quality Designation
R: Refusal
GA: Grain Size Analysis
Kt: Triaxial Permeability Test
VOC: Volatils organic compounds

Analytics Parameters and Tests in Laboratory

MET: Metals
PAH: Polycyclic aromatic hydrocarbon
MAH: Monocyclics aromatic hydrocarbon
THH: Total halogeneted hydrocarbon
BTEX: Benzene, toluene, ethylbenzene, xylenes (totals)
PH: Petroleum hydrocarbon C10-C50
LEA: Leachate test

Coordinates: Nad 83 UTM 18
X: 5.721.813,000
Y: 415.832,000
Bench Mark:
Groundwater Level Elevation Date
Free Phase Level Elevation Date

Depth (m)	Elevation (m)	Soil Profile	Well Construction Diagram	Well Construction Description	Sample Type and Number	State	Recovery (%)	N / RQD	Others	VOC (ppm)	Depth (ft)
0	261,00										0
	260,87	Top soil: Organic material. 0,13m			CC-1		66				
	260,09	Grey sand with traces of silt and gravel. 0,91m			0,91m CO-2		74				
2	259,40	* (Probable till)			1,60m SS-3		71	32	GA		10
		Boulders (pink granite) 1,60m			2,21m						
		Grey sand with traces of silt and gravel, moist with presence of boulders (pink granite) * (Probable till)			SS-4		63	46			
4					3,66m						
					SS-5		66	43	GA		
					5,08m						
6	255,21	Boulders with grey sand and gravel. 5,79m			CO-6		75				20
					6,40m						
	253,40				SS-7		21	R			
8		End of drilling at a depth of 7,6 meters. 7,60m			7,60m						30
10											40
12											50
14											60
16											
18											
20											

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FIELD TECHNICIAN: **Philip Binette, tech.** APPROVED BY: **Patrick L-Distefano, Eng.**

SOUNDING LOG

NO. **PZ-05**

PROJECT: **New landfill site study** FILE NO: **167020077** DATE: **2017-12-01**

LOCATION: **New landfill, Site 4** CLIENT: **The Cree Nation of Nemaska**

Sounding Type: | **From** | **To**

Rotational drilling | 0,00 | 16,87

Sample Type

SS Split Spoon: 51 mm O.D.
ST Shelby Tube:
TS Piston Tube:
CR Core sample, Caliper:
PW Core sample Fondatec
GS Grab Sample
AU Manual Auger
WS Wash Sample
TU PVC Tubing (Geoprobe)

State of Sample

Disturbed Intact Lost Core

Tests and Measurement in Field

N: Standard Penetration Test
RQD: Rock Quality Designation
R: Refusal
GA: Grain Size Analysis
Kt: Triaxial Permeability Test
VOC: Volatils organic compounds

Analytics Parameters and Tests in Laboratory

MET: Metals
PAH: Polycyclic aromatic hydrocarbon
MAH: Monocyclics aromatic hydrocarbon
THH: Total halogeneted hydrocarbon
BTEX: Benzene, toluene, ethylbenzene, xylenes (totals)
PH: Petroleum hydrocarbon C10-C50
LEA: Leachate test

Coordinates: Nad 83 UTM 18
X: 5.721.955,000
Y: 415.949,000

Bench Mark:

Groundwater Level

Elevation	Date
250,12m	17-12-06

Free Phase Level

Elevation	Date

Depth (m)	Elevation (m)	Soil Profile	Depth	Sample Type and Number	State	Recovery (%)	N / RQD	Others	VOC (ppm)	Depth (ft)
0	258,00									0
	257,94	Top soil: organic material.	0,06m							
		Grey sand with traces of silt and gravel. * (Probable till)		CC-1		40				
				CC-2		100				
2										
	255,05	Grey silt with traces of sand and gravel. * (Probable till)	2,95m							
4	253,58	Grey sand, with traces of silt and gravel with boulders of granite. Alterations layers of boulders and sand. * (Probable till)	4,42m	SS-3		66	80	GA		10
				SS-4		42				
6				SS-5		13	R			20
8		▽ 7.88								
	248,86	Grey sand with gravel and boulders of granite, cobbles. * (Probable till)	9,14m	SS-6		17	R			30
10										
12				CO-7		25				40
14				CO-8		25				
16				CO-9		13				50
	241,13	End of drilling at a depth of 16,87 meters.	16,87m							
18										60
20										

Well Construction

Diagram	Description
	1,00m
	0,00m
	Bentonite
	3,05m
	PVC
	Fill
	9,75m
	10,14m
	10,82m
	Silica sand
	Crepine
	13,87m
	16,87m

0,91m
1,52m
3,57m
5,03m
6,71m
9,75m
12,80m
15,55m
16,87m

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FIELD TECHNICIAN: **Philip Binette, tech.** APPROVED BY: **Patrick L-Distefano, Eng.**

SOUNDING LOG

NO. **PZ-06**

PROJECT: **New landfill site study** FILE NO: **167020077** DATE: **2017-12-03**

LOCATION: **New landfill, Site 4** CLIENT: **The Cree Nation of Nemaska**

Sounding Type:	From	To
Rotational drilling	0,00	11,23

Sample Type

SS Split Spoon: 51 mm O.D.
ST Shelby Tube:
TS Piston Tube:
CR Core sample, Caliper:
PW Core sample Fondatec
GS Grab Sample
AU Manual Auger
WS Wash Sample
TU PVC Tubing (Geoprobe)

State of Sample

Disturbed Intact Lost Core

Tests and Measurement in Field

N: Standard Penetration Test
RQD: Rock Quality Designation
R: Refusal
GA: Grain Size Analysis
Kt: Triaxial Permeability Test
VOC: Volatils organic compounds

Analytics Parameters and Tests in Laboratory

MET: Metals
PAH: Polycyclic aromatic hydrocarbon
MAH: Monocyclics aromatic hydrocarbon
THH: Total halogeneted hydrocarbon
BTEX: Benzene, toluene, ethylbenzene, xylenes (totals)
PH: Petroleum hydrocarbon C10-C50
LEA: Leachate test

Coordinates: Nad 83 UTM 18
X: 5.721.676,000
Y: 415.935,000
Bench Mark:
Groundwater Level

Elevation	Date
250,30m	17-12-07

Free Phase Level

Elevation	Date

Depth (m)	Elevation (m)	Groundwater	Free Phase	Soil Profile	Well Construction: Diagram / Description	Sample Type and Number	State	Recovery (%)	N / RQD	Others	VOC (ppm)	Depth (ft)
0	250,50											0
	250,32	0.2		Top soil: Organic matérial with yellow sand. 0,18m	0,00m							
				Grey sand with traces of silt and gravel, moist, presence of boulders. * (Probable till) 1,83m	0,61m PVC	CC-1		40				
2	248,67				1,22m	CC-2		44				
	248,06			Grey sandy silt, with traces of gravel. * (Probable till) 2,44m	Bentonite 2,44m	CC-3		44				10
				Grey silty sand, with traces of gravel and cobbles, saturated. * (Probable till) 3,66m	3,35m Fill 3,66m	CC-4		65		GA		
4	246,84				4,57m 4,88m 5,18m	CC-5		63				
				Grey sandy silt, firm, with traces of gravel, cobbles, saturated. * (Probable till) 5,49m	4,88m 5,49m	CO-6		27				
6	245,01			Silt and gravel, presence of pink granite boulders. * (Probable till)	Silica sand Screen 6,71m							20
8					8,23m							
10						CO-7		22				30
	239,83				10,67m	SS-8		66	91	GA		
	239,27			Grey sand with traces of silt, gravel and granite cobbles, saturated. * (Probable till) 11,23m	11,23m							
12				End of drilling at a depth of 11,23 meters.								40
14												
16												50
18												60
20												

FIELD TECHNICIAN: **Philip Binette, tech.** APPROVED BY: **Patrick L-Distefano, Eng.**

Appendix H LANDFILL COST ESTIMATES

Nemaska new landfill estimates

No	Description	Unit	Unit Price	Quantity	TOTAL
	2016-2017				
	Site Selection Study				
1	New site localisation study - Poly-Géo	lump sum	$41 000,00	1	$41 000,00
2	New site localisation study - Stantec	lump sum	$59 000,00	1	$59 000,00
	TOTAL 2016-2017				**$100 000,00**
	2017-2018				
	Preliminary Studies				
1	Environmental and Social Impact Assessment Study	lump sum	$75 000,00	1	$75 000,00
2	Preliminary Plans and Specifications	lump sum	$25 000,00	1	$25 000,00
3	*Excavator and operator for test pits provided by the CNN*	*days*	*$1 500,00*	*6*	*$9 000,00*
4	*Vehicle provided by the CNN*	*days*	*$150,00*	*16*	*$2 400,00*
	TOTAL 2017-2018				**$111 400,00**
	2018-2019				
	Studies				
1	Final Plans & Specifications	lump sum	$10 000,00	1	$10 000,00
2	Request for CA and tender management	lump sum	$25 000,00	1	$25 000,00
	TOTAL 2018-2019				**$35 000,00**
	2019-2020				
	Global items				
1	Supply and installation of fence	m.lin.	$230,00	640	$147 200,00
2	Signs	lump sum	$4 500,00	1	$4 500,00
3	Supply and installation of gate at truck entrance (lockable)	lump sum	$5 000,00	1	$5 000,00
4	Acces road	m.lin.	$800,00	100	$80 000,00
5	Diverse items	lump sum	$95 000,00	1	$95 000,00
	Trenches 1 and 2 - Opening - 24,000m3 capacity - lifespan = 5 years				
1	Deforestation	m²	$2,20	9800	$21 560,00
2	Removal of organic soil	m²	$2,50	8100	$20 250,00
3	Class B material excavation	m³	$11,00	32500	$357 500,00
4	Berm construction	m³	$15,00	15000	$225 000,00
5	Berm: organic soil and seeding	m²	$6,00	3000	$18 000,00
6	In trench access road	m.lin.	$200,00	250	$50 000,00
7	Ditch excavation	m.lin.	$40,00	420	$16 800,00
8	Culvert	lump sum	$10 000,00	4	$40 000,00
9	Supervision + As-Built plan	lump sum	$85 000,00	1	$85 000,00
10	*Vehicle provided by the CNN*	*days*	*$150,00*	*20*	*$3 000,00*
	TOTAL 2019-2020				**$1 168 810,00**
	2020-2021				
	OPENING OF THE NEW SITE				
	Professionnal services				
1	Assistance, training, visits	lump sum	$25 000,00	1	$25 000,00
2	*Vehicle provided by the CNN*	*days*	*$150,00*	*5*	*$750,00*
	TOTAL 2020-2021				**$25 750,00**
	GRAND TOTAL				**$1 440 960,00**

LEGEND	Future landfill
Studies	$175 000,00
Construction	$1 080 810,00
Engineering	$85 000,00
Construction supervision	*$85 000,00*
Services provided by CNN	$15 150,00
Contingencies (25% of construction costs)	$270 202,50
TOTAL	**$1 711 162,50**

APPENDIX C LANDFILL ACCESS ROAD OPTIONS STUDY

Nemaska New Landfill Access Road Options

Technical Memorandum

Prepared for:

Cree Nation of Nemaska

Prepared by:

Stantec Consulting Ltd.

January 12, 2023

167020077-300-EN-R-0002-0

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Table of Contents

1.0 CONTEXT 1

2.0 GENERAL DESCRIPTION OF THE ACCESS ROAD 2
2.1 OPTION 1 2
2.2 OPTION 2 2
2.3 OPTION 3 2

3.0 OPTIONS COMPARISON 3
3.1 TECHNICAL AND ADMINISTRATIVE CRITERIA 3
3.2 FINANCIAL CRITERIA 4
3.3 BIOPHYSICAL AND ENVIRONMENTAL CRITERIA 5
3.3.1 Vegetation 5
3.3.2 Watercourses and Fish 6
3.3.3 Wildlife 6
3.3.4 Birds 7
3.3.5 Species at risk 7
3.3.6 Synthesis 8
3.4 CREE LAND AND RESOURCE USE 9
3.4.1 Hunting and Trapping 9
3.4.2 Fishing 9
3.4.3 Berries and Plants Gathering 9
3.4.4 Camps and Trails 10
3.4.5 Water Quality and Visual Aesthetics 10
3.4.6 Synthesis 10
3.5 OVERALL COMPARISON 11

4.0 REFERENCES 12

LIST OF TABLES

Table 1 Technical and Administrative Criteria 4
Table 2 Financial Criteria 4
Table 3 Avian species at risk around the study area 8
Table 4 Biophysical and Environmental Criteria 8
Table 5 Land and Resource Use Criteria 10
Table 6 Overall Comparison 11

APPENDIX

APPENDIX 1 Figure 1 - proposed landfill site with the three access road options and the environmental components

Abbreviations

ATV	All-terrain vehicle
CDPNQ	Centre de données sur le patrimoine naturel du Québec
CNG	Cree Nation Government
CNN	Cree Nation of Nemaska
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
MFFP	Ministère des Forêts, de la Faune et des Parcs
RRLIRM	Regulation respecting the landfilling and incineration of residual materials
SARA	Species at Risk Act

1.0 CONTEXT

Stantec was mandated in March 2016 by the Cree Nation of Nemaska (CNN) to undertake a study (Stantec, 2018) that would identify a location for a new waste disposal site for the community. The main objective of this study was to identify a new waste disposal site that will meet the current and future needs of the population to be served while conforming to all applicable regulations and best practice guidelines and ensuring that no community land of importance is disturbed.

Aerial photo interpretations identified nine potential sites meeting the landfill site selection requirements. The nine sites were assessed as per the agreed selection requirements, as topography, drainage, flora, fauna, heritage and distance from waterbodies and watercourses. Sites 4, 7 and 8 were identified as being the best potential sites and were selected for further analysis.

Available information was used to complete a selection matrix comparing the three sites. Site 8 was recommended and approved by the Band Council in November 2016.

However, subsequently additional information was obtained, and further constraints were identified making Site 8 unacceptable as a possible site for the development of the future landfill. After revising the rating system based on the information obtained from further field investigations, Site 4 was rated as the highest.

Site 4 meets all the selection requirements including land area, environment and topography, culture and nature, infrastructure and development, regulatory requirements especially those of the *Regulation respecting the landfilling and incineration of residual materials* (RRLIRM) and the Zoning By-Law of the Eeyou Istchee James Bay Regional Government. As a result, Site 4 was recommended and approved by the Band Council in November 2017.

The purpose of the following report is to present possible road options accessing the landfill. All of the proposed options have been evaluated on different criteria like technical, administrative, financial, biophysical, environmental as well as land and resource use. At the end, the evaluations of each criterion were combined, without any criterion ranking, to determine which would be the best option for the new access road.

2.0 GENERAL DESCRIPTION OF THE ACCESS ROAD

During the project, three possible access road options were identified leading to Site 4 from aerial photo-interpretation conducted by a geomorphologist. The road layouts were determined taking into account the bodies of water, soil composition, topography and natural barriers.

Figure 1 inserted in Appendix 1 shows the general location of the local study area with the proposed landfill site, the three access road options and the environmental components.

There is currently no access road leading to the selected site, therefore, one will need to be built. This general statement applies to the three access road options.

The proposed access road is a gravel two-way road, seven and half meters (7.5 m) wide. The preliminary design structure thickness is composed of 900 mm of MG-112 gravel and 300 mm of MG-20 gravel.

None of the road options would cross an intermittent water course and the road construction would therefore not require the installation of culverts.

2.1 OPTION 1

This option is the northernmost and closest to the Route du Nord. The road would measure 440 m, would have a steep slope (average 3.6% and maximum 4.6%). This road does not cross any wetland. However, it would cross Hydro-Quebec power line right-of-way.

2.2 OPTION 2

This option is the middle road. It would measure 450 m, would have an average 2.7% and a maximum 3.2% slope. This road would cross an open peatland and a shrubby swamp near the Route du Nord.

2.3 OPTION 3

This option is the southernmost. The road would measure 880 m, would have a slow slope (average 1,1% and maximum 3%). However, it would cross several open peatlands and a small wooden swamp.

3.0 OPTIONS COMPARISON

Each option considered comes with its own challenges and has its strengths and weaknesses. In order to determine which would be the best option for the new access road, the three options presented in section 2 can be compared based on the following criteria (categories):

- Technical and administrative;
- Financial;
- Biophysical and environmental; and
- Land and resource use.

In their respective section below, each of these general criteria is broken down into sub-criteria. Stantec has assigned a color to each sub-criterion to facilitate comparison between the road options: green indicates the best option, yellow indicates an intermediate option, and orange indicates the least favourable option or the option presenting the most challenges. Red means not acceptable. An overall comparison, using the same color code, is provided at the end of this technical note. Stantec did not rank each general criterion (technical and administrative; financial; biophysical and environmental; land and resource use) though, considering that the relative importance of each criterion would be better determined by the CNN.

3.1 TECHNICAL AND ADMINISTRATIVE CRITERIA

Technical aspects vary according to physical constraints associated with each route. Each option would require the same amount of backfill considering that Option 2, even if it’s sloped, the soil removed upstream would be reused downstream.

Construction of Option 1 would require less time than the construction of Options 2 and 3 because Option 1 route is shorter and does not cross any peat areas. The Option 1 road follows a slight curve and may pose more safety risks when the collection truck would join the Route du Nord.

Table 1 summarizes technical considerations related to each access road option.

Table 1 Technical and Administrative Criteria

Criteria	Option 1	Option 2	Option 3
Type of soil	Till	Till with shrubby swamp and open peatland	Till with small open peatland areas
Topography	Steep slope (4.6%)	Gentle slope (3.2%)	Gentle slope (2.7%)
Works required and maintenance	Normal	Normal	Normal
Water crossings	0	0	0
Safety	Junction with Route du Nord within a curve section	Junction with Route du Nord in straight section	Junction with Route du Nord in straight section
Administrative	Crossing of Hydro-Quebec power line right-of-way	-	-
Overall Results	**Not acceptable**	**Good**	**Good**

From a technical point of view, Stantec suggests that Options 2 and 3 would present most interesting technical characteristics while Option 1 presents risks and should not be considered.

3.2 FINANCIAL CRITERIA

Option 1 would involve snow melting slowly because of its north exposure. In terms of road maintenance, costs increase correspondingly to the length of the road, so the longer access road route (Option 3) is anticipated to have higher maintenance and operation costs.

Table 2 summarizes criteria related to cost for each access road option.

Table 2 Financial Criteria

Criteria	Option 1	Option 2	Option 3
Length	440 m	450 m	880 m
Excavation / backfill	Normal	Normal	Normal
Operational costs	Low	Low	Average
Overall Results	**Good**	**Good**	**Average**

From a financial point of view, Stantec suggests that Options 1 and 2 would incur the lowest costs.

3.3 BIOPHYSICAL AND ENVIRONMENTAL CRITERIA

Stantec carried out vegetation field surveys between September 3rd and 5th, 2019. A total of 80 vegetation stations were inventoried in the Project Development Area, including the three access road options and the proposed landfill site.

3.3.1 Vegetation

The Project is located in the Eastern Taiga Shield Ecozone in Québec according to Canada's ecological land classification system (Statistics Canada, 2018). It is included in the Spruce-moss domain bioclimatic domain (Gouvernement du Québec, 2003). This zone is represented by a uniform forest dominated by the black spruce and an undergrowth composed of hypnaceous mosses and ericaceous shrubs. Herbaceous species are rare in this area.

Option 1

The first road option crosses 3 types of terrestrial habitats: a black spruce stand, a jack pine forest and a shrubby field (under the Hydro-Quebec right-of-way).

The tree layer of the black spruce stand is dominated by black spruce (*Picea mariana*), with jack pine (*Pinus banksiana*). The shrub layer is mostly composed of sheep laurel (*Kalmia angustifolia*), velvet-leaved blueberry (*Vaccinium myrtilloides*) and speckled alder (*Alnus incana ssp. rugosa*). The herbaceous layer is dominated by mosses and sphagnums (*Sphagnum sp*.). Soils seems to be well drained as no hydrological indicators were observed in this habitat.

The jack pine forest is the most common terrestrial habitat within the study area. The tree layer is strongly dominated by jack pines, with black spruce in low density (0-10%). The shrub layer is mostly composed of sheep laurel and the herbaceous layer is mostly non-existent, except for mosses, sphagnums and lichens covering soils and rocks.

The shrubby field is located mostly under Hydro-Quebec powerline. The terrain is well drained, and the tree layer is almost non-existent, as a few jack pines are observed through the habitat. The shrub layer is dominated by speckled alder, velvet-leaved blueberry and sheep laurel. There is no herbaceous is this area, except for some lichens.

No wetlands are crossed by this road option.

Option 2

Road option 2 crosses mostly the jack pine terrestrial habitat, as described above. Although, one wetland complex of two types of wetlands was identified at the crossing of this option and Route du Nord. The wetland complex is composed of a shrubby swamp (WL02A) and an open peatland (WL02B). The shrubby swamp is located on the south side of the option 2 road. It is mostly composed of common Labrador tea (*Rhododendron groenlandicum*) and leatherleaf (*Chemaedaphne calyculata*). Three-seeded sedge (*Carex trisperma)*, bunchberry (*Cornus canadensis*), sphagnums and lichens are mostly observed in the herbaceous layer. The open peatland is on the north side of the road and is very similar to the shrubby swamp as for its vegetation composition, although, changes in the drainage class and organic matter depth were observed. Throughout the survey, the limit of peatlands was placed between stations where organic matter depth shifted from less than 30 cm to above 30 cm.

Option 3

Option 3 is the longest possible road, and also crosses numerous habitats. From the Route du Nord, it crosses 4 peatlands, a wooded swamp, a jack pine forest, and a black bruce stand. The numerous peatlands in its crossing are similar to the one described above, with the tree layer composed mainly of black spruce and jack pine in low density, leatherleaf and common Labrador tea dominating the shrub layer, and a diversified but not dense herbaceous layer. Mostly, a thick layer of organic matter (30 to 60 cm or more) was observed in these wetlands.

The small wooded swamp on the south side of the option road showed the same tree layer dominance of the black spruce and jack pine, with the presence of the glandular birch (*Betula glandulosa*) and the speckled alder (*Alnus incana ssp. rugosa*) in the shrub layer. The herbaceous layer was non-existent.

3.3.2 Watercourses and Fish

According to the ministère des Forêts, de la Faune et des Parcs (MFFP) (through the Centre de données sur le patrimoine naturel du Québec (CDPNQ)), a few fish species are present, or potentially present within 8 km of the Project.

Although, no watercourse or ditch was observed in the road options study areas during the field survey in September 2019. Therefore, none of the three options is causing any impact on fish or fish habitat.

3.3.3 Wildlife

Wildlife inventories were not conducted during the field survey in 2019, and no terrestrial wildlife was observed.

The project is located within the Woodland caribou (*Rangifer tarandus caribou*), Central Mountain population, repartition area. This specie is considered endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) but has no Species at Risk Act (SARA) status. The Project is located within the Quebec's recovery plan for the 2013-2023 period (Équipe de rétablissement du Caribou forestier du Québec, 2013).

3.3.4 Birds

No specific wildlife inventory occurred in the context of this study. During the field visits, no avian wildlife was observed.

According to the Quebec breeding bird Atlas (QBBA/AONQ, 2013), the Project is located in the 18VC12 Square. Fifty-eight (58) species were identified within that square between 2010 and 2021. Of those, 4 are species at risk with a federal and/or provincial status. Those are the Red Crossbill (*Loxia curvirostra*), the Common Nighthawk (*Chordeiles minor*), the Olive-sided Flycatcher (*Contopus cooperi*) and the Rusty Blackbird (*Euphagus carolinus*) (see 3.3.5.2).

3.3.5 Species at risk

3.3.5.1 Vegetation

A request of information to the CDPNQ provided information on vegetation species at risk within 8 km of the Project. According to the CDPNQ (2019), no plant species of concern was registered on the study site or in a radius of 8 km.

During the surveys carried out between September 3rd and 5th, 2019, all observations of plant species designated threatened or vulnerable, or likely to be so designated, were recorded using the Garmin GNSS GLO receiver. During the field surveys, no provincially listed or federally listed species at risk was found.

3.3.5.2 Wildlife

A request of information to the CDPNQ provided information on wildlife species at risk within 8 km of the Project. According to the CDPNQ (2019), no wildlife or aquatic species of concern was registered on the study site or in an 8 km radius.

Although, as mentioned in section 2.2.4, according to the Quebec breeding bird Atlas, there are 4 species at risk in the 18VC12 Square.

Table 3 Avian species at risk around the study area

English name	Latin name	Status QC	COSEWIC Status	SARA Status	General Habitat
Common Nighthawk	*Chordeiles minor*	Susceptible	Special Concern	Threatened (under consideration for status change)	Open spaces, mountains, clear pine forests
Olive-sided Flycatcher	*Contopus cooperi*	Susceptible	Special Concern	Threatened (under consideration for status change)	Coniferous forests, burns, glades. In migration, usually seen at the tops of dead trees
Rusty Blackbird	*Euphagus carolinus*	Susceptible	-	-	Riparian groves, swamp forests; bogs

Considering the different habitats within the study area, it could be possible for the Common Nighthawk to be seen in the jack pine forests.

3.3.6 Synthesis

Table 4 summarizes the positive and negative aspects of each access road option in view of each biophysical and environmental criterion.

Table 4 Biophysical and Environmental Criteria

Criteria	Option 1	Option 2	Option 3
Hydrography	0 water crossing	0 water crossing	0 water crossing
Wetland	0 m intersected	86 m intersected	88 m intersected
Vegetation	440 m wooded	360 m wooded	785 m wooded
Fish	no watercourse observed	no watercourse observed	no watercourse observed
Wildlife	Wooded and open terrestrial habitat	Mostly wooded area,	Wetlands and wooded areas
Birds	Wooded and open terrestrial habitat	Mostly wooded area,	Wetlands and wooded areas
Overall Result	**Good**	**Average**	**Average**

From a biophysical and environmental point of view, Stantec estimates that Option 1 would have fewer impacts since it does not impact any wetlands and does not require as much deforestation given that part of it would intersect the Hydro-Québec transmission line right-of-way.

3.4 CREE LAND AND RESOURCE USE

In April and September 2021, Stantec conducted interviews with Mr. Charles Cheezo, tallyman of trapline R16, where the potential landfill site would be located. The objectives of these interviews were to document the land and resource use within the potential landfill site's general area, to present the three access road options, and to gather his comments and recommendations.

The tallyman had no preference for a particular access road option. However, he indicated some land and resource use elements to consider in the design and planning stages of the access road as summarized in the subsequent sections.

3.4.1 Hunting and Trapping

The potential landfill's general area is the tallyman's rabbit snaring area. Charles Cheezo snares rabbit within this area and along section of the Route du Nord. Following the major forest fire that affected the Nemaska territory in the 1980s, rabbit had disappeared from the area, but nowadays, they have returned in high numbers.

Beaver lodges can be observed in the creek located northeast of the potential landfill site, approximately 300 m from access road Option 1. The tallyman traps beaver in this creek, but not every year as he alternates his hunting spots. During the April 2021 interview, Charles Cheezo mentioned that he was "saving that beaver area for next year".

Big game, mostly bear and moose, cross the Route du Nord in the area between where access road Option 2 and Option 3 would connect to the Route du Nord, especially during the fall. The ground is hard and there are gravel patches along the way. Big game usually follows these the gravel portions. They don't usually walk in a soft areas. Furthermore, on the other side (of the Route du Nord), there's a small creek. Marten, rabbits, and squirrels cross the Route du Nord in that area as well.

The tallyman and other land users hunt partridge and ptarmigan along the Route du Nord, in proximity to the potential landfill site.

3.4.2 Fishing

Some 20 years ago, land users were fishing brook trout in the creek located northeast of the potential landfill site, but now there are a lot of truck traffic on the Route du Nord that affects fishing activities in the nearby watercourses.

The tallyman fishes pike in the lakes located 2 to 4 km northeast of the potential landfill site.

3.4.3 Berries and Plants Gathering

No berries or plants gathering activities were reported in the area. However, since the area is easily accessible by the Nemaska Road and the Route du Nord, several community members use the land and resources on trapline R16 without informing the tallyman.

3.4.4 Camps and Trails

The Cheezo family used to camp between the lakes located approximately 4 km northeast of the potential landfill site, where the transmission line now passes. They were trapping beaver there during the winter. They still use that area sometimes and bring all their materials and supplies with them. The old winter trail was once passing close to the potential landfill site and through the lakes area, but it is not present anymore.

The tallyman and other land users use the powerline right-of-way to circulate by snowmobile and all-terrain vehicle (ATV). Access road Option 1 is the only one that would intersect the Hydro-Québec powerline right-of-way.

3.4.5 Water Quality and Visual Aesthetics

Charles Cheezo expressed a concern regarding water quality in the creek located northeast of the potential landfill site, approximately 300 m from access road Option 1. Since the tallyman sometimes trap beaver in this creek and consumes it, and since that creek connects to a lake northeast of it as well as with Champion Lake to the northwest, he would like the potential landfill site and related access road to be as far as possible from the creek.

Additionally, the tallyman would not want the potential landfill site to be visible from the Route du Nord. Therefore, the potential landfill site would have to be located at a sufficient distance from the road, and the land-clearing should be limited to the necessary; trees around the landfill site should remain in place as much as possible.

3.4.6 Synthesis

Table 5 summarizes the positive and negative aspects of each access road option with regards to land and resource use.

Table 5 Land and Resource Use Criteria

Criteria	Option 1	Option 2	Option 3
Hunting and Trapping	Beaver (alternating) Beaver lodges 300 m from Option 1	No activities reported	No activities reported
Fishing	Creek located 300 m from Option 1	No activities reported	No activities reported
Berries and plants gathering	No activities reported	No activities reported	No activities reported
Camps and trails	Utilization of the powerline right-of-way to circulate by skidoo	No activities reported	No activities reported
Water Quality	Creek located 300 m from Option 1	No bodies of water	No bodies of water
Overall Result	**Average**	**Good**	**Good**

3.5 OVERALL COMPARISON

Table 6 shows the overall comparison for each criterion.

Table 6 Overall Comparison

Criteria	Option 1	Option 2	Option 3
Technical and Administrative	Not acceptable	Good	Good
Financial	Good	Good	Average
Biophysical and Environmental	Good	Average	Average
Land and Resource Use	Average	Good	Good
General	**Not acceptable**	**Good**	**Average**

In terms of financial, biophysical and environmental aspects, Option 1 appears to be the most favourable: it would involve lower constructions and operation costs, does not cross wetlands and requires less deforestation.

When it comes to technical aspects to consider for the construction of the access road, Options 2 and 3 appears the most favourable, while Option 1 presents safety issues related to the junction with the Route du Nord and administrative issues related to the crossing of Hydro-Québec power line right-of-way.

The proximity of Option 1 with the creek located some 300 m to the northeast and the fact that it would intersect the powerline right-of-way, where some people circulate by skidoo and ATV, makes it less interesting from a land user point of view.

Access road options 2 and 3 would both have the same impacts on land and resource use, which are considered less than Option 1.

Notwithstanding the technical criteria, options 1 and 2 would have been favourable; however, safety issues make option 1 unacceptable. In that context, option 2 is the recommended option but further detailed characterization work could be needed to assess the nature of the soil in order to establish the foundations of the road.

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STANTEC CONSULTING LTD., 2018. Site Selection and Baseline Study for a New Landfill Site in Nemaska, N/Ref: 167020077-214-MR-R001-0, 165 p.

APPENDIX 1

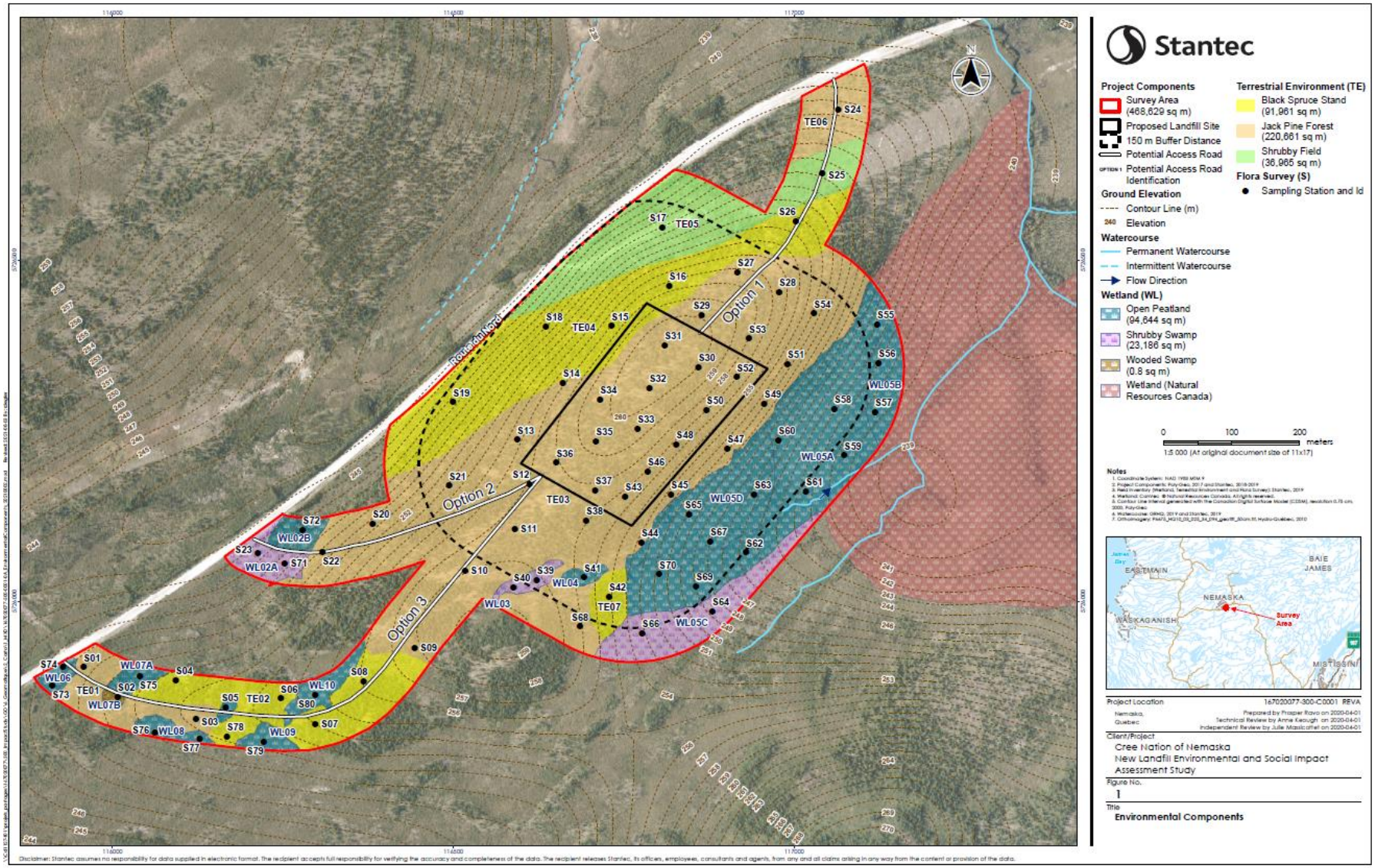


Figure 1 - Proposed landfill site with the three access road options and the environmental components

APPENDIX D DRAWINGS

Stantec

CREE NATION OF NEMESKA

NEMESKA NEW LANDFILL

LIST OF PLANS

SHEET	DESCRIPTION	REVISION
VR0000	COVER	0
VR0001	LEGEND	0
VR0002	NEW LANDFILL AND ACCESS ROAD GENERAL LAYOUT	0
VR0003	PROPOSED ACCESS ROAD VIEW PLAN AND PROFILES	0
VR0004	PROPOSED LANDFILL PLAN VIEW AND PROFILES	0
VR0005	SECTIONS AND DETAILS	0

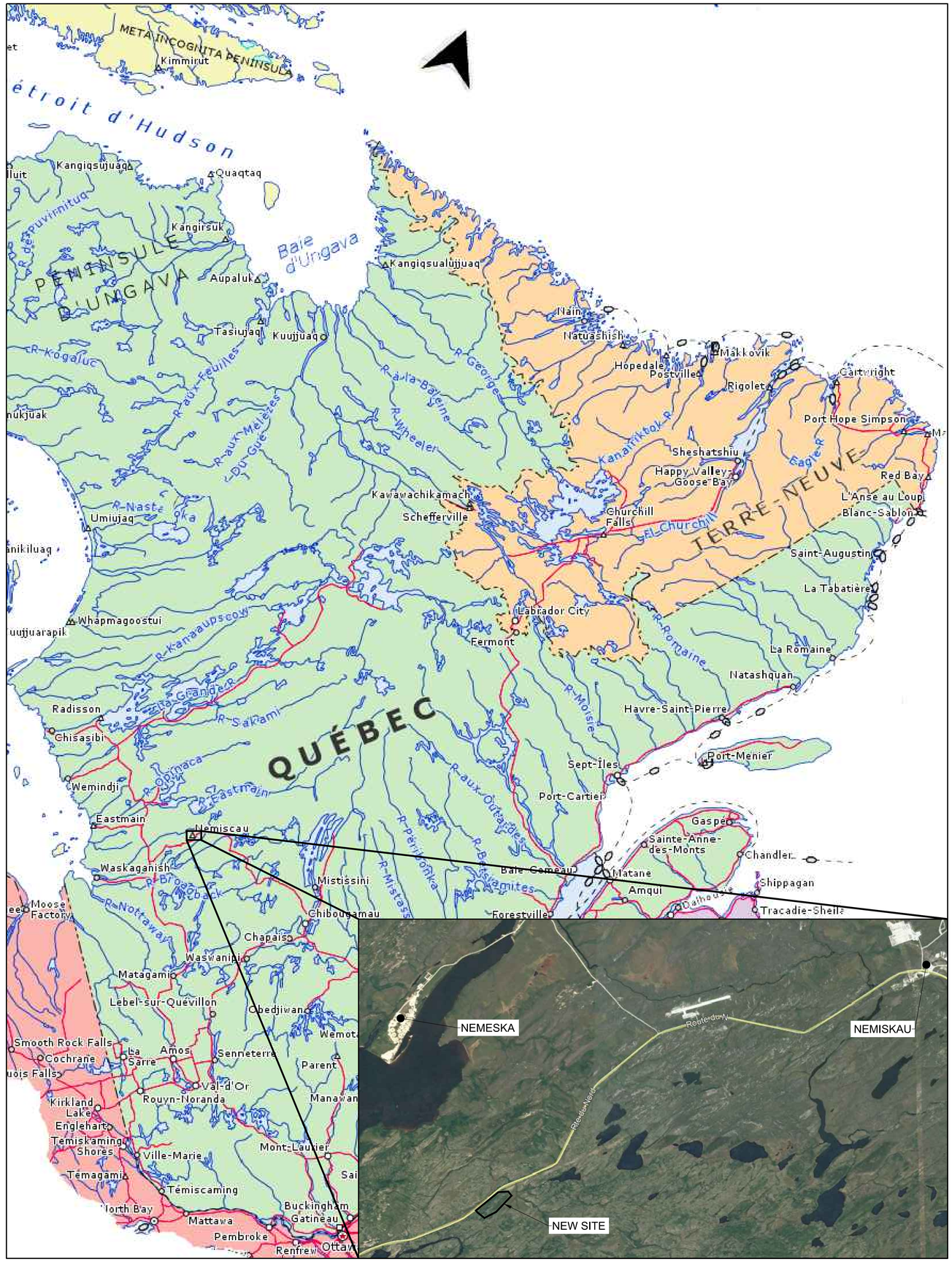
Stantec Consulting Ltd

FOR FINAL STUDY

DATE: 2023-10-25

2024.02.20

PROJET NUMBER: 167020077



CARTOGRAPHY

SURVEY

EXISTING		PROPOSED
	TERMINAL PARCEL	
	LANDMARK SUVEYING	
	STATION	
	DRILLING	
	OBSERVATION WELL	

CADASTRE

EXISTING		PROPOSED
	LINE EASEMENT	
	PARCEL LINE	
23-120	PARCEL NUMBER	23-120

TOPOGRAPHY

EXISTING		PROPOSED
	TOP OF SLOPE	
	BOTTOM OF SLOPE	
	SLOPE CHANGE LINE	
	TREE	
	SHRUB	
	STRAIN	
	LIMITATION OF WOODY	
	HEDGE	
10 10	PRIMARY LEVEL CURVE	10 10
10 10	SECONDARY LEVEL CURVE	10 10
ROC	UNDERGROUND ROCK	ROC
	PROFILE NATURAL GROUD / PROFILE FINISHED GROUND	

PLANNING

LAND AND BUILDING

EXISTING		PROPOSED
#325	BUILDING	#325
BOX	PO BOX	
	BOLLARD	
	FENCE	
	RAIL	
	RAILWAY DETAL	
	BARRIER CROSSING	
	INDICATOR CROSSING	
	LANTERN CROSSING	
	WALL CONSTRUCTION	

PARK AND GREEN AREA

EXISTING		PROPOSED
	BIKE PATH	
	PARK BENCH	
	GARBAGE	

ADMINISTRATIVE LIMIT

EXISTING		PROPOSED
	MUNICIPAL BOUNDARY	

NETWORK UTILITIES

WATER

EXISTING		PROPOSED
	DRINKING WATER	
	PROFILE DRINKING WATER PIPE	
	NON-DRINKABLE WATER	
	PROFILE NON-DRINKABLE WATER PIPE	
	FIRE HYDRANT	
	VALVE	
	INBOX SERVICE	
	VALVE CHAMBER	
	WATER WELL	
	CAP	
	REDUCER	
	BUMPER BLOCK	
	ELBOWS	
	CROSS	
	T	
	SLEEVE	
20cm	PIV	PIV
PI PI	FIRE PROYECTION	PI PI
	CONTAMINATED CONDUCT	

SANITARY SEWER

EXISTING		PROPOSED
	SANITARY AND COMBINED SEWER	
	DISCHARGE	
	PROFILE SANITARY AND COMBINED SEWER PIPE	
	PROFILE DISCHARGE PIPE	
	CONTAMINATED CONDUCT	
	COMBINED MANHOLE	U1
S	SANITARY MANHOLE	S1
	CAP	
	BLOCK ATTACHED	
S	SEPTIC TANK	

STORM SEWER

EXISTING		PROPOSED
	STORM SEWER	
	FOUNDATION DRAIN	
	CONNECTION TO SUMP	
	PROFILE STORM SEWER PIPE	
P	STORM MANHOLE	P1
	STORM SUMP-MANHOLE	
	CIRCULAR SUMP	
	RECTANGULAR SUMP	
R	SIDEWALK SUMP	
	CAP	
	BLOCK ATTACHED	
	CONTROL MANHOLE	
UT	PROCESSING UNIT	UT
	DITCH	
	DITCH EDGE	
	PROFILE DITCH	
G	PROFILE LEFT DITCH	G
D	PROFILE RIGHT DITCH	D
DA DA	DALOT	DA DA
DA DA	PROFILE DALOT	DA DA
	CONTAMINATED CONDUCT	

SERVICE

EXISTING		PROPOSED
	DISAFFECTED / TO DISAFFECT	
	TO REMOVE	

NETWORK UTILITIES

TELECOMMUNICATIONS

EXISTING		PROPOSED
TS	UNDERGROUND TELEPHONE NETWORK	TS
TA	AIR TELEPHONE NETWORK	TA
T T	TELEPHONE NETWORK MASSIF	T T
T	POST AND TELEPHONE GUIDE	T
TE	POST AND TELEPHONE AND ELECTRIC GUIDE	TE
T	MANHOLE	
	JUNCTION BOX	
	BEACON TRACKING	
	PHONE BOOTH	
FO	OPTICAL FIBER	FO
FOA	AIR OPTICAL FIBER	FOA
FOS	UNDERGROUND OPTICAL FIBER	FOS
FO FO	OPTICAL FIBER MASSIF	FO FO

CABLE

EXISTING		PROPOSED
CS	UNDERGROUND CABLE NETWORK	CS
CA	CABLE NETWORK AIR	CA
C	POST AND CABLE GUIDE	C
C	MANHOLE	
	JUNCTION BOX	
	BEACON TRACKING	

ELECTRICITY

EXISTING		PROPOSED
ES	UNDERGROUND POWER NETWORK	ES
EA	AIR POWER NETWORK	EA
E E	POWER NETWORK MASSIF	E E
E	MANHOLE	
	JUNCTION BOX	
	BEACON TRACKING	
E	POWER POLE	E
EL	POWER POLE WITH LAMP	EL
ET	POWER POLE WITH TRANSFORMER	ET
	PYLON	

GAS

EXISTING		PROPOSED
GAZ	UNDERGROUND GAS NETWORK	GAZ
AIR	PRESSURIZED AIR	AR
	BEACON TRACKING	
	MANHOLE	
	VALVE	

HYDROGRAPHIE

HYDROLOGIE

EXISTING		PROPOSED
	WATER LINE - BASE TIDE	
	WATER LINE - HIGH TIDE	
	HIGH WATER LINE	
	WATER OF THE DAY	
	WATERSHED	
	SUB-BASIN	
	100 YEAR CLASS FLOOD ZONE	
	20 YEAR CLASS FLOOD ZONE	
	OTHER CLASS FLOOD ZONE	
	PIEZOMETER	

BASIN NUMBER / BASIN AREA / PEOPLE / HECTARE — 01 / 200ha-ha / 200 pers.

WATER ELEVATION — NIVEAU EAU: 0,000

REGULATOR FLOW (L / sec) — 50

LOW POINT — P.B.

DIRECTION OF FLOW

NETWORK SLOPE — 0.5%

OUTLET AND DIRECTION / TYPE OF SEWER / MANHOLE NUMBER — P 00 00,000

OUTLET AND DIRECTION / TYPE OF SEWER / MANHOLE NUMBER — P 00,000 00 00,000

OUTLET AND DIRECTION

TOP OF MANHOLE — SEBLIS 00,000

PIPE OUTLET — RADEAU 00,000

TOP OF MANHOLE — WEST 00,000

PIPE OUTLET — RADEAU 00,000

NATURAL GROUND ELEVATION — T.N. 100,000

PIPE OUTLET — RAD.00,000

ROAD AND ROADWAY

ROAD AND ROAD OF COMMUNICATION

EXISTING		PROPOSED
	CENTER LINE	
	CENTER PROFILE	
D	PROFILE RIGHT WATER COURSE	D
G	PROFILE LEFT WATER COURSE	G
	UNPAVED SHOULDER	
	PAVED SHOULDER	
	PATH (GRAVEL, EARTH, SAND)	
	PRIVATE PAVED AUTO ENTRY	
	PRIVATE GRAVEL ENTRANCE	
	STREET CURB	
	PAVING	
	SCARFIED PAVING	
	SIDEWALK	
	HANDICAPPED DROP	
	CRASH BARRIER	
	RETAINING WALL	
	KERF	
ABRIBUS	BUS SHELTERS	ABRIBUS
450w	PARKING METER	450w
	CULVERT	

LIGHTING

EXISTING		PROPOSED
ECS	UNDERGROUND CABLE LIGHTING	ECS
ECA	AIR CABLE LIGHTING	ECA
	SINGLE LAMP	
	DOUBLE LAMP	
	MULTIPLE LAMP	
	DECORATIVE LAMP	
EC	POST LAMP	EC
MT	PULLING CABLE MASSIF	MT
	JUNCTION BOX	
	CONTROL BOX	
	STREET CROSSING	

SIGNALING

EXISTING		PROPOSED
	CONTROL BOX	
	TRAFIC LIGHT	
	ROAD SIGN	

MARKING

ROADWAY

EXISTING		PROPOSED
	MARKING LINE	
	AXIAL LINE 3m x 6m	
	CONTINUITY LINE 1m x 3m	
	GUIDING LINE 0,5m x 1m	
	ALTERNATE CIRCULATION 3m x 3m	
	PEDESTRIAN CROSSING BAND 0,4m x 0,4m x 2,4m	
	ROUNDABOUT YIELD 1m x 1m x 0,3m	

BUS

EXISTING		PROPOSED
	MARKING LINE	
	RESERVED WAY	

CYCLING TRACK

EXISTING		PROPOSED
	MARKING LINE	
	AXIAL LINE 1m x 3m	
	INTERSECTION BIKE CROSSING 1m x 1m	
	BIKE CROSSING LINE 0,4m x 0,4m x 0,4m	
	BIKE CROSSING STRIP 0,3m x 0,3m x 2,4m	

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0	FINAL STUDY	G.R.-C.	J.R.	2024.02.20
A	FOR IMPACT STUDY	L.M.S.	J.R.	2023.10.25

File Name: 167020077-CM-0-0001.DWG — 2023.01.13 YYYY.MM.DD

Prepared — MAXIME FORTIN, TECHN.

Drawn

JULIEN ROSSET, B. SC., M.A.A.

Project Manager

Permit-Seal

Client/Project Logo

Client/Project

CREE NATION OF NEMESKA

NEMESKA NEW LANDFILL

NEMASKA, QUEBEC

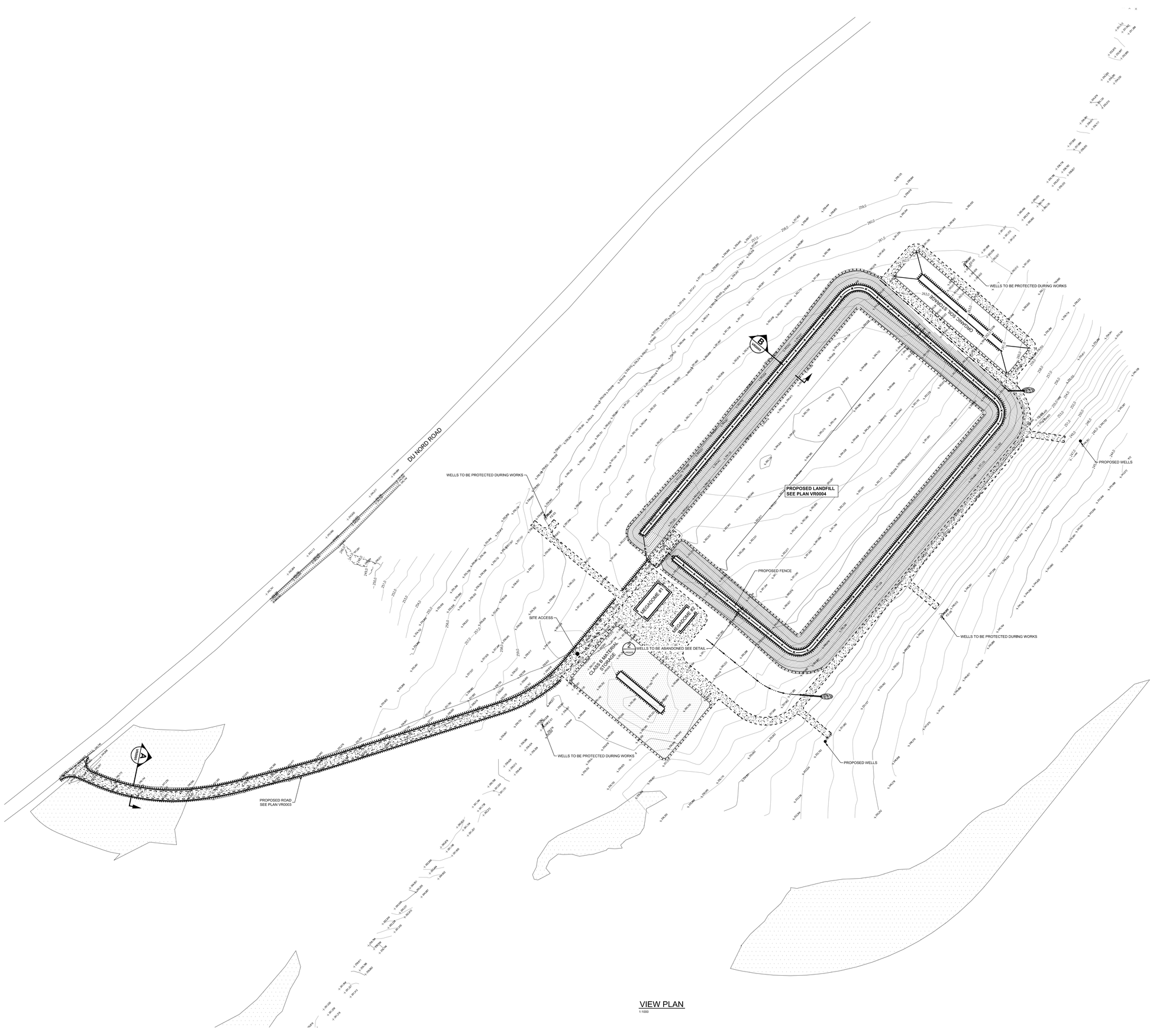
Title

LEGEND

Project No.	Scale
167020077	NONE
Iss./Rev. 0	Sheet 1 of 5
Drawing No.	VR0001

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2023.02.20 11:22:29

ISO A0



VIEW PLAN

1:1000

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Notes

1. THE CONTRACTOR HAS THE RESPONSIBILITY TO LOCATE ALL KNOWN EXISTING UTILITY SERVICES (SHOWN ON THE PLANS OR NOT) BY THE OWNERS OF SUCH SERVICES. THE POSITIONS AND ELEVATIONS OF THE VARIOUS EXISTING STRUCTURES AND SERVICES (PUBLIC OR MUNICIPAL UTILITIES) SHOWN ON THE PLANS ARE ONLY APPROXIMATE. THE CONTRACTOR SHOULD VERIFY THEIR ACCURACY ON THE SITE.
2. THE CONTRACTOR MUST SUPPORT AND PROTECT THE EXISTING SEWER AND AQUEDUCT PIPES, CABLES AND UNDERGROUND STRUCTURES OF PUBLIC UTILITIES, ELECTRICAL AND TELEPHONE LINES. THE CONTRACTOR IS THE ONLY PERSON RESPONSIBLE FOR BREAKAGE OF EXISTING WORKS AND MUST REPLACE THEM AT HIS EXPENSE.
3. THE CONTRACTOR MUST COORDINATE ITS WORK, IF APPROPRIATE, WITH ALL OTHER CONTRACTORS, COMPANIES OR UTILITIES WHICH WILL PERFORM WORK OF ANY KIND DURING THE PERIOD OF WORK PERFORMANCE OF THIS AGREEMENT. THE CONTRACTOR MUST TAKE THIS INTO ACCOUNT WHEN PREPARING HIS TENDER.
4. ALL SEWER MANHOLES, SUMPS, WATER VALVE BOXES, PUBLIC UTILITY MANHOLE, ETC, MUST BE ADJUSTED TO THE FINISHED PROFILE.
5. THE CONTRACTOR MUST REPAIR DRIVEWAYS AND LANDS DAMAGED DURING THE WORK, TO THE OWNER'S SATISFACTION.

0	FINAL STUDY	G.R.-C.	J.R.	2024.02.20
A	FOR IMPACT STUDY	LAK.S.	J.R.	2023.10.26
Issued/Revision		By	Appd	YYYY.MM.DD

File Name: 167020077-CH-D-0002.DWG — 2023.01.13 YYYY.MM.DD

Prepared — MAXIME FORTIN, TECHN. Drawn

JULIEN ROSSET, B. SC., M.A.A. Project Manager

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Client/Project Logo

Client/Project

CREE NATION OF NEMESKA

NEMESKA NEW LANDFILL

NEMASKA, QUEBEC

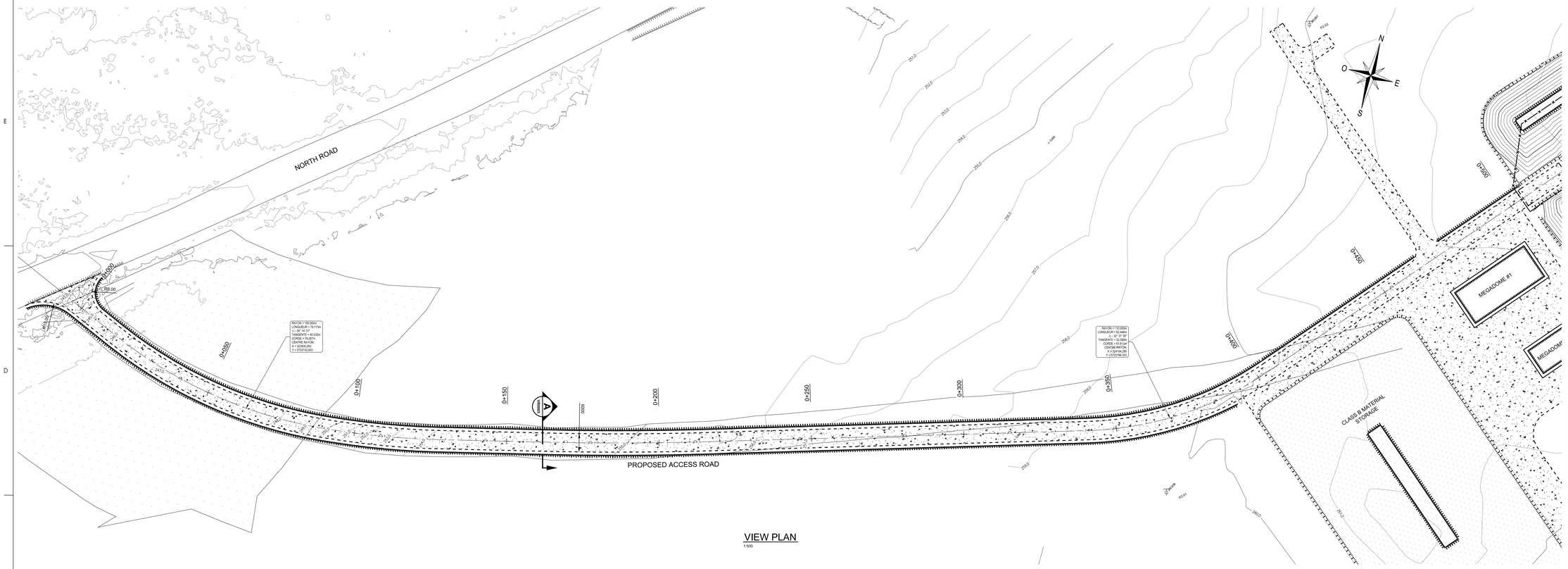
Title

NEW LANDFILL AND ACCESS ROAD GENERAL LAYOUT

Project No.	Scale
167020077	1 : 1000
Iss./Rev. 0	Sheet 2 of 5
	Drawing No. VR0002

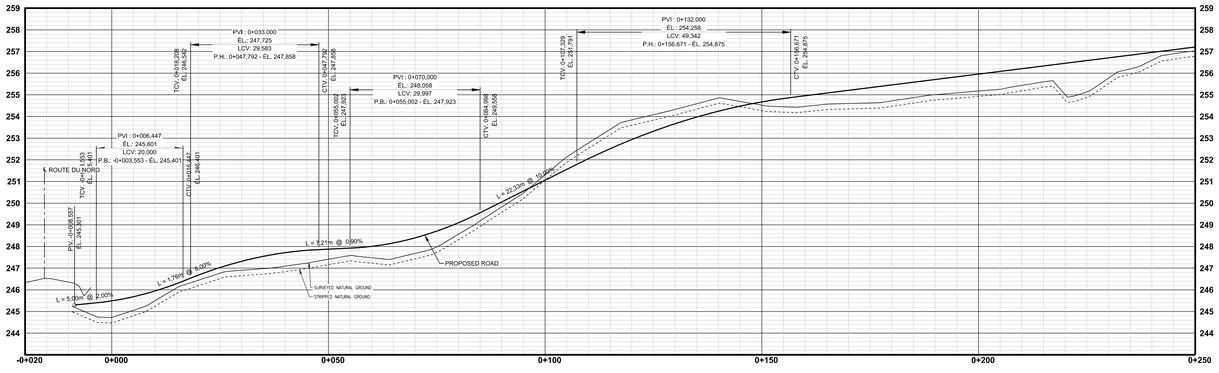
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ISO A0

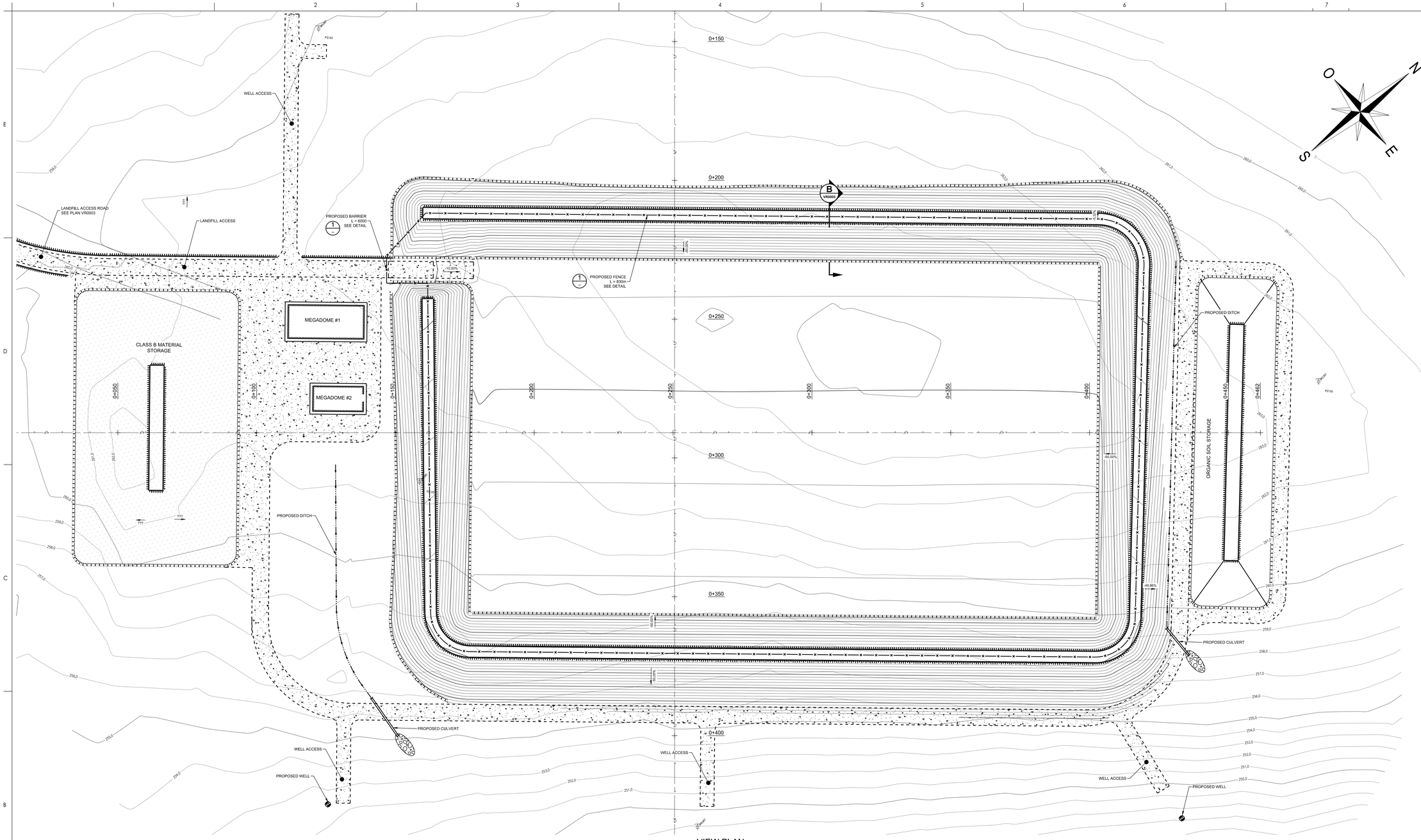


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1:500

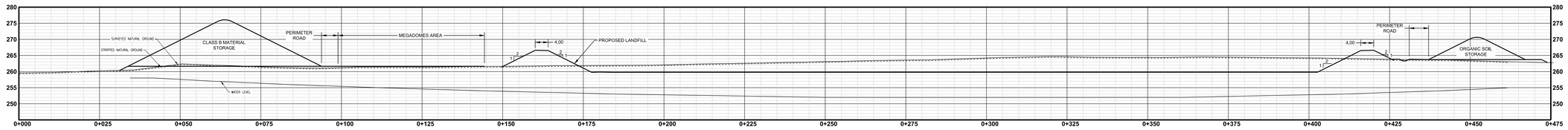


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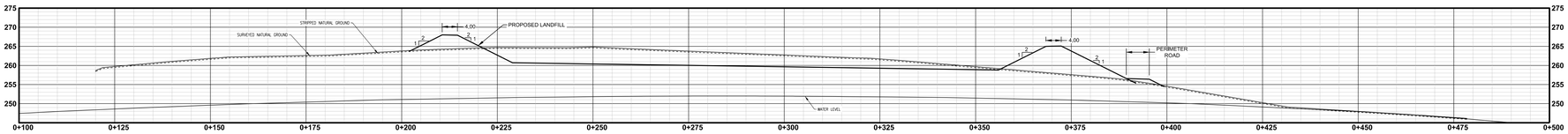
VIEW PLAN

1:500



LONGITUDINAL PROFILE

H. 1:250 - V. 1:5



TRANSVERSAL PROFILE

H. 1:250 - V. 1:5

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0 FINAL STUDY	G.R.-C.	J.R.	2024.02.20
A FOR IMPACT STUDY	L.M.S.	J.R.	2023.10.25

File Name: 167020077-C3-D-0004.DWG — 2023.01.13 YYYY.MM.DD

Prepared: MAXIME FORTIN, TECHN. — Drawn

JULIEN ROSSET, B. SC., M.A.A. — Project Manager

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Client/Project
CREE NATION OF NEMESKA

NEMESKA NEW LANDFILL

NEMASKA, QUEBEC

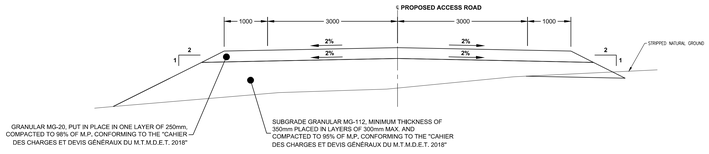
Title
PROPOSED LANDFILL
PLAN VIEW AND PROFILES

Project No. 167020077 — Scale H : 1:500 - V : 1:500

Iss./Rev. 0 — Sheet 4 of 5 — Drawing No. VR0004

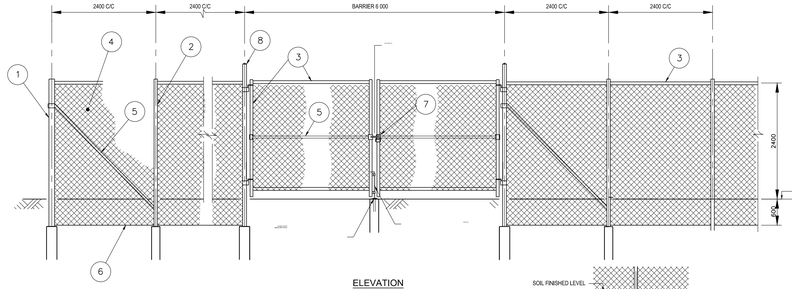
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ISO A0



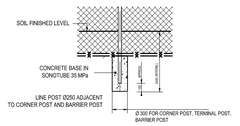
ROAD STRUCTURE
COUPE A
1:50

LEGEND
1. CORNER OR TERMINAL POST Ø89mm INCLUDING ø90mm CAP
2. INTERMEDIATE LINE POST SIZED 60mm (2 3/8") INCLUDING POST CAP
3. TUBULAR OR ANGULAR CHASSIS Ø 42
4. CHAIN LINK FENCE
5. SPACER SLEEVE Ø48
6. GALVANIZED STEEL BOTTOM WIRE CAL. 6 , CAL. 16 LIGATURE @ 400mm C/C
7. BOLT FASTENING SYSTEM
8. 6 METERS, Ø115mm BARRIER POST



ELEVATION
6 METER BARRIER

CHAIN LINK FENCE
DÉTAIL 1
NONE



POLE FOUNDATION

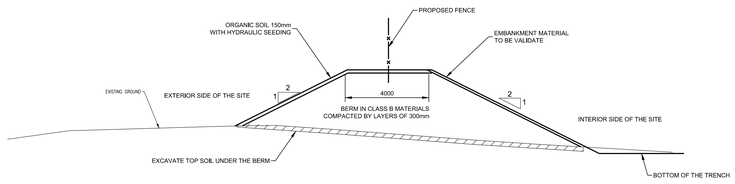
NOTES:
1) GRILLAGE MUST:
- HAVE 2400mm HEIGHT,
- BE GALVANIZED TO COMPLY WITH CLASS 3;
- CHAIN LINK FENCE, DIMENSIONS 50mm X 50mm.
- STEEL WIRE CLIPS CAL.9

2) ALL POSTS MUST BE OF STEEL GALVANISED AT HIGH TEMPERATURE TO PROVIDE A LAYER OF 550 g/m MINIMUM, COMPLIANT TO STANDARD ASTM A-120

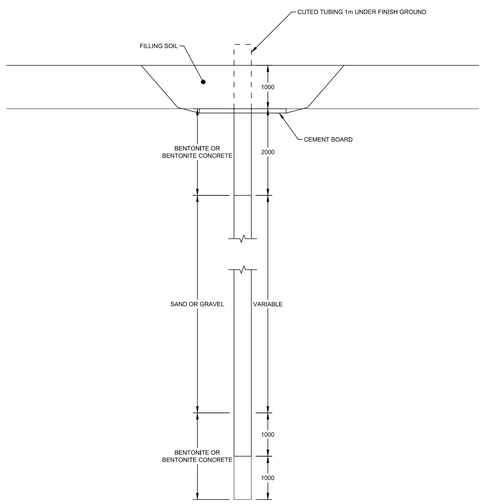
3) BY TERMINAL POST IS EGAL TO:
BARRIER POSTS, CORNER POSTS AND TERMINAL POST.
FOR THESE POSTS, CONTRACTOR SHALL SUPPLY A STANDARD TUBE WITH AN EXTERIOR DIAMETER OF 89,9mm.
LENGTH OF SUCH POSTS SHALL EXCEED TO THE 1070mm (78") WIDTH OF THE SCREEN.

4)TERMINAL POST MUST BE SUPPLIED AND INSTALLED WITH TWO (2) SUPPORT BARS OR SPACERS. THEY SHALL BE PROVIDED WITH 45 ° SUPPORTS AND BE ABLE TO HOLD THREE (3) ROWS OF BARBWIRE. SUPPORT BARS OR SPACERS SHALL BE SUPPLIED ALONG WITH ALL ACCESSORIES RELATED TO THEIR INSTALLATION.
ALL TERMINAL POSTS SHALL BE INSTALLED IN A CONCRETE BASE OF 300mm DIAMETRE (35MPa). THE DEPTH OF THE CONCRETE BASE IN THE SOIL SHALL BE 2100mm. THE REINFORCING POSTS SHALL BE INSTALLED EVERY SIXTH (6t) METERS.

5) INTERMEDIATE LINE POSTS CONFORMING TO THE ASTM A120-72a (AASHTO M181-63) NORM, MADE OF GALVANIZED STEEL OF STANDARD WEIGHT, SIZED 60mm (2 3/8") INCLUDING POST CAP.
THEY SHALL BE SUPPLIED WITH 45 ° SUPPORTS AND BE CAPABLE OF HOLDING THREE (3) ROWS OF BARBWIRE. INTERMEDIATE POSTS AIRE TO BE DIRECTLY BURIED IN THE SOIL AT A DEPTH OF 1200mm EXCEPT FOR POSTS ADJOINING TO ANGLE AND BARRIER POSTS WHICH ARE INSTALLED IN A 250mm DIAMETRE (35MPa) CONCRETE BASE. THE CONCRETE BASE SHALL BE 1200mm DEEP IN THE SOIL.



LANDFILL BERM
COUPE B
1:50



WELLS TO BE ABANDONED
DÉTAIL 2
NONE

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0 FINAL STUDY	G.R.-C.	J.R.	2024.02.20
A FOR IMPACT STUDY	I.-M.S.	J.R.	2023.10.25

File Name: 167020077-C3-D-0005.DWG — 2023.01.13 YYYY.MM.DD

Prepared — MAXIME FORTIN, TECHN. Drawn

JULIEN ROSSET, B. SC., M.A.A. Project Manager

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Client/Project Logo

Client/Project
CREE NATION OF NEMESKA

NEMESKA NEW LANDFILL

NEMASKA, QUEBEC

Title
SECTIONS AND DETAILS

Project No. 167020077
Scale INDICATED
Iss./Rev. 0
Sheet 5 of 5
Drawing No. VR0005

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2024.02.20 11:23:41

ISO A0

APPENDIX E SURFACE WATER SAMPLES ANALYSIS RESULTS

Votre # du projet: 167020077
Adresse du site: FUTURE LEET NEMASKA
Votre # Bordereau: C#179010-01-01

Attention: Patrick Leblanc-DiStefano

STANTEC CONSULTING LTD
Robert Bourassa
1060 Boul. Robert-Bourassa
Montreal, QC
Canada H3B 4V3

Date du rapport: 2018/08/13
Rapport: R2389647
Version: 1 - Finale

CERTIFICAT D'ANALYSES

 # DE DOSSIER MAXXAM: B832499
Reçu: 2018/08/03, 12:40

Matrice: EAU DE SURFACE
Nombre d'échantillons reçus: 4

Analyses	Quantité	Date de l' extraction	Date Analysé	Méthode de laboratoire	Référence Primaire
Demande biochimique en oxygène (5 jours) (2)	4	2018/08/03	2018/08/08	STL SOP-00008	MA315-DBO 1.1 R3 m
Coliformes fécaux (1)	4	N/A	2018/08/03	STL SOP-00189	MA700-FEC.EC1.0 R5m
Matières en suspension	2	2018/08/07	2018/08/07	STL SOP-00015	MA.104–S.S. 2.0 m
Métaux extractibles totaux par ICP	1	2018/08/07	2018/08/07	STL SOP-00006	MA.200–Mét. 1.2 R5 m
Métaux extractibles totaux par ICP	1	2018/08/09	2018/08/10	STL SOP-00006	MA.200–Mét. 1.2 R5 m
Azote ammoniacal	2	N/A	2018/08/06	STL SOP-00040	MA.300–N 2.0 R2 m
pH	4	N/A	2018/08/03	STL SOP-00038	MA.100–pH 1.1 R3 m
Phénols totaux par 4-AAP	2	2018/08/09	2018/08/10	STL SOP-00033	MA404–I.Phé 2.2 R2 m

Remarques:

Les laboratoires Maxxam sont certifiés ISO/IEC 17025:2005 pour certains paramètres précis des portées d'accréditation. Sauf indication contraire, les méthodes d'analyses utilisées par Maxxam s'inspirent des méthodes de référence d'organismes provinciaux, fédéraux et américains, tels que le CCME, le MDDELCC, l'EPA et l'APHA.

Toutes les analyses présentées ont été réalisées conformément aux procédures et aux pratiques relatives à la méthodologie, à l'assurance qualité et au contrôle de la qualité généralement appliqués par les employés de Maxxam (sauf s'il en a été convenu autrement par écrit entre le client et Maxxam). Toutes les données de laboratoire rencontrent les contrôles statistiques et respectent tous les critères de CQ et les critères de performance des méthodes, sauf s'il en a été signalé autrement. Tous les blancs de méthode sont rapportés, toutefois, les données des échantillons correspondants ne sont pas corrigées pour la valeur du blanc, sauf indication contraire. Le cas échéant, sauf indication contraire, l'incertitude de mesure n'a pas été prise en considération lors de la déclaration de la conformité à la norme de référence.

Les responsabilités de Maxxam sont restreintes au coût réel de l'analyse, sauf s'il en a été convenu autrement par écrit. Il n'existe aucune autre garantie, explicite ou implicite. Le client a fait appel à Maxxam pour l'analyse de ses échantillons conformément aux méthodes de référence mentionnées dans ce rapport. L'interprétation et l'utilisation des résultats sont sous l'entière responsabilité du client et ne font pas partie des services offerts par Maxxam, sauf si convenu autrement par écrit. Maxxam ne peut pas garantir l'exactitude des résultats qui dépendent des renseignements fournis par le client ou son représentant.

Les résultats des échantillons solides, sauf les biotes, sont rapportés en fonction de la masse sèche, sauf indication contraire. Les analyses organiques ne sont pas corrigées en fonction de la récupération, sauf pour les méthodes de dilution isotopique.
Les résultats s'appliquent seulement aux échantillons analysés. Si l'échantillonnage n'est pas effectué par Maxxam, les résultats se rapportent aux échantillons fournis pour analyse.
Le présent rapport ne doit pas être reproduit, sinon dans son intégralité, sans le consentement écrit du laboratoire.

889 Montée de Liesse, Ville St-Laurent, Québec, Canada H4T 1P5 Tel: (514) 448-9001 Fax: (514) 448-9199 Ligne sans frais : 1-877-4MAXXAM (462-9926)

Votre # du projet: 167020077
Adresse du site: FUTURE LEET NEMASKA
Votre # Bordereau: C#179010-01-01

Attention: Patrick Leblanc-DiStefano

STANTEC CONSULTING LTD
Robert Bourassa
1060 Boul. Robert-Bourassa
Montreal, QC
Canada H3B 4V3

Date du rapport: 2018/08/13
Rapport: R2389647
Version: 1 - Finale

CERTIFICAT D'ANALYSES

 # DE DOSSIER MAXXAM: B832499

Reçu: 2018/08/03, 12:40

Lorsque la méthode de référence comprend un suffixe « m », cela signifie que la méthode d'analyse du laboratoire contient des modifications validées et appliquées afin d'améliorer la performance de la méthode de référence.

Notez: Les données brutes sont utilisées pour le calcul du RPD (% d'écart relatif). L'arrondissement des résultats finaux peut expliquer la variation apparente.

(1) Cette analyse a été effectuée par Maxxam Microbiologie-Montréal
(2) Veuillez noter qu'advenant l'impossibilité de débuter une analyse de demande biochimique en oxygène (DBO) à l'intérieur des 48 heures du délai de conservation (d'un échantillon conservé à 4°C), l'échantillon sera congelé, à moins d'une indication contraire d'une règlementation spécifique, afin de prolonger son délai de conservation à 180 jours.

Note : Les paramètres inclus dans le présent certificat sont accrédités par le MDDELCC, à moins d'indication contraire.

clé de cryptage

Veuillez adresser toute question concernant ce certificat d'analyse à votre chargé(e) de projets
Rodrigo Caffarengo,
Courriel: RCaffarengo@maxxam.ca
Téléphone (514)448-9001 Ext:7066336

==========

Ce rapport a été produit et distribué en utilisant une procédure automatisée sécuritaire.
Maxxam a mis en place des procédures qui protègent contre l'utilisation non autorisée de la signature électronique et emploie les «signataires» requis, conformément à la section 5.10.2 de la norme ISO/CEI 17025:2005(E). Veuillez vous référer à la page des signatures de validation pour obtenir les détails des validations pour chaque division.

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Dossier Maxxam: B832499
Date du rapport: 2018/08/13

STANTEC CONSULTING LTD
Votre # du projet: 167020077
Adresse du site: FUTURE LEET NEMASKA
Initiales du préleveur: MF

MÉTAUX EXTRACTIBLES TOTAUX (EAU DE SURFACE)

ID Maxxam				FP3130		FP3132		
Date d'échantillonnage				2018/08/01		2018/08/01		
# Bordereau				C#179010-01-01		C#179010-01-01		
	Unités	A	B	SW-2	Lot CQ	SW-4	LDR	Lot CQ
MÉTAUX								
Zinc (Zn)	ug/L	**5000**	67	<20	1922887	<20	20	1923916

LDR = Limite de détection rapportée
Lot CQ = Lot contrôle qualité

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Dossier Maxxam: B832499
Date du rapport: 2018/08/13

STANTEC CONSULTING LTD
Votre # du projet: 167020077
Adresse du site: FUTURE LEET NEMASKA
Initiales du préleveur: MF

PARAMÈTRES CONVENTIONNELS (EAU DE SURFACE)

ID Maxxam			FP3130		FP3132		
Date d'échantillonnage			2018/08/01		2018/08/01		
# Bordereau			C#179010-01-01		C#179010-01-01		
	Unités	B	SW-2	LDR	SW-4	LDR	Lot CQ
CONVENTIONNELS							
Azote ammoniacal (N-NH3)	mg/L	-	<0.020	0.020	<0.020	0.020	1922599
DBO5	mg/L	-	<4.0	4.0	<4.0	4.0	1922178
pH	pH	-	6.22	N/A	6.09	N/A	1922447
Phénols-4AAP	mg/L	0.5	<0.0020	0.0020	<0.0020	0.0020	1923872
Matières en suspension (MES)	mg/L	-	9.3	0.74	0.70	0.20	1922937

LDR = Limite de détection rapportée
Lot CQ = Lot contrôle qualité
N/A = Non Applicable

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Dossier Maxxam: B832499
Date du rapport: 2018/08/13

STANTEC CONSULTING LTD
Votre # du projet: 167020077
Adresse du site: FUTURE LEET NEMASKA
Initiales du préleveur: MF

MICROBIOLOGIE (EAU DE SURFACE)

ID Maxxam		FP3130	FP3132		
Date d'échantillonnage		2018/08/01	2018/08/01		
# Bordereau		C#179010-01-01	C#179010-01-01		
	Unités	SW-2	SW-4	LDR	Lot CQ
TESTS MICROBIOLOGIQUES					
Coliformes fécaux	UFC/100ml	<10	<10	10	1922422

LDR = Limite de détection rapportée
Lot CQ = Lot contrôle qualité

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Dossier Maxxam: B832499
Date du rapport: 2018/08/13

STANTEC CONSULTING LTD
Votre # du projet: 167020077
Adresse du site: FUTURE LEET NEMASKA
Initiales du préleveur: MF

REMARQUES GÉNÉRALES

pH: Délai maximum de conservation dépassé sur réception.: FP3130, FP3132

A,B: Les critères des sols proviennent de l'Annexe 2 du « Guide d'intervention-Protection des sols et réhabilitation des terrains contaminés. MDDELCC, 2016. » et intitulé « Grille des critères génériques pour les sols ».Les critères des sols sont ceux de la province géologique des Basses-Terres du Saint-Laurent.

Les critères A et B pour l'eau souterraine proviennent de l'annexe 7 intitulé « Grille des critères de qualité des eaux souterraines » du guide d'intervention mentionné plus haut. A=Eau de consommation; B=Résurgence dans l'eau de surface

Ces références ne sont rapportées qu'à titre indicatif et ne doivent être interprétées dans aucun autre contexte.

- = Ce composé ne fait pas partie de la réglementation.

Les résultats ne se rapportent qu'aux échantillons soumis pour analyse

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STANTEC CONSULTING LTD
Votre # du projet: 167020077
Adresse du site: FUTURE LEET NEMASKA
Initiales du préleveur: MF

RAPPORT ASSURANCE QUALITÉ

Lot AQ/CQ	Init	Type CQ	Groupe	Date Analysé	Valeur	Réc	Unités
1922178	LPU	MRC	DBO5	2018/08/08		110	%
1922178	LPU	Blanc fortifié	DBO5	2018/08/08		104	%
1922178	LPU	Blanc fortifié DUP	DBO5	2018/08/08		110	%
1922178	LPU	Blanc de méthode	DBO5	2018/08/08	<4.0		mg/L
1922178	LPU	Blanc de méthode DUP	DBO5	2018/08/08	<2.0		mg/L
1922447	JGZ	Blanc fortifié	pH	2018/08/03		102	%
1922599	JGZ	MRC	Azote ammoniacal (N-NH3)	2018/08/06		104	%
1922599	JGZ	Blanc fortifié	Azote ammoniacal (N-NH3)	2018/08/06		99	%
1922599	JGZ	Blanc de méthode	Azote ammoniacal (N-NH3)	2018/08/06	<0.020		mg/L
1922887	RNP	Blanc fortifié	Zinc (Zn)	2018/08/07		97	%
1922887	RNP	Blanc de méthode	Zinc (Zn)	2018/08/07	29, LDR=20		ug/L
1922937	ND2	Blanc fortifié	Matières en suspension (MES)	2018/08/07		100	%
1922937	ND2	Blanc de méthode	Matières en suspension (MES)	2018/08/07	<0.20		mg/L
1923872	GGC	Blanc fortifié	Phénols-4AAP	2018/08/10		101	%
1923872	GGC	Blanc de méthode	Phénols-4AAP	2018/08/10	<0.0020		mg/L
1923916	DKH	Blanc fortifié	Zinc (Zn)	2018/08/10		106	%
1923916	DKH	Blanc de méthode	Zinc (Zn)	2018/08/10	<20		ug/L

LDR = Limite de détection rapportée

MRC: Un échantillon de concentration connue préparé dans des conditions rigoureuses par un organisme externe. Utilisé pour vérifier la justesse de la méthode.

Blanc fortifié: Un blanc, d'une matrice exempte de contaminants, auquel a été ajouté une quantité connue d'analyte provenant généralement d'une deuxième source. Utilisé pour évaluer la précision de la méthode.

Blanc de méthode: Une partie aliquote de matrice pure soumise au même processus analytique que les échantillons, du prétraitement au dosage. Sert à évaluer toutes contaminations du laboratoire.

Réc = Récupération

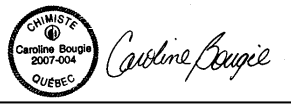
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Dossier Maxxam: B832499
Date du rapport: 2018/08/13

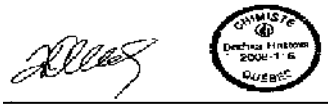
STANTEC CONSULTING LTD
Votre # du projet: 167020077
Adresse du site: FUTURE LEET NEMASKA
Initiales du préleveur: MF

PAGE DES SIGNATURES DE VALIDATION

Les résultats analytiques ainsi que les données de contrôle-qualité contenus dans ce rapport furent vérifiés et validés par les personnes suivantes:



Caroline Bougie, B.Sc. Chimiste



Dochka Koleva Hristova, B.Sc., Chimiste



Miryam Assayag, B.Sc. Chimiste



Pouya Salehi

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Maxxam
Une société du Groupe Bureau Veritas

Maxxam Analytics International Corporation o/a Maxxam Analytics
889, Montée de Liesse, Saint-Laurent, Quebec Canada H4T 1P5 Tel:(514) 448-9001 Ligne sans frais:(877) 462-9926 x Fax:(514) 448-9199 www.maxxam.ca

Bordereau de Transmission d'Échantillons

INFORMATION FACTURATION:		Information Rapport		Information Projet		À l'usage du laboratoire seulement	
Compagnie	#4087 STANTEC CONSULTING LTD	Compagnie	#6081 STANTEC CONSULTING LTD	N° de cotation	B70641	# dossier Maxxam	# Commande:
Attention de	ACCOUNTS PAYABLE	Attention de	Patrick Leblanc-DiStefano	N° de commande			179010
Adresse	P.O. Box 38212	Adresse	1060 Boul. Robert-Bourassa	N° de projet	167020077	Bordereau de Transmission d'Échantillons	Chargé(e) de Projets
	Dartmouth NS B3B 1X2		Montreal QC H3B 4V3	Nom du projet			
Téléphone	Téléc	Téléphone	Téléc	# de site	Future LEET Nemaska	C#179010-01-01	Rodrigo Cellerenge
Courriel	SAPinvoices@Stantec.com	Courriel	Patrick.Leblanc-DiStefano@stantec.com	Échantillonneur	Michael Feigen		

Critères et Règlements

- Potable
- RDS
- RMD
- REMR
- Autre (spécifier)

Essai de pompage: 24h (Art. 6.1&6.2) / 48h (Art. 6.2) / 72h (Art. 6.1&6.2)

Rég. CUM: Égout sanitaire Art.10 / Égout pluvial Art.11

Qualité Eau Potable: Rég. Pâtes & Papiers (Art.104) / Rég. Pâtes & Papiers (Art.112) / Municipal / Non-municipality

Instructions spéciales

Remarque: Pour les échantillons d'eau potable soumis à la réglementation - S.V.P utiliser le formulaire client rattaché à l'eau potable

Délais requis

S.V.P notifier à l'avance en cas de projet urgent

Délai Régulier
(Sera applicable si le délai de l'urgence n'est pas précisé)
Délai Régulier = 5 Jours ouvrables pour la plupart des analyses.
S.V.P Veuillez noter que le délai pour certaines analyses telles que le DBO5 et les Dioxines/Furannes est > 5 jours - Contactez votre chargé de projets pour les détails.

Délai rapide (Si applicable à tous les échantillons)
Date Requise: _____ Heure Requise: _____
Veuillez noter que tout échantillon reçu après 15H00, sera considéré comme reçu le lendemain (jour ouvrable) à 8H00.

Conserver les échantillons en milieu froid (< 10 oC) de l'échantillonnage à la livraison chez Maxxam

	Étiquette code-barres de l'échantillon	Identification de l'échantillon	Date d'échantillonn	Heure	Matrice	Eau potable réglementée ? (O / N)	Métaux filtrés sur le terrain O/N	Azote ammoniacal	Coliformes fécaux	Demande biochimique en oxygène (5 jours)	Matières en suspension	Métaux extractibles totaux (basse limite): Zn	pH	Phénols totaux par 4-AAP				# of Bottles	Commentaires
1		SW-1	18-8-1		SUF.			X	X	X	X	X	X	X				7	
2		SW-2	1		1			X	X	X	X	X	X	X				1	
3		SW-3	1		1														
4		SW-4	1		1			X	X	X	X	X	X	X				1	
5																			
6																			
7																			
8																			
9																			
10																			

B832499_COC RGH 03/08

DESSAISI PAR: (Signature)	Date: (AAAA/MM/JJ)	Heure	REÇU PAR: (Signature)	Date: (AAAA/MM/JJ)	Heure	Contenants utilisés et non soumis
Michael Feigen	18-8-2		VUE DW 125	18/08/25	8:00	

Réservé au laboratoire

Court Délai de	Température (°C) de Réception	Sceau légal intact sur le glacière
☐	8 & 9	☐ Oui ☐ Non

* SAUF ACCORD CONTRAIRE PASSÉ PAR ÉCRIT, LES SERVICES COMPRIS DANS CETTE CHAÎNE DE RESPONSABILITÉS SONT SOUMIS AUX CONDITIONS GÉNÉRALES STANDARD DE MAXXAM. PAR LA SIGNATURE DE CETTE CHAÎNE DE RESPONSABILITÉS, VOUS CONFIRMEZ QUE VOUS AVIEZ PRIS CONNAISSANCE DES CONDITIONS GÉNÉRALES ET QUE VOUS LES ACCEPTEZ TELLES QU'ELLES SE PRÉSENTENT AU WWW.MAXXAM.CA/TERMS.

* IL EST DE LA RESPONSABILITÉ DE LA PERSONNE RAPPORTANT L'ÉCHANTILLON DE S'ASSURER DE L'EXACTITUDE DU BORDEREAU DE TRANSMISSION. UN MANQUEMENT À CETTE PROCÉDURE PEUT SE TRADUIRE PAR UN RETARD DANS LE DÉLAI ANALYTIQUE.

Blanc: Maxxam Jaune: Client

EXPEDITEUR WI: 577 ICE: YOS

APPENDIX F HYDROGEOLOGICAL ASSESSMENT REPORT

NEMASKA NEW WASTE DISPOSAL SITE
HYDROGEOLOGICAL ASSESSMENT

NEMASKA, QUEBEC

Prepared for:

Stantec Consulting Ltd

200-555 René-Lévesque Boulevard West
Montreal, QC H2Z 1B1

Prepared by:

BluMetric Environmental Inc.
200-1500 Du Collège Street
Saint-Laurent, QC H4L 5G6

Project Number: 230448-00
September 6, 2023

NEMASKA NEW WASTE DISPOSAL SITE
HYDROGEOLOGICAL ASSESSMENT

NEMASKA, QC

Prepared for:

Stantec Consulting Ltd.
200-555 René-Levesque Boulevard West
Montreal, QC, H2Z 1B1

Prepared by:

BluMetric Environmental Inc.
200-1500 Du Collège Street
Saint-Laurent, QC K4L 5G6

Project Number: 230448-00

September 6, 2023

TABLE OF CONTENTS

1. INTRODUCTION 1
1.1 OBJECTIVES AND LOCATION 1
1.2 SITE DESCRIPTION AND BACKGROUND 1
2. METHODOLOGY 3
3. SITE CHARACTERISTICS 5
3.1 PHYSIOGRAPHY AND CLIMATE CONDITIONS 5
3.2 GEOLOGY 7
3.3 HYDROGEOLOGY 7
3.3.1 Hydro-stratigraphic Units 7
3.3.2 Hydraulic Properties 7
3.3.3 Groundwater Flow 10
3.3.4 Seasonal Groundwater Fluctuation or Temporal Variations in Water Level 16
3.4 GROUNDWATER CLASSIFICATION OR AQUIFER POTENTIAL 18
3.5 OTHERS OBSERVATION: PERMEABILITY AND INFILTRATION POTENTIAL 19
4. CLOSING 19

LIST OF TABLES

Table 1: Piezometric Survey Results - 2017 and 2021 9
Table 2: Summary of the Aquifer Characteristics 10
Table 3: Answers to Questions about Groundwater Classification – Unconsolidated Till 19

LIST OF FIGURES

Figure 1: Site Location Map 2
Figure 2: Potential Landfill Contour and Topography 4
Figure 3: Surface Geology 6
Figure 4: Bedrock Geology 8
Figure 5a: Groundwater Depth Relative to the Ground Surface (December 1st, 2017) 12
Figure 5b: Groundwater Depth Relative to the Ground Surface (August 4th, 2020) 13
Figure 6a: Groundwater Elevation (December 1st, 2017) 14
Figure 6b: Groundwater Elevation (August 4th, 2020) 15

LIST OF APPENDICES

Appendix A: Data

Revision History

Version	Description
August 21, 2023	BluMetric Preliminary Report
September 6, 2023	BluMetric Final Report

1. INTRODUCTION

1.1 OBJECTIVES AND LOCATION

BluMetric Environmental Inc. (BluMetric®) was retained by Stantec Consulting Ltd (Stantec®) to complete a hydrogeological report for a New Solid Waste Disposal. This report documents the hydrogeology impact assessment of the Preferred Alternative Landfill Footprint or Site n° 4 for the Environmental Assessment (EA) for a new landfill footprint at the Cree community of Nemaska, in support of the Stantec report (2021[1]). The disposal of waste in an open trench, as proposed, can lead to the leaching and infiltration of various contaminants in the soils, which can degrade surface water and groundwater quality and nearby ecosystems. Consequently, the hydrogeological setting was investigated at the proposed landfill location to document initial conditions in order to assess potential impacts.

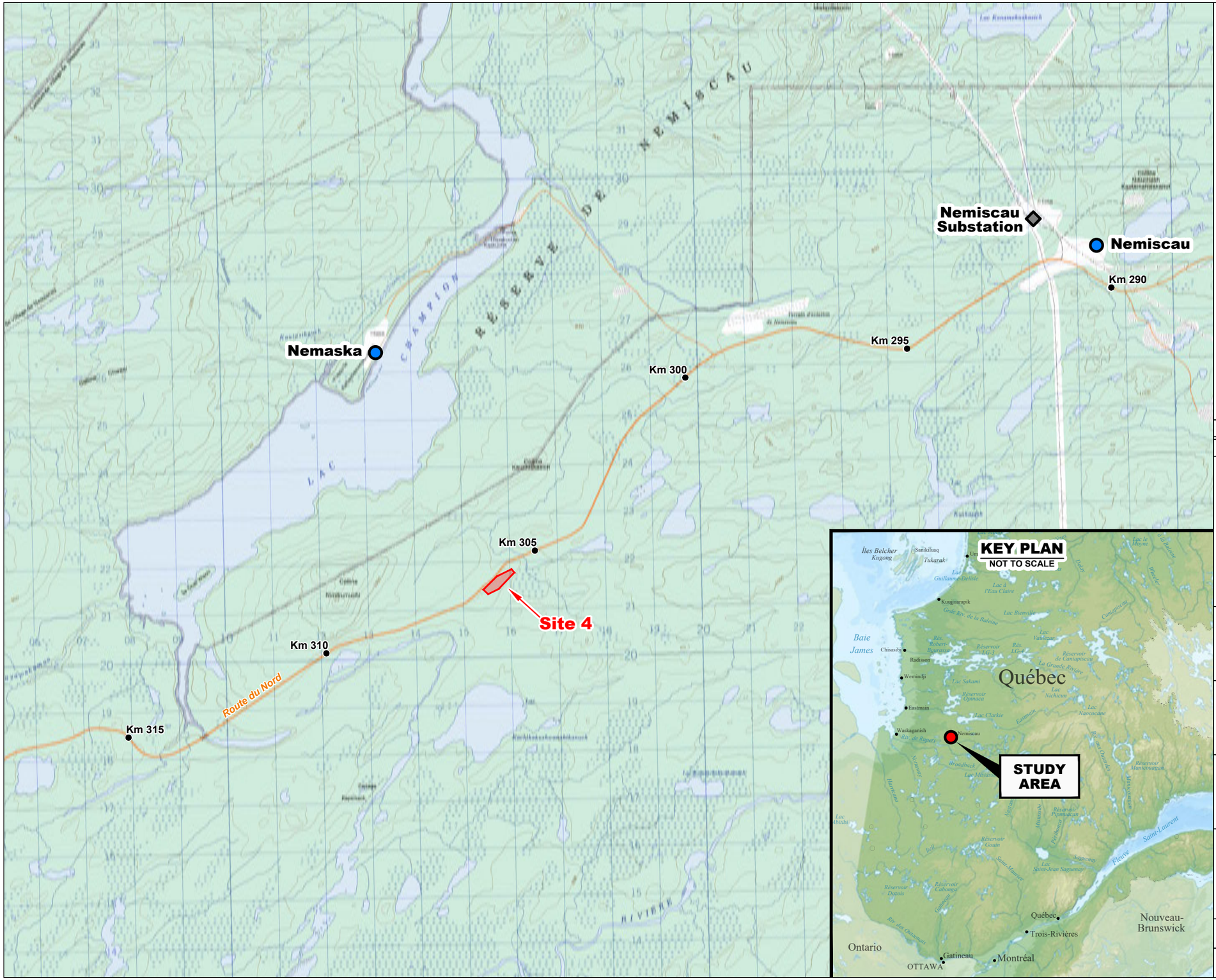
The study is part of the technical search for a solid waste landfill site in the town of Nemaska, and the preparation of an environmental and social impact study to be submitted to the COMEX[2]. The location and extent of future infrastructure for the site, is still at preliminary stages of development, and is located at kilometer 305 of the Route du Nord, east of the Cree community of Nemaska (**Figure 1**). This is site number 4 of all the sites surveyed in PolyGeo's report (2017[3]). This new waste disposal site project is located in the territory governed by the James Bay and Northern Quebec Agreement (JBNQA).

1.2 SITE DESCRIPTION AND BACKGROUND

According to Poly-Géo (2017):

> "Site 4 covers an area of about 21.5 ha on the south side of the Route du Nord, on a broad ridge of till (drumlin) aligned along a NE-SW axis (Map 3A; Appendix 3). Site 4 is 17 km from Nemaska, and as such is the site nearest to the town. It is bounded to the northwest by the road and to the north by the power line right-of-way. There are lowlands with peat bog along the southeastern boundary of the site and a rocky, partially till-covered area at its southern end. Tree cover (mostly jack pine with some black spruce) is scattered at the top of the site and a little denser on the northwest and southeast slopes."

[1] Stantec, 2021. *Nemaska New Waste Disposal Site Impact Assessment – Hydrogeological Study*. Ref. 167020077-300-EN-N-0001-0, March 31, 2021
[2] COMEX: Environmental and Social Impact Review Committee (Review Committee or COMEX)
[3] Poly-Géo inc., 2017. *Nemaska new waste disposal site – Photointerpretation and field investigations*. Final technical report presented to the Cree Nation of Nemaska. April 2017 ref. 16026, 6 pages and 5 appendices



LEGEND

POTENTIAL WASTE DISPOSAL AREA

REV.	DESCRIPTION	DATE	BY	CHK

REFERENCE :
TOPOGRAPHIC MAP 32 N/9 LAC CHAMPION, 1:50,000, ENERGY, MINES AND RESOURCES CANADA, 1990.

NOTE :
PROPRIETARY INFORMATION MAY NOT BE REPRODUCED OR DIVULGED WITHOUT PRIOR WRITTEN CONSENT OF BLUMETRIC ENVIRONMENTAL INC. DO NOT SCALE DRAWING. THIS DRAWING MAY HAVE BEEN REDUCED. ALL SCALE NOTATIONS INDICATED ARE BASED ON 11"x17" FORMAT DRAWINGS.

1:80 000 0 1.0 2.0 3.0
SCALE (km)
THIS SCALE TO BE USED TO OBTAIN APPROXIMATE DIMENSIONS FOR INFORMATION

N W E S

CLIENT

Stantec Consulting Ltd

PROJECT

Nemaska New Waste Disposal Site
Hydrogeological Assessment
Nemaska, Quebec

TITLE

Site Location Map

BluMetric Environmental
1500 du Collège Street, Suite 200
Saint-Laurent, Québec H4L 5G6
TEL.: 514 844-7199 FAX: 514 841-9111
Email: montreal@blumetric.ca
Web site: www.blumetric.ca

PROJECT #	DATE	REV.	FIG.
230448	2023-08-17	-	1

DRAWN	DESIGNED	CHECKED	CAD DRAWING
K.T.	L.A.	L.A.	230448-FIG1.DWG

On this Site n° 4, data was collected from a series of test pits (Poly-Géo Inc. 2017) and boreholes (Stantec 2017[4]). **Figure 2** shows the topography of the site. Work was completed in 2017 includes:

- Twenty-three exploratory test pits (PU-04-01 to PU-04-23) with a Volvo EC250E shovel excavator at the proposed site. The test pits were left open for a minimum of 24 hours to allow the water level to stabilize.
- Six boreholes (PZ-1 to PZ-6) drilled using a drill rig. Soil sampling was conducted using split-spoon sampling methods. Boulders were encountered during the drilling, and diamond coring was conducted to progress drilling through the boulders.Bedrock was not encountered in the boreholes. The six boreholes were completed as monitoring wells, although PZ-4 appears to have been damaged following the initial installation and could not be located in additional testing.
- The goal of the boreholes drilling was to intersect the water table and to install groundwater monitoring wells to assess groundwater flow conditions and quality at the site. Groundwater was observed in each borehole during drilling. Water-level surveys were carried out on three occasions in all monitoring wells except PZ-4.

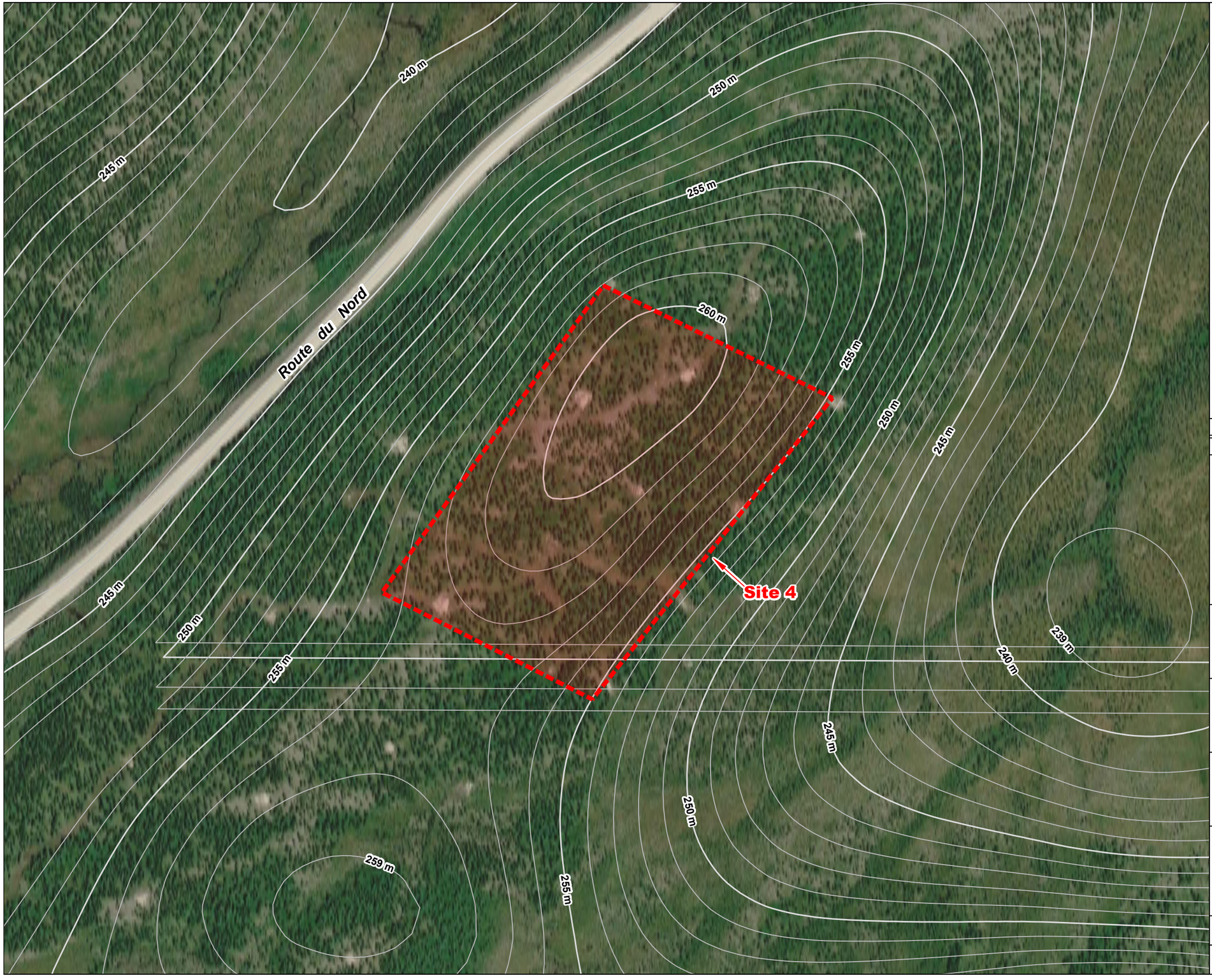
2. METHODOLOGY

The work program was a collaborative effort between BluMetric and Stantec. The study of the hydrogeological assessment in the project area was carried out using existing available information (Stantec 2017 and 2021; PoliGéo, 2017), and the results from geotechnical and hydrogeological fieldwork performed to characterize the proposed site. Information on regional groundwater resources in the project area from mining and industrial project reports (Example: Wesa-Envir-Eau, 2012[5]) was also used, as well as information deduced from available bedrock and surficial geology maps (SIGÉOM[6]).

A desktop review was conducted for the preparation of a hydrogeological report, including study of the regulatory framework and requirements overseeing the Waste disposal site. No field studies have been carried out by BluMetric.

New interpretations of the permeability tests carried out in 2021 and 2022 by Stantec have been made.

[4] Stantec, 217. Sounding log – PZ-1 to PZ-6
[5] Wesa Envir-Eau, 2012. *Étude Hydrogéologique Projet Whabouchi – Némaska Lithium.* Ref HB10015-00-01
[6] SIGÉOM : Ministères des Ressources naturelles et des Forêts : Interactive map: https://sigeom.mines.gouv.qc.ca/signet/classes/I1108_afchCarteIntr



LEGEND

POTENTIAL LANDFILL SITE (SITE 4)

REV.	DESCRIPTION	DATE	BY	CHK

REFERENCE :
AERIAL PHOTOGRAPHY, JULY 2020, GOOGLE EARTH, 2023.

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1:3 000 0 20 40 60 80 100
SCALE (m)
THIS SCALE TO BE USED TO OBTAIN APPROXIMATE DIMENSIONS FOR INFORMATION

N W E S

CLIENT

Stantec Consulting Ltd

PROJECT

Nemaska New Waste Disposal Site
Hydrogeological Assessment
Nemaska, Quebec

TITLE

Potential Landfill Contour
and Topography

BluMetric Environmental
1500 du Collège Street, Suite 200
Saint-Laurent, Québec H4L 5G6
TEL.: 514 844-7199 FAX: 514 841-9111
Email: montreal@blumetric.ca
Web site: www.blumetric.ca

PROJECT #	DATE	REV.	FIG.
230448	2023-08-17	-	2

DRAWN	DESIGNED	CHECKED	CAD DRAWING
K.T.	L.A.	L.A.	230448-FIG2.DWG

3. SITE CHARACTERISTICS

3.1 PHYSIOGRAPHY AND CLIMATE CONDITIONS

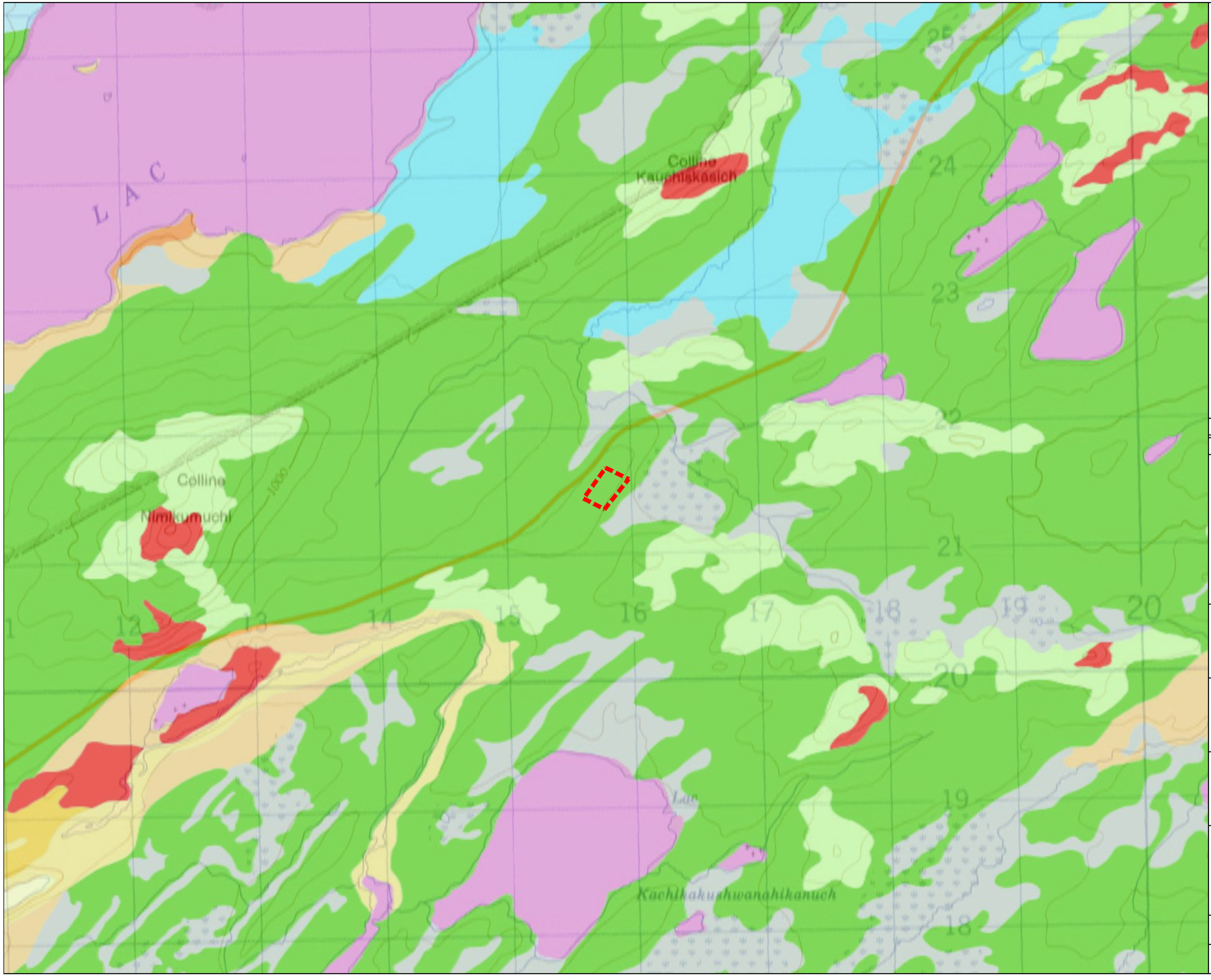
The Site n° 4 proposed for the new waste disposal site for the Cree community of Nemaska is located about 17 km south-west of the town of Nemaska, QC **(Figure 1)**. Relief in the area varies little, but Site N° 4 lies on a hill at an altitude of around 260 m, descending rapidly to the west and the Route du Nord at around 245 m (150 m distance), to the southeast along the river at an altitude of 239 m at a distance of 250 m (**Figure 2**). Most of the territory, however, lies below 240 m elevation, with a general south-westerly slope towards Lac Champignon. Nimikumuchi Hill (over 1000 m above sea level) lies about 3 km west of site No. 4 (**Figure 3**).

Vegetation in the area is typical of the Boreal Shield and Rupert River Plateau as defined in Canada's Ecological Framework (Wesa Envir-Eau, 2012[7]): "Vegetation is dominated by stands of black spruce and balsam fir, but the dominant climax species is balsam fir. A low cover of hypnaceous mosses is common, while sphagnum mosses occupy poorly drained depressions". This description was confirmed in the field.

The Nemaska region is part of the Boreal Shield ecozone. Canada's Ecological Framework defines the climate of this territory as generally continental, with long, cold winters and short, relatively warm summers. The climate in the study area is characterized by an average temperature below 0°C, which can drop as low as -51 °C in the winter and rise to 34 °C in the summer. Maximum temperatures are highest in July, with averages ranging from 20.0 to 23.1 °C, while minimum temperatures are observed in January, with averages ranging from -28.0 to -24.2 °C. Average temperatures are below 0 °C between November and April at all selected stations.

The area receives on average 683 to 961 mm of precipitation, roughly divided between rain and snow.

[7] Wesa Envir-Eau (2012). *Étude hydrologique Projet Whabouchi – Nemaska Lithium.* Gatineau, Quebec: Ref. HB10015-00-03.



LEGEND

NEMASKA NEW LANDFILL POTENTIAL SITE

GEOLOGY DESCRIPTION NEAR THE SITE

MORPHOSEDIMENTOLOGICAL ZONES:

- Till in generally continuous coverage
- Till in thin and discontinuous cover
- Non-differentiated organic sediment

REV.	DESCRIPTION	DATE	BY	CHK

REFERENCE :

1. TOPOGRAPHIC MAP 32 N/9 LAC CHAMPION, 1:50,000, ENERGY, MINES AND RESOURCES CANADA, 1990;
2. SIGEOM DATA, MINISTÈRE DES RESSOURCES NATURELLES ET DES FORÊTS, 2023.

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1:30 000 0 250 500 750 1000
SCALE (m)
THIS SCALE TO BE USED TO OBTAIN APPROXIMATE DIMENSIONS FOR INFORMATION

N W E S

CLIENT

Stantec Consulting Ltd

PROJECT

Nemaska New Waste Disposal Site
Hydrogeological Assessment
Nemaska, Quebec

TITLE

Surface Geology

BluMetric Environmental
1500 du Collège Street, Suite 200
Saint-Laurent, Québec H4L 5G6
TEL.: 514 844-7199 FAX: 514 841-9111
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Web site: www.blumetric.ca

PROJECT #	DATE	REV.	FIG.
230448	2023-08-17	-	3

DRAWN	DESIGNED	CHECKED	CAD DRAWING
K.T.	L.A.	L.A.	230448-FIG3.DWG

3.2 GEOLOGY

The local geology was established from various documents (Lamarche et al, 2018[8]; SIGÉOM) following exploration drilling, trenching and observations carried out by Stantec (2017 and 2021) and Poly-Géol (2017). The following general stratigraphic sequence is found on the site:

- Unsaturated topsoil, 0.06 to 0.18 m thickness;
- till (silty sand with some gravel and traces of clay and pebbles) or sand. The till thickness observed ranged from 7.5 m to more than 20 m;
- According to data from Poily-Géo (2017) the bedrock was encountered within 0.5 m in three test pits located to the southwest (i.e., PU-04-08, PU-04-09, and PU-04-11) of the site. Bedrock was not reported to be intercepted in the boreholes or test pits extent of the proposed landfill.

Figure 3 shows a map of the site's surface geology, which clearly indicates that the site is covered by a thick, continuous layer of gravelly till.

According to SIGÉOM, Site No. 4 is in the Archean-age Canadian Shield, in the northeastern part of the Lake Superior province, under the Nemiscau or Opinaca province. The site is hosted by the Champion Lake formations. As shown in **Figure 4**, granite biotite and amphibolized basalt cover most of the site.

3.3 HYDROGEOLOGY

3.3.1 Hydro-stratigraphic Units

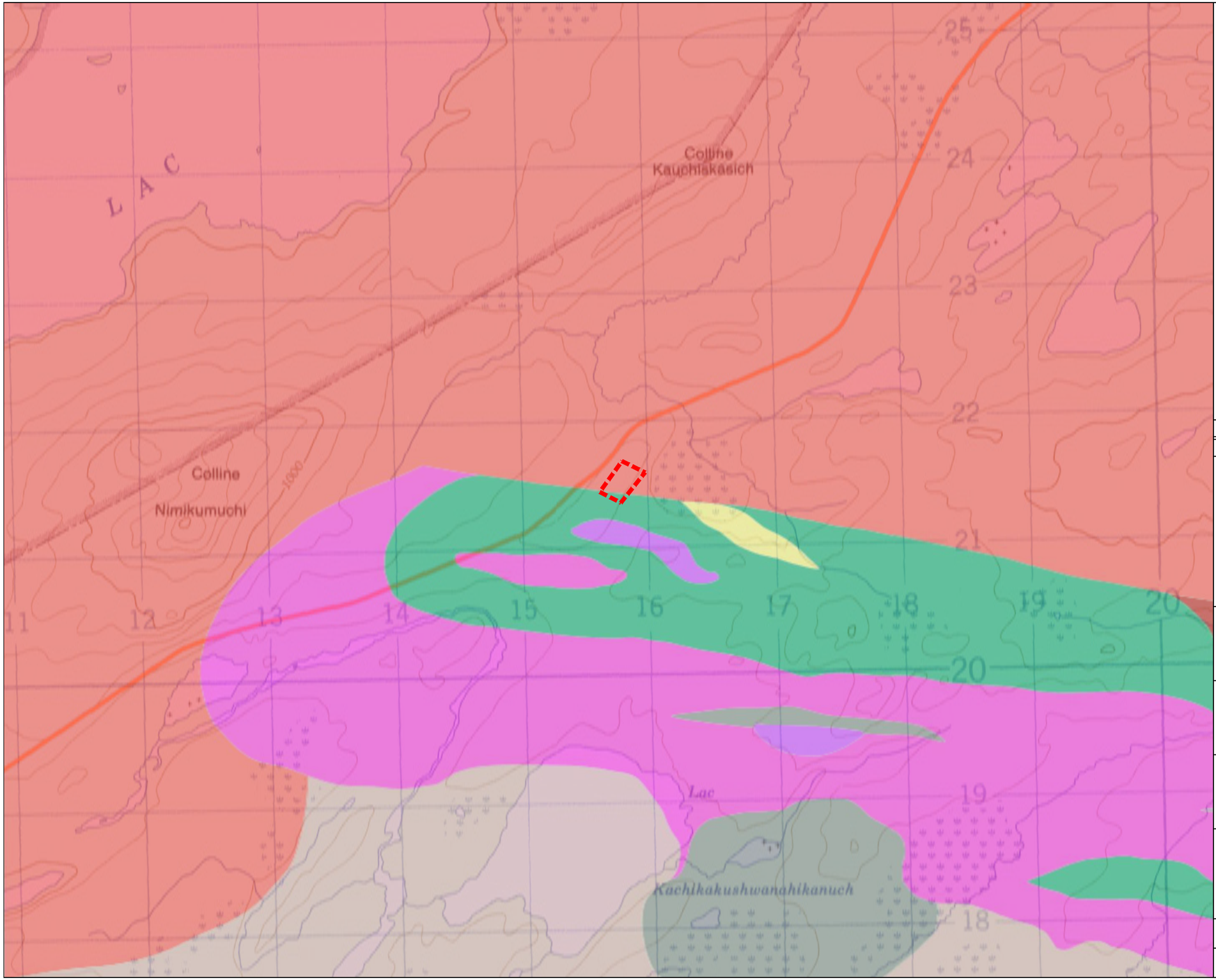
Based on available information and as previously described, two hydro-stratigraphic units or hydrogeological formations are present in the study area, namely:

- unconsolidated deposits (till and sand); and
- Rock of various types.

3.3.2 Hydraulic Properties

Hydraulic properties of the till or sand (**Table 1: lithology from borehole description**) deposits encountered beneath the proposed landfill site must be estimated to assess the impact of site operation on local groundwater resources. Sug tests were carried out on the piezometers by Stantec in 2017 and 2021. Data from 2020 tests on PZ-1, PZ-3 and PZ-6 were re-interpreted and the results were compared with those from Stantec 2021.

[8] Lamarche, O., Daubois V. et Dubé-Loubert H.. 2018. *Géologie des dépôts de surface de la région de Nemaska (SNRC 32N03 portion nord, 32N06, 32N07 et 32N portion nord), Eeyou Istchee Baie-James* (MERN)



LEGEND

NEMASKA NEW LANDFILL POTENTIAL SITE

GEOLOGY DESCRIPTION NEAR THE SITE

GEOLOGICAL ZONES:

- Biotite granite
- Amphibolitized basalt; levels of ultramafic volcanic rocks
- Peridotite, pyroxenite and gabbro
- Paragneiss with biotite-hornblende ± garnet, containing <10% mobilisate
- White granitic pegmatite with muscovite-garnet ± biotite

REV.	DESCRIPTION	DATE	BY	CHK

REFERENCE :

1. TOPOGRAPHIC MAP 32 N/9 LAC CHAMPION, 1:50,000, ENERGY, MINES AND RESOURCES CANADA, 1990;
2. SIGEOM DATA, MINISTÈRE DES RESSOURCES NATURELLES ET DES FORÊTS, 2023.

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1:30 000 0 250 500 750 1000

SCALE (m)

THIS SCALE TO BE USED TO OBTAIN APPROXIMATE DIMENSIONS FOR INFORMATION

N W E S

CLIENT

Stantec Consulting Ltd

PROJECT

Nemaska New Waste Disposal Site
Hydrogeological Assessment
Nemaska, Quebec

TITLE

Bedrock Geology

BluMetric Environmental
1500 du Collège Street, Suite 200
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TEL.: 514 844-7199 FAX: 514 841-9111
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PROJECT #	DATE	REV.	FIG.
230448	2023-08-17	-	4

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K.T.	L.A.	L.A.	230448-FIG4.DWG

Table 1: Piezometric Survey results - 2017 and 2021

Well / Borehole	Lithology from borehole descriptions	Geographic cordinates		Depth of sounding (m bgs)	Elevation (n)		GWL December 2017		GWL August 1st, 2018		GWL August 4th, 2020		GWL June 16, 2021	
		Easting	Northing		Ground	PVC	Water depth / ground surface (m)	Elevation (m)	Water depth / ground surface (m)	Elevation (m)	Water depth / ground surface (m)	Elevation (m)	Water depth / ground surface (m)	Elevation (m)
PZ-01	Grey sand with gravel to grey silty sand with boulders	324217.92	5722649.15	17.68	259.867	260.838	5.45	254.42	6.48	253.39	5.65	254.22	-	-
PZ-02[a]	Grey sand with cobbles and boulders with traces of silt	324370.15	5722733.99	20.04	261.399	262.581	7.70	253.70	8.94	252.46	12.29	249.11	12.10	249.30
PZ-03	Grey sand with traces of silt, cobbles, and boulders	324221.00	5722809.42	12.37	260.067	260.897	7.89	252.18	7.03	253.04	7.37	252.70	6.60	253.47
PZ-04	Grey sand with traces of silt to boulders with grey sand and gravel	-	-	7.60	-	-	NA	NA	NA	NA	NA	NA	NA	NA
PZ-05[b]	Grey sand with traces of silt or gravel	324547.76	5723007.17	16.87	262.621	263.507	7.99	254.63	Dry	Dry	Dry	Dry	Dry	Dry
PZ-06	Grey sand with silt to grey sandy silt with traces of gravel and boulders	324529.84	5722732.51	11.23	248.919	249.907	0.21	248.71	0.40	248.52	0.58	248.34	0.31	248.61

[a] The Well depth measured when it was built in November 2017 is 17.58 m, whereas the depth measured in June 2021 is 14.47 m. The well appears to be poorly installed (silted up and/or sunken).

[b] The depth (in relation to the PVC) of the well when it was installed in November 2017 was 14.87 m, compared with a depth of 10.18 m. The strainer is installed between 11.87 and 14.87m in relation to the pvc top. The entire length of the strainer seems blocked since 2018. The well is badly installed

The raw data and graphs of the tests are presented in **Table 2** and **Appendix A.**

Table 2: Summary of the Aquifer Characteristics

Monitoring Well	Analysis method		Hydraulic conductivity (K)
PZ-1	Stantec	Kansas Geological Survey (KGS) method[1]	3.6×10^{-7} m/s
	BluMetric	Hvorlev / Bower & Rice	1.2×10^{-6} m/s
PZ-3	Stantec	Kansas Geological Survey (KGS) method	1.6×10^{-6} m/s
	BluMetric	Hvorlev / Bower & Rice	2.54×10^{-6} m/s
PZ-6	Stantec	Kansas Geological Survey KGS) method	1.1×10^{-7} m/s
	BluMetric	Hvorlev / Bower & Rice	2.69×10^{-7} m/s

[1]: Hyder et al.'s (1994) KGS model for interpreting permeability tests is best suited to variable-level tests performed in cylindrical filter beds, whereas on-site tests are of the hydraulic shock type. This KGS model extends the Cooper et al. (1967) solution to the problems of partial penetration wells and wells affected by parietal effects. The Hyder et al. (1994) solution is in fact a generalization of the work of Dougherty & Babu (1984) on partial penetration and of Moench & Hsieh (1985) on parietal effects (Duhaime, 2012[9]).

3.3.3 Groundwater Flow

Static water levels measured on December 1-8, 2017, August 1st, 2018, August 4th, 2020, and June 16, 2021 are listed in **Table 1**. Note that no wells and therefore no information (water level, pumping test, etc.) were listed in the MELCCFP's[10] Hydrogeological Information System (SIH) for the area within a 10 km radius of the study site.

Continuous monitoring of water levels over a one-year period from June 2021 to June 2022 was carried out using a datalogger, the data for which is presented in **Appendix A**.

The depth of groundwater in the sand deposits was determined from observations on test-pit walls, and measurements in monitoring wells. The water table level was measured at depths varying between 0.2 m and 7.99 m below ground surface in 2017 compared to between 0.3 m and 12.1 m below ground surface in 2021 (**Table 1**). According to Poly-Géo (2017), groundwater was generally not encountered in the test pits, except for PU-04-01, PU-04-12, and PU-04-16.

Figures 5a and **5b** show water level depths relative to ground surface in December 2017 and August 2020. **Figures 6a** and **6b** represent water level elevations and flow direction in till overburden deposits in December 2017 and August 2020. The main groundwater flow direction is oriented

[9] Duhaime, F. (2012). *Mesure de la conductivité hydraulique du dépôt d'argile Champlain de Lachenaie, Québec: théorie et applications* [Thèse de doctorat, École Polytechnique de Montréal]. PolyPublie. https://publications.polymtl.ca/929/
[10] MELCCFP : Ministère de Environnement, de la lutte contre les changements climatiques, de la Faune et des Parcs, Québec

toward the east/southeast with a horizontal hydraulic gradient in the order of 0.025 m/m in August 2020, to 0.034 m/m in December 2017. Groundwater flow is generally to the southeast, toward the tributary to Lac Champion.

The average underground flow velocity v is calculated from Darcy's law:

$$v = K\, ih / n$$

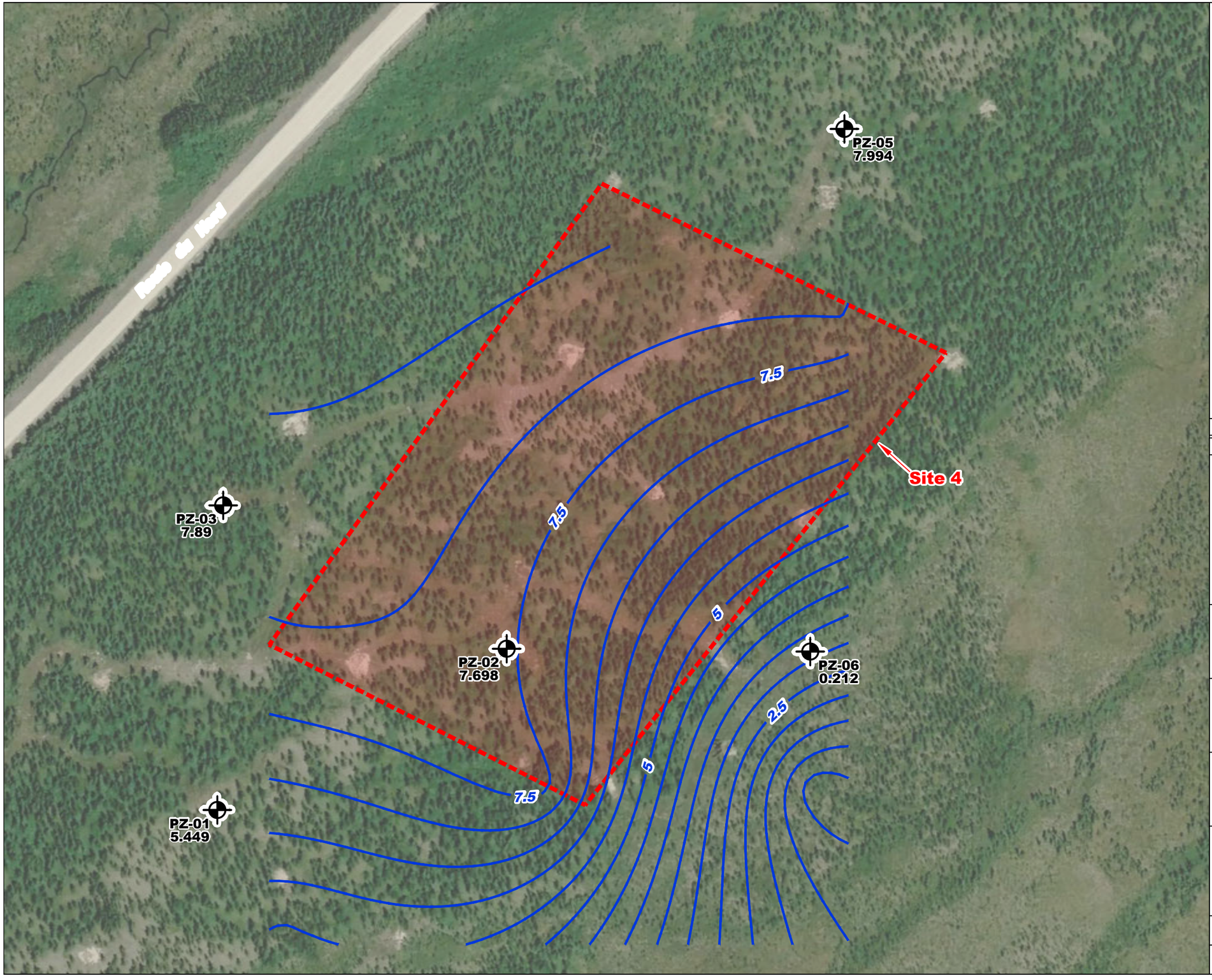
where :

K is the hydraulic conductivity of the hydrogeological medium (see Table 2),
ih the mean horizontal hydraulic gradient (estimated from measured piezometric data), and
n is the effective porosity or specific yield (%) (typical values taken from the literature (Domenico & Schwartz, 1990[11]; Fetter, 1988[12]; Freeze & Cherry, 1979[13]; Bear, 1972[14]).

For till, values for K are set at between 1.1×10^{-7} and 2.9×10^{-6} m/s (geometric mean 6.3×10^{-7} m/s) and values for n 25% (typical value for medium to fine sand). Therefore, considering a range of gradient between 0.025 and 0.034 m/m, linear groundwater velocity is estimated to be between $1 \times 1\ 0^{-8}$ m/s to 2.2×10^{-7} m/s (0.0009 to 0.019 m/day).

The groundwater depth extrapolation maps (**Figures 5a** and **5b**) show that the boundaries of Site no. 4 have an unsaturated layer of at least 2m. Water level data from PZ-2 (upstream) and PZ-6 (downstream) in spring will therefore be important to see whether Site No. 4 always maintains an unsaturated layer of at least 1 m.

[11] Domenico P.A. and Schwartz F.W., 1990, Physical and Chemical Hydrogeology, John Wiley & Sons, New York, 824 p.
[12] Fetter, C. W., 1988. Applied Hydrogeology, Merrill Publishing Company, Colombus, 592 p
[13] Freeze, A. and Cherry, J., 1979, Groundwater, Prentice Hall, New Jersey, 418 p.
[14] Biar, J. 1972. Dynamics of fluids in porous media. Dover Publications, New York 764p.



LEGEND

NEMASKA NEW LANDFILL POTENTIAL SITE

2.5 ISO-DEPTH GROUNDWATER CONTOUR (m)

MONITORING WELL

0.212 GROUNDWATER DEPTH RELATIVE TO THE GROUND SURFACE (m)

REV.	DESCRIPTION	DATE	BY	CHK

REFERENCE :
AERIAL PHOTOGRAPHY, JULY 2020, GOOGLE EARTH, 2023.

NOTE :
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1:2 000 0 20 40 60 80
SCALE (m)
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N W E S

CLIENT

Stantec Consulting Ltd

PROJECT

Nemaska New Waste Disposal Site
Hydrogeological Assessment
Nemaska, Quebec

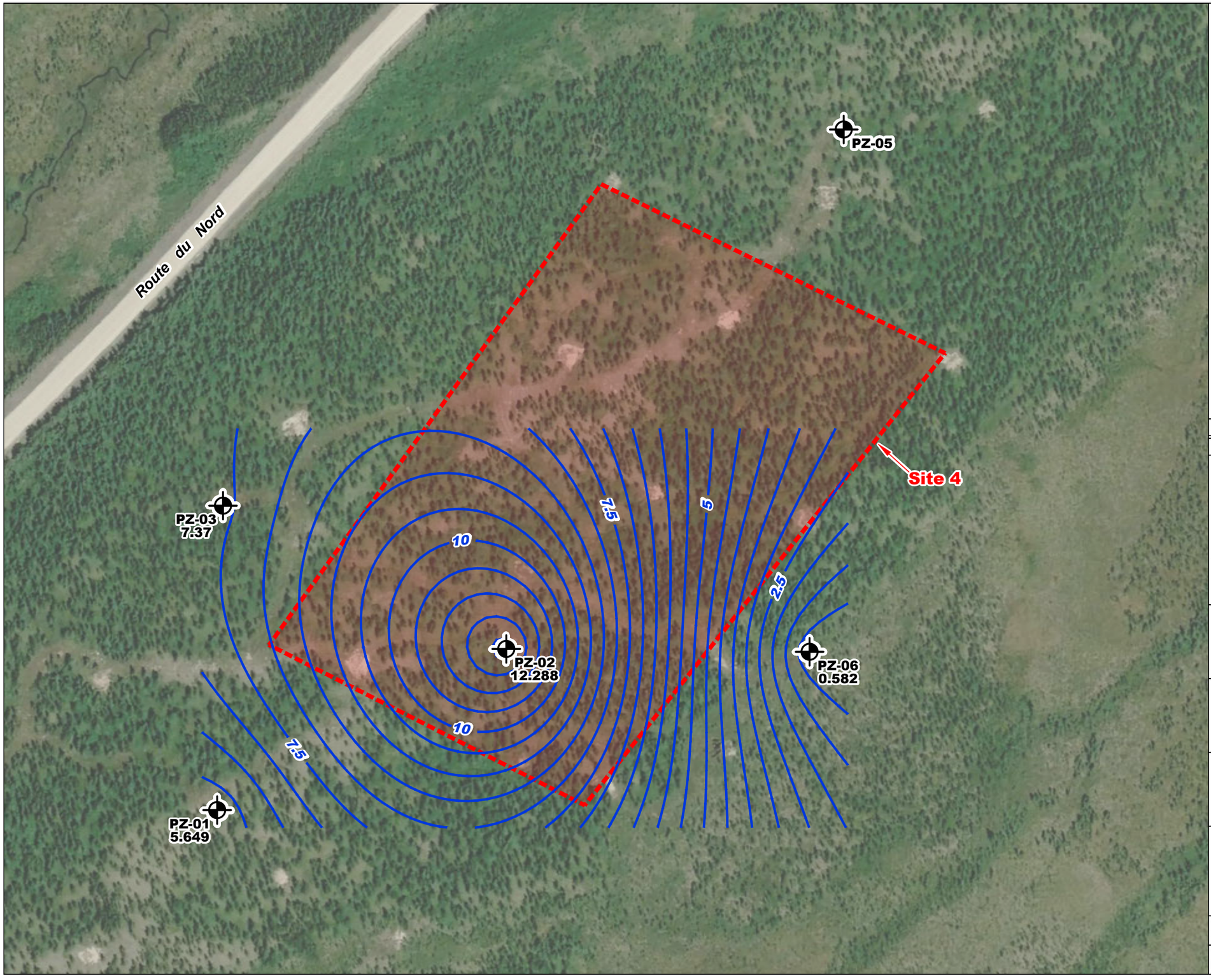
TITLE

Groundwater Depth
Relative to the Ground Surface
(December 1st, 2017)

BluMetric Environmental
1500 du Collège Street, Suite 200
Saint-Laurent, Québec H4L 5G6
TEL.: 514 844-7199 FAX: 514 841-9111
Email: montreal@blumetric.ca
Web site: www.blumetric.ca

PROJECT #	DATE	REV.	FIG.
230448	2023-08-17	-	5a

DRAWN	DESIGNED	CHECKED	CAD DRAWING
K.T.	L.A.	L.A.	230448-FIG5a.DWG



LEGEND

NEMASKA NEW LANDFILL POTENTIAL SITE

2.5 — ISO-DEPTH GROUNDWATER CONTOUR (m)

MONITORING WELL

0.582 — GROUNDWATER DEPTH RELATIVE TO THE GROUND SURFACE (m)

REV.	DESCRIPTION	DATE	BY	CHK

REFERENCE :
AERIAL PHOTOGRAPHY, JULY 2020, GOOGLE EARTH, 2023.

NOTE :
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1:2 000 0 20 40 60 80
SCALE (m)
THIS SCALE TO BE USED TO OBTAIN APPROXIMATE DIMENSIONS FOR INFORMATION

N W E S

CLIENT

Stantec Consulting Ltd

PROJECT

Nemaska New Waste Disposal Site
Hydrogeological Assessment
Nemaska, Quebec

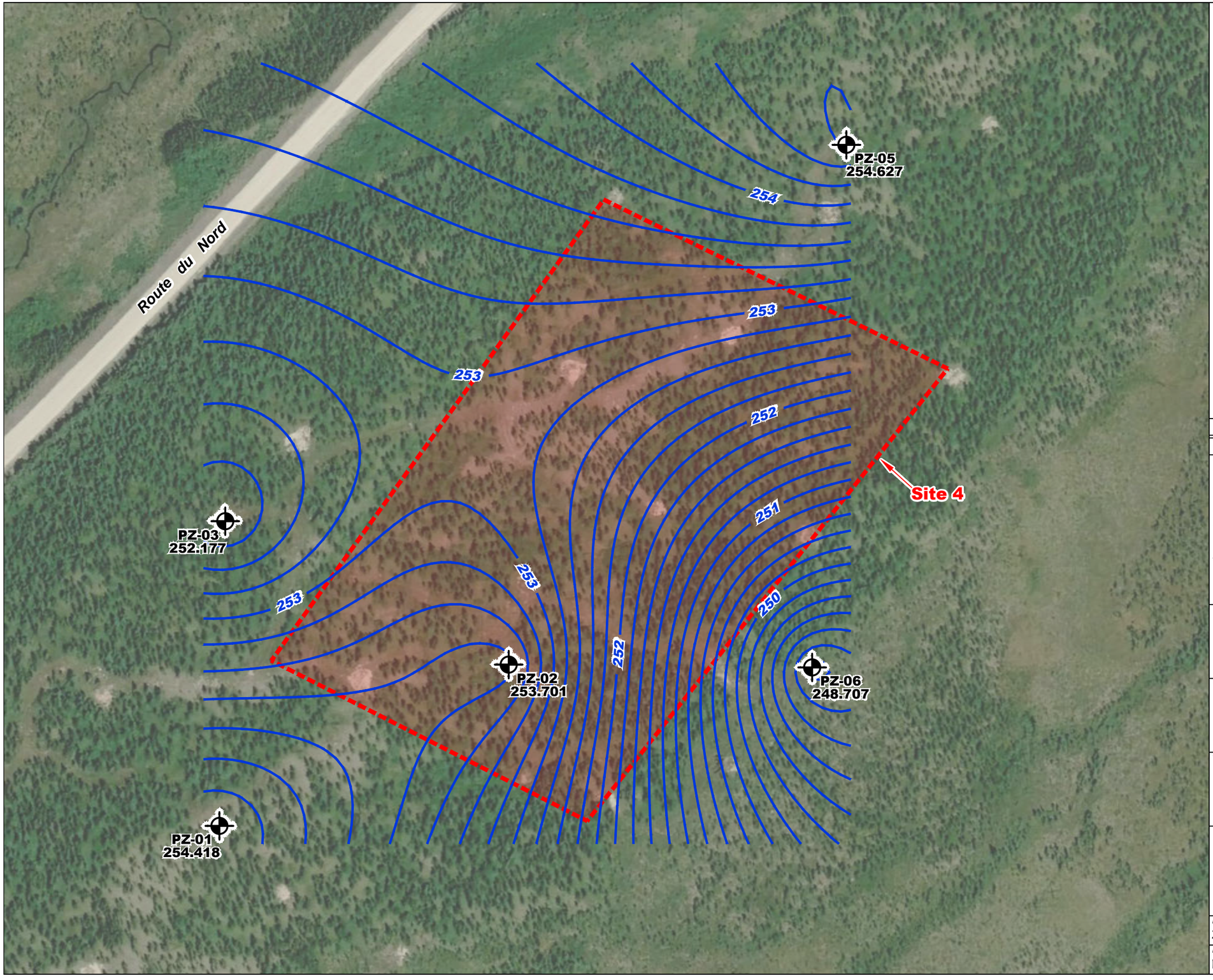
TITLE

Groundwater Depth
Relative to the Ground Surface
(August 4th, 2020)

BluMetric Environmental
1500 du Collège Street, Suite 200
Saint-Laurent, Québec H4L 5G6
TEL.: 514 844-7199 FAX: 514 841-9111
Email: montreal@blumetric.ca
Web site: www.blumetric.ca

PROJECT #	DATE	REV.	FIG.
230448	2023-08-17	-	5b

DRAWN	DESIGNED	CHECKED	CAD DRAWING
K.T.	L.A.	L.A.	230448-FIG5b.DWG



LEGEND

NEMASKA NEW LANDFILL POTENTIAL SITE

250 ISO-DEPTH GROUNDWATER CONTOUR (m)

MONITORING WELL

248.707 GROUNDWATER ELEVATION (m)

REV.	DESCRIPTION	DATE	BY	CHK

REFERENCE :
AERIAL PHOTOGRAPHY, JULY 2020, GOOGLE EARTH, 2023.

NOTE :
PROPRIETARY INFORMATION MAY NOT BE REPRODUCED OR DIVULGED WITHOUT PRIOR WRITTEN CONSENT OF BLUMETRIC ENVIRONMENTAL INC. DO NOT SCALE DRAWING. THIS DRAWING MAY HAVE BEEN REDUCED. ALL SCALE NOTATIONS INDICATED ARE BASED ON 11"x17" FORMAT DRAWINGS.

1:2 000 0 20 40 60 80
SCALE (m)
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N W E S

CLIENT

Stantec Consulting Ltd

PROJECT

Nemaska New Waste Disposal Site
Hydrogeological Assessment
Nemaska, Quebec

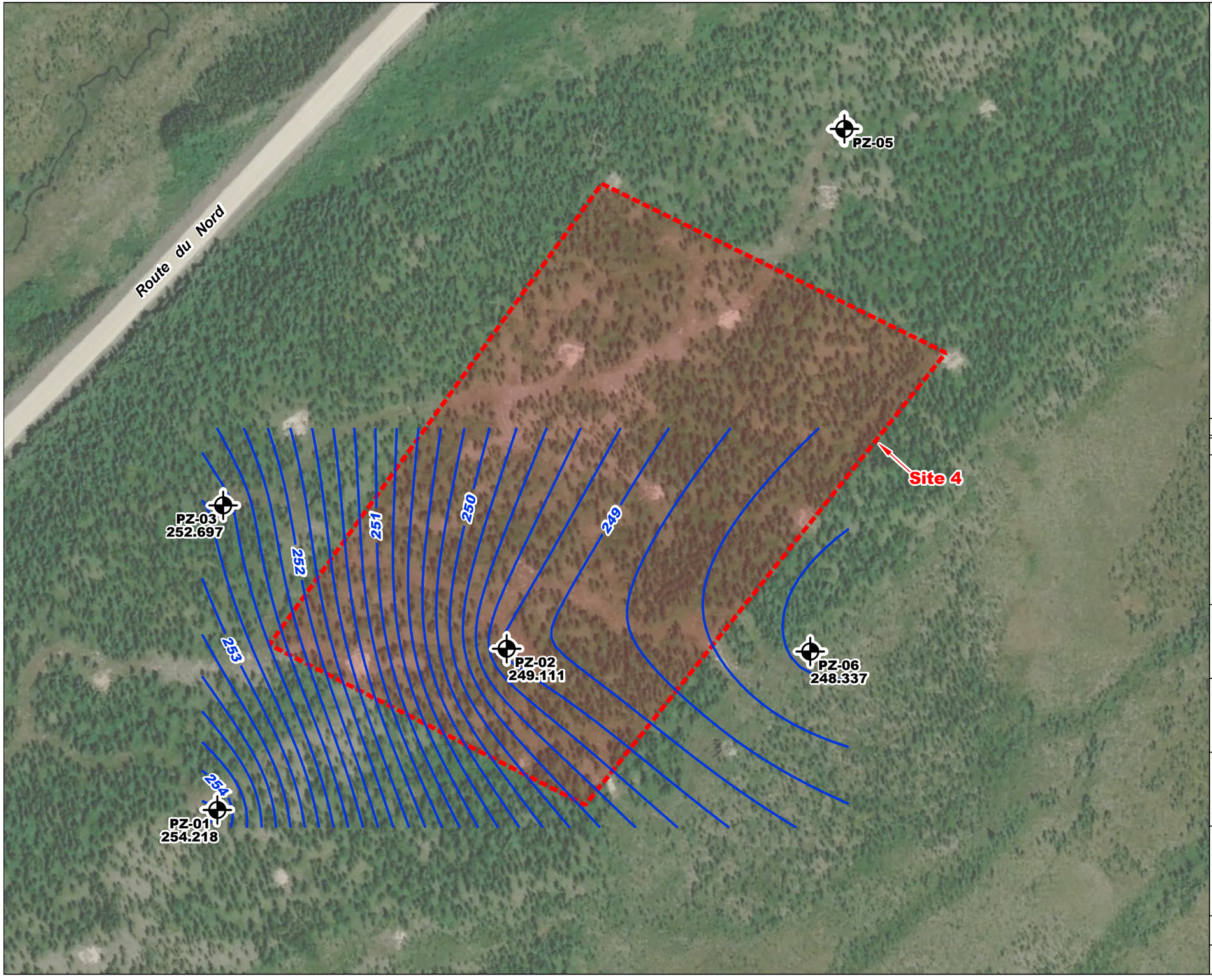
TITLE

Groundwater Elevation
(December 1st, 2017)

BluMetric Environmental
1500 du Collège Street, Suite 200
Saint-Laurent, Québec H4L 5G6
TEL.: 514 844-7199 FAX: 514 841-9111
Email: montreal@blumetric.ca
Web site: www.blumetric.ca

PROJECT #	DATE	REV.	FIG.
230448	2023-08-17	-	6a

DRAWN	DESIGNED	CHECKED	CAD DRAWING
K.T.	L.A.	L.A.	230448-FIG6a.DWG



LEGEND

NEMASKA NEW LANDFILL POTENTIAL SITE

249 ISO-DEPTH GROUNDWATER CONTOUR (m)

MONITORING WELL

248.337 GROUNDWATER ELEVATION (m)

REV.	DESCRIPTION	DATE	BY	CHK

REFERENCE :
AERIAL PHOTOGRAPHY, JULY 2020, GOOGLE EARTH, 2023.

NOTE :
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1:2 000 0 20 40 60 80
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N W E S

CLIENT

Stantec Consulting Ltd

PROJECT

Nemaska New Waste Disposal Site
Hydrogeological Assessment
Nemaska, Quebec

TITLE

Groundwater Elevation
(August 4th, 2020)

BluMetric Environmental
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Saint-Laurent, Québec H4L 5G6
TEL.: 514 844-7199 FAX: 514 841-9111
Email: montreal@blumetric.ca
Web site: www.blumetric.ca

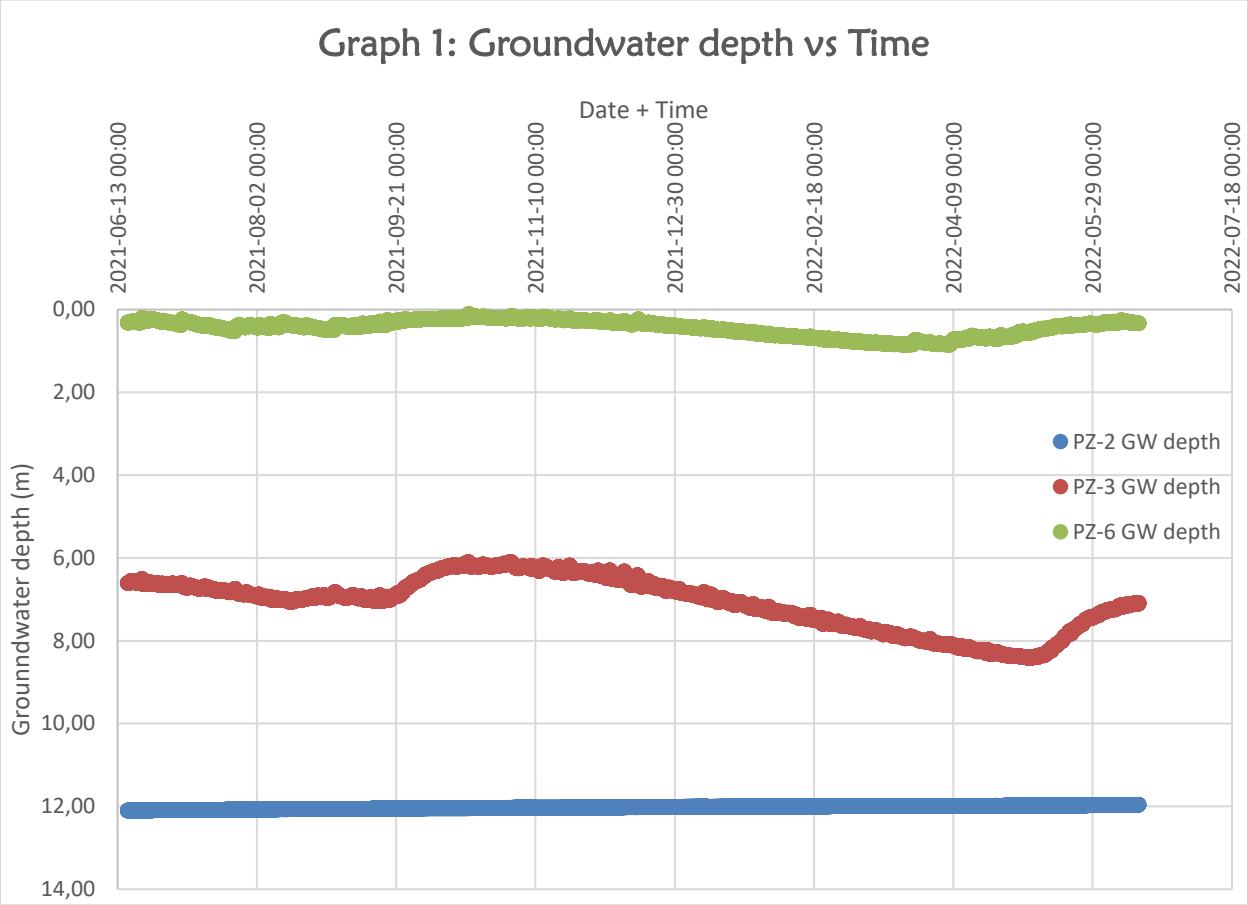
PROJECT #	DATE	REV.	FIG.
230448	2023-08-17	-	6b

DRAWN	DESIGNED	CHECKED	CAD DRAWING
K.T.	L.A.	L.A.	230448-FIG6b.DWG

3.3.4 Seasonal Groundwater Fluctuation or Temporal Variations in Water Level

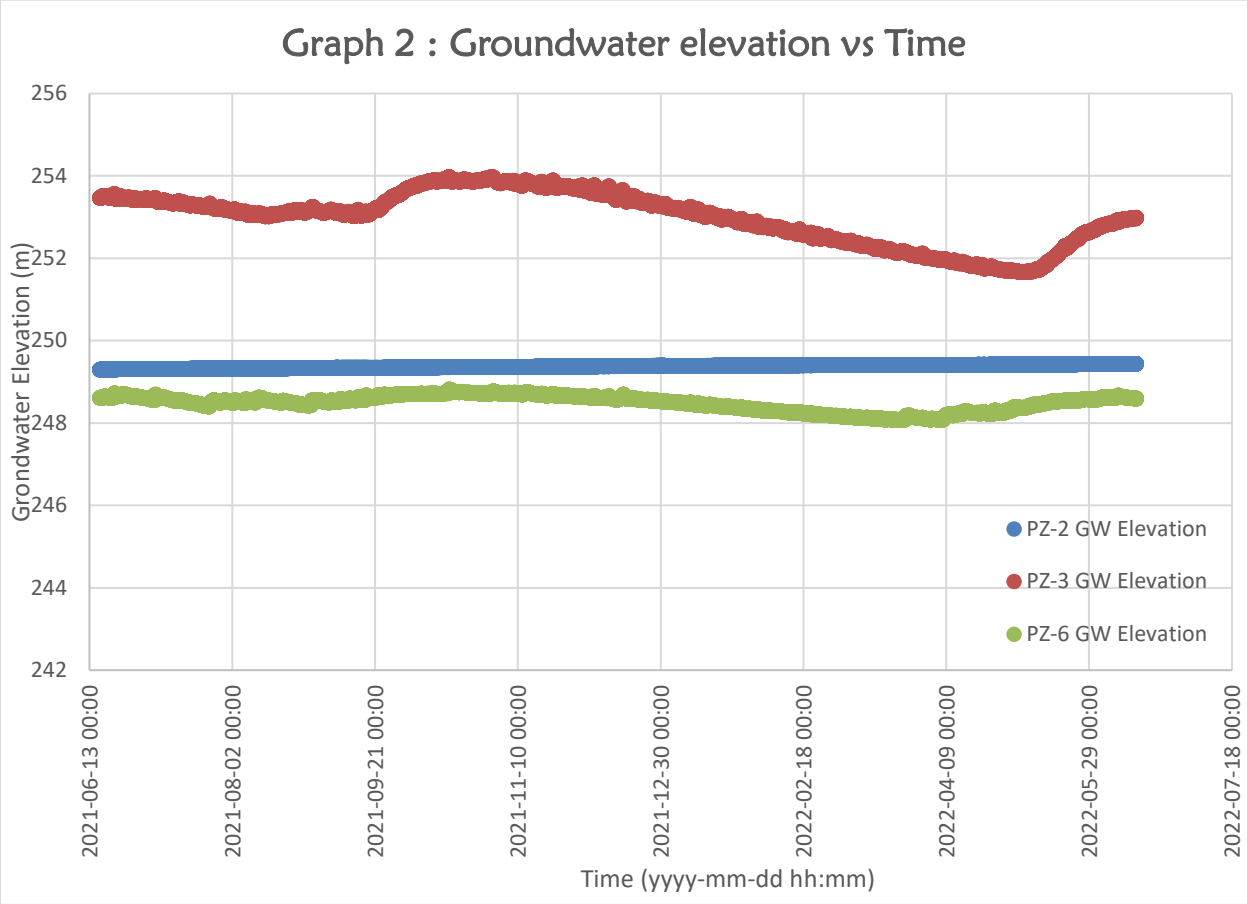
Monitoring temporal variations in the water table provides additional information on the behavior of the till aquifer following rainfall events. Water level recordings in wells PZ-2, PZ-3 and PZ-6 between June 2021 and June 2020 enabled seasonal fluctuations to be measured. Monitoring in well PZ-5 was inconclusive, as there was insufficient water in the well in June 2021 and at the start of winter.

Graph 1 shows the variation in water level relative to the ground as a function of time for the water table in till. Downstream (PZ-6), water levels are always close to the surface (0.11 to 0.85 m), while PZ-2 (high level of topography) a constant layer of more than 12 m remains unsaturated throughout the year.



PZ-2 and PZ-6 seem to maintain the same unsaturated soil layer over time. The greatest seasonal variation in water depth is observed in PZ-3. Site No. 4 appears to maintain the same unsaturated soil layer from June 2021 to June 2022. The depth of the water table in the PZ-6 sector varies from 0.11 m in spring (flood period) to 0.85 m at low-water (summer). Although the water level is very close to the surface, the site does not appear to be flooded in spring.

Graph 2 shows the variation in groundwater elevation for the till or sand water table.



3.4 GROUNDWATER CLASSIFICATION OR AQUIFER POTENTIAL

As summarised in Stantec (2021), there are some specifications regarding hydrogeological conditions for the construction of a new landfill according to provincial regulation, the *Regulation respecting the landfilling and incineration of residual materials* (RRLIRM[15]) in Québec. Among other things, the RRLIRM specifies:

- Preferably, it is suggested to construct a new landfill over an impermeable layer of soil and overburden to limit leachate infiltration that would contaminate groundwater. However, in the case that such conditions are not available at an economic distance from the community concerned, the landfill must be located at minimum distances from certain uses or infrastructures or may be prohibited at certain sites depending on local hydrogeological conditions and the use of water.
- There are no water-supply facilities near the location proposed for the construction of the landfill. The site is located more than 5 km southeast of the existing drinking water wells.
- Article 16 of the RRLIRM indicates that the development of a landfill is also prohibited on land below which there is a free water table with a high aquifer potential. According to Article 16, « a high aquifer potential » is an aquifer where at least 25 cubic metres per hour (m3/hr) of water can be pumped continuously from the same production well.
- According to Article 16 guidelines, a pumping test is required to establish the potential of a water table aquifer. However, a pumping test is not required in all landfill projects, but only for those where the preliminary hydrogeological study indicates the presence of a hydrostratigraphic unit likely to present high aquifer potential (i.e., several meters of saturated sediment, a layer of coarse sand or gravel at least a few meters thick, fractured rock outcropping or under a layer of permeable deposits, etc.).

The Quebec groundwater classification procedure (MEF, 1999[16]) categorizes aquifers into three classes. The information relevant to the questions posed in this procedure is presented in **Tables 3** for unconsolidated till deposits and explained below. According to the information available, there are no existing or planned collective water catchment structures within a one-kilometer radius of the site, nor are there any planned developments. There are no known private surface or groundwater catchment structures within 1 km of the study site. There is therefore no potential for the hydrostratigraphic units to be used as a water supply source within one kilometer of the site.

[15] https://www.legisquebec.gouv.qc.ca/en/document/cr/Q-2,%20r.%2019

[16] MEF, 1999. Guide de classification des eaux souterraine du Québec. Service des pesticides et des eaux souterraines, Direction des politiques des secteurs agricole et naturel, Direction Générale de l'environnement. 1er février 1999. https://www.demandesinfos.environnement.gouv.qc.ca/dossiers/eau/4197_fiche.pdf

Table 3: Answers to Questions about Groundwater Classification – Unconsolidated Till

Questions	Answers
Hydrogeological unit:	Unconsolidated deposit – till: sand with gravel to grey silty sand with boulders
Collective or potential catchment work:	No
Presence of a catchment structure:	No
Transmissivity > 1 m^2/d :	Non. T=K*bsat., bsat.=9 m and K = $6.3x10^{-7}$ m/s, So T=0,49 m^2/d So Transmissivity < 1 m2/d
Physico-chemistry satisfactory:	Data not available
Development project:	No

Thus, according to the geoscientific information analyzed and the Quebec groundwater classification procedure (MEF, 1999), the hydrogeological till formation at the target site is Class III with a weak hydraulic connection where present. Class III is justified by the insufficient quantity of water and uneconomical extraction.

3.5 OTHERS OBSERVATION: PERMEABILITY AND INFILTRATION POTENTIAL

The most important factors influencing soil infiltration capacity are the natural slope of the soil (topography), the type and properties of unsaturated soils and aquifer, geological and hydro-geological conditions. In addition to soil permeability (hydraulic conductivity), it is therefore important to know the infiltration capacity of surface soils.

The hydraulic conductivities measured in the tests (Table 2) show average to low permeability values. A safety factor should be applied to these values, so that long-term landfill use conditions can take account of possible clogging in the design of the drainage system.

It is therefore important to complete the current study with a water balance study that considers infiltration through the unsaturated zone of the soil.

4. CLOSING

The findings presented in this report are based on conditions observed at the specified dates and locations, and on the analysis of samples for the specified parameters. Unless otherwise stated, the findings cannot be extended to previous or future site conditions, portions of the site that were not investigated directly, or types of analysis not performed.

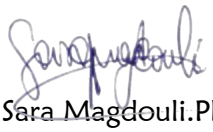
Nothing in this report is intended to constitute or provide a legal opinion. BluMetric makes no representation as to compliance with environmental laws, rules, regulations or policies established by regulatory agencies.

This report has been prepared for Stantec. Any use a third party makes of this report, any reliance on the report, or decisions based upon the report, are the responsibility of those third parties unless authorization is received from BluMetric in writing. BluMetric accepts no responsibility for any loss or damages suffered by any unauthorized third party because of decisions made or actions taken based on this report.

Respectfully submitted,
BluMetric Environmental Inc.



Léonard Agassounon, géo.Ph.D..
Senior Hydrogeologist



Sara Magdouli.Ph.D..
Market Lead

APPENDIX A

Data

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Bureau 818
Montreal (QC)
H2Y 1N3

Project: Nemaska New Waste Disposal Site – Hydrogeological assessr

Number: 230448-00

Client: Stantec

Location: Nemaska	Slug Test: PZ-1_2020	Test Well: PZ-1
Test Conducted by: Stantec	Test Date: 2020-08-04	
Water level at t=0 [m]: NAN	Static Water Level [m]: 6.62	Water level change at t=0 [m]: 0.00

	Time [s]	Water Level [m]	WL Change [m]
1	0	6.62	0.00
2	1	6.6402	0.0202
3	2	6.6163	-0.0037
4	3	6.6163	-0.0037
5	4	6.9363	0.3163
6	5	6.8528	0.2328
7	6	7.1581	0.5381
8	7	7.1544	0.5344
9	8	7.1489	0.5289
10	9	7.1462	0.5262
11	10	7.1425	0.5225
12	11	7.1398	0.5198
13	12	7.1398	0.5198
14	13	7.137	0.517
15	14	7.1425	0.5225
16	15	7.247	0.627
17	16	7.1938	0.5738
18	17	7.1251	0.5051
19	18	7.1233	0.5032
20	19	7.1187	0.4987
21	20	7.1187	0.4987
22	21	7.1168	0.4968
23	22	7.1141	0.4941
24	23	7.1141	0.4941
25	24	7.1113	0.4913
26	25	7.1077	0.4877
27	26	7.1077	0.4877
28	27	7.1049	0.4849
29	28	7.1049	0.4849
30	29	7.1022	0.4822
31	30	7.0994	0.4794
32	31	7.0994	0.4794
33	32	7.093	0.473
34	33	7.093	0.473
35	34	7.093	0.473
36	35	7.0903	0.4703
37	36	7.0875	0.4675
38	37	7.0875	0.4675
39	38	7.0875	0.4675
40	39	7.0838	0.4638
41	40	7.0838	0.4638
42	41	7.0811	0.4611
43	42	7.0783	0.4583
44	43	7.0783	0.4583
45	44	7.0756	0.4556
46	45	7.0756	0.4556
47	46	7.0756	0.4556
48	47	7.0719	0.4519

	Time [s]	Water Level [m]	WL Change [m]
49	48	7.0719	0.4519
50	49	7.0692	0.4492
51	50	7.0664	0.4464
52	51	7.0628	0.4428
53	52	7.0628	0.4428
54	53	7.06	0.44
55	54	7.06	0.44
56	55	7.0573	0.4372
57	56	7.0573	0.4372
58	57	7.0573	0.4372
59	58	7.0545	0.4345
60	59	7.0545	0.4345
61	60	7.0508	0.4308
62	61	7.0481	0.4281
63	62	7.0453	0.4253
64	63	7.0453	0.4253
65	64	7.0453	0.4253
66	65	7.0453	0.4253
67	66	7.0426	0.4226
68	67	7.0426	0.4226
69	68	7.0389	0.4189
70	69	7.0389	0.4189
71	70	7.0362	0.4162
72	71	7.0362	0.4162
73	72	7.0334	0.4134
74	73	7.0307	0.4107
75	74	7.0307	0.4107
76	75	7.0307	0.4107
77	76	7.027	0.407
78	77	7.027	0.407
79	78	7.0243	0.4043
80	79	7.0215	0.4015
81	80	7.0215	0.4015
82	81	7.0215	0.4015
83	82	7.0188	0.3987
84	83	7.0188	0.3987
85	84	7.0151	0.3951
86	85	7.0151	0.3951
87	86	7.0151	0.3951
88	87	7.0151	0.3951
89	88	7.0123	0.3923
90	89	7.0096	0.3896
91	90	7.0096	0.3896
92	91	7.0096	0.3896
93	92	7.0059	0.3859
94	93	7.0059	0.3859
95	94	7.0032	0.3832
96	95	7.0032	0.3832
97	96	7.0004	0.3804
98	97	7.0004	0.3804
99	98	6.9977	0.3777
100	99	6.9977	0.3777
101	100	6.9977	0.3777

	Time [s]	Water Level [m]	WL Change [m]
102	101	6.994	0.374
103	102	6.9977	0.3777
104	103	6.994	0.374
105	104	6.994	0.374
106	105	6.9913	0.3712
107	106	6.9913	0.3712
108	107	6.9913	0.3712
109	108	6.9885	0.3685
110	109	6.9858	0.3658
111	110	6.9885	0.3685
112	111	6.9858	0.3658
113	112	6.9858	0.3658
114	113	6.9793	0.3593
115	114	6.9821	0.3621
116	115	6.9793	0.3593
117	116	6.9793	0.3593
118	117	6.9766	0.3566
119	118	6.9766	0.3566
120	119	6.9766	0.3566
121	120	6.9738	0.3538
122	121	6.9738	0.3538
123	122	6.9738	0.3538
124	123	6.9738	0.3538
125	124	6.9702	0.3502
126	125	6.9702	0.3502
127	126	6.9674	0.3474
128	127	6.9674	0.3474
129	128	6.9674	0.3474
130	129	6.9674	0.3474
131	130	6.9647	0.3447
132	131	6.9647	0.3447
133	132	6.9619	0.3419
134	133	6.9583	0.3382
135	134	6.9583	0.3382
136	135	6.9583	0.3382
137	136	6.9555	0.3355
138	137	6.9555	0.3355
139	138	6.9528	0.3327
140	139	6.9555	0.3355
141	140	6.9528	0.3327
142	141	6.9528	0.3327
143	142	6.9491	0.3291
144	143	6.9491	0.3291
145	144	6.9491	0.3291
146	145	6.9463	0.3263
147	146	6.9436	0.3236
148	147	6.9463	0.3263
149	148	6.9436	0.3236
150	149	6.9436	0.3236
151	150	6.9408	0.3208
152	151	6.9436	0.3236
153	152	6.9408	0.3208
154	153	6.9372	0.3172

	Time [s]	Water Level [m]	WL Change [m]
155	154	6.9372	0.3172
156	155	6.9372	0.3172
157	156	6.9344	0.3144
158	157	6.9344	0.3144
159	158	6.9344	0.3144
160	159	6.9344	0.3144
161	160	6.9344	0.3144
162	161	6.9317	0.3117
163	162	6.9317	0.3117
164	163	6.9289	0.3089
165	164	6.9289	0.3089
166	165	6.9289	0.3089
167	166	6.9253	0.3053
168	167	6.9253	0.3053
169	168	6.9225	0.3025
170	169	6.9225	0.3025
171	170	6.9225	0.3025
172	171	6.9198	0.2997
173	172	6.9198	0.2997
174	173	6.9198	0.2997
175	174	6.9198	0.2997
176	175	6.9198	0.2997
177	176	6.917	0.297
178	177	6.917	0.297
179	178	6.9133	0.2933
180	179	6.9133	0.2933
181	180	6.9133	0.2933
182	181	6.9106	0.2906
183	182	6.9106	0.2906
184	183	6.9106	0.2906
185	184	6.9106	0.2906
186	185	6.9106	0.2906
187	186	6.9106	0.2906
188	187	6.9078	0.2878
189	188	6.9078	0.2878
190	189	6.9051	0.2851
191	190	6.9051	0.2851
192	191	6.9051	0.2851
193	192	6.9051	0.2851
194	193	6.8987	0.2787
195	194	6.9014	0.2814
196	195	6.9014	0.2814
197	196	6.8987	0.2787
198	197	6.8987	0.2787
199	198	6.8987	0.2787
200	199	6.8959	0.2759
201	200	6.8959	0.2759
202	201	6.8959	0.2759
203	202	6.8959	0.2759
204	203	6.8959	0.2759
205	204	6.8959	0.2759
206	205	6.8923	0.2722
207	206	6.8923	0.2722

	Time [s]	Water Level [m]	WL Change [m]
208	207	6.8923	0.2722
209	208	6.8923	0.2722
210	209	6.8895	0.2695
211	210	6.8895	0.2695
212	211	6.8895	0.2695
213	212	6.8895	0.2695
214	213	6.8868	0.2668
215	214	6.8868	0.2668
216	215	6.884	0.264
217	216	6.884	0.264
218	217	6.884	0.264
219	218	6.8803	0.2603
220	219	6.8803	0.2603
221	220	6.884	0.264
222	221	6.8776	0.2576
223	222	6.8803	0.2603
224	223	6.8776	0.2576
225	224	6.8776	0.2576
226	225	6.8776	0.2576
227	226	6.8776	0.2576
228	227	6.8748	0.2548
229	228	6.8748	0.2548
230	229	6.8721	0.2521
231	230	6.8748	0.2548
232	231	6.8721	0.2521
233	232	6.8721	0.2521
234	233	6.8684	0.2484
235	234	6.8684	0.2484
236	235	6.8684	0.2484
237	236	6.8684	0.2484
238	237	6.8684	0.2484
239	238	6.8684	0.2484
240	239	6.8684	0.2484
241	240	6.8657	0.2457
242	241	6.8657	0.2457
243	242	6.8657	0.2457
244	243	6.8657	0.2457
245	244	6.8629	0.2429
246	245	6.8629	0.2429
247	246	6.8629	0.2429
248	247	6.8629	0.2429
249	248	6.8629	0.2429
250	249	6.8602	0.2402
251	250	6.8602	0.2402
252	251	6.8602	0.2402
253	252	6.8565	0.2365
254	253	6.8602	0.2402
255	254	6.8565	0.2365
256	255	6.8565	0.2365
257	256	6.8565	0.2365
258	257	6.8565	0.2365
259	258	6.8565	0.2365
260	259	6.8538	0.2337

	Time [s]	Water Level [m]	WL Change [m]
261	260	6.8538	0.2337
262	261	6.8565	0.2365
263	262	6.851	0.231
264	263	6.851	0.231
265	264	6.8538	0.2337
266	265	6.851	0.231
267	266	6.851	0.231
268	267	6.851	0.231
269	268	6.8483	0.2283
270	269	6.8483	0.2283
271	270	6.8483	0.2283
272	271	6.8483	0.2283
273	272	6.8446	0.2246
274	273	6.8483	0.2283
275	274	6.8483	0.2283
276	275	6.8446	0.2246
277	276	6.8446	0.2246
278	277	6.8446	0.2246
279	278	6.8418	0.2218
280	279	6.8391	0.2191
281	280	6.8418	0.2218
282	281	6.8418	0.2218
283	282	6.8418	0.2218
284	283	6.8391	0.2191
285	284	6.8391	0.2191
286	285	6.8391	0.2191
287	286	6.8391	0.2191
288	287	6.8354	0.2154
289	288	6.8354	0.2154
290	289	6.8354	0.2154
291	290	6.8354	0.2154
292	291	6.8327	0.2127
293	292	6.8327	0.2127
294	293	6.8327	0.2127
295	294	6.8327	0.2127
296	295	6.8327	0.2127
297	296	6.8299	0.2099
298	297	6.8299	0.2099
299	298	6.8299	0.2099
300	299	6.8299	0.2099
301	300	6.8299	0.2099
302	301	6.8299	0.2099
303	302	6.8299	0.2099
304	303	6.8299	0.2099
305	304	6.8272	0.2072
306	305	6.8272	0.2072
307	306	6.8272	0.2072
308	307	6.8235	0.2035
309	308	6.8235	0.2035
310	309	6.8235	0.2035
311	310	6.8235	0.2035
312	311	6.8235	0.2035
313	312	6.8235	0.2035

	Time [s]	Water Level [m]	WL Change [m]
314	313	6.8208	0.2008
315	314	6.8208	0.2008
316	315	6.8208	0.2008
317	316	6.8208	0.2008
318	317	6.8208	0.2008
319	318	6.8208	0.2008
320	319	6.8208	0.2008
321	320	6.818	0.198
322	321	6.818	0.198
323	322	6.818	0.198
324	323	6.818	0.198
325	324	6.818	0.198
326	325	6.8152	0.1952
327	326	6.818	0.198
328	327	6.8152	0.1952
329	328	6.8152	0.1952
330	329	6.8152	0.1952
331	330	6.8152	0.1952
332	331	6.8116	0.1916
333	332	6.8116	0.1916
334	333	6.8116	0.1916
335	334	6.8116	0.1916
336	335	6.8116	0.1916
337	336	6.8116	0.1916
338	337	6.8116	0.1916
339	338	6.8116	0.1916
340	339	6.8088	0.1888
341	340	6.8088	0.1888
342	341	6.8088	0.1888
343	342	6.8061	0.1861
344	343	6.8061	0.1861
345	344	6.8061	0.1861
346	345	6.8061	0.1861
347	346	6.8088	0.1888
348	347	6.8061	0.1861
349	348	6.8061	0.1861
350	349	6.8061	0.1861
351	350	6.8033	0.1833
352	351	6.8061	0.1861
353	352	6.8033	0.1833
354	353	6.8033	0.1833
355	354	6.8033	0.1833
356	355	6.8033	0.1833
357	356	6.7997	0.1797
358	357	6.7997	0.1797
359	358	6.7997	0.1797
360	359	6.7997	0.1797
361	360	6.7997	0.1797
362	361	6.7997	0.1797
363	362	6.7969	0.1769
364	363	6.7997	0.1797
365	364	6.7997	0.1797
366	365	6.7969	0.1769

	Time [s]	Water Level [m]	WL Change [m]
367	366	6.7997	0.1797
368	367	6.7969	0.1769
369	368	6.7942	0.1742
370	369	6.7969	0.1769
371	370	6.7942	0.1742
372	371	6.7942	0.1742
373	372	6.7942	0.1742
374	373	6.7914	0.1714
375	374	6.7914	0.1714
376	375	6.7914	0.1714
377	376	6.7914	0.1714
378	377	6.7914	0.1714
379	378	6.7914	0.1714
380	379	6.7914	0.1714
381	380	6.7914	0.1714
382	381	6.7914	0.1714
383	382	6.7878	0.1677
384	383	6.7878	0.1677
385	384	6.7878	0.1677
386	385	6.7878	0.1677
387	386	6.7878	0.1677
388	387	6.7878	0.1677
389	388	6.785	0.165
390	389	6.785	0.165
391	390	6.785	0.165
392	391	6.785	0.165
393	392	6.785	0.165
394	393	6.785	0.165
395	394	6.785	0.165
396	395	6.7823	0.1623
397	396	6.7823	0.1623
398	397	6.7823	0.1623
399	398	6.7823	0.1623
400	399	6.7823	0.1623
401	400	6.785	0.165
402	401	6.7795	0.1595
403	402	6.7823	0.1623
404	403	6.7823	0.1623
405	404	6.7823	0.1623
406	405	6.7823	0.1623
407	406	6.7823	0.1623
408	407	6.7795	0.1595
409	408	6.7823	0.1623
410	409	6.7795	0.1595
411	410	6.7823	0.1623
412	411	6.7795	0.1595
413	412	6.7795	0.1595
414	413	6.7795	0.1595
415	414	6.7795	0.1595
416	415	6.7758	0.1558
417	416	6.7795	0.1595
418	417	6.7758	0.1558
419	418	6.7758	0.1558

	Time [s]	Water Level [m]	WL Change [m]
420	419	6.7758	0.1558
421	420	6.7758	0.1558
422	421	6.7758	0.1558
423	422	6.7758	0.1558
424	423	6.7758	0.1558
425	424	6.7758	0.1558
426	425	6.7731	0.1531
427	426	6.7758	0.1558
428	427	6.7731	0.1531
429	428	6.7731	0.1531
430	429	6.7731	0.1531
431	430	6.7731	0.1531
432	431	6.7731	0.1531
433	432	6.7703	0.1503
434	433	6.7703	0.1503
435	434	6.7703	0.1503
436	435	6.7703	0.1503
437	436	6.7703	0.1503
438	437	6.7703	0.1503
439	438	6.7667	0.1467
440	439	6.7667	0.1467
441	440	6.7667	0.1467
442	441	6.7667	0.1467
443	442	6.7667	0.1467
444	443	6.7667	0.1467
445	444	6.7667	0.1467
446	445	6.7667	0.1467
447	446	6.7667	0.1467
448	447	6.7667	0.1467
449	448	6.7639	0.1439
450	449	6.7639	0.1439
451	450	6.7639	0.1439
452	451	6.7639	0.1439
453	452	6.7639	0.1439
454	453	6.7639	0.1439
455	454	6.7639	0.1439
456	455	6.7639	0.1439
457	456	6.7612	0.1412
458	457	6.7639	0.1439
459	458	6.7639	0.1439
460	459	6.7639	0.1439
461	460	6.7639	0.1439
462	461	6.7612	0.1412
463	462	6.7639	0.1439
464	463	6.7639	0.1439
465	464	6.7612	0.1412
466	465	6.7612	0.1412
467	466	6.7612	0.1412
468	467	6.7612	0.1412
469	468	6.7612	0.1412
470	469	6.7584	0.1384
471	470	6.7584	0.1384
472	471	6.7584	0.1384

	Time [s]	Water Level [m]	WL Change [m]
473	472	6.7584	0.1384
474	473	6.7584	0.1384
475	474	6.7584	0.1384
476	475	6.7612	0.1412
477	476	6.7584	0.1384
478	477	6.7584	0.1384
479	478	6.7584	0.1384
480	479	6.7584	0.1384
481	480	6.7584	0.1384
482	481	6.7548	0.1347
483	482	6.7548	0.1347
484	483	6.7548	0.1347
485	484	6.7548	0.1347
486	485	6.752	0.132
487	486	6.752	0.132
488	487	6.7548	0.1347
489	488	6.7548	0.1347
490	489	6.752	0.132
491	490	6.7548	0.1347
492	491	6.7548	0.1347
493	492	6.7548	0.1347
494	493	6.752	0.132
495	494	6.752	0.132
496	495	6.752	0.132
497	496	6.752	0.132
498	497	6.752	0.132
499	498	6.752	0.132
500	499	6.752	0.132
501	500	6.752	0.132
502	501	6.7492	0.1292
503	502	6.752	0.132
504	503	6.7492	0.1292
505	504	6.7492	0.1292
506	505	6.7492	0.1292
507	506	6.7492	0.1292
508	507	6.7492	0.1292
509	508	6.7492	0.1292
510	509	6.7492	0.1292
511	510	6.7492	0.1292
512	511	6.7492	0.1292
513	512	6.7465	0.1265
514	513	6.7492	0.1292
515	514	6.7492	0.1292
516	515	6.7492	0.1292
517	516	6.7492	0.1292
518	517	6.7465	0.1265
519	518	6.7465	0.1265
520	519	6.7465	0.1265
521	520	6.7465	0.1265
522	521	6.7465	0.1265
523	522	6.7465	0.1265
524	523	6.7465	0.1265
525	524	6.7465	0.1265

	Time [s]	Water Level [m]	WL Change [m]
526	525	6.7465	0.1265
527	526	6.7465	0.1265
528	527	6.7465	0.1265
529	528	6.7428	0.1228
530	529	6.7428	0.1228
531	530	6.7428	0.1228
532	531	6.7465	0.1265
533	532	6.7428	0.1228
534	533	6.7428	0.1228
535	534	6.7428	0.1228
536	535	6.7428	0.1228
537	536	6.7428	0.1228
538	537	6.7428	0.1228
539	538	6.7401	0.1201
540	539	6.7428	0.1228
541	540	6.7401	0.1201
542	541	6.7428	0.1228
543	542	6.7401	0.1201
544	543	6.7401	0.1201
545	544	6.7401	0.1201
546	545	6.7401	0.1201
547	546	6.7401	0.1201
548	547	6.7401	0.1201
549	548	6.7373	0.1173
550	549	6.7401	0.1201
551	550	6.7401	0.1201
552	551	6.7401	0.1201
553	552	6.7401	0.1201
554	553	6.7401	0.1201
555	554	6.7401	0.1201
556	555	6.7401	0.1201
557	556	6.7373	0.1173
558	557	6.7373	0.1173
559	558	6.7346	0.1146
560	559	6.7346	0.1146
561	560	6.7346	0.1146
562	561	6.7346	0.1146
563	562	6.7346	0.1146
564	563	6.7346	0.1146
565	564	6.7373	0.1173
566	565	6.7373	0.1173
567	566	6.7373	0.1173
568	567	6.7346	0.1146
569	568	6.7346	0.1146
570	569	6.7373	0.1173
571	570	6.7346	0.1146
572	571	6.7346	0.1146
573	572	6.7346	0.1146
574	573	6.7346	0.1146
575	574	6.7346	0.1146
576	575	6.7309	0.1109
577	576	6.7309	0.1109
578	577	6.7309	0.1109

	Time [s]	Water Level [m]	WL Change [m]
579	578	6.7309	0.1109
580	579	6.7309	0.1109
581	580	6.7309	0.1109
582	581	6.7309	0.1109
583	582	6.7346	0.1146
584	583	6.7309	0.1109
585	584	6.7346	0.1146
586	585	6.7309	0.1109
587	586	6.7309	0.1109
588	587	6.7309	0.1109
589	588	6.7346	0.1146
590	589	6.7309	0.1109
591	590	6.7309	0.1109
592	591	6.7309	0.1109
593	592	6.7309	0.1109
594	593	6.7309	0.1109
595	594	6.7309	0.1109
596	595	6.7309	0.1109
597	596	6.7309	0.1109
598	597	6.7309	0.1109
599	598	6.7282	0.1082
600	599	6.7282	0.1082
601	600	6.7309	0.1109
602	601	6.7309	0.1109
603	602	6.7309	0.1109
604	603	6.7282	0.1082
605	604	6.7282	0.1082
606	605	6.7309	0.1109
607	606	6.7282	0.1082
608	607	6.7282	0.1082
609	608	6.7282	0.1082
610	609	6.7282	0.1082
611	610	6.7282	0.1082
612	611	6.7282	0.1082
613	612	6.7282	0.1082
614	613	6.7282	0.1082
615	614	6.7282	0.1082
616	615	6.7254	0.1054
617	616	6.7282	0.1082
618	617	6.7282	0.1082
619	618	6.7282	0.1082
620	619	6.7254	0.1054
621	620	6.7254	0.1054
622	621	6.7282	0.1082
623	622	6.7254	0.1054
624	623	6.7254	0.1054
625	624	6.7254	0.1054
626	625	6.7254	0.1054
627	626	6.7254	0.1054
628	627	6.7254	0.1054
629	628	6.7254	0.1054
630	629	6.7254	0.1054
631	630	6.7227	0.1027

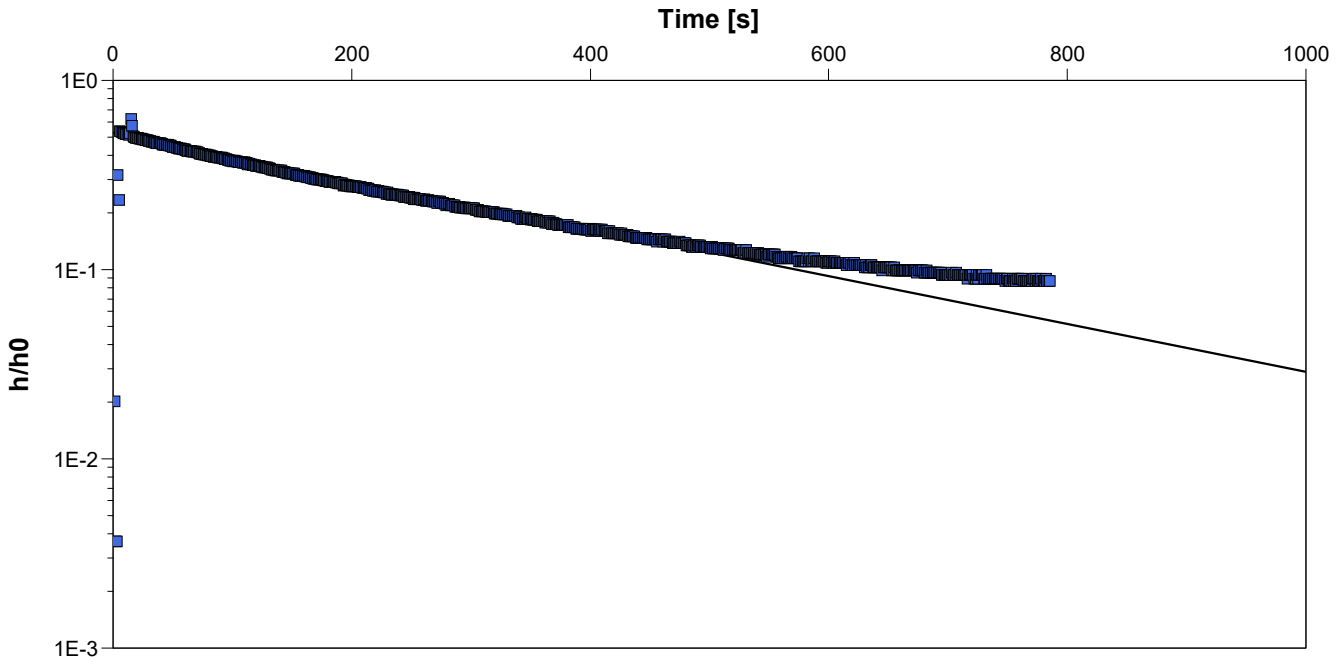
	Time [s]	Water Level [m]	WL Change [m]
632	631	6.7254	0.1054
633	632	6.7227	0.1027
634	633	6.7227	0.1027
635	634	6.7227	0.1027
636	635	6.7254	0.1054
637	636	6.7254	0.1054
638	637	6.7227	0.1027
639	638	6.7227	0.1027
640	639	6.7227	0.1027
641	640	6.7227	0.1027
642	641	6.7227	0.1027
643	642	6.7227	0.1027
644	643	6.7227	0.1027
645	644	6.7227	0.1027
646	645	6.719	0.099
647	646	6.7227	0.1027
648	647	6.7227	0.1027
649	648	6.7227	0.1027
650	649	6.7227	0.1027
651	650	6.7227	0.1027
652	651	6.7227	0.1027
653	652	6.7227	0.1027
654	653	6.719	0.099
655	654	6.719	0.099
656	655	6.7227	0.1027
657	656	6.719	0.099
658	657	6.719	0.099
659	658	6.719	0.099
660	659	6.719	0.099
661	660	6.719	0.099
662	661	6.719	0.099
663	662	6.719	0.099
664	663	6.719	0.099
665	664	6.719	0.099
666	665	6.719	0.099
667	666	6.719	0.099
668	667	6.719	0.099
669	668	6.719	0.099
670	669	6.719	0.099
671	670	6.719	0.099
672	671	6.719	0.099
673	672	6.719	0.099
674	673	6.719	0.099
675	674	6.7163	0.0962
676	675	6.719	0.099
677	676	6.719	0.099
678	677	6.719	0.099
679	678	6.719	0.099
680	679	6.719	0.099
681	680	6.7163	0.0962
682	681	6.7163	0.0962
683	682	6.719	0.099
684	683	6.7163	0.0962

	Time [s]	Water Level [m]	WL Change [m]
685	684	6.7163	0.0962
686	685	6.7163	0.0962
687	686	6.7163	0.0962
688	687	6.7163	0.0962
689	688	6.7163	0.0962
690	689	6.7163	0.0962
691	690	6.7163	0.0962
692	691	6.7163	0.0962
693	692	6.7163	0.0962
694	693	6.7163	0.0962
695	694	6.7163	0.0962
696	695	6.7135	0.0935
697	696	6.7135	0.0935
698	697	6.7135	0.0935
699	698	6.7135	0.0935
700	699	6.7135	0.0935
701	700	6.7135	0.0935
702	701	6.7135	0.0935
703	702	6.7135	0.0935
704	703	6.7163	0.0962
705	704	6.7135	0.0935
706	705	6.7135	0.0935
707	706	6.7135	0.0935
708	707	6.7163	0.0962
709	708	6.7135	0.0935
710	709	6.7135	0.0935
711	710	6.7135	0.0935
712	711	6.7135	0.0935
713	712	6.7135	0.0935
714	713	6.7135	0.0935
715	714	6.7135	0.0935
716	715	6.7135	0.0935
717	716	6.7098	0.0898
718	717	6.7135	0.0935
719	718	6.7135	0.0935
720	719	6.7135	0.0935
721	720	6.7135	0.0935
722	721	6.7135	0.0935
723	722	6.7098	0.0898
724	723	6.7098	0.0898
725	724	6.7135	0.0935
726	725	6.7098	0.0898
727	726	6.7135	0.0935
728	727	6.7135	0.0935
729	728	6.7135	0.0935
730	729	6.7135	0.0935
731	730	6.7098	0.0898
732	731	6.7098	0.0898
733	732	6.7135	0.0935
734	733	6.7098	0.0898
735	734	6.7098	0.0898
736	735	6.7098	0.0898
737	736	6.7098	0.0898

	Time [s]	Water Level [m]	WL Change [m]
738	737	6.7098	0.0898
739	738	6.7098	0.0898
740	739	6.7098	0.0898
741	740	6.7098	0.0898
742	741	6.7098	0.0898
743	742	6.7098	0.0898
744	743	6.7098	0.0898
745	744	6.7098	0.0898
746	745	6.7098	0.0898
747	746	6.7098	0.0898
748	747	6.7098	0.0898
749	748	6.7071	0.0871
750	749	6.7098	0.0898
751	750	6.7098	0.0898
752	751	6.7071	0.0871
753	752	6.7071	0.0871
754	753	6.7071	0.0871
755	754	6.7098	0.0898
756	755	6.7071	0.0871
757	756	6.7098	0.0898
758	757	6.7071	0.0871
759	758	6.7098	0.0898
760	759	6.7098	0.0898
761	760	6.7098	0.0898
762	761	6.7098	0.0898
763	762	6.7098	0.0898
764	763	6.7071	0.0871
765	764	6.7071	0.0871
766	765	6.7071	0.0871
767	766	6.7071	0.0871
768	767	6.7071	0.0871
769	768	6.7071	0.0871
770	769	6.7071	0.0871
771	770	6.7071	0.0871
772	771	6.7098	0.0898
773	772	6.7098	0.0898
774	773	6.7071	0.0871
775	774	6.7098	0.0898
776	775	6.7071	0.0871
777	776	6.7071	0.0871
778	777	6.7071	0.0871
779	778	6.7098	0.0898
780	779	6.7071	0.0871
781	780	6.7071	0.0871
782	781	6.7071	0.0871
783	782	6.7098	0.0898
784	783	6.7071	0.0871
785	784	6.7071	0.0871
786	785	6.7071	0.0871

BluMetric Environnement Inc. 276, rue St-Jacques Bureau 818 Montreal (QC) H2Y 1N3	**Slug Test Analysis Report** Project: Nemaska New Waste Disposal Site – Hydrogeological assess Number: 230448-00 Client: Stantec

Location: Nemaska	Slug Test: PZ-1_2020	Test Well: PZ-1
Test Conducted by: Stantec		Test Date: 2020-08-04
Analysis Performed by: LA	PZ-1_2020_Hvor	Analysis Date: 2023-08-18
Aquifer Thickness: 8.98 m		

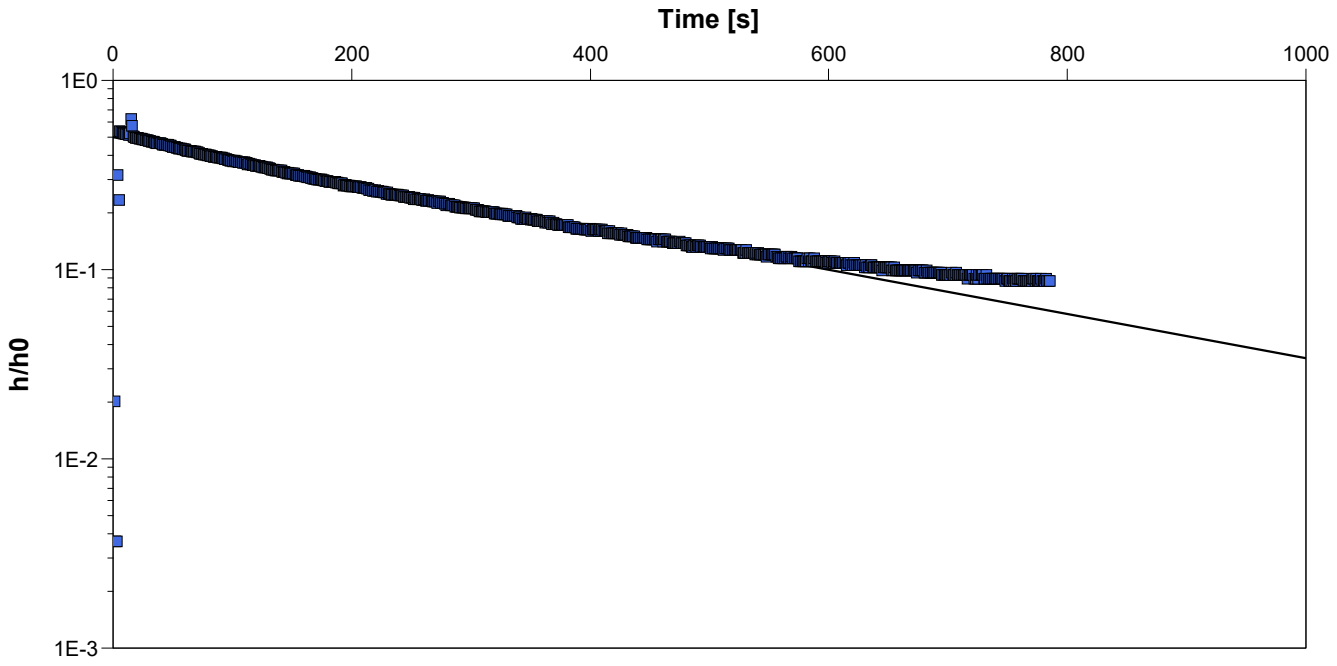


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
PZ-1	1.44×10^{-6}	

BluMetric Environnement Inc. 276, rue St-Jacques Bureau 818 Montreal (QC) H2Y 1N3	**Slug Test Analysis Report**
	Project: Nemaska New Waste Disposal Site – Hydrogeological assess
	Number: 230448-00
	Client: Stantec

Location: Nemaska	Slug Test: PZ-1_2020	Test Well: PZ-1
Test Conducted by: Stantec		Test Date: 2020-08-04
Analysis Performed by: LA	PZ-1_B-R	Analysis Date: 2023-08-18
Aquifer Thickness: 8.98 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
PZ-1	1.03×10^{-6}	

BluMetric Environnement Inc.
276, rue St-Jacques
Bureau 818
Montreal (QC)
H2Y 1N3

Slug Test - Analyses Report

Project: Nemaska New Waste Disposal Site – Hydrogeological assessr

Number: 230448-00

Client: Stantec

Location: Nemaska	Slug Test: PZ-1_2020	Test Well: PZ-1
Test Conducted by: Stantec		Test Date: 2020-08-04
Aquifer Thickness: 8.98 m		

	Analysis Name	Analysis Performed b	Analysis Date	Method name	Well	T [m²/s]	K [m/s]	S
1	PZ-1_2020_Hvor	LA	2023-08-18	Hvorslev	PZ-1		1.44×10^{-6}	
2	PZ-1_B-R	LA	2023-08-18	Bouwer & Rice	PZ-1		1.03×10^{-6}	

BluMetric Environnement Inc.
276, rue St-Jacques
Bureau 818
Montreal (QC)
H2Y 1N3

Project: Nemaska New Waste Disposal Site – Hydrogeological assessr

Number: 230448-00

Client: Stantec

Location: Nemaska	Slug Test: PZ-3_2020	Test Well: PZ-3
Test Conducted by: Stantec	Test Date: 2020-08-04	
Water level at t=0 [m]: NAN	Static Water Level [m]: 8.20	Water level change at t=0 [m]: 0.00

	Time [s]	Water Level [m]	WL Change [m]
1	0	8.1395	-0.0605
2	1	8.8508	0.6508
3	2	8.695	0.495
4	3	8.6794	0.4794
5	4	8.6739	0.4739
6	5	8.6702	0.4703
7	6	8.6648	0.4648
8	7	8.6583	0.4583
9	8	8.6583	0.4583
10	9	8.6556	0.4556
11	10	8.6446	0.4446
12	11	8.6437	0.4437
13	12	8.6409	0.4409
14	13	8.9233	0.7233
15	14	8.8123	0.6123
16	15	8.684	0.484
17	16	8.6721	0.4721
18	17	8.6327	0.4327
19	18	8.6299	0.4299
20	19	8.6235	0.4235
21	20	8.6235	0.4235
22	21	8.618	0.418
23	22	8.618	0.418
24	23	8.6116	0.4116
25	24	8.6116	0.4116
26	25	8.6088	0.4088
27	26	8.6061	0.4061
28	27	8.6061	0.4061
29	28	8.6024	0.4024
30	29	8.5997	0.3997
31	30	8.5969	0.3969
32	31	8.5942	0.3942
33	32	8.5878	0.3878
34	33	8.5878	0.3878
35	34	8.585	0.385
36	35	8.5823	0.3823
37	36	8.5786	0.3786
38	37	8.5758	0.3758
39	38	8.5731	0.3731
40	39	8.5731	0.3731
41	40	8.5694	0.3694
42	41	8.5667	0.3667
43	42	8.5639	0.3639
44	43	8.5612	0.3612
45	44	8.5612	0.3612
46	45	8.5575	0.3575
47	46	8.5548	0.3548
48	47	8.5548	0.3548

	Time [s]	Water Level [m]	WL Change [m]
49	48	8.552	0.352
50	49	8.5493	0.3493
51	50	8.5493	0.3493
52	51	8.5456	0.3456
53	52	8.5428	0.3428
54	53	8.5401	0.3401
55	54	8.5364	0.3364
56	55	8.5364	0.3364
57	56	8.5337	0.3337
58	57	8.5309	0.3309
59	58	8.5309	0.3309
60	59	8.5282	0.3282
61	60	8.5245	0.3245
62	61	8.5218	0.3218
63	62	8.5218	0.3218
64	63	8.5098	0.3098
65	64	8.4915	0.2915
66	65	8.4915	0.2915
67	66	8.5126	0.3126
68	67	8.5126	0.3126
69	68	8.5098	0.3098
70	69	8.5071	0.3071
71	70	8.5071	0.3071
72	71	8.5043	0.3043
73	72	8.4998	0.2998
74	73	8.4998	0.2998
75	74	8.497	0.297
76	75	8.497	0.297
77	76	8.4933	0.2933
78	77	8.4933	0.2933
79	78	8.4906	0.2906
80	79	8.4906	0.2906
81	80	8.4878	0.2878
82	81	8.4878	0.2878
83	82	8.4851	0.2851
84	83	8.4814	0.2814
85	84	8.4787	0.2787
86	85	8.4787	0.2787
87	86	8.4759	0.2759
88	87	8.4759	0.2759
89	88	8.4732	0.2732
90	89	8.4732	0.2732
91	90	8.4695	0.2695
92	91	8.4667	0.2668
93	92	8.4667	0.2668
94	93	8.464	0.264
95	94	8.464	0.264
96	95	8.4603	0.2603
97	96	8.4576	0.2576
98	97	8.4576	0.2576
99	98	8.4576	0.2576
100	99	8.4548	0.2548
101	100	8.4548	0.2548

	Time [s]	Water Level [m]	WL Change [m]
102	101	8.4521	0.2521
103	102	8.4484	0.2484
104	103	8.4484	0.2484
105	104	8.4484	0.2484
106	105	8.4457	0.2457
107	106	8.4429	0.2429
108	107	8.4429	0.2429
109	108	8.4402	0.2402
110	109	8.4402	0.2402
111	110	8.4411	0.2411
112	111	8.4365	0.2365
113	112	8.4338	0.2338
114	113	8.4338	0.2338
115	114	8.431	0.231
116	115	8.431	0.231
117	116	8.4292	0.2292
118	117	8.4292	0.2292
119	118	8.4246	0.2246
120	119	8.4255	0.2255
121	120	8.4246	0.2246
122	121	8.4218	0.2218
123	122	8.42	0.22
124	123	8.4228	0.2228
125	124	8.4191	0.2191
126	125	8.42	0.22
127	126	8.4172	0.2172
128	127	8.4172	0.2172
129	128	8.4172	0.2172
130	129	8.4127	0.2127
131	130	8.4108	0.2108
132	131	8.4108	0.2108
133	132	8.4081	0.2081
134	133	8.4081	0.2081
135	134	8.4081	0.2081
136	135	8.4053	0.2053
137	136	8.4053	0.2053
138	137	8.4053	0.2053
139	138	8.4017	0.2017
140	139	8.4017	0.2017
141	140	8.3989	0.1989
142	141	8.3989	0.1989
143	142	8.3989	0.1989
144	143	8.3989	0.1989
145	144	8.3962	0.1962
146	145	8.3934	0.1934
147	146	8.3934	0.1934
148	147	8.3898	0.1898
149	148	8.387	0.187
150	149	8.387	0.187
151	150	8.387	0.187
152	151	8.387	0.187
153	152	8.3843	0.1843
154	153	8.3843	0.1843

	Time [s]	Water Level [m]	WL Change [m]
155	154	8.3843	0.1843
156	155	8.3806	0.1806
157	156	8.3806	0.1806
158	157	8.3806	0.1806
159	158	8.3778	0.1778
160	159	8.3751	0.1751
161	160	8.3751	0.1751
162	161	8.3751	0.1751
163	162	8.3751	0.1751
164	163	8.3723	0.1723
165	164	8.3723	0.1723
166	165	8.3687	0.1687
167	166	8.3687	0.1687
168	167	8.3659	0.1659
169	168	8.3659	0.1659
170	169	8.3659	0.1659
171	170	8.3659	0.1659
172	171	8.3632	0.1632
173	172	8.3632	0.1632
174	173	8.3632	0.1632
175	174	8.3632	0.1632
176	175	8.3604	0.1604
177	176	8.3604	0.1604
178	177	8.3604	0.1604
179	178	8.3604	0.1604
180	179	8.3568	0.1568
181	180	8.3568	0.1568
182	181	8.354	0.154
183	182	8.354	0.154
184	183	8.3513	0.1513
185	184	8.354	0.154
186	185	8.3513	0.1513
187	186	8.3513	0.1513
188	187	8.3513	0.1513
189	188	8.3476	0.1476
190	189	8.3476	0.1476
191	190	8.3476	0.1476
192	191	8.3448	0.1448
193	192	8.3448	0.1448
194	193	8.3448	0.1448
195	194	8.3448	0.1448
196	195	8.3421	0.1421
197	196	8.3448	0.1448
198	197	8.3421	0.1421
199	198	8.3393	0.1393
200	199	8.3421	0.1421
201	200	8.3393	0.1393
202	201	8.3393	0.1393
203	202	8.3393	0.1393
204	203	8.3357	0.1357
205	204	8.3357	0.1357
206	205	8.3357	0.1357
207	206	8.3329	0.1329

	Time [s]	Water Level [m]	WL Change [m]
208	207	8.3329	0.1329
209	208	8.3302	0.1302
210	209	8.3302	0.1302
211	210	8.3329	0.1329
212	211	8.3302	0.1302
213	212	8.3302	0.1302
214	213	8.3302	0.1302
215	214	8.3302	0.1302
216	215	8.3274	0.1274
217	216	8.3274	0.1274
218	217	8.3238	0.1238
219	218	8.3238	0.1238
220	219	8.3238	0.1238
221	220	8.3238	0.1238
222	221	8.3238	0.1238
223	222	8.321	0.121
224	223	8.321	0.121
225	224	8.3155	0.1155
226	225	8.321	0.121
227	226	8.321	0.121
228	227	8.3183	0.1183
229	228	8.3183	0.1183
230	229	8.3183	0.1183
231	230	8.3183	0.1183
232	231	8.3155	0.1155
233	232	8.3155	0.1155
234	233	8.3155	0.1155
235	234	8.3155	0.1155
236	235	8.3118	0.1118
237	236	8.3118	0.1118
238	237	8.3118	0.1118
239	238	8.3118	0.1118
240	239	8.3118	0.1118
241	240	8.3091	0.1091
242	241	8.3091	0.1091
243	242	8.3091	0.1091
244	243	8.3091	0.1091
245	244	8.3091	0.1091
246	245	8.3063	0.1063
247	246	8.3063	0.1063
248	247	8.3063	0.1063
249	248	8.3063	0.1063
250	249	8.3063	0.1063
251	250	8.3027	0.1027
252	251	8.3027	0.1027
253	252	8.3027	0.1027
254	253	8.3027	0.1027
255	254	8.3027	0.1027
256	255	8.3027	0.1027
257	256	8.3027	0.1027
258	257	8.3027	0.1027
259	258	8.2999	0.0999
260	259	8.2999	0.0999

	Time [s]	Water Level [m]	WL Change [m]
261	260	8.2972	0.0972
262	261	8.2972	0.0972
263	262	8.2972	0.0972
264	263	8.2972	0.0972
265	264	8.2944	0.0944
266	265	8.2944	0.0944
267	266	8.2944	0.0944
268	267	8.2944	0.0944
269	268	8.2944	0.0944
270	269	8.2944	0.0944
271	270	8.2944	0.0944
272	271	8.2907	0.0907
273	272	8.2944	0.0944
274	273	8.2907	0.0907
275	274	8.2907	0.0907
276	275	8.2907	0.0907
277	276	8.2907	0.0907
278	277	8.288	0.088
279	278	8.288	0.088
280	279	8.288	0.088
281	280	8.288	0.088
282	281	8.2853	0.0853
283	282	8.2853	0.0853
284	283	8.288	0.088
285	284	8.288	0.088
286	285	8.288	0.088
287	286	8.2853	0.0853
288	287	8.2825	0.0825
289	288	8.2825	0.0825
290	289	8.2825	0.0825
291	290	8.2825	0.0825
292	291	8.2825	0.0825
293	292	8.2825	0.0825
294	293	8.2825	0.0825
295	294	8.2788	0.0788
296	295	8.2825	0.0825
297	296	8.2788	0.0788
298	297	8.2825	0.0825
299	298	8.2825	0.0825
300	299	8.2788	0.0788
301	300	8.2788	0.0788
302	301	8.2761	0.0761
303	302	8.2761	0.0761
304	303	8.2761	0.0761
305	304	8.2761	0.0761
306	305	8.2788	0.0788
307	306	8.2761	0.0761
308	307	8.2761	0.0761
309	308	8.2761	0.0761
310	309	8.2761	0.0761
311	310	8.2733	0.0733
312	311	8.2761	0.0761
313	312	8.2733	0.0733

	Time [s]	Water Level [m]	WL Change [m]
314	313	8.2733	0.0733
315	314	8.2733	0.0733
316	315	8.2733	0.0733
317	316	8.2733	0.0733
318	317	8.2697	0.0697
319	318	8.2697	0.0697
320	319	8.2697	0.0697
321	320	8.2697	0.0697
322	321	8.2697	0.0697
323	322	8.2697	0.0697
324	323	8.2697	0.0697
325	324	8.2697	0.0697
326	325	8.2697	0.0697
327	326	8.2697	0.0697
328	327	8.2697	0.0697
329	328	8.2669	0.0669
330	329	8.2669	0.0669
331	330	8.2669	0.0669
332	331	8.2669	0.0669
333	332	8.2669	0.0669
334	333	8.2669	0.0669
335	334	8.2669	0.0669
336	335	8.2669	0.0669
337	336	8.2642	0.0642
338	337	8.2642	0.0642
339	338	8.2642	0.0642
340	339	8.2642	0.0642
341	340	8.2642	0.0642
342	341	8.2614	0.0614
343	342	8.2614	0.0614
344	343	8.2614	0.0614
345	344	8.2642	0.0642
346	345	8.2614	0.0614
347	346	8.2614	0.0614
348	347	8.2614	0.0614
349	348	8.2614	0.0614
350	349	8.2578	0.0578
351	350	8.2578	0.0578
352	351	8.2578	0.0578
353	352	8.2578	0.0578
354	353	8.2614	0.0614
355	354	8.2614	0.0614
356	355	8.2578	0.0578
357	356	8.2614	0.0614
358	357	8.2578	0.0578
359	358	8.255	0.055
360	359	8.2578	0.0578
361	360	8.2578	0.0578
362	361	8.2578	0.0578
363	362	8.2578	0.0578
364	363	8.255	0.055
365	364	8.255	0.055
366	365	8.255	0.055

	Time [s]	Water Level [m]	WL Change [m]
367	366	8.255	0.055
368	367	8.2578	0.0578
369	368	8.255	0.055
370	369	8.255	0.055
371	370	8.2578	0.0578
372	371	8.255	0.055
373	372	8.255	0.055
374	373	8.255	0.055
375	374	8.255	0.055
376	375	8.255	0.055
377	376	8.2523	0.0523
378	377	8.2523	0.0523
379	378	8.255	0.055
380	379	8.2523	0.0523
381	380	8.2523	0.0523
382	381	8.2523	0.0523
383	382	8.2523	0.0523
384	383	8.2523	0.0523
385	384	8.2523	0.0523
386	385	8.2523	0.0523
387	386	8.2523	0.0523
388	387	8.2523	0.0523
389	388	8.2495	0.0495
390	389	8.2495	0.0495
391	390	8.2523	0.0523
392	391	8.2495	0.0495
393	392	8.2495	0.0495
394	393	8.2495	0.0495
395	394	8.2495	0.0495
396	395	8.2495	0.0495
397	396	8.2495	0.0495
398	397	8.2495	0.0495
399	398	8.2495	0.0495
400	399	8.2495	0.0495
401	400	8.2495	0.0495
402	401	8.2495	0.0495
403	402	8.2458	0.0458
404	403	8.2495	0.0495
405	404	8.2495	0.0495
406	405	8.2495	0.0495
407	406	8.2458	0.0458
408	407	8.2458	0.0458
409	408	8.2458	0.0458
410	409	8.2458	0.0458
411	410	8.2458	0.0458
412	411	8.2431	0.0431
413	412	8.2431	0.0431
414	413	8.2458	0.0458
415	414	8.2458	0.0458
416	415	8.2458	0.0458
417	416	8.2458	0.0458
418	417	8.2458	0.0458
419	418	8.2458	0.0458

	Time [s]	Water Level [m]	WL Change [m]
420	419	8.2431	0.0431
421	420	8.2431	0.0431
422	421	8.2431	0.0431
423	422	8.2431	0.0431
424	423	8.2431	0.0431
425	424	8.2431	0.0431
426	425	8.2431	0.0431
427	426	8.2431	0.0431
428	427	8.2431	0.0431
429	428	8.2431	0.0431
430	429	8.2431	0.0431
431	430	8.2403	0.0403
432	431	8.2403	0.0403
433	432	8.2403	0.0403
434	433	8.2403	0.0403
435	434	8.2431	0.0431
436	435	8.2403	0.0403
437	436	8.2403	0.0403
438	437	8.2403	0.0403
439	438	8.2403	0.0403
440	439	8.2431	0.0431
441	440	8.2403	0.0403
442	441	8.2403	0.0403
443	442	8.2403	0.0403
444	443	8.2403	0.0403
445	444	8.2376	0.0376
446	445	8.2403	0.0403
447	446	8.2403	0.0403
448	447	8.2403	0.0403
449	448	8.2403	0.0403
450	449	8.2403	0.0403
451	450	8.2403	0.0403
452	451	8.2403	0.0403
453	452	8.2376	0.0376
454	453	8.2403	0.0403
455	454	8.2376	0.0376
456	455	8.2376	0.0376
457	456	8.2376	0.0376
458	457	8.2376	0.0376
459	458	8.2376	0.0376
460	459	8.2339	0.0339
461	460	8.2339	0.0339
462	461	8.2339	0.0339
463	462	8.2339	0.0339
464	463	8.2376	0.0376
465	464	8.2376	0.0376
466	465	8.2339	0.0339
467	466	8.2339	0.0339
468	467	8.2339	0.0339
469	468	8.2312	0.0312
470	469	8.2339	0.0339
471	470	8.2339	0.0339
472	471	8.2339	0.0339

	Time [s]	Water Level [m]	WL Change [m]
473	472	8.2339	0.0339
474	473	8.2339	0.0339
475	474	8.2312	0.0312
476	475	8.2339	0.0339
477	476	8.2339	0.0339
478	477	8.2339	0.0339
479	478	8.2339	0.0339
480	479	8.2312	0.0312
481	480	8.2312	0.0312
482	481	8.2312	0.0312
483	482	8.2312	0.0312
484	483	8.2312	0.0312
485	484	8.2312	0.0312
486	485	8.2312	0.0312
487	486	8.2312	0.0312
488	487	8.2312	0.0312
489	488	8.2312	0.0312
490	489	8.2312	0.0312
491	490	8.2312	0.0312
492	491	8.2312	0.0312
493	492	8.2312	0.0312
494	493	8.2312	0.0312
495	494	8.2312	0.0312
496	495	8.2312	0.0312
497	496	8.2284	0.0284
498	497	8.2284	0.0284
499	498	8.2312	0.0312
500	499	8.2284	0.0284
501	500	8.2284	0.0284
502	501	8.2312	0.0312
503	502	8.2284	0.0284
504	503	8.2312	0.0312
505	504	8.2284	0.0284
506	505	8.2284	0.0284
507	506	8.2284	0.0284
508	507	8.2284	0.0284
509	508	8.2284	0.0284
510	509	8.2284	0.0284
511	510	8.2284	0.0284
512	511	8.2284	0.0284
513	512	8.2284	0.0284
514	513	8.2284	0.0284
515	514	8.2284	0.0284
516	515	8.2284	0.0284
517	516	8.2284	0.0284
518	517	8.2284	0.0284
519	518	8.2248	0.0248
520	519	8.2248	0.0248
521	520	8.2248	0.0248
522	521	8.2248	0.0248
523	522	8.2284	0.0284
524	523	8.2284	0.0284
525	524	8.2284	0.0284

	Time [s]	Water Level [m]	WL Change [m]
526	525	8.2284	0.0284
527	526	8.2284	0.0284
528	527	8.2284	0.0284
529	528	8.2284	0.0284
530	529	8.2284	0.0284
531	530	8.2248	0.0248
532	531	8.2284	0.0284
533	532	8.2248	0.0248
534	533	8.2248	0.0248
535	534	8.2248	0.0248
536	535	8.2248	0.0248
537	536	8.2248	0.0248
538	537	8.2248	0.0248
539	538	8.2248	0.0248
540	539	8.2284	0.0284
541	540	8.2248	0.0248
542	541	8.2248	0.0248
543	542	8.2248	0.0248
544	543	8.2284	0.0284
545	544	8.2248	0.0248
546	545	8.2248	0.0248
547	546	8.2248	0.0248
548	547	8.2248	0.0248
549	548	8.2248	0.0248
550	549	8.2248	0.0248
551	550	8.2248	0.0248
552	551	8.2248	0.0248
553	552	8.2248	0.0248
554	553	8.2284	0.0284
555	554	8.2248	0.0248
556	555	8.2284	0.0284
557	556	8.2248	0.0248
558	557	8.2248	0.0248
559	558	8.2248	0.0248
560	559	8.2248	0.0248
561	560	8.2248	0.0248
562	561	8.2248	0.0248
563	562	8.2248	0.0248
564	563	8.222	0.022
565	564	8.2248	0.0248
566	565	8.222	0.022
567	566	8.2248	0.0248
568	567	8.222	0.022
569	568	8.222	0.022
570	569	8.222	0.022
571	570	8.2248	0.0248
572	571	8.2248	0.0248
573	572	8.2248	0.0248
574	573	8.222	0.022
575	574	8.2248	0.0248
576	575	8.222	0.022
577	576	8.222	0.022
578	577	8.2248	0.0248

	Time [s]	Water Level [m]	WL Change [m]
579	578	8.222	0.022
580	579	8.222	0.022
581	580	8.222	0.022
582	581	8.222	0.022
583	582	8.222	0.022
584	583	8.222	0.022
585	584	8.222	0.022
586	585	8.222	0.022
587	586	8.222	0.022
588	587	8.2248	0.0248
589	588	8.222	0.022
590	589	8.222	0.022
591	590	8.222	0.022
592	591	8.222	0.022
593	592	8.222	0.022
594	593	8.2193	0.0193
595	594	8.222	0.022
596	595	8.222	0.022
597	596	8.222	0.022
598	597	8.2248	0.0248
599	598	8.222	0.022
600	599	8.2248	0.0248
601	600	8.2248	0.0248
602	601	8.222	0.022
603	602	8.222	0.022
604	603	8.222	0.022
605	604	8.222	0.022
606	605	8.222	0.022
607	606	8.222	0.022
608	607	8.2248	0.0248
609	608	8.222	0.022
610	609	8.2193	0.0193
611	610	8.2193	0.0193
612	611	8.222	0.022
613	612	8.2193	0.0193
614	613	8.222	0.022
615	614	8.222	0.022
616	615	8.222	0.022
617	616	8.2193	0.0193
618	617	8.222	0.022
619	618	8.222	0.022
620	619	8.222	0.022
621	620	8.222	0.022
622	621	8.222	0.022
623	622	8.222	0.022
624	623	8.222	0.022
625	624	8.222	0.022
626	625	8.222	0.022
627	626	8.222	0.022
628	627	8.222	0.022
629	628	8.222	0.022
630	629	8.222	0.022
631	630	8.222	0.022

	Time [s]	Water Level [m]	WL Change [m]
632	631	8.222	0.022
633	632	8.222	0.022
634	633	8.222	0.022
635	634	8.2193	0.0193
636	635	8.2193	0.0193
637	636	8.222	0.022
638	637	8.2193	0.0193
639	638	8.222	0.022
640	639	8.222	0.022
641	640	8.222	0.022
642	641	8.222	0.022
643	642	8.2193	0.0193
644	643	8.2193	0.0193
645	644	8.2193	0.0193
646	645	8.2193	0.0193
647	646	8.2165	0.0165
648	647	8.2165	0.0165
649	648	8.2193	0.0193
650	649	8.2193	0.0193
651	650	8.2193	0.0193
652	651	8.2165	0.0165
653	652	8.2193	0.0193
654	653	8.2193	0.0193
655	654	8.2165	0.0165
656	655	8.2193	0.0193
657	656	8.2165	0.0165
658	657	8.2193	0.0193
659	658	8.2193	0.0193
660	659	8.2193	0.0193
661	660	8.2165	0.0165
662	661	8.2193	0.0193
663	662	8.2193	0.0193
664	663	8.2193	0.0193
665	664	8.2193	0.0193
666	665	8.2193	0.0193
667	666	8.2193	0.0193
668	667	8.2165	0.0165
669	668	8.2193	0.0193
670	669	8.2193	0.0193
671	670	8.2165	0.0165
672	671	8.2193	0.0193
673	672	8.2165	0.0165
674	673	8.2165	0.0165
675	674	8.2193	0.0193
676	675	8.2193	0.0193
677	676	8.2193	0.0193
678	677	8.2193	0.0193
679	678	8.2193	0.0193
680	679	8.2193	0.0193
681	680	8.2165	0.0165
682	681	8.2193	0.0193
683	682	8.2165	0.0165
684	683	8.2165	0.0165

	Time [s]	Water Level [m]	WL Change [m]
685	684	8.2193	0.0193
686	685	8.2165	0.0165
687	686	8.2165	0.0165
688	687	8.2165	0.0165
689	688	8.2193	0.0193
690	689	8.2165	0.0165
691	690	8.2165	0.0165
692	691	8.2165	0.0165
693	692	8.2165	0.0165
694	693	8.2165	0.0165
695	694	8.2165	0.0165
696	695	8.2165	0.0165
697	696	8.2165	0.0165
698	697	8.2165	0.0165
699	698	8.2165	0.0165
700	699	8.2165	0.0165
701	700	8.2165	0.0165
702	701	8.2165	0.0165
703	702	8.2165	0.0165
704	703	8.2193	0.0193
705	704	8.2165	0.0165
706	705	8.2165	0.0165
707	706	8.2165	0.0165
708	707	8.2165	0.0165
709	708	8.2165	0.0165
710	709	8.2165	0.0165
711	710	8.2165	0.0165
712	711	8.2165	0.0165
713	712	8.2165	0.0165
714	713	8.2128	0.0128
715	714	8.2165	0.0165
716	715	8.2165	0.0165
717	716	8.2165	0.0165
718	717	8.2165	0.0165
719	718	8.2128	0.0128
720	719	8.2165	0.0165
721	720	8.2165	0.0165
722	721	8.2165	0.0165
723	722	8.2165	0.0165
724	723	8.2165	0.0165
725	724	8.2165	0.0165
726	725	8.2165	0.0165
727	726	8.2165	0.0165
728	727	8.2165	0.0165
729	728	8.2165	0.0165
730	729	8.2165	0.0165
731	730	8.2165	0.0165
732	731	8.2193	0.0193
733	732	8.2165	0.0165
734	733	8.2165	0.0165
735	734	8.2165	0.0165
736	735	8.2165	0.0165
737	736	8.2165	0.0165

	Time [s]	Water Level [m]	WL Change [m]
738	737	8.2165	0.0165
739	738	8.2165	0.0165
740	739	8.2165	0.0165
741	740	8.2165	0.0165
742	741	8.2165	0.0165
743	742	8.2165	0.0165
744	743	8.2165	0.0165
745	744	8.2165	0.0165
746	745	8.2165	0.0165
747	746	8.2165	0.0165
748	747	8.2128	0.0128
749	748	8.2128	0.0128
750	749	8.2128	0.0128
751	750	8.2128	0.0128
752	751	8.2128	0.0128
753	752	8.2128	0.0128
754	753	8.2128	0.0128
755	754	8.2165	0.0165
756	755	8.2165	0.0165
757	756	8.2165	0.0165
758	757	8.2128	0.0128
759	758	8.2128	0.0128
760	759	8.2128	0.0128
761	760	8.2128	0.0128
762	761	8.2128	0.0128
763	762	8.2128	0.0128
764	763	8.2128	0.0128
765	764	8.2128	0.0128
766	765	8.2165	0.0165
767	766	8.2165	0.0165
768	767	8.2128	0.0128
769	768	8.2128	0.0128
770	769	8.2165	0.0165
771	770	8.2165	0.0165
772	771	8.2128	0.0128
773	772	8.2128	0.0128
774	773	8.2165	0.0165
775	774	8.2165	0.0165
776	775	8.2165	0.0165
777	776	8.2128	0.0128
778	777	8.2165	0.0165
779	778	8.2128	0.0128
780	779	8.2165	0.0165
781	780	8.2128	0.0128
782	781	8.2128	0.0128
783	782	8.2165	0.0165
784	783	8.2128	0.0128
785	784	8.2128	0.0128
786	785	8.2165	0.0165
787	786	8.2165	0.0165
788	787	8.2165	0.0165
789	788	8.2128	0.0128
790	789	8.2128	0.0128

	Time [s]	Water Level [m]	WL Change [m]
791	790	8.2165	0.0165
792	791	8.2128	0.0128
793	792	8.2165	0.0165
794	793	8.2165	0.0165
795	794	8.2165	0.0165
796	795	8.2165	0.0165
797	796	8.2165	0.0165
798	797	8.2128	0.0128
799	798	8.2165	0.0165
800	799	8.2128	0.0128
801	800	8.2165	0.0165
802	801	8.2165	0.0165
803	802	8.2165	0.0165
804	803	8.2165	0.0165
805	804	8.2128	0.0128
806	805	8.2165	0.0165
807	806	8.2128	0.0128
808	807	8.2128	0.0128
809	808	8.2128	0.0128
810	809	8.2101	0.0101
811	810	8.2128	0.0128
812	811	8.2128	0.0128
813	812	8.2128	0.0128
814	813	8.2128	0.0128
815	814	8.2165	0.0165
816	815	8.2128	0.0128
817	816	8.2128	0.0128
818	817	8.2128	0.0128
819	818	8.2128	0.0128
820	819	8.2128	0.0128
821	820	8.2128	0.0128
822	821	8.2128	0.0128
823	822	8.2128	0.0128
824	823	8.2128	0.0128
825	824	8.2128	0.0128
826	825	8.2128	0.0128
827	826	8.2165	0.0165
828	827	8.2128	0.0128
829	828	8.2128	0.0128
830	829	8.2128	0.0128
831	830	8.2128	0.0128
832	831	8.2128	0.0128
833	832	8.2128	0.0128
834	833	8.2128	0.0128
835	834	8.2128	0.0128
836	835	8.2128	0.0128
837	836	8.2128	0.0128
838	837	8.2128	0.0128
839	838	8.2128	0.0128
840	839	8.2128	0.0128
841	840	8.2128	0.0128
842	841	8.2128	0.0128
843	842	8.2128	0.0128

	Time [s]	Water Level [m]	WL Change [m]
844	843	8.2128	0.0128
845	844	8.2128	0.0128
846	845	8.2128	0.0128
847	846	8.2128	0.0128
848	847	8.2128	0.0128
849	848	8.2128	0.0128
850	849	8.2128	0.0128
851	850	8.2128	0.0128
852	851	8.2128	0.0128
853	852	8.2128	0.0128
854	853	8.2128	0.0128
855	854	8.2128	0.0128
856	855	8.2128	0.0128
857	856	8.2128	0.0128
858	857	8.2128	0.0128
859	858	8.2128	0.0128
860	859	8.2128	0.0128
861	860	8.2128	0.0128
862	861	8.2165	0.0165
863	862	8.2165	0.0165
864	863	8.2165	0.0165
865	864	8.2128	0.0128
866	865	8.2128	0.0128
867	866	8.2128	0.0128
868	867	8.2128	0.0128
869	868	8.2128	0.0128
870	869	8.2128	0.0128
871	870	8.2128	0.0128
872	871	8.2147	0.0147
873	872	8.2147	0.0147
874	873	8.2128	0.0128
875	874	8.2128	0.0128
876	875	8.2128	0.0128
877	876	8.2128	0.0128
878	877	8.2128	0.0128
879	878	8.2128	0.0128
880	879	8.2128	0.0128
881	880	8.2128	0.0128
882	881	8.2128	0.0128
883	882	8.2147	0.0147
884	883	8.2128	0.0128
885	884	8.2128	0.0128
886	885	8.2128	0.0128
887	886	8.2128	0.0128
888	887	8.2128	0.0128
889	888	8.2128	0.0128
890	889	8.2128	0.0128
891	890	8.2128	0.0128
892	891	8.2128	0.0128
893	892	8.2128	0.0128
894	893	8.2101	0.0101
895	894	8.2147	0.0147
896	895	8.2128	0.0128

	Time [s]	Water Level [m]	WL Change [m]
897	896	8.2128	0.0128
898	897	8.2128	0.0128
899	898	8.2128	0.0128
900	899	8.2128	0.0128
901	900	8.2128	0.0128
902	901	8.2128	0.0128
903	902	8.2101	0.0101
904	903	8.2128	0.0128
905	904	8.2119	0.0119
906	905	8.2101	0.0101
907	906	8.2128	0.0128
908	907	8.2128	0.0128
909	908	8.2128	0.0128
910	909	8.2128	0.0128
911	910	8.2128	0.0128
912	911	8.2101	0.0101
913	912	8.2147	0.0147
914	913	8.2128	0.0128
915	914	8.2101	0.0101
916	915	8.2119	0.0119
917	916	8.2101	0.0101
918	917	8.2101	0.0101
919	918	8.2101	0.0101
920	919	8.2101	0.0101
921	920	8.2101	0.0101
922	921	8.2119	0.0119
923	922	8.2119	0.0119
924	923	8.2101	0.0101
925	924	8.2101	0.0101
926	925	8.2128	0.0128
927	926	8.2147	0.0147
928	927	8.2101	0.0101
929	928	8.2101	0.0101
930	929	8.2147	0.0147
931	930	8.2119	0.0119
932	931	8.2119	0.0119
933	932	8.2101	0.0101
934	933	8.2119	0.0119
935	934	8.2101	0.0101
936	935	8.2119	0.0119
937	936	8.2147	0.0147
938	937	8.2101	0.0101
939	938	8.2147	0.0147
940	939	8.2119	0.0119
941	940	8.2147	0.0147
942	941	8.2147	0.0147
943	942	8.2119	0.0119
944	943	8.2119	0.0119
945	944	8.2119	0.0119
946	945	8.2119	0.0119
947	946	8.2119	0.0119
948	947	8.2119	0.0119
949	948	8.2119	0.0119

	Time [s]	Water Level [m]	WL Change [m]
950	949	8.2119	0.0119
951	950	8.2119	0.0119
952	951	8.2119	0.0119
953	952	8.2147	0.0147
954	953	8.2119	0.0119
955	954	8.2119	0.0119
956	955	8.2119	0.0119
957	956	8.2147	0.0147
958	957	8.2147	0.0147
959	958	8.2119	0.0119
960	959	8.2119	0.0119
961	960	8.2119	0.0119
962	961	8.2119	0.0119
963	962	8.2119	0.0119
964	963	8.2119	0.0119
965	964	8.2119	0.0119
966	965	8.2119	0.0119
967	966	8.2147	0.0147
968	967	8.2147	0.0147
969	968	8.2119	0.0119
970	969	8.2119	0.0119
971	970	8.2119	0.0119
972	971	8.2119	0.0119
973	972	8.2119	0.0119
974	973	8.2119	0.0119
975	974	8.2119	0.0119
976	975	8.2119	0.0119
977	976	8.2119	0.0119
978	977	8.2119	0.0119
979	978	8.2119	0.0119
980	979	8.2119	0.0119
981	980	8.2092	0.0092
982	981	8.2092	0.0092

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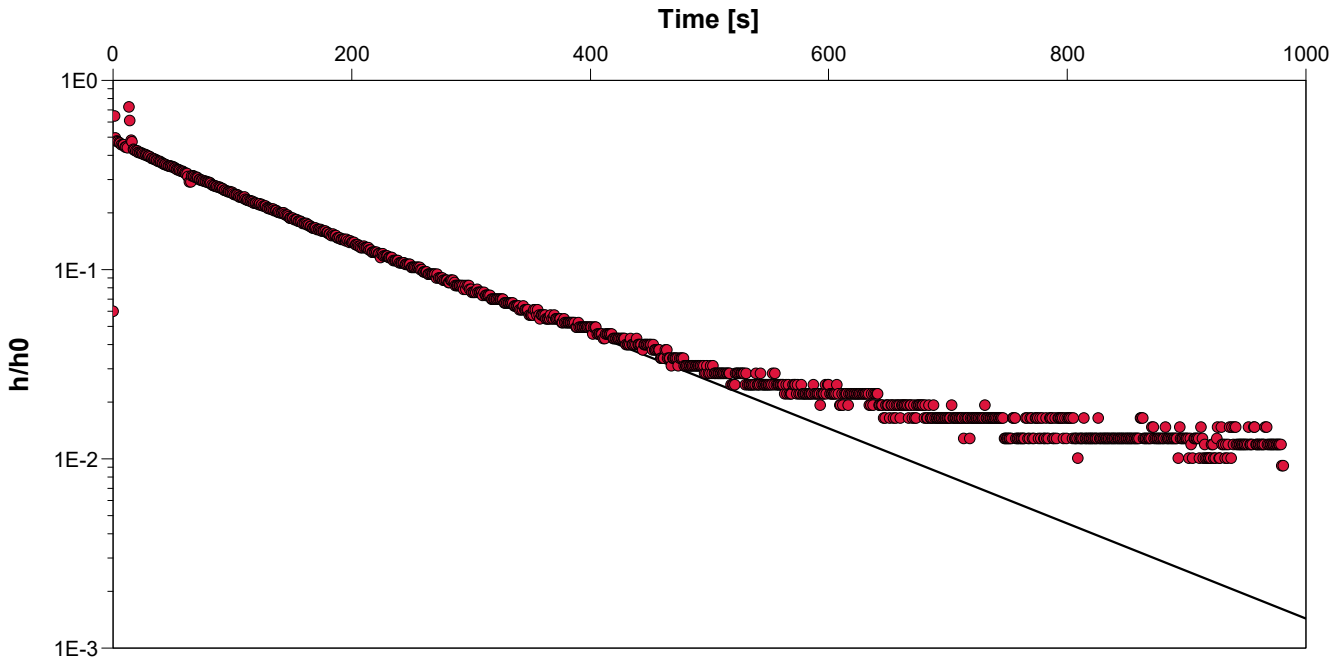
Slug Test Analysis Report

Project: Nemaska New Waste Disposal Site – Hydrogeological assessr

Number: 230448-00

Client: Stantec

Location: Nemaska	Slug Test: PZ-3_2020	Test Well: PZ-3
Test Conducted by: Stantec		Test Date: 2020-08-04
Analysis Performed by: LA	PZ-3_2020_Hvors	Analysis Date: 2023-08-18
Aquifer Thickness: 4.70 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
PZ-3	2.86×10^{-6}	

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Montreal (QC)
H2Y 1N3

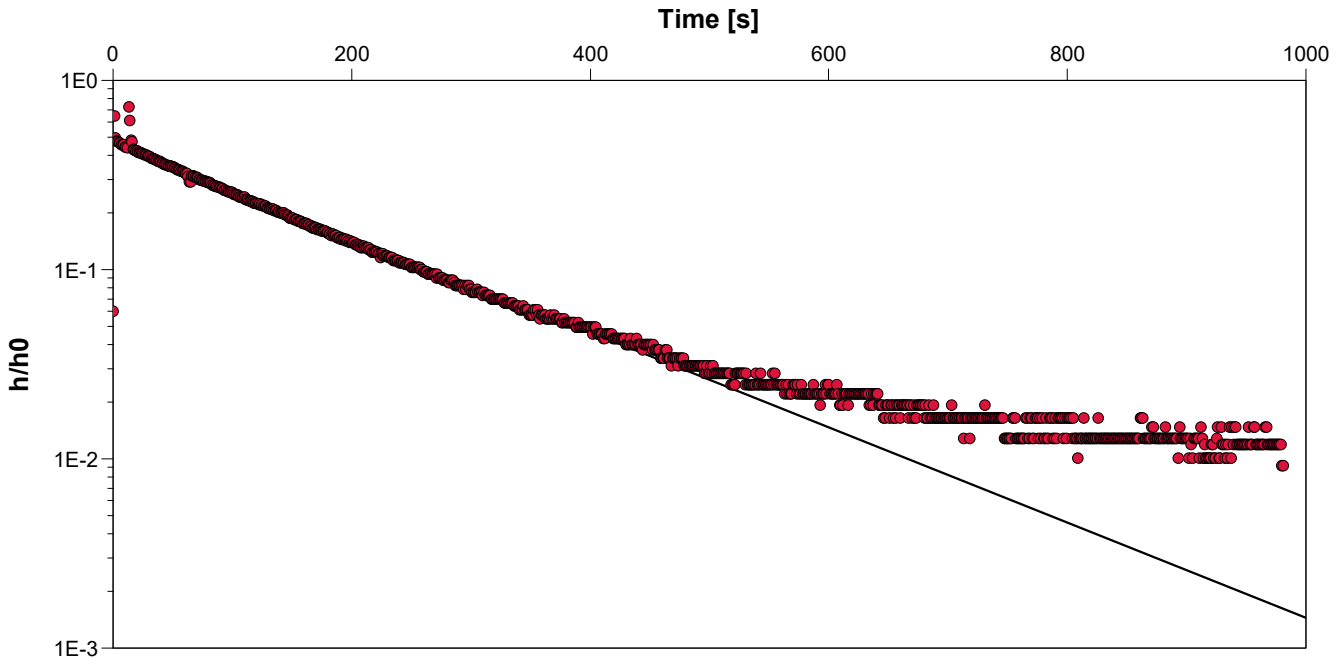
Slug Test Analysis Report

Project: Nemaska New Waste Disposal Site – Hydrogeological assessr

Number: 230448-00

Client: Stantec

Location: Nemaska	Slug Test: PZ-3_2020	Test Well: PZ-3
Test Conducted by: Stantec		Test Date: 2020-08-04
Analysis Performed by: LA	PZ-3_2020 B-R	Analysis Date: 2023-08-18
Aquifer Thickness: 4.70 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
PZ-3	2.22×10^{-6}	

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Bureau 818
Montreal (QC)
H2Y 1N3

Slug Test - Analyses Report

Project: Nemaska New Waste Disposal Site – Hydrogeological assessr

Number: 230448-00

Client: Stantec

Location: Nemaska	Slug Test: PZ-3_2020	Test Well: PZ-3
Test Conducted by: Stantec		Test Date: 2020-08-04
Aquifer Thickness: 4.70 m		

	Analysis Name	Analysis Performed b	Analysis Date	Method name	Well	T [m²/s]	K [m/s]	S
1	PZ-3_2020_Hvors	LA	2023-08-18	Hvorslev	PZ-3		2.86×10^{-6}	
2	PZ-3_2020 B-R	LA	2023-08-18	Bouwer & Rice	PZ-3		2.22×10^{-6}	

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Montreal (QC)
H2Y 1N3

Project: Nemaska New Waste Disposal Site – Hydrogeological assessr

Number: 230448-00

Client: Stantec

Location: Nemaska	Slug Test: PZ-6_2020	Test Well: PZ-6
Test Conducted by: Stantec	Test Date: 2020-08-04	
Water level at t=0 [m]: NAN	Static Water Level [m]: 1.57	Water level change at t=0 [m]: 0.00

	Time [s]	Water Level [m]	WL Change [m]
1	0	1.7378	0.1677
2	1	2.1026	0.5326
3	2	2.1053	0.5353
4	3	2.1108	0.5408
5	4	2.1053	0.5353
6	5	2.1053	0.5353
7	6	2.1053	0.5353
8	7	2.1026	0.5326
9	8	2.0989	0.5289
10	9	2.0989	0.5289
11	10	2.0989	0.5289
12	11	2.0989	0.5289
13	12	2.0962	0.5262
14	13	2.0989	0.5289
15	14	2.0962	0.5262
16	15	2.0962	0.5262
17	16	2.0962	0.5262
18	17	2.0934	0.5234
19	18	2.0934	0.5234
20	19	2.0934	0.5234
21	20	2.0934	0.5234
22	21	2.0934	0.5234
23	22	2.0907	0.5207
24	23	2.0934	0.5234
25	24	2.0907	0.5207
26	25	2.0907	0.5207
27	26	2.0907	0.5207
28	27	2.087	0.517
29	28	2.087	0.517
30	29	2.087	0.517
31	30	2.087	0.517
32	31	2.0843	0.5142
33	32	2.0843	0.5142
34	33	2.0843	0.5142
35	34	2.0843	0.5142
36	35	2.0843	0.5142
37	36	2.0843	0.5142
38	37	2.0843	0.5142
39	38	2.0843	0.5142
40	39	2.0843	0.5142
41	40	2.0843	0.5142
42	41	2.0843	0.5142
43	42	2.0843	0.5142
44	43	2.0843	0.5142
45	44	2.0815	0.5115
46	45	2.0815	0.5115
47	46	2.0815	0.5115
48	47	2.0815	0.5115

	Time [s]	Water Level [m]	WL Change [m]
49	48	2.0815	0.5115
50	49	2.0815	0.5115
51	50	2.0788	0.5087
52	51	2.0788	0.5087
53	52	2.0788	0.5087
54	53	2.0815	0.5115
55	54	2.0788	0.5087
56	55	2.0751	0.5051
57	56	2.0788	0.5087
58	57	2.0788	0.5087
59	58	2.0751	0.5051
60	59	2.0751	0.5051
61	60	2.0751	0.5051
62	61	2.0751	0.5051
63	62	2.0723	0.5023
64	63	2.0751	0.5051
65	64	2.0751	0.5051
66	65	2.0751	0.5051
67	66	2.0751	0.5051
68	67	2.0723	0.5023
69	68	2.0723	0.5023
70	69	2.0723	0.5023
71	70	2.0723	0.5023
72	71	2.0723	0.5023
73	72	2.0723	0.5023
74	73	2.0696	0.4996
75	74	2.0696	0.4996
76	75	2.0696	0.4996
77	76	2.0696	0.4996
78	77	2.0696	0.4996
79	78	2.0659	0.4959
80	79	2.0659	0.4959
81	80	2.0659	0.4959
82	81	2.0659	0.4959
83	82	2.0659	0.4959
84	83	2.0659	0.4959
85	84	2.0659	0.4959
86	85	2.0659	0.4959
87	86	2.0659	0.4959
88	87	2.0659	0.4959
89	88	2.0696	0.4996
90	89	2.0659	0.4959
91	90	2.0632	0.4932
92	91	2.0632	0.4932
93	92	2.0632	0.4932
94	93	2.0632	0.4932
95	94	2.0632	0.4932
96	95	2.0632	0.4932
97	96	2.0632	0.4932
98	97	2.0604	0.4904
99	98	2.0604	0.4904
100	99	2.0632	0.4932
101	100	2.0632	0.4932

	Time [s]	Water Level [m]	WL Change [m]
102	101	2.0659	0.4959
103	102	2.0632	0.4932
104	103	2.0604	0.4904
105	104	2.0604	0.4904
106	105	2.0604	0.4904
107	106	2.0577	0.4877
108	107	2.0577	0.4877
109	108	2.0604	0.4904
110	109	2.0604	0.4904
111	110	2.0604	0.4904
112	111	2.0604	0.4904
113	112	2.0577	0.4877
114	113	2.0577	0.4877
115	114	2.0577	0.4877
116	115	2.054	0.484
117	116	2.054	0.484
118	117	2.054	0.484
119	118	2.054	0.484
120	119	2.0513	0.4813
121	120	2.054	0.484
122	121	2.054	0.484
123	122	2.0513	0.4813
124	123	2.0513	0.4813
125	124	2.0513	0.4813
126	125	2.0513	0.4813
127	126	2.0513	0.4813
128	127	2.0513	0.4813
129	128	2.0513	0.4813
130	129	2.0513	0.4813
131	130	2.0513	0.4813
132	131	2.0485	0.4785
133	132	2.0513	0.4813
134	133	2.0485	0.4785
135	134	2.0513	0.4813
136	135	2.0485	0.4785
137	136	2.0485	0.4785
138	137	2.0485	0.4785
139	138	2.0485	0.4785
140	139	2.0485	0.4785
141	140	2.0458	0.4757
142	141	2.0485	0.4785
143	142	2.0485	0.4785
144	143	2.0458	0.4757
145	144	2.0458	0.4757
146	145	2.0458	0.4757
147	146	2.0458	0.4757
148	147	2.0458	0.4757
149	148	2.0458	0.4757
150	149	2.0458	0.4757
151	150	2.0421	0.4721
152	151	2.0421	0.4721
153	152	2.0421	0.4721
154	153	2.0421	0.4721

	Time [s]	Water Level [m]	WL Change [m]
155	154	2.0421	0.4721
156	155	2.0421	0.4721
157	156	2.0421	0.4721
158	157	2.0421	0.4721
159	158	2.0421	0.4721
160	159	2.0421	0.4721
161	160	2.0421	0.4721
162	161	2.0393	0.4693
163	162	2.0393	0.4693
164	163	2.0393	0.4693
165	164	2.0393	0.4693
166	165	2.0393	0.4693
167	166	2.0393	0.4693
168	167	2.0393	0.4693
169	168	2.0366	0.4666
170	169	2.0393	0.4693
171	170	2.0393	0.4693
172	171	2.0366	0.4666
173	172	2.0366	0.4666
174	173	2.0366	0.4666
175	174	2.0366	0.4666
176	175	2.0366	0.4666
177	176	2.0366	0.4666
178	177	2.0366	0.4666
179	178	2.0338	0.4638
180	179	2.0274	0.4574
181	180	2.0366	0.4666
182	181	2.0338	0.4638
183	182	2.0338	0.4638
184	183	2.0338	0.4638
185	184	2.032	0.462
186	185	2.0338	0.4638
187	186	2.0338	0.4638
188	187	2.0302	0.4602
189	188	2.0302	0.4602
190	189	2.0302	0.4602
191	190	2.0302	0.4602
192	191	2.0302	0.4602
193	192	2.0302	0.4602
194	193	2.0302	0.4602
195	194	2.0302	0.4602
196	195	2.0302	0.4602
197	196	2.0302	0.4602
198	197	2.0302	0.4602
199	198	2.0302	0.4602
200	199	2.0293	0.4593
201	200	2.0302	0.4602
202	201	2.0274	0.4574
203	202	2.0265	0.4565
204	203	2.0265	0.4565
205	204	2.0265	0.4565
206	205	2.0265	0.4565
207	206	2.0247	0.4547

	Time [s]	Water Level [m]	WL Change [m]
208	207	2.0265	0.4565
209	208	2.0274	0.4574
210	209	2.0247	0.4547
211	210	2.0247	0.4547
212	211	2.0228	0.4528
213	212	2.0228	0.4528
214	213	2.0228	0.4528
215	214	2.0201	0.4501
216	215	2.0228	0.4528
217	216	2.0201	0.4501
218	217	2.0201	0.4501
219	218	2.0201	0.4501
220	219	2.0228	0.4528
221	220	2.0228	0.4528
222	221	2.0201	0.4501
223	222	2.0201	0.4501
224	223	2.0201	0.4501
225	224	2.0201	0.4501
226	225	2.0173	0.4473
227	226	2.0201	0.4501
228	227	2.0201	0.4501
229	228	2.0173	0.4473
230	229	2.0173	0.4473
231	230	2.0173	0.4473
232	231	2.0173	0.4473
233	232	2.0173	0.4473
234	233	2.0173	0.4473
235	234	2.0173	0.4473
236	235	2.0173	0.4473
237	236	2.0173	0.4473
238	237	2.0146	0.4446
239	238	2.0146	0.4446
240	239	2.0146	0.4446
241	240	2.0146	0.4446
242	241	2.0146	0.4446
243	242	2.0146	0.4446
244	243	2.0146	0.4446
245	244	2.0146	0.4446
246	245	2.0146	0.4446
247	246	2.0109	0.4409
248	247	2.0109	0.4409
249	248	2.0109	0.4409
250	249	2.0109	0.4409
251	250	2.0109	0.4409
252	251	2.0109	0.4409
253	252	2.0109	0.4409
254	253	2.0109	0.4409
255	254	2.0109	0.4409
256	255	2.0109	0.4409
257	256	2.0082	0.4382
258	257	2.0109	0.4409
259	258	2.0082	0.4382
260	259	2.0082	0.4382

	Time [s]	Water Level [m]	WL Change [m]
261	260	2.0054	0.4354
262	261	2.0082	0.4382
263	262	2.0082	0.4382
264	263	2.0082	0.4382
265	264	2.0054	0.4354
266	265	2.0082	0.4382
267	266	2.0054	0.4354
268	267	2.0054	0.4354
269	268	2.0082	0.4382
270	269	2.0054	0.4354
271	270	2.0054	0.4354
272	271	2.0054	0.4354
273	272	2.0054	0.4354
274	273	2.0054	0.4354
275	274	2.0018	0.4317
276	275	2.0054	0.4354
277	276	2.0018	0.4317
278	277	2.0018	0.4317
279	278	2.0018	0.4317
280	279	2.0018	0.4317
281	280	2.0018	0.4317
282	281	2.0018	0.4317
283	282	2.0018	0.4317
284	283	2.0018	0.4317
285	284	2.0018	0.4317
286	285	2.0018	0.4317
287	286	2.0018	0.4317
288	287	2.0018	0.4317
289	288	1.999	0.429
290	289	2.0018	0.4317
291	290	1.999	0.429
292	291	1.999	0.429
293	292	1.999	0.429
294	293	1.999	0.429
295	294	1.999	0.429
296	295	1.999	0.429
297	296	1.999	0.429
298	297	1.999	0.429
299	298	1.999	0.429
300	299	1.999	0.429
301	300	1.999	0.429
302	301	1.9963	0.4263
303	302	1.9963	0.4263
304	303	1.9963	0.4263
305	304	1.9963	0.4263
306	305	1.9963	0.4263
307	306	1.9963	0.4263
308	307	1.9963	0.4263
309	308	1.9963	0.4263
310	309	1.9963	0.4263
311	310	1.9963	0.4263
312	311	1.9963	0.4263
313	312	1.9963	0.4263

	Time [s]	Water Level [m]	WL Change [m]
314	313	1.9963	0.4263
315	314	1.9963	0.4263
316	315	1.9935	0.4235
317	316	1.9963	0.4263
318	317	1.9935	0.4235
319	318	1.9935	0.4235
320	319	1.9935	0.4235
321	320	1.9898	0.4198
322	321	1.9898	0.4198
323	322	1.9935	0.4235
324	323	1.9898	0.4198
325	324	1.9935	0.4235
326	325	1.9898	0.4198
327	326	1.9898	0.4198
328	327	1.9898	0.4198
329	328	1.9898	0.4198
330	329	1.9898	0.4198
331	330	1.9898	0.4198
332	331	1.9898	0.4198
333	332	1.9898	0.4198
334	333	1.9871	0.4171
335	334	1.9871	0.4171
336	335	1.9871	0.4171
337	336	1.9871	0.4171
338	337	1.9871	0.4171
339	338	1.9871	0.4171
340	339	1.9843	0.4143
341	340	1.9871	0.4171
342	341	1.9871	0.4171
343	342	1.9871	0.4171
344	343	1.9843	0.4143
345	344	1.9843	0.4143
346	345	1.9843	0.4143
347	346	1.9871	0.4171
348	347	1.9843	0.4143
349	348	1.9843	0.4143
350	349	1.9843	0.4143
351	350	1.9843	0.4143
352	351	1.9843	0.4143
353	352	1.9843	0.4143
354	353	1.9843	0.4143
355	354	1.9843	0.4143
356	355	1.9816	0.4116
357	356	1.9816	0.4116
358	357	1.9843	0.4143
359	358	1.9843	0.4143
360	359	1.9816	0.4116
361	360	1.9816	0.4116
362	361	1.9816	0.4116
363	362	1.9816	0.4116
364	363	1.9843	0.4143
365	364	1.9816	0.4116
366	365	1.9816	0.4116

	Time [s]	Water Level [m]	WL Change [m]
367	366	1.9779	0.4079
368	367	1.9779	0.4079
369	368	1.9779	0.4079
370	369	1.9779	0.4079
371	370	1.9779	0.4079
372	371	1.9779	0.4079
373	372	1.9779	0.4079
374	373	1.9779	0.4079
375	374	1.9779	0.4079
376	375	1.9779	0.4079
377	376	1.9779	0.4079
378	377	1.9779	0.4079
379	378	1.9752	0.4052
380	379	1.9752	0.4052
381	380	1.9752	0.4052
382	381	1.9752	0.4052
383	382	1.9724	0.4024
384	383	1.9752	0.4052
385	384	1.9752	0.4052
386	385	1.9724	0.4024
387	386	1.9724	0.4024
388	387	1.9752	0.4052
389	388	1.9724	0.4024
390	389	1.9724	0.4024
391	390	1.9724	0.4024
392	391	1.9724	0.4024
393	392	1.9724	0.4024
394	393	1.9724	0.4024
395	394	1.9724	0.4024
396	395	1.9724	0.4024
397	396	1.9697	0.3997
398	397	1.9697	0.3997
399	398	1.9724	0.4024
400	399	1.9724	0.4024
401	400	1.9724	0.4024
402	401	1.9724	0.4024
403	402	1.9697	0.3997
404	403	1.9697	0.3997
405	404	1.9697	0.3997
406	405	1.9697	0.3997
407	406	1.9706	0.4006
408	407	1.9697	0.3997
409	408	1.9706	0.4006
410	409	1.9697	0.3997
411	410	1.9697	0.3997
412	411	1.9697	0.3997
413	412	1.966	0.396
414	413	1.9697	0.3997
415	414	1.9697	0.3997
416	415	1.966	0.396
417	416	1.9678	0.3978
418	417	1.9632	0.3932
419	418	1.966	0.396

	Time [s]	Water Level [m]	WL Change [m]
420	419	1.9678	0.3978
421	420	1.966	0.396
422	421	1.9632	0.3932
423	422	1.9678	0.3978
424	423	1.9651	0.3951
425	424	1.966	0.396
426	425	1.9651	0.3951
427	426	1.9651	0.3951
428	427	1.9632	0.3932
429	428	1.9632	0.3932
430	429	1.9632	0.3932
431	430	1.9632	0.3932
432	431	1.9651	0.3951
433	432	1.9614	0.3914
434	433	1.9614	0.3914
435	434	1.9614	0.3914
436	435	1.9605	0.3905
437	436	1.9614	0.3914
438	437	1.9614	0.3914
439	438	1.9614	0.3914
440	439	1.9651	0.3951
441	440	1.9605	0.3905
442	441	1.9578	0.3878
443	442	1.9587	0.3887
444	443	1.9587	0.3887
445	444	1.9614	0.3914
446	445	1.9614	0.3914
447	446	1.9614	0.3914
448	447	1.9587	0.3887
449	448	1.9614	0.3914
450	449	1.9587	0.3887
451	450	1.9587	0.3887
452	451	1.9587	0.3887
453	452	1.9587	0.3887
454	453	1.9578	0.3878
455	454	1.9587	0.3887
456	455	1.9587	0.3887
457	456	1.9587	0.3887
458	457	1.9587	0.3887
459	458	1.9587	0.3887
460	459	1.9587	0.3887
461	460	1.9587	0.3887
462	461	1.9578	0.3878
463	462	1.9559	0.3859
464	463	1.9559	0.3859
465	464	1.9559	0.3859
466	465	1.9559	0.3859
467	466	1.9559	0.3859
468	467	1.9559	0.3859
469	468	1.9541	0.3841
470	469	1.9559	0.3859
471	470	1.9559	0.3859
472	471	1.9532	0.3832

	Time [s]	Water Level [m]	WL Change [m]
473	472	1.9559	0.3859
474	473	1.9532	0.3832
475	474	1.9559	0.3859
476	475	1.9559	0.3859
477	476	1.9559	0.3859
478	477	1.9532	0.3832
479	478	1.9532	0.3832
480	479	1.9532	0.3832
481	480	1.9532	0.3832
482	481	1.9495	0.3795
483	482	1.9495	0.3795
484	483	1.9495	0.3795
485	484	1.9532	0.3832
486	485	1.9495	0.3795
487	486	1.9532	0.3832
488	487	1.9495	0.3795
489	488	1.9495	0.3795
490	489	1.9495	0.3795
491	490	1.9495	0.3795
492	491	1.9495	0.3795
493	492	1.9495	0.3795
494	493	1.9495	0.3795
495	494	1.9495	0.3795
496	495	1.9495	0.3795
497	496	1.9495	0.3795
498	497	1.9495	0.3795
499	498	1.9468	0.3767
500	499	1.9495	0.3795
501	500	1.9495	0.3795
502	501	1.9495	0.3795
503	502	1.9468	0.3767
504	503	1.9468	0.3767
505	504	1.9468	0.3767
506	505	1.9468	0.3767
507	506	1.9468	0.3767
508	507	1.944	0.374
509	508	1.944	0.374
510	509	1.944	0.374
511	510	1.944	0.374
512	511	1.944	0.374
513	512	1.944	0.374
514	513	1.944	0.374
515	514	1.944	0.374
516	515	1.944	0.374
517	516	1.944	0.374
518	517	1.944	0.374
519	518	1.944	0.374
520	519	1.944	0.374
521	520	1.9413	0.3712
522	521	1.9413	0.3712
523	522	1.9413	0.3712
524	523	1.9413	0.3712
525	524	1.9413	0.3712

	Time [s]	Water Level [m]	WL Change [m]
526	525	1.9413	0.3712
527	526	1.9376	0.3676
528	527	1.9413	0.3712
529	528	1.9413	0.3712
530	529	1.9413	0.3712
531	530	1.9413	0.3712
532	531	1.9376	0.3676
533	532	1.9413	0.3712
534	533	1.9376	0.3676
535	534	1.9413	0.3712
536	535	1.9413	0.3712
537	536	1.9376	0.3676
538	537	1.9376	0.3676
539	538	1.9376	0.3676
540	539	1.9376	0.3676
541	540	1.9376	0.3676
542	541	1.9348	0.3648
543	542	1.9376	0.3676
544	543	1.9348	0.3648
545	544	1.9348	0.3648
546	545	1.9348	0.3648
547	546	1.9348	0.3648
548	547	1.9348	0.3648
549	548	1.9348	0.3648
550	549	1.9348	0.3648
551	550	1.9348	0.3648
552	551	1.9348	0.3648
553	552	1.9348	0.3648
554	553	1.9348	0.3648
555	554	1.9321	0.3621
556	555	1.9321	0.3621
557	556	1.9321	0.3621
558	557	1.9321	0.3621
559	558	1.9321	0.3621
560	559	1.9321	0.3621
561	560	1.9321	0.3621
562	561	1.9321	0.3621
563	562	1.9321	0.3621
564	563	1.9321	0.3621
565	564	1.9321	0.3621
566	565	1.9321	0.3621
567	566	1.9321	0.3621
568	567	1.9284	0.3584
569	568	1.9321	0.3621
570	569	1.9321	0.3621
571	570	1.9321	0.3621
572	571	1.9284	0.3584
573	572	1.9284	0.3584
574	573	1.9284	0.3584
575	574	1.9284	0.3584
576	575	1.9284	0.3584
577	576	1.9284	0.3584
578	577	1.9284	0.3584

	Time [s]	Water Level [m]	WL Change [m]
579	578	1.9284	0.3584
580	579	1.9257	0.3557
581	580	1.9284	0.3584
582	581	1.9257	0.3557
583	582	1.9257	0.3557
584	583	1.9257	0.3557
585	584	1.9229	0.3529
586	585	1.9257	0.3557
587	586	1.9257	0.3557
588	587	1.9257	0.3557
589	588	1.9229	0.3529
590	589	1.9229	0.3529
591	590	1.9229	0.3529
592	591	1.9211	0.3511
593	592	1.9229	0.3529
594	593	1.9229	0.3529
595	594	1.9202	0.3502
596	595	1.9229	0.3529
597	596	1.9229	0.3529
598	597	1.9229	0.3529
599	598	1.9229	0.3529
600	599	1.9202	0.3502
601	600	1.9202	0.3502
602	601	1.9202	0.3502
603	602	1.9202	0.3502
604	603	1.9202	0.3502
605	604	1.9202	0.3502
606	605	1.9202	0.3502
607	606	1.9202	0.3502
608	607	1.9202	0.3502
609	608	1.9202	0.3502
610	609	1.9202	0.3502
611	610	1.9202	0.3502
612	611	1.9165	0.3465
613	612	1.9183	0.3483
614	613	1.9202	0.3502
615	614	1.9202	0.3502
616	615	1.9202	0.3502
617	616	1.9156	0.3456
618	617	1.9165	0.3465
619	618	1.9156	0.3456
620	619	1.9165	0.3465
621	620	1.9165	0.3465
622	621	1.9156	0.3456
623	622	1.9156	0.3456
624	623	1.9202	0.3502
625	624	1.9165	0.3465
626	625	1.9165	0.3465
627	626	1.9156	0.3456
628	627	1.9156	0.3456
629	628	1.9156	0.3456
630	629	1.9156	0.3456
631	630	1.9156	0.3456

	Time [s]	Water Level [m]	WL Change [m]
632	631	1.9128	0.3428
633	632	1.9165	0.3465
634	633	1.9156	0.3456
635	634	1.9156	0.3456
636	635	1.9156	0.3456
637	636	1.9156	0.3456
638	637	1.9128	0.3428
639	638	1.9128	0.3428
640	639	1.9128	0.3428
641	640	1.9128	0.3428
642	641	1.9128	0.3428
643	642	1.9128	0.3428
644	643	1.9128	0.3428
645	644	1.9128	0.3428
646	645	1.9138	0.3438
647	646	1.9128	0.3428
648	647	1.9092	0.3392
649	648	1.911	0.341
650	649	1.9092	0.3392
651	650	1.9128	0.3428
652	651	1.9138	0.3438
653	652	1.9128	0.3428
654	653	1.9128	0.3428
655	654	1.9092	0.3392
656	655	1.9092	0.3392
657	656	1.9092	0.3392
658	657	1.9092	0.3392
659	658	1.9092	0.3392
660	659	1.9092	0.3392
661	660	1.9092	0.3392
662	661	1.9092	0.3392
663	662	1.9092	0.3392
664	663	1.9092	0.3392
665	664	1.9092	0.3392
666	665	1.9064	0.3364
667	666	1.9064	0.3364
668	667	1.9064	0.3364
669	668	1.9064	0.3364
670	669	1.9092	0.3392
671	670	1.9092	0.3392
672	671	1.9092	0.3392
673	672	1.9064	0.3364
674	673	1.9064	0.3364
675	674	1.9064	0.3364
676	675	1.9064	0.3364
677	676	1.9064	0.3364
678	677	1.9064	0.3364
679	678	1.9064	0.3364
680	679	1.9037	0.3337
681	680	1.9037	0.3337
682	681	1.9037	0.3337
683	682	1.9037	0.3337
684	683	1.9037	0.3337

	Time [s]	Water Level [m]	WL Change [m]
685	684	1.9037	0.3337
686	685	1.9037	0.3337
687	686	1.9037	0.3337
688	687	1.9037	0.3337
689	688	1.9064	0.3364
690	689	1.9064	0.3364
691	690	1.9037	0.3337
692	691	1.9037	0.3337
693	692	1.9009	0.3309
694	693	1.9037	0.3337
695	694	1.9037	0.3337
696	695	1.9037	0.3337
697	696	1.9009	0.3309
698	697	1.9009	0.3309
699	698	1.9009	0.3309
700	699	1.9009	0.3309
701	700	1.9009	0.3309
702	701	1.9009	0.3309
703	702	1.9009	0.3309
704	703	1.9037	0.3337
705	704	1.9009	0.3309
706	705	1.9009	0.3309
707	706	1.8973	0.3273
708	707	1.9009	0.3309
709	708	1.8973	0.3273
710	709	1.9009	0.3309
711	710	1.8973	0.3273
712	711	1.9009	0.3309
713	712	1.8973	0.3273
714	713	1.8973	0.3273
715	714	1.8973	0.3273
716	715	1.8973	0.3273
717	716	1.8973	0.3273
718	717	1.8973	0.3273
719	718	1.8973	0.3273
720	719	1.8973	0.3273
721	720	1.8945	0.3245
722	721	1.8973	0.3273
723	722	1.8973	0.3273
724	723	1.8973	0.3273
725	724	1.8973	0.3273
726	725	1.8973	0.3273
727	726	1.8945	0.3245
728	727	1.8945	0.3245
729	728	1.8945	0.3245
730	729	1.8945	0.3245
731	730	1.8945	0.3245
732	731	1.8945	0.3245
733	732	1.8945	0.3245
734	733	1.8945	0.3245
735	734	1.8945	0.3245
736	735	1.8945	0.3245
737	736	1.8945	0.3245

	Time [s]	Water Level [m]	WL Change [m]
738	737	1.8945	0.3245
739	738	1.8945	0.3245
740	739	1.8945	0.3245
741	740	1.8918	0.3218
742	741	1.8918	0.3218
743	742	1.8918	0.3218
744	743	1.8918	0.3218
745	744	1.8918	0.3218
746	745	1.8918	0.3218
747	746	1.8918	0.3218
748	747	1.8881	0.3181
749	748	1.8918	0.3218
750	749	1.8881	0.3181
751	750	1.8881	0.3181
752	751	1.8918	0.3218
753	752	1.8881	0.3181
754	753	1.8918	0.3218
755	754	1.8918	0.3218
756	755	1.8918	0.3218
757	756	1.8918	0.3218
758	757	1.8881	0.3181
759	758	1.8881	0.3181
760	759	1.8881	0.3181
761	760	1.8881	0.3181
762	761	1.8881	0.3181
763	762	1.8881	0.3181
764	763	1.8853	0.3153
765	764	1.8881	0.3181
766	765	1.8881	0.3181
767	766	1.8881	0.3181
768	767	1.8881	0.3181
769	768	1.8881	0.3181
770	769	1.8881	0.3181
771	770	1.8853	0.3153
772	771	1.8853	0.3153
773	772	1.8853	0.3153
774	773	1.8853	0.3153
775	774	1.8853	0.3153
776	775	1.8853	0.3153
777	776	1.8853	0.3153
778	777	1.8853	0.3153
779	778	1.8853	0.3153
780	779	1.8853	0.3153
781	780	1.8853	0.3153
782	781	1.8853	0.3153
783	782	1.8853	0.3153
784	783	1.8826	0.3126
785	784	1.8853	0.3153
786	785	1.8826	0.3126
787	786	1.8826	0.3126
788	787	1.8826	0.3126
789	788	1.8826	0.3126
790	789	1.8853	0.3153

	Time [s]	Water Level [m]	WL Change [m]
791	790	1.8826	0.3126
792	791	1.8826	0.3126
793	792	1.8826	0.3126
794	793	1.8826	0.3126
795	794	1.8826	0.3126
796	795	1.8826	0.3126
797	796	1.8826	0.3126
798	797	1.8826	0.3126
799	798	1.8826	0.3126
800	799	1.8826	0.3126
801	800	1.8826	0.3126
802	801	1.8826	0.3126
803	802	1.8826	0.3126
804	803	1.8826	0.3126
805	804	1.8798	0.3098
806	805	1.8826	0.3126
807	806	1.8798	0.3098
808	807	1.8798	0.3098
809	808	1.8798	0.3098
810	809	1.8798	0.3098
811	810	1.8798	0.3098
812	811	1.8762	0.3062
813	812	1.8762	0.3062
814	813	1.8762	0.3062
815	814	1.8762	0.3062
816	815	1.8762	0.3062
817	816	1.8762	0.3062
818	817	1.8762	0.3062
819	818	1.8762	0.3062
820	819	1.8762	0.3062
821	820	1.8762	0.3062
822	821	1.8762	0.3062
823	822	1.8762	0.3062
824	823	1.8762	0.3062
825	824	1.8762	0.3062
826	825	1.8734	0.3034
827	826	1.8734	0.3034
828	827	1.8734	0.3034
829	828	1.8762	0.3062
830	829	1.8734	0.3034
831	830	1.8762	0.3062
832	831	1.8762	0.3062
833	832	1.8734	0.3034
834	833	1.8734	0.3034
835	834	1.8762	0.3062
836	835	1.8762	0.3062
837	836	1.8762	0.3062
838	837	1.8734	0.3034
839	838	1.8734	0.3034
840	839	1.8734	0.3034
841	840	1.8734	0.3034
842	841	1.8734	0.3034
843	842	1.8734	0.3034

	Time [s]	Water Level [m]	WL Change [m]
844	843	1.8734	0.3034
845	844	1.8707	0.3007
846	845	1.8707	0.3007
847	846	1.8707	0.3007
848	847	1.8679	0.2979
849	848	1.8679	0.2979
850	849	1.8707	0.3007
851	850	1.8679	0.2979
852	851	1.8707	0.3007
853	852	1.8707	0.3007
854	853	1.8707	0.3007
855	854	1.8679	0.2979
856	855	1.8707	0.3007
857	856	1.8679	0.2979
858	857	1.8679	0.2979
859	858	1.8707	0.3007
860	859	1.8679	0.2979
861	860	1.8679	0.2979
862	861	1.8707	0.3007
863	862	1.8707	0.3007
864	863	1.8679	0.2979
865	864	1.8679	0.2979
866	865	1.8707	0.3007
867	866	1.8679	0.2979
868	867	1.8679	0.2979
869	868	1.8679	0.2979
870	869	1.8679	0.2979
871	870	1.8679	0.2979
872	871	1.8679	0.2979
873	872	1.8679	0.2979
874	873	1.8679	0.2979
875	874	1.8679	0.2979
876	875	1.8679	0.2979
877	876	1.8643	0.2942
878	877	1.8643	0.2942
879	878	1.8679	0.2979
880	879	1.8643	0.2942
881	880	1.8679	0.2979
882	881	1.8643	0.2942
883	882	1.8643	0.2942
884	883	1.8643	0.2942
885	884	1.8643	0.2942
886	885	1.8643	0.2942
887	886	1.8643	0.2942
888	887	1.8615	0.2915
889	888	1.8643	0.2942
890	889	1.8615	0.2915
891	890	1.8643	0.2942
892	891	1.8643	0.2942
893	892	1.8643	0.2942
894	893	1.8615	0.2915
895	894	1.8643	0.2942
896	895	1.8643	0.2942

	Time [s]	Water Level [m]	WL Change [m]
897	896	1.8643	0.2942
898	897	1.8615	0.2915
899	898	1.8615	0.2915
900	899	1.8615	0.2915
901	900	1.8615	0.2915
902	901	1.8615	0.2915
903	902	1.8633	0.2933
904	903	1.8615	0.2915
905	904	1.8615	0.2915
906	905	1.8615	0.2915
907	906	1.8615	0.2915
908	907	1.8615	0.2915
909	908	1.8588	0.2887
910	909	1.8615	0.2915
911	910	1.8588	0.2887
912	911	1.8588	0.2887
913	912	1.8597	0.2897
914	913	1.8615	0.2915
915	914	1.8615	0.2915
916	915	1.8588	0.2887
917	916	1.8588	0.2887
918	917	1.8588	0.2887
919	918	1.8588	0.2887
920	919	1.8615	0.2915
921	920	1.8588	0.2887
922	921	1.8588	0.2887
923	922	1.8588	0.2887
924	923	1.8588	0.2887
925	924	1.8588	0.2887
926	925	1.8588	0.2887
927	926	1.8588	0.2887
928	927	1.8588	0.2887
929	928	1.8588	0.2887
930	929	1.8588	0.2887
931	930	1.856	0.286
932	931	1.8588	0.2887
933	932	1.8588	0.2887
934	933	1.856	0.286
935	934	1.8569	0.2869
936	935	1.856	0.286
937	936	1.856	0.286
938	937	1.856	0.286
939	938	1.856	0.286
940	939	1.856	0.286
941	940	1.856	0.286
942	941	1.856	0.286
943	942	1.856	0.286
944	943	1.856	0.286
945	944	1.8523	0.2823
946	945	1.8523	0.2823
947	946	1.8542	0.2842
948	947	1.8542	0.2842
949	948	1.8569	0.2869

	Time [s]	Water Level [m]	WL Change [m]
950	949	1.8569	0.2869
951	950	1.8523	0.2823
952	951	1.8523	0.2823
953	952	1.8523	0.2823
954	953	1.8523	0.2823
955	954	1.8523	0.2823
956	955	1.8496	0.2796
957	956	1.8542	0.2842
958	957	1.8523	0.2823
959	958	1.8523	0.2823
960	959	1.8514	0.2814
961	960	1.8496	0.2796
962	961	1.8523	0.2823
963	962	1.8496	0.2796
964	963	1.8496	0.2796
965	964	1.8496	0.2796
966	965	1.8496	0.2796
967	966	1.8542	0.2842
968	967	1.8523	0.2823
969	968	1.8514	0.2814
970	969	1.8496	0.2796
971	970	1.8496	0.2796
972	971	1.8514	0.2814
973	972	1.8514	0.2814
974	973	1.8496	0.2796
975	974	1.8468	0.2768
976	975	1.8496	0.2796
977	976	1.8468	0.2768
978	977	1.8478	0.2777
979	978	1.8478	0.2777
980	979	1.8468	0.2768
981	980	1.8478	0.2777
982	981	1.8468	0.2768
983	982	1.8468	0.2768
984	983	1.8478	0.2777
985	984	1.8468	0.2768
986	985	1.8478	0.2777
987	986	1.8468	0.2768
988	987	1.8478	0.2777
989	988	1.8468	0.2768
990	989	1.845	0.275
991	990	1.845	0.275
992	991	1.845	0.275
993	992	1.845	0.275
994	993	1.8468	0.2768
995	994	1.8468	0.2768
996	995	1.8478	0.2777
997	996	1.845	0.275
998	997	1.8468	0.2768
999	998	1.8441	0.2741
1000	999	1.8441	0.2741
1001	1000	1.845	0.275
1002	1001	1.8478	0.2777

	Time [s]	Water Level [m]	WL Change [m]
1003	1002	1.8478	0.2777
1004	1003	1.845	0.275
1005	1004	1.845	0.275
1006	1005	1.845	0.275
1007	1006	1.8423	0.2722
1008	1007	1.845	0.275
1009	1008	1.845	0.275
1010	1009	1.845	0.275
1011	1010	1.845	0.275
1012	1011	1.845	0.275
1013	1012	1.845	0.275
1014	1013	1.845	0.275
1015	1014	1.8404	0.2704
1016	1015	1.8404	0.2704
1017	1016	1.8423	0.2722
1018	1017	1.845	0.275
1019	1018	1.8423	0.2722
1020	1019	1.8423	0.2722
1021	1020	1.8423	0.2722
1022	1021	1.8423	0.2722
1023	1022	1.8423	0.2722
1024	1023	1.8423	0.2722
1025	1024	1.8404	0.2704
1026	1025	1.8423	0.2722
1027	1026	1.845	0.275
1028	1027	1.845	0.275
1029	1028	1.8423	0.2722
1030	1029	1.8423	0.2722
1031	1030	1.8423	0.2722
1032	1031	1.8423	0.2722
1033	1032	1.8423	0.2722
1034	1033	1.8423	0.2722
1035	1034	1.8395	0.2695
1036	1035	1.8395	0.2695
1037	1036	1.8395	0.2695
1038	1037	1.8395	0.2695
1039	1038	1.8395	0.2695
1040	1039	1.8395	0.2695
1041	1040	1.8395	0.2695
1042	1041	1.8395	0.2695
1043	1042	1.8395	0.2695
1044	1043	1.8395	0.2695
1045	1044	1.8395	0.2695
1046	1045	1.8395	0.2695
1047	1046	1.8423	0.2722
1048	1047	1.8423	0.2722
1049	1048	1.8395	0.2695
1050	1049	1.8395	0.2695
1051	1050	1.8395	0.2695
1052	1051	1.8358	0.2658
1053	1052	1.8358	0.2658
1054	1053	1.8395	0.2695
1055	1054	1.8395	0.2695

	Time [s]	Water Level [m]	WL Change [m]
1056	1055	1.8358	0.2658
1057	1056	1.8358	0.2658
1058	1057	1.8395	0.2695
1059	1058	1.8395	0.2695
1060	1059	1.8358	0.2658
1061	1060	1.8395	0.2695
1062	1061	1.8358	0.2658
1063	1062	1.8395	0.2695
1064	1063	1.8395	0.2695
1065	1064	1.8358	0.2658
1066	1065	1.8358	0.2658
1067	1066	1.8358	0.2658
1068	1067	1.8395	0.2695
1069	1068	1.8358	0.2658
1070	1069	1.8358	0.2658
1071	1070	1.8358	0.2658
1072	1071	1.8358	0.2658
1073	1072	1.8358	0.2658
1074	1073	1.8358	0.2658
1075	1074	1.8331	0.2631
1076	1075	1.8331	0.2631
1077	1076	1.8303	0.2603
1078	1077	1.8303	0.2603
1079	1078	1.8331	0.2631
1080	1079	1.8331	0.2631
1081	1080	1.8331	0.2631
1082	1081	1.8331	0.2631
1083	1082	1.8331	0.2631
1084	1083	1.8331	0.2631
1085	1084	1.8331	0.2631
1086	1085	1.8331	0.2631
1087	1086	1.8303	0.2603
1088	1087	1.8331	0.2631
1089	1088	1.8303	0.2603
1090	1089	1.8303	0.2603
1091	1090	1.8303	0.2603
1092	1091	1.8331	0.2631
1093	1092	1.8303	0.2603
1094	1093	1.8331	0.2631
1095	1094	1.8331	0.2631
1096	1095	1.8303	0.2603
1097	1096	1.8331	0.2631
1098	1097	1.8303	0.2603
1099	1098	1.8303	0.2603
1100	1099	1.8303	0.2603
1101	1100	1.8303	0.2603
1102	1101	1.8303	0.2603
1103	1102	1.8303	0.2603
1104	1103	1.8303	0.2603
1105	1104	1.8303	0.2603
1106	1105	1.8303	0.2603
1107	1106	1.8303	0.2603
1108	1107	1.8303	0.2603

	Time [s]	Water Level [m]	WL Change [m]
1109	1108	1.8303	0.2603
1110	1109	1.8276	0.2576
1111	1110	1.8303	0.2603
1112	1111	1.8303	0.2603
1113	1112	1.8276	0.2576
1114	1113	1.8276	0.2576
1115	1114	1.8276	0.2576
1116	1115	1.8276	0.2576
1117	1116	1.8276	0.2576
1118	1117	1.8239	0.2539
1119	1118	1.8276	0.2576
1120	1119	1.8276	0.2576
1121	1120	1.8303	0.2603
1122	1121	1.8276	0.2576
1123	1122	1.8276	0.2576
1124	1123	1.8276	0.2576
1125	1124	1.8276	0.2576
1126	1125	1.8276	0.2576
1127	1126	1.8276	0.2576
1128	1127	1.8239	0.2539
1129	1128	1.8239	0.2539
1130	1129	1.8239	0.2539
1131	1130	1.8239	0.2539
1132	1131	1.8239	0.2539
1133	1132	1.8239	0.2539
1134	1133	1.8239	0.2539
1135	1134	1.8239	0.2539
1136	1135	1.8239	0.2539
1137	1136	1.8239	0.2539
1138	1137	1.8239	0.2539
1139	1138	1.8239	0.2539
1140	1139	1.8239	0.2539
1141	1140	1.8239	0.2539
1142	1141	1.8239	0.2539
1143	1142	1.8239	0.2539
1144	1143	1.8239	0.2539
1145	1144	1.8239	0.2539
1146	1145	1.8239	0.2539
1147	1146	1.8239	0.2539
1148	1147	1.8239	0.2539
1149	1148	1.8212	0.2512
1150	1149	1.8212	0.2512
1151	1150	1.8239	0.2539
1152	1151	1.8212	0.2512
1153	1152	1.8212	0.2512
1154	1153	1.8212	0.2512
1155	1154	1.8239	0.2539
1156	1155	1.8239	0.2539
1157	1156	1.8212	0.2512
1158	1157	1.8212	0.2512
1159	1158	1.8212	0.2512
1160	1159	1.8212	0.2512
1161	1160	1.8212	0.2512

	Time [s]	Water Level [m]	WL Change [m]
1162	1161	1.8212	0.2512
1163	1162	1.8212	0.2512
1164	1163	1.8212	0.2512
1165	1164	1.8212	0.2512
1166	1165	1.8212	0.2512
1167	1166	1.8212	0.2512
1168	1167	1.8212	0.2512
1169	1168	1.8212	0.2512
1170	1169	1.8212	0.2512
1171	1170	1.8212	0.2512
1172	1171	1.8212	0.2512
1173	1172	1.8212	0.2512
1174	1173	1.8184	0.2484
1175	1174	1.8184	0.2484
1176	1175	1.8184	0.2484
1177	1176	1.8184	0.2484
1178	1177	1.8184	0.2484
1179	1178	1.8184	0.2484
1180	1179	1.8184	0.2484
1181	1180	1.8184	0.2484
1182	1181	1.8184	0.2484
1183	1182	1.8184	0.2484
1184	1183	1.8184	0.2484
1185	1184	1.8184	0.2484
1186	1185	1.8184	0.2484
1187	1186	1.8184	0.2484
1188	1187	1.8184	0.2484
1189	1188	1.8184	0.2484
1190	1189	1.8184	0.2484
1191	1190	1.8184	0.2484
1192	1191	1.8184	0.2484
1193	1192	1.8184	0.2484
1194	1193	1.8184	0.2484
1195	1194	1.8184	0.2484
1196	1195	1.8157	0.2457
1197	1196	1.8157	0.2457
1198	1197	1.8157	0.2457
1199	1198	1.8157	0.2457
1200	1199	1.8157	0.2457
1201	1200	1.8157	0.2457
1202	1201	1.8157	0.2457
1203	1202	1.8157	0.2457
1204	1203	1.8157	0.2457
1205	1204	1.8157	0.2457
1206	1205	1.8157	0.2457
1207	1206	1.8157	0.2457
1208	1207	1.8157	0.2457
1209	1208	1.8157	0.2457
1210	1209	1.8157	0.2457
1211	1210	1.8157	0.2457
1212	1211	1.8157	0.2457
1213	1212	1.8157	0.2457
1214	1213	1.8157	0.2457

	Time [s]	Water Level [m]	WL Change [m]
1215	1214	1.8157	0.2457
1216	1215	1.8157	0.2457
1217	1216	1.8157	0.2457
1218	1217	1.8184	0.2484
1219	1218	1.8157	0.2457
1220	1219	1.8157	0.2457
1221	1220	1.8157	0.2457
1222	1221	1.812	0.242
1223	1222	1.8157	0.2457
1224	1223	1.812	0.242
1225	1224	1.812	0.242
1226	1225	1.8093	0.2392
1227	1226	1.812	0.242
1228	1227	1.812	0.242
1229	1228	1.8093	0.2392
1230	1229	1.8093	0.2392
1231	1230	1.812	0.242
1232	1231	1.812	0.242
1233	1232	1.812	0.242
1234	1233	1.812	0.242
1235	1234	1.8093	0.2392
1236	1235	1.8093	0.2392
1237	1236	1.812	0.242
1238	1237	1.812	0.242
1239	1238	1.812	0.242
1240	1239	1.8093	0.2392
1241	1240	1.8093	0.2392
1242	1241	1.812	0.242
1243	1242	1.8093	0.2392
1244	1243	1.8093	0.2392
1245	1244	1.812	0.242
1246	1245	1.8093	0.2392
1247	1246	1.8093	0.2392
1248	1247	1.8093	0.2392
1249	1248	1.8065	0.2365
1250	1249	1.8093	0.2392
1251	1250	1.8065	0.2365
1252	1251	1.8093	0.2392
1253	1252	1.8065	0.2365
1254	1253	1.8093	0.2392
1255	1254	1.8093	0.2392
1256	1255	1.8065	0.2365
1257	1256	1.8065	0.2365
1258	1257	1.8065	0.2365
1259	1258	1.8093	0.2392
1260	1259	1.8065	0.2365
1261	1260	1.8065	0.2365
1262	1261	1.8065	0.2365
1263	1262	1.8065	0.2365
1264	1263	1.8065	0.2365
1265	1264	1.8065	0.2365
1266	1265	1.8037	0.2337
1267	1266	1.8037	0.2337

	Time [s]	Water Level [m]	WL Change [m]
1268	1267	1.8037	0.2337
1269	1268	1.8065	0.2365
1270	1269	1.8065	0.2365
1271	1270	1.8037	0.2337
1272	1271	1.8065	0.2365
1273	1272	1.8037	0.2337
1274	1273	1.8065	0.2365
1275	1274	1.8065	0.2365
1276	1275	1.8065	0.2365
1277	1276	1.8093	0.2392
1278	1277	1.8065	0.2365
1279	1278	1.8065	0.2365
1280	1279	1.8065	0.2365
1281	1280	1.8037	0.2337
1282	1281	1.8065	0.2365
1283	1282	1.8065	0.2365
1284	1283	1.8065	0.2365
1285	1284	1.8065	0.2365
1286	1285	1.8065	0.2365
1287	1286	1.8037	0.2337
1288	1287	1.8037	0.2337
1289	1288	1.8037	0.2337
1290	1289	1.8037	0.2337
1291	1290	1.8037	0.2337
1292	1291	1.8037	0.2337
1293	1292	1.8001	0.2301
1294	1293	1.8001	0.2301
1295	1294	1.8037	0.2337
1296	1295	1.8065	0.2365
1297	1296	1.8037	0.2337
1298	1297	1.8037	0.2337
1299	1298	1.8037	0.2337
1300	1299	1.8037	0.2337
1301	1300	1.8037	0.2337
1302	1301	1.8037	0.2337
1303	1302	1.8037	0.2337
1304	1303	1.8037	0.2337
1305	1304	1.8037	0.2337
1306	1305	1.8037	0.2337
1307	1306	1.8037	0.2337
1308	1307	1.8037	0.2337
1309	1308	1.8001	0.2301
1310	1309	1.8001	0.2301
1311	1310	1.8037	0.2337
1312	1311	1.8037	0.2337
1313	1312	1.8037	0.2337
1314	1313	1.8001	0.2301
1315	1314	1.8037	0.2337
1316	1315	1.8037	0.2337
1317	1316	1.8001	0.2301
1318	1317	1.8001	0.2301
1319	1318	1.8001	0.2301
1320	1319	1.8001	0.2301

	Time [s]	Water Level [m]	WL Change [m]
1321	1320	1.8001	0.2301
1322	1321	1.8001	0.2301
1323	1322	1.8001	0.2301
1324	1323	1.8001	0.2301
1325	1324	1.8001	0.2301
1326	1325	1.8001	0.2301
1327	1326	1.7973	0.2273
1328	1327	1.7973	0.2273
1329	1328	1.8001	0.2301
1330	1329	1.8001	0.2301
1331	1330	1.7973	0.2273
1332	1331	1.7973	0.2273
1333	1332	1.7973	0.2273
1334	1333	1.7973	0.2273
1335	1334	1.7973	0.2273
1336	1335	1.7973	0.2273
1337	1336	1.7973	0.2273
1338	1337	1.7973	0.2273
1339	1338	1.7973	0.2273
1340	1339	1.7946	0.2246
1341	1340	1.7973	0.2273
1342	1341	1.7973	0.2273
1343	1342	1.7946	0.2246
1344	1343	1.7973	0.2273
1345	1344	1.7973	0.2273
1346	1345	1.7973	0.2273
1347	1346	1.7973	0.2273
1348	1347	1.7946	0.2246
1349	1348	1.7946	0.2246
1350	1349	1.7973	0.2273
1351	1350	1.7973	0.2273
1352	1351	1.7946	0.2246
1353	1352	1.7973	0.2273
1354	1353	1.7946	0.2246
1355	1354	1.7946	0.2246
1356	1355	1.7973	0.2273
1357	1356	1.7946	0.2246
1358	1357	1.7946	0.2246
1359	1358	1.7946	0.2246
1360	1359	1.7946	0.2246
1361	1360	1.7946	0.2246
1362	1361	1.7946	0.2246
1363	1362	1.7909	0.2209
1364	1363	1.7909	0.2209
1365	1364	1.7946	0.2246
1366	1365	1.7909	0.2209
1367	1366	1.7909	0.2209
1368	1367	1.7909	0.2209
1369	1368	1.7909	0.2209
1370	1369	1.7909	0.2209
1371	1370	1.7909	0.2209
1372	1371	1.7946	0.2246
1373	1372	1.7946	0.2246

	Time [s]	Water Level [m]	WL Change [m]
1374	1373	1.7946	0.2246
1375	1374	1.7946	0.2246
1376	1375	1.7909	0.2209
1377	1376	1.7946	0.2246
1378	1377	1.7946	0.2246
1379	1378	1.7909	0.2209
1380	1379	1.7946	0.2246
1381	1380	1.7946	0.2246
1382	1381	1.7909	0.2209
1383	1382	1.7909	0.2209
1384	1383	1.7909	0.2209
1385	1384	1.7909	0.2209
1386	1385	1.7909	0.2209
1387	1386	1.7909	0.2209
1388	1387	1.7909	0.2209
1389	1388	1.7909	0.2209
1390	1389	1.7909	0.2209
1391	1390	1.7946	0.2246
1392	1391	1.7909	0.2209
1393	1392	1.7909	0.2209
1394	1393	1.7909	0.2209
1395	1394	1.7909	0.2209
1396	1395	1.7909	0.2209
1397	1396	1.7909	0.2209
1398	1397	1.7909	0.2209
1399	1398	1.7909	0.2209
1400	1399	1.7882	0.2182
1401	1400	1.7882	0.2182
1402	1401	1.7909	0.2209
1403	1402	1.7909	0.2209
1404	1403	1.7882	0.2182
1405	1404	1.7882	0.2182
1406	1405	1.7882	0.2182
1407	1406	1.7882	0.2182
1408	1407	1.7882	0.2182
1409	1408	1.7882	0.2182
1410	1409	1.7882	0.2182
1411	1410	1.7882	0.2182
1412	1411	1.7882	0.2182
1413	1412	1.7882	0.2182
1414	1413	1.7882	0.2182
1415	1414	1.7882	0.2182
1416	1415	1.7882	0.2182
1417	1416	1.7882	0.2182
1418	1417	1.7882	0.2182
1419	1418	1.7882	0.2182
1420	1419	1.7854	0.2154
1421	1420	1.7882	0.2182
1422	1421	1.7854	0.2154
1423	1422	1.7854	0.2154
1424	1423	1.7854	0.2154
1425	1424	1.7882	0.2182
1426	1425	1.7854	0.2154

	Time [s]	Water Level [m]	WL Change [m]
1427	1426	1.7882	0.2182
1428	1427	1.7854	0.2154
1429	1428	1.7854	0.2154
1430	1429	1.7854	0.2154
1431	1430	1.7827	0.2127
1432	1431	1.7854	0.2154
1433	1432	1.7854	0.2154
1434	1433	1.7854	0.2154
1435	1434	1.7854	0.2154
1436	1435	1.7854	0.2154
1437	1436	1.7827	0.2127
1438	1437	1.7854	0.2154
1439	1438	1.7854	0.2154
1440	1439	1.7854	0.2154
1441	1440	1.7827	0.2127
1442	1441	1.7854	0.2154
1443	1442	1.7827	0.2127
1444	1443	1.7827	0.2127
1445	1444	1.7854	0.2154
1446	1445	1.7854	0.2154
1447	1446	1.7827	0.2127
1448	1447	1.7854	0.2154
1449	1448	1.7827	0.2127
1450	1449	1.7827	0.2127
1451	1450	1.7827	0.2127
1452	1451	1.7827	0.2127
1453	1452	1.7827	0.2127
1454	1453	1.7827	0.2127
1455	1454	1.7827	0.2127
1456	1455	1.7827	0.2127
1457	1456	1.7827	0.2127
1458	1457	1.7827	0.2127
1459	1458	1.7827	0.2127
1460	1459	1.7827	0.2127
1461	1460	1.7827	0.2127
1462	1461	1.7827	0.2127
1463	1462	1.7827	0.2127
1464	1463	1.7827	0.2127
1465	1464	1.7827	0.2127
1466	1465	1.7827	0.2127
1467	1466	1.779	0.209
1468	1467	1.779	0.209
1469	1468	1.779	0.209
1470	1469	1.7827	0.2127
1471	1470	1.779	0.209
1472	1471	1.779	0.209
1473	1472	1.779	0.209
1474	1473	1.779	0.209
1475	1474	1.779	0.209
1476	1475	1.779	0.209
1477	1476	1.779	0.209
1478	1477	1.779	0.209
1479	1478	1.779	0.209

	Time [s]	Water Level [m]	WL Change [m]
1480	1479	1.779	0.209
1481	1480	1.779	0.209
1482	1481	1.7763	0.2063
1483	1482	1.779	0.209
1484	1483	1.779	0.209
1485	1484	1.779	0.209
1486	1485	1.779	0.209
1487	1486	1.779	0.209
1488	1487	1.7763	0.2063
1489	1488	1.779	0.209
1490	1489	1.7763	0.2063
1491	1490	1.779	0.209
1492	1491	1.779	0.209
1493	1492	1.7763	0.2063
1494	1493	1.779	0.209
1495	1494	1.779	0.209
1496	1495	1.779	0.209
1497	1496	1.779	0.209
1498	1497	1.779	0.209
1499	1498	1.779	0.209
1500	1499	1.779	0.209
1501	1500	1.7763	0.2063
1502	1501	1.7763	0.2063
1503	1502	1.779	0.209
1504	1503	1.7763	0.2063
1505	1504	1.7763	0.2063
1506	1505	1.7735	0.2035
1507	1506	1.7763	0.2063
1508	1507	1.7763	0.2063
1509	1508	1.7735	0.2035
1510	1509	1.7763	0.2063
1511	1510	1.7763	0.2063
1512	1511	1.7763	0.2063
1513	1512	1.7763	0.2063
1514	1513	1.7763	0.2063
1515	1514	1.7763	0.2063
1516	1515	1.7735	0.2035
1517	1516	1.7763	0.2063
1518	1517	1.7763	0.2063
1519	1518	1.7763	0.2063
1520	1519	1.7735	0.2035
1521	1520	1.7763	0.2063
1522	1521	1.7735	0.2035
1523	1522	1.7735	0.2035
1524	1523	1.7763	0.2063
1525	1524	1.7763	0.2063
1526	1525	1.7763	0.2063
1527	1526	1.7735	0.2035
1528	1527	1.7763	0.2063
1529	1528	1.7735	0.2035
1530	1529	1.7763	0.2063
1531	1530	1.7763	0.2063
1532	1531	1.7735	0.2035

	Time [s]	Water Level [m]	WL Change [m]
1533	1532	1.7735	0.2035
1534	1533	1.7735	0.2035
1535	1534	1.7763	0.2063
1536	1535	1.7763	0.2063
1537	1536	1.7763	0.2063
1538	1537	1.7735	0.2035
1539	1538	1.7763	0.2063
1540	1539	1.7735	0.2035
1541	1540	1.7763	0.2063
1542	1541	1.7735	0.2035
1543	1542	1.7735	0.2035
1544	1543	1.7735	0.2035
1545	1544	1.7735	0.2035
1546	1545	1.7735	0.2035
1547	1546	1.7735	0.2035
1548	1547	1.7735	0.2035
1549	1548	1.7708	0.2008
1550	1549	1.7735	0.2035
1551	1550	1.7708	0.2008
1552	1551	1.7735	0.2035
1553	1552	1.7735	0.2035
1554	1553	1.7735	0.2035
1555	1554	1.7735	0.2035
1556	1555	1.7735	0.2035
1557	1556	1.7735	0.2035
1558	1557	1.7708	0.2008
1559	1558	1.7735	0.2035
1560	1559	1.7708	0.2008
1561	1560	1.7708	0.2008
1562	1561	1.7708	0.2008
1563	1562	1.7708	0.2008
1564	1563	1.7708	0.2008
1565	1564	1.7708	0.2008
1566	1565	1.7708	0.2008
1567	1566	1.7671	0.1971
1568	1567	1.7708	0.2008
1569	1568	1.7671	0.1971
1570	1569	1.7671	0.1971
1571	1570	1.7671	0.1971
1572	1571	1.7708	0.2008
1573	1572	1.7671	0.1971
1574	1573	1.7671	0.1971
1575	1574	1.7671	0.1971
1576	1575	1.7671	0.1971
1577	1576	1.7671	0.1971
1578	1577	1.7671	0.1971
1579	1578	1.7671	0.1971
1580	1579	1.7671	0.1971
1581	1580	1.7671	0.1971
1582	1581	1.7671	0.1971
1583	1582	1.7671	0.1971
1584	1583	1.7671	0.1971
1585	1584	1.7671	0.1971

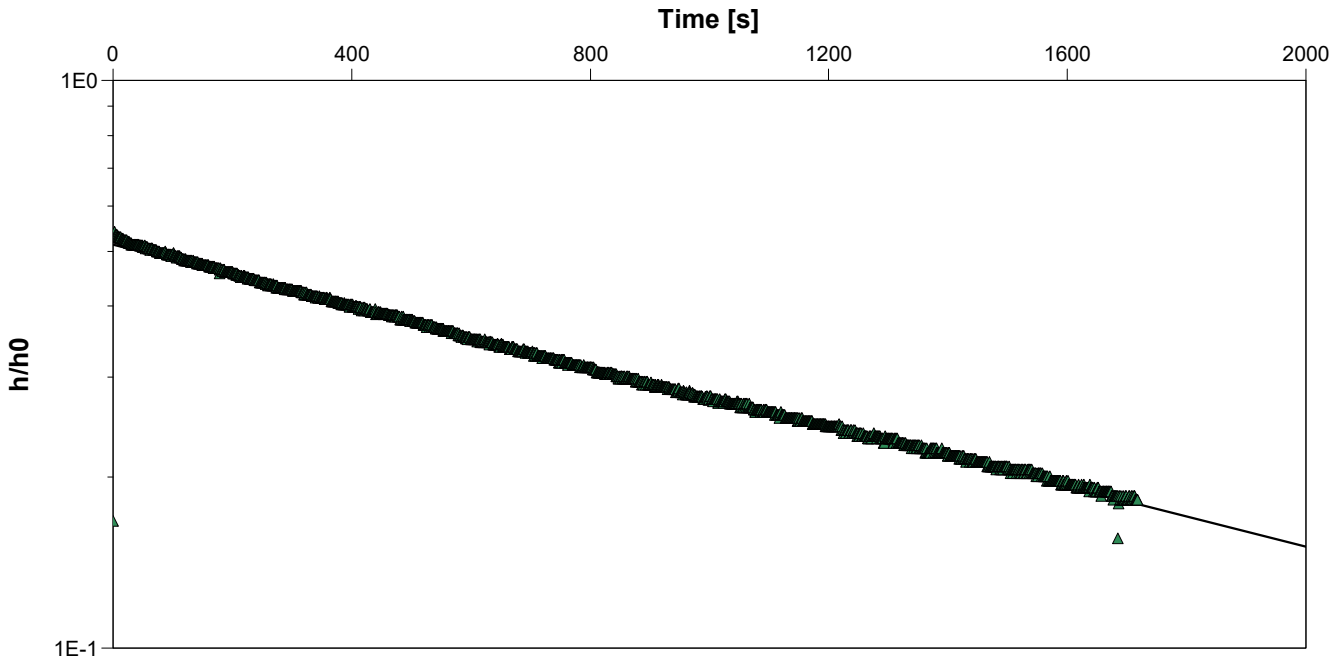
	Time [s]	Water Level [m]	WL Change [m]
1586	1585	1.7671	0.1971
1587	1586	1.7671	0.1971
1588	1587	1.7671	0.1971
1589	1588	1.7671	0.1971
1590	1589	1.7643	0.1943
1591	1590	1.7643	0.1943
1592	1591	1.7643	0.1943
1593	1592	1.7671	0.1971
1594	1593	1.7671	0.1971
1595	1594	1.7643	0.1943
1596	1595	1.7643	0.1943
1597	1596	1.7643	0.1943
1598	1597	1.7643	0.1943
1599	1598	1.7671	0.1971
1600	1599	1.7671	0.1971
1601	1600	1.7643	0.1943
1602	1601	1.7671	0.1971
1603	1602	1.7643	0.1943
1604	1603	1.7643	0.1943
1605	1604	1.7643	0.1943
1606	1605	1.7643	0.1943
1607	1606	1.7643	0.1943
1608	1607	1.7643	0.1943
1609	1608	1.7643	0.1943
1610	1609	1.7643	0.1943
1611	1610	1.7643	0.1943
1612	1611	1.7643	0.1943
1613	1612	1.7643	0.1943
1614	1613	1.7643	0.1943
1615	1614	1.7643	0.1943
1616	1615	1.7616	0.1916
1617	1616	1.7616	0.1916
1618	1617	1.7616	0.1916
1619	1618	1.7616	0.1916
1620	1619	1.7643	0.1943
1621	1620	1.7616	0.1916
1622	1621	1.7616	0.1916
1623	1622	1.7616	0.1916
1624	1623	1.7616	0.1916
1625	1624	1.7643	0.1943
1626	1625	1.7616	0.1916
1627	1626	1.7616	0.1916
1628	1627	1.7643	0.1943
1629	1628	1.7616	0.1916
1630	1629	1.7616	0.1916
1631	1630	1.7616	0.1916
1632	1631	1.7616	0.1916
1633	1632	1.7616	0.1916
1634	1633	1.7616	0.1916
1635	1634	1.7616	0.1916
1636	1635	1.7616	0.1916
1637	1636	1.7588	0.1888
1638	1637	1.7616	0.1916

	Time [s]	Water Level [m]	WL Change [m]
1639	1638	1.7643	0.1943
1640	1639	1.7616	0.1916
1641	1640	1.7616	0.1916
1642	1641	1.7616	0.1916
1643	1642	1.7616	0.1916
1644	1643	1.7616	0.1916
1645	1644	1.7588	0.1888
1646	1645	1.7616	0.1916
1647	1646	1.7588	0.1888
1648	1647	1.7588	0.1888
1649	1648	1.7588	0.1888
1650	1649	1.7588	0.1888
1651	1650	1.7616	0.1916
1652	1651	1.7616	0.1916
1653	1652	1.7616	0.1916
1654	1653	1.7588	0.1888
1655	1654	1.7588	0.1888
1656	1655	1.7588	0.1888
1657	1656	1.7588	0.1888
1658	1657	1.7552	0.1852
1659	1658	1.7588	0.1888
1660	1659	1.7588	0.1888
1661	1660	1.7588	0.1888
1662	1661	1.7588	0.1888
1663	1662	1.7588	0.1888
1664	1663	1.7588	0.1888
1665	1664	1.7588	0.1888
1666	1665	1.7588	0.1888
1667	1666	1.7588	0.1888
1668	1667	1.7588	0.1888
1669	1668	1.7588	0.1888
1670	1669	1.7588	0.1888
1671	1670	1.7588	0.1888
1672	1671	1.7588	0.1888
1673	1672	1.7588	0.1888
1674	1673	1.7588	0.1888
1675	1674	1.7552	0.1852
1676	1675	1.7552	0.1852
1677	1676	1.7552	0.1852
1678	1677	1.7524	0.1824
1679	1678	1.7552	0.1852
1680	1679	1.7552	0.1852
1681	1680	1.7552	0.1852
1682	1681	1.7552	0.1852
1683	1682	1.7552	0.1852
1684	1683	1.7552	0.1852
1685	1684	1.7552	0.1852
1686	1685	1.7258	0.1558
1687	1686	1.7497	0.1797
1688	1687	1.7552	0.1852
1689	1688	1.7524	0.1824
1690	1689	1.7524	0.1824
1691	1690	1.7552	0.1852

	Time [s]	Water Level [m]	WL Change [m]
1692	1691	1.7524	0.1824
1693	1692	1.7524	0.1824
1694	1693	1.7524	0.1824
1695	1694	1.7552	0.1852
1696	1695	1.7524	0.1824
1697	1696	1.7524	0.1824
1698	1697	1.7552	0.1852
1699	1698	1.7524	0.1824
1700	1699	1.7552	0.1852
1701	1700	1.7524	0.1824
1702	1701	1.7524	0.1824
1703	1702	1.7524	0.1824
1704	1703	1.7552	0.1852
1705	1704	1.7552	0.1852
1706	1705	1.7524	0.1824
1707	1706	1.7524	0.1824
1708	1707	1.7524	0.1824
1709	1708	1.7552	0.1852
1710	1709	1.7524	0.1824
1711	1710	1.7552	0.1852
1712	1711	1.7524	0.1824
1713	1712	1.7552	0.1852
1714	1713	1.7552	0.1852
1715	1714	1.7524	0.1824
1716	1715	1.7524	0.1824
1717	1716	1.7524	0.1824
1718	1717	1.7524	0.1824
1719	1718	1.7524	0.1824

BluMetric Environnement Inc. 276, rue St-Jacques Bureau 818 Montreal (QC) H2Y 1N3	**Slug Test Analysis Report**
	Project: Nemaska New Waste Disposal Site – Hydrogeological assess
	Number: 230448-00
	Client: Stantec

Location: Nemaska	Slug Test: PZ-6_2020	Test Well: PZ-6
Test Conducted by: Stantec		Test Date: 2020-08-04
Analysis Performed by: LA	PZ-6_2020_Hvors	Analysis Date: 2023-08-18
Aquifer Thickness: 8.03 m		

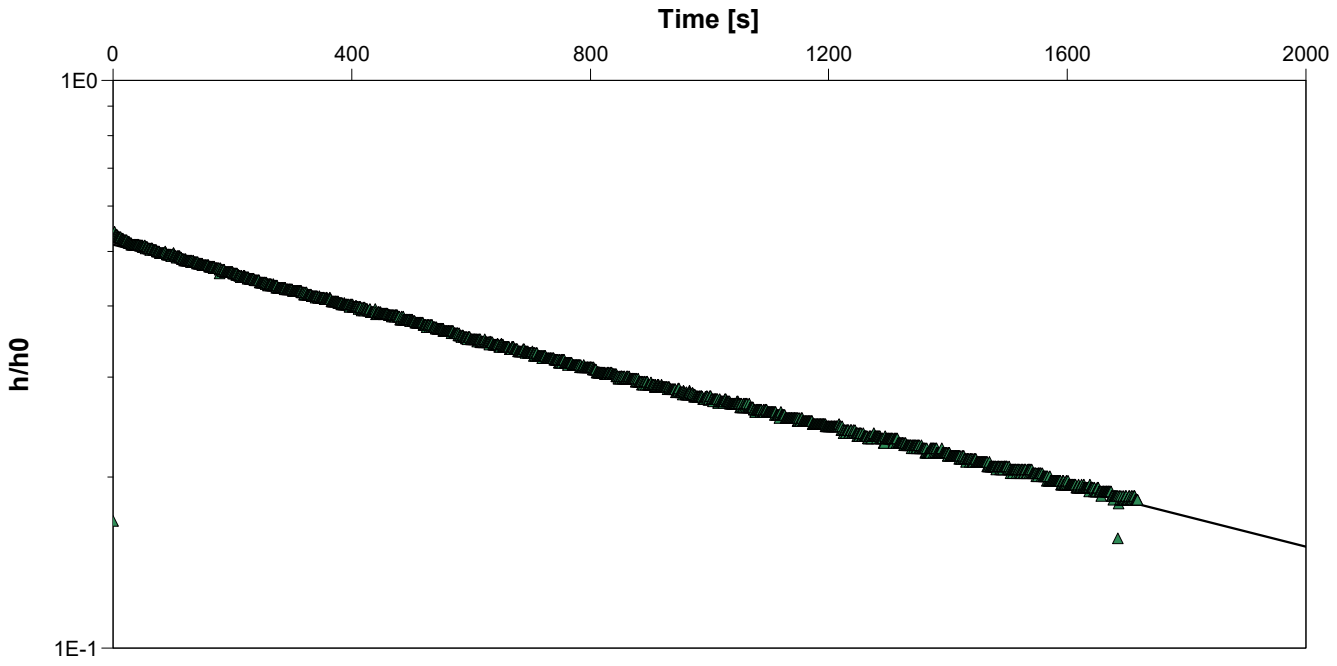


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
PZ-6	3.03×10^{-7}	

BluMetric Environnement Inc. 276, rue St-Jacques Bureau 818 Montreal (QC) H2Y 1N3	**Slug Test Analysis Report**
	Project: Nemaska New Waste Disposal Site – Hydrogeological assess
	Number: 230448-00
	Client: Stantec

Location: Nemaska	Slug Test: PZ-6_2020	Test Well: PZ-6
Test Conducted by: Stantec		Test Date: 2020-08-04
Analysis Performed by: LA	PZ-6_2020_B-R	Analysis Date: 2023-08-18
Aquifer Thickness: 8.03 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
PZ-6	2.34×10^{-7}	

BluMetric Environnement Inc.
276, rue St-Jacques
Bureau 818
Montreal (QC)
H2Y 1N3

Slug Test - Analyses Report

Project: Nemaska New Waste Disposal Site – Hydrogeological assessr

Number: 230448-00

Client: Stantec

Location: Nemaska	Slug Test: PZ-6_2020	Test Well: PZ-6
Test Conducted by: Stantec		Test Date: 2020-08-04
Aquifer Thickness: 8.03 m		

	Analysis Name	Analysis Performed b	Analysis Date	Method name	Well	T [m²/s]	K [m/s]	S
1	PZ-6_2020_Hvors	LA	2023-08-18	Hvorslev	PZ-6		3.03×10^{-7}	
2	PZ-6_2020_B-R	LA	2023-08-18	Bouwer & Rice	PZ-6		2.34×10^{-7}	

APPENDIX G GROUNDWATER SAMPLES ANALYSIS RESULTS

Votre # du projet: 167020077
Adresse du site: FUTURE LEET NEMASKA
Votre # Bordereau: C#176945-01-01

Attention: Patrick Leblanc DiStefano

STANTEC CONSULTING LTD
MTL/ Darmouth
P.O. Box 38212
Dartmouth, NS
CANADA B3B 1X2

Date du rapport: 2018/08/13
Rapport: R2389568
Version: 1 - Finale

CERTIFICAT D'ANALYSES

 # DE DOSSIER MAXXAM: B832486
Reçu: 2018/08/03, 12:40

Matrice: EAU SOUTERRAINE
Nombre d'échantillons reçus: 4

Analyses	Quantité	Date de l' extraction	Date Analysé	Méthode de laboratoire	Référence Primaire
Anions	4	N/A	2018/08/07	STL SOP-00014	MA.300–Ions 1.3 R3 m
Demande biochimique en oxygène (5 jours) (3)	4	2018/08/03	2018/08/08	STL SOP-00008	MA315-DBO 1.1 R3 m
Benzène, toluène, éthylbenzène, xylène	4	N/A	2018/08/08	STL SOP-00145	MA.400–COV 2.0 R4 m
Cyanures totaux	4	2018/08/09	2018/08/10	STL SOP-00035	MA300-CN 1.2 R3 m
Demande chimique en oxygène	4	2018/08/07	2018/08/08	STL SOP-00009	MA315-DCO 1.1 R4 m
Coliformes fécaux (1)	4	N/A	2018/08/03	STL SOP-00189	MA700-FEC.EC 1.0 R5m
Conductivité	4	N/A	2018/08/10	STL SOP-00038	SM 23 2510-B m
Métaux dissous par ICP-MS (basse limite)	4	N/A	2018/08/08	STL SOP-00006	MA.200–Mét. 1.2 R5 m
Azote ammoniacal	4	N/A	2018/08/06	STL SOP-00040	MA.300–N 2.0 R2 m
Phénols totaux par 4-AAP	4	2018/08/09	2018/08/10	STL SOP-00033	MA404–I.Phé 2.2 R2 m
Sulfures (exprimés en S2-) (2)	4	2018/08/07	2018/08/07	QUE SOP-00107	MA. 300 – S 1.2 R3 m

Remarques:

Les laboratoires Maxxam sont certifiés ISO/IEC 17025:2005 pour certains paramètres précis des portées d'accréditation. Sauf indication contraire, les méthodes d'analyses utilisées par Maxxam s'inspirent des méthodes de référence d'organismes provinciaux, fédéraux et américains, tels que le CCME, le MDDELCC, l'EPA et l'APHA.

Toutes les analyses présentées ont été réalisées conformément aux procédures et aux pratiques relatives à la méthodologie, à l'assurance qualité et au contrôle de la qualité généralement appliqués par les employés de Maxxam (sauf s'il en a été convenu autrement par écrit entre le client et Maxxam). Toutes les données de laboratoire rencontrent les contrôles statistiques et respectent tous les critères de CQ et les critères de performance des méthodes, sauf s'il en a été signalé autrement. Tous les blancs de méthode sont rapportés, toutefois, les données des échantillons correspondants ne sont pas corrigées pour la valeur du blanc, sauf indication contraire. Le cas échéant, sauf indication contraire, l'incertitude de mesure n'a pas été prise en considération lors de la déclaration de la conformité à la norme de référence.

Les responsabilités de Maxxam sont restreintes au coût réel de l'analyse, sauf s'il en a été convenu autrement par écrit. Il n'existe aucune autre garantie, explicite ou implicite. Le client a fait appel à Maxxam pour l'analyse de ses échantillons conformément aux méthodes de référence mentionnées dans ce rapport. L'interprétation et l'utilisation des résultats sont sous l'entière responsabilité du client et ne font pas partie des services offerts par Maxxam, sauf si convenu autrement par écrit. Maxxam ne peut pas garantir l'exactitude des résultats qui dépendent des renseignements fournis par le client ou son représentant.

Les résultats des échantillons solides, sauf les biotes, sont rapportés en fonction de la masse sèche, sauf indication contraire. Les analyses organiques ne

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Votre # du projet: 167020077
Adresse du site: FUTURE LEET NEMASKA
Votre # Bordereau: C#176945-01-01

Attention: Patrick Leblanc DiStefano

STANTEC CONSULTING LTD
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CANADA B3B 1X2

Date du rapport: 2018/08/13
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CERTIFICAT D'ANALYSES

 # DE DOSSIER MAXXAM: B832486

Reçu: 2018/08/03, 12:40

sont pas corrigées en fonction de la récupération, sauf pour les méthodes de dilution isotopique.

Les résultats s'appliquent seulement aux échantillons analysés. Si l'échantillonnage n'est pas effectué par Maxxam, les résultats se rapportent aux échantillons fournis pour analyse.

Le présent rapport ne doit pas être reproduit, sinon dans son intégralité, sans le consentement écrit du laboratoire.

Lorsque la méthode de référence comprend un suffixe « m », cela signifie que la méthode d'analyse du laboratoire contient des modifications validées et appliquées afin d'améliorer la performance de la méthode de référence.

Notez: Les données brutes sont utilisées pour le calcul du RPD (% d'écart relatif). L'arrondissement des résultats finaux peut expliquer la variation apparente.

(1) Cette analyse a été effectuée par Maxxam Microbiologie-Montréal
(2) Cette analyse a été effectuée par Maxxam - Québec
(3) Veuillez noter qu'advenant l'impossibilité de débuter une analyse de demande biochimique en oxygène (DBO) à l'intérieur des 48 heures du délai de conservation (d'un échantillon conservé à 4°C), l'échantillon sera congelé, à moins d'une indication contraire d'une règlementation spécifique, afin de prolonger son délai de conservation à 180 jours.

Note : Les paramètres inclus dans le présent certificat sont accrédités par le MDDELCC, à moins d'indication contraire.

clé de cryptage

Veuillez adresser toute question concernant ce certificat d'analyse à votre chargé(e) de projets
Rodrigo Caffarengo,
Courriel: RCaffarengo@maxxam.ca
Téléphone (514)448-9001 Ext:7066336

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Dossier Maxxam: B832486
Date du rapport: 2018/08/13

STANTEC CONSULTING LTD
Votre # du projet: 167020077
Adresse du site: FUTURE LEET NEMASKA
Initiales du préleveur: MF

BTEX PAR GC/MS (EAU SOUTERRAINE)

ID Maxxam				FP3089	FP3090	FP3091	FP3092		
Date d'échantillonnage				2018/08/01	2018/08/01	2018/08/01	2018/08/01		
# Bordereau				C#176945-01-01	C#176945-01-01	C#176945-01-01	C#176945-01-01		
	Unités	**A**	**B**	**PZ-01**	**PZ-03**	**PZ-06**	**DUP**	**LDR**	**Lot CQ**
VOLATILS									
Benzène	ug/L	**0.5**	950	<0.20	<0.20	<0.20	<0.20	0.20	1923312
Toluène	ug/L	**24**	200	0.24	0.19	0.18	0.16	0.10	1923312
Éthylbenzène	ug/L	**2.4**	160	<0.10	<0.10	<0.10	<0.10	0.10	1923312
Xylènes (o,m,p) †	ug/L	**300**	370	<0.40	<0.40	<0.40	<0.40	0.40	1923312
Récupération des Surrogates (%)									
4-Bromofluorobenzène	%	-	-	105	104	104	104	N/A	1923312
D4-1,2-Dichloroéthane	%	-	-	118	123	118	124	N/A	1923312
D8-Toluène	%	-	-	95	95	95	94	N/A	1923312

LDR = Limite de détection rapportée
Lot CQ = Lot contrôle qualité
† Accréditation non existante pour ce paramètre
N/A = Non Applicable

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Dossier Maxxam: B832486
Date du rapport: 2018/08/13

STANTEC CONSULTING LTD
Votre # du projet: 167020077
Adresse du site: FUTURE LEET NEMASKA
Initiales du préleveur: MF

MÉTAUX DISSOUS (EAU SOUTERRAINE)

ID Maxxam				FP3089	FP3090	FP3091	FP3092		
Date d'échantillonnage				2018/08/01	2018/08/01	2018/08/01	2018/08/01		
# Bordereau				C#176945-01-01	C#176945-01-01	C#176945-01-01	C#176945-01-01		
	Unités	**A**	**B**	**PZ-01**	**PZ-03**	**PZ-06**	**DUP**	**LDR**	**Lot CQ**
MÉTAUX ICP-MS									
Bore (B)	ug/L	**5000**	28000	<20	<20	<20	<20	20	1922474
Cadmium (Cd)	ug/L	**5**	1.1	<0.20	<0.20	<0.20	<0.20	0.20	1922474
Calcium (Ca)	ug/L	**-**	-	3100	2200	2100	2100	300	1922474
Chrome (Cr)	ug/L	**50**	-	<0.50	<0.50	<0.50	<0.50	0.50	1922474
Dureté totale (CaCO3) †	ug/L	**-**	-	8500	6500	5900	6000	1000	1922474
Fer (Fe)	ug/L	**-**	-	66	160	<60	<60	60	1922474
Magnésium (Mg)	ug/L	**-**	-	200	220	190	200	100	1922474
Manganèse (Mn)	ug/L	**50**	2300	19	**59**	4.2	4.3	0.40	1922474
Mercure (Hg)	ug/L	**1**	0.0013	**<0.10 (1)**	**<0.10 (1)**	**<0.10 (1)**	0.23	0.10	1922474
Nickel (Ni)	ug/L	**70**	260	2.6	6.3	<1.0	<1.0	1.0	1922474
Plomb (Pb)	ug/L	**10**	34	0.11	0.15	0.17	<0.10	0.10	1922474
Sodium (Na)	ug/L	**200000**	-	8000	3300	7900	8000	100	1922474
Zinc (Zn)	ug/L	**5000**	67	<5.0	5.9	<5.0	<5.0	5.0	1922474

LDR = Limite de détection rapportée
Lot CQ = Lot contrôle qualité
† Accréditation non existante pour ce paramètre
(1) LDR excède le critère

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Dossier Maxxam: B832486
Date du rapport: 2018/08/13

STANTEC CONSULTING LTD
Votre # du projet: 167020077
Adresse du site: FUTURE LEET NEMASKA
Initiales du préleveur: MF

PARAMÈTRES CONVENTIONNELS (EAU SOUTERRAINE)

ID Maxxam				FP3089	FP3090	FP3091		FP3092		
Date d'échantillonnage				2018/08/01	2018/08/01	2018/08/01		2018/08/01		
# Bordereau				C#176945-01-01	C#176945-01-01	C#176945-01-01		C#176945-01-01		
	Unités	A	B	PZ-01	PZ-03	PZ-06	LDR	DUP	LDR	Lot CQ
CONVENTIONNELS										
Azote ammoniacal (N-NH3)	mg/L	-	-	<0.020	<0.020	<0.020	0.020	<0.060	0.060	1922599
Conductivité	mS/cm	-	-	0.063	0.036	0.058	0.0010	0.062	0.0010	1922992
Cyanures Totaux	mg/L	-	0.022	<0.0030	<0.0030	<0.0030	0.0030	<0.0030	0.0030	1923686
DBO5	mg/L	-	-	<4.0	<4.0	<4.0	4.0	<4.0	4.0	1922395
DCO	mg/L	-	-	<10	<10	<10	10	<10	10	1923120
Phénols-4AAP	mg/L	-	0.5	<0.0020	<0.0020	<0.0020	0.0020	<0.0020	0.0020	1923898
Sulfures (exprimés en S2-)	mg/L	**0.05**	-	<0.020	<0.020	0.033	0.020	0.035	0.020	1923069
Chlorures (Cl)	mg/L	**250**	860	0.39	0.18	1.2	0.050	1.2	0.050	1922736
Nitrate(N) et Nitrite(N)	mg/L	**10**	-	<0.020	<0.020	<0.020	0.020	<0.020	0.020	1922736
Sulfates (SO4)	mg/L	**-**	-	9.2	2.2	2.1	0.50	2.0	0.50	1922736

LDR = Limite de détection rapportée
Lot CQ = Lot contrôle qualité

ID Maxxam				FP3092		
Date d'échantillonnage				2018/08/01		
# Bordereau				C#176945-01-01		
	Unités	A	B	DUP Dup. de Lab.	LDR	Lot CQ
CONVENTIONNELS						
Conductivité	mS/cm	-	-	0.061	0.0010	1922992

LDR = Limite de détection rapportée
Lot CQ = Lot contrôle qualité
Duplicata de laboratoire

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Dossier Maxxam: B832486
Date du rapport: 2018/08/13

STANTEC CONSULTING LTD
Votre # du projet: 167020077
Adresse du site: FUTURE LEET NEMASKA
Initiales du préleveur: MF

MICROBIOLOGIE (EAU SOUTERRAINE)

ID Maxxam		FP3089	FP3090	FP3091	FP3092		
Date d'échantillonnage		2018/08/01	2018/08/01	2018/08/01	2018/08/01		
# Bordereau		C#176945-01-01	C#176945-01-01	C#176945-01-01	C#176945-01-01		
	Unités	**PZ-01**	**PZ-03**	**PZ-06**	**DUP**	**LDR**	**Lot CQ**
TESTS MICROBIOLOGIQUES							
Coliformes fécaux	UFC/100ml	<10	<10	<10	<10	10	1922467

LDR = Limite de détection rapportée
Lot CQ = Lot contrôle qualité

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Dossier Maxxam: B832486
Date du rapport: 2018/08/13

STANTEC CONSULTING LTD
Votre # du projet: 167020077
Adresse du site: FUTURE LEET NEMASKA
Initiales du préleveur: MF

REMARQUES GÉNÉRALES

A,B: Les critères des sols proviennent de l'Annexe 2 du « Guide d'intervention-Protection des sols et réhabilitation des terrains contaminés. MDDELCC, 2016. » et intitulé « Grille des critères génériques pour les sols ».Les critères des sols sont ceux de la province géologique des Basses-Terres du Saint-Laurent.

Les critères A et B pour l'eau souterraine proviennent de l'annexe 7 intitulé « Grille des critères de qualité des eaux souterraines » du guide d'intervention mentionné plus haut. A=Eau de consommation; B=Résurgence dans l'eau de surface

Ces références ne sont rapportées qu'à titre indicatif et ne doivent être interprétées dans aucun autre contexte.

- = Ce composé ne fait pas partie de la réglementation.

Les résultats ne se rapportent qu'aux échantillons soumis pour analyse

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STANTEC CONSULTING LTD
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Initiales du préleveur: MF

RAPPORT ASSURANCE QUALITÉ

Lot AQ/CQ	Init	Type CQ	Groupe	Date Analysé	Valeur	Réc	Unités
1922395	LPU	MRC	DBO5	2018/08/08		109	%
1922395	LPU	Blanc fortifié	DBO5	2018/08/08		107	%
1922395	LPU	Blanc fortifié DUP	DBO5	2018/08/08		98	%
1922395	LPU	Blanc de méthode	DBO5	2018/08/08	<4.0		mg/L
1922395	LPU	Blanc de méthode DUP	DBO5	2018/08/08	<4.0		mg/L
1922474	DKH	Blanc fortifié	Bore (B)	2018/08/07		94	%
			Cadmium (Cd)	2018/08/07		106	%
			Calcium (Ca)	2018/08/07		96	%
			Chrome (Cr)	2018/08/07		91	%
			Fer (Fe)	2018/08/07		95	%
			Magnésium (Mg)	2018/08/07		95	%
			Manganèse (Mn)	2018/08/07		95	%
			Mercure (Hg)	2018/08/07		105	%
			Nickel (Ni)	2018/08/07		92	%
			Plomb (Pb)	2018/08/07		104	%
			Sodium (Na)	2018/08/07		91	%
			Zinc (Zn)	2018/08/07		93	%
1922474	DKH	Blanc de méthode	Bore (B)	2018/08/07	<20		ug/L
			Cadmium (Cd)	2018/08/07	<0.20		ug/L
			Calcium (Ca)	2018/08/07	<300		ug/L
			Chrome (Cr)	2018/08/07	<0.50		ug/L
			Dureté totale (CaCO3)	2018/08/07	<1000		ug/L
			Fer (Fe)	2018/08/07	<60		ug/L
			Magnésium (Mg)	2018/08/07	<100		ug/L
			Manganèse (Mn)	2018/08/07	<0.40		ug/L
			Mercure (Hg)	2018/08/07	<0.10		ug/L
			Nickel (Ni)	2018/08/07	<1.0		ug/L
			Plomb (Pb)	2018/08/07	<0.10		ug/L
			Sodium (Na)	2018/08/07	<100		ug/L
			Zinc (Zn)	2018/08/07	<5.0		ug/L
1922599	JGZ	MRC	Azote ammoniacal (N-NH3)	2018/08/06		104	%
1922599	JGZ	Blanc fortifié	Azote ammoniacal (N-NH3)	2018/08/06		99	%
1922599	JGZ	Blanc de méthode	Azote ammoniacal (N-NH3)	2018/08/06	<0.020		mg/L
1922736	ECA	Blanc fortifié	Chlorures (Cl)	2018/08/06		113	%
			Nitrate(N) et Nitrite(N)	2018/08/06		111	%
			Sulfates (SO4)	2018/08/06		105	%
1922736	ECA	Blanc de méthode	Chlorures (Cl)	2018/08/06	<0.050		mg/L
			Nitrate(N) et Nitrite(N)	2018/08/06	<0.020		mg/L
			Sulfates (SO4)	2018/08/06	<0.50		mg/L
1922992	HMS	Blanc fortifié	Conductivité	2018/08/10		106	%
1922992	HMS	Blanc de méthode	Conductivité	2018/08/10	<0.0010		mS/cm
1923069	LAR	MRC	Sulfures (exprimés en S2-)	2018/08/07		101	%
1923069	LAR	Blanc de méthode	Sulfures (exprimés en S2-)	2018/08/07	<0.020		mg/L
1923120	AMA	Blanc fortifié	DCO	2018/08/08		98	%
1923120	AMA	Blanc fortifié DUP	DCO	2018/08/08		90	%
1923120	AMA	Blanc de méthode	DCO	2018/08/08	<10		mg/L
1923312	SCW	Blanc fortifié	4-Bromofluorobenzène	2018/08/08		104	%
			D4-1,2-Dichloroéthane	2018/08/08		121	%
			D8-Toluène	2018/08/08		96	%
			Benzène	2018/08/08		99	%
			Toluène	2018/08/08		92	%

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Dossier Maxxam: B832486
Date du rapport: 2018/08/13

STANTEC CONSULTING LTD
Votre # du projet: 167020077
Adresse du site: FUTURE LEET NEMASKA
Initiales du préleveur: MF

RAPPORT ASSURANCE QUALITÉ (SUITE)

Lot AQ/CQ	Init	Type CQ	Groupe	Date Analysé	Valeur	Réc	Unités
			Éthylbenzène	2018/08/08		91	%
			Xylènes (o,m,p)	2018/08/08		91	%
1923312	SCW	Blanc de méthode	4-Bromofluorobenzène	2018/08/08		105	%
			D4-1,2-Dichloroéthane	2018/08/08		122	%
			D8-Toluène	2018/08/08		95	%
			Benzène	2018/08/08	<0.20		ug/L
			Toluène	2018/08/08	<0.10		ug/L
			Éthylbenzène	2018/08/08	<0.10		ug/L
			Xylènes (o,m,p)	2018/08/08	<0.40		ug/L
1923686	JL1	Blanc fortifié	Cyanures Totaux	2018/08/10		99	%
1923686	JL1	Blanc de méthode	Cyanures Totaux	2018/08/10	<0.0030		mg/L
1923898	GGC	Blanc fortifié	Phénols-4AAP	2018/08/10		85	%
1923898	GGC	Blanc de méthode	Phénols-4AAP	2018/08/10	<0.0020		mg/L

MRC: Un échantillon de concentration connue préparé dans des conditions rigoureuses par un organisme externe. Utilisé pour vérifier la justesse de la méthode.

Blanc fortifié: Un blanc, d'une matrice exempte de contaminants, auquel a été ajouté une quantité connue d'analyte provenant généralement d'une deuxième source. Utilisé pour évaluer la précision de la méthode.

Blanc de méthode: Une partie aliquote de matrice pure soumise au même processus analytique que les échantillons, du prétraitement au dosage. Sert à évaluer toutes contaminations du laboratoire.

Surrogate: Composé se comportant de façon similaire aux composés analysés et ajouté à l'échantillon avant l'analyse. Sert à évaluer la qualité de l'extraction.

Réc = Récupération

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Dossier Maxxam: B832486
Date du rapport: 2018/08/13

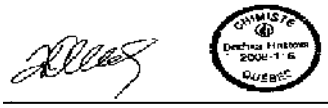
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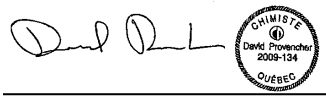
Les résultats analytiques ainsi que les données de contrôle-qualité contenus dans ce rapport furent vérifiés et validés par les personnes suivantes:



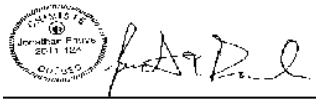
Caroline Bougie, B.Sc. Chimiste



Dochka Koleva Hristova, B.Sc., Chimiste



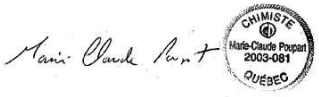
David Provencher, B.Sc., Chimiste, Analyste Senior



Jonathan Fauvel, B.Sc, Chimiste



Miryam Assayag, B.Sc. Chimiste



Marie-Claude Poupart, B.Sc., Chimiste



Pouya Salehi

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STANTEC CONSULTING LTD
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Les résultats analytiques ainsi que les données de contrôle-qualité contenus dans ce rapport furent vérifiés et validés par les personnes suivantes:

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Maxxam Analytics International Corporation o/a Maxxam Analytics
Une société du Groupe Bureau Veritas
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Bordereau de Transmission d'Échantillons

Page 1 of 2

INFORMATION FACTURATION:		Information Rapport		Information Projet		À l'usage du laboratoire seulement	
Compagnie	#4087 STANTEC CONSULTING LTD	Compagnie	Karine Gagnon Patrick Lefebvre	N° de cotation	B50248	# dossier Maxxam	# Commande:
Attention de	ACCOUNTS PAYABLE	Attention de		N° de commande			176945
Adresse	P.O. Box 38212	Adresse		N° de projet	167020077	Bordereau de Transmission d'Échantillons	Chargé(e) de Projets
	Dartmouth NS B3B 1X2			Nom du projet			
Téléphone	Téléc	Téléphone	Téléco	# de site	Future LEET Komoka	C#176945-01-01	Rodrigo Caffarengo
Courriel	accounts.payable.invoices@stantec.com	Courriel	Patrick.Leblanc-Lefebvre@stantec.com	Échantillonneur	Michael Reign		

Critères et Règlements

- Potable
- RDS
- RMD
- REIMR
- Autre (spécifier)

Essai de pompage: 24h (Art. 6.1&6.2) / 48h (Art. 6.2) / 72h (Art. 6.1&6.2)

Rég. CUM: Égout sanitaire Art.18 / Égout pluvial Art.11

Qualité Eau Potable: Rég. Pâtes & Papiers (Art.104) / Rég. Pâtes & Papiers (Art.112) — Municipal / Non-municipale

Instructions spéciales

Remarque: Pour les échantillons d'eau potable soumis à la réglementation - S.V.P utiliser la formulaire client rattaché à l'eau potable

Conserver les échantillons en milieu froid (< 10 oC) de l'échantillonnage à la livraison chez Maxxam

Analyses demandées

	Étiquette codebar de l'échantillon	Identification de l'échantillon	Date d'échantillonn	Heure	Matrice	Eau potable réglementée ? (O / N)	Métaux filtrés sur le terrain (O/N)	Anions-NO2 et NO3,SO4,Cl	B, Cd, Cr, Fe, Mn, Na, Ni, Pb, Zn-Mét dis	Conductivité	Azote ammoniacal	Mercure par ICP-MS	Phénols totaux par 4-AAP	Sulfures (exprimés en S2-)	Demande chimique en oxygène	Demande biochimique en oxygène (5 jours)	Cyanures totaux	# of Bottles	Commentaires
1		PZ-01	18-8-1		Sout		O	X	X	X	X	X	X	X	X	X	X	10	Métaux filtrés sur le terrain
2		~~PZ-02~~																	
3		PZ-03	18-8-1		Sout		O	X	X	X	X	X	X	X	X	X	X	10	
4		~~PZ-05~~																	
5		PZ-06	18-8-1		Sout		O	X	X	X	X	X	X	X	X	X	X	10	
6		DUP	18-8-1		Sout		O	X	X	X	X	X	X	X	X	X	X	10	
7																			
8																			
9																			
10																			

Délais requis

S.V.P notifier à l'avance en cas de projet urgent

Délai Régulier
(Sera applicable si le délai de l'urgence n'est pas précisé)
Délai Régulier = 5 jours ouvrables pour la plupart des analyses.
S.V.P Veuillez noter que le délai pour certaines analyses telles que la DBO5 et les Dioxines/Furannes est > 5 jours - Contactez votre chargé de projets pour les délais.

Délai rapide (Si applicable à tous les échantillons)
Date Requise: _____ Heure Requise: _____
Veuillez noter que tout échantillon reçu après 15H00, sera considéré comme reçu le lendemain (jour ouvrable) à 8H00.

* DESSAISI PAR: (Signature)	Date: (AAAA/MM/JJ)	Heure	REÇU PAR: (Signature)	Date: (AAAA/MM/JJ)	Heure	Contenants utilisés et non soumis
	18-8-2			2018/08/03	12:20	

Réservé au laboratoire

Court Délai de	Température (°C) de Réception	Sceau légal intact sur la glacière
☐	10,10,9	☐ Oui ☐ Non

* SAUF ACCORD CONTRAIRE PASSÉ PAR ÉCRIT, LES SERVICES COMPRIS DANS CETTE CHAÎNE DE RESPONSABILITÉS SONT SOUMIS AUX CONDITIONS GÉNÉRALES STANDARD DE MAXXAM. PAR LA SIGNATURE DE CETTE CHAÎNE DE RESPONSABILITÉS, VOUS CONFIRMEZ QUE VOUS AVEZ PRIS CONNAISSANCE DES CONDITIONS GÉNÉRALES ET QUE VOUS LES ACCEPTEZ TELLES QU'ELLES SE PRÉSENTENT AU WWW.MAXXAM.CA/TERMS.

* IL EST DE LA RESPONSABILITÉ DU CLIENT DE FACILITER DE L'EXACTITUDE DU BORDEREAU DE TRANSMISSION. UN MANQUEMENT À CETTE PROCÉDURE PEUT SE TRADUIRE PAR UN RETARD DANS LE DÉLAI ANALYTIQUE.

Blanc: Maxxam Jaune: Client

B832486_COC RC4
03/08

EXPONIBUS WT:533 DC5:458

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Bordereau de Transmission d'Échantillons

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Attention de	ACCOUNTS PAYABLE	Attention de	Karine Gagnon	N° de commande			176945
Adresse	P.O. Box 38212	Adresse		N° de projet	167020077	Bordereau de Transmission d'Échantillons	Chargé(e) de Projets
	Dartmouth NS B3B 1X2			Nom du projet		C#176945-01-02	Rodrigo Cafferengo
Téléphone	Téléc	Téléphone	Téléco	# de site	Rotary Leaf Nemaska		
Courriel	accounts.payable.invoices@stantec.com	Courriel	patrick.lefebvre-dufresne@stantec.com	Échantillonneur	Michael Fregon		

Critères et Règlements

- Policique
- RDS
- RMD
- REMAR
- Autre (spécifier)

Essai de pompage: 24h (Art. 6.1&6.2) / 48h (Art. 6.2) / 72h (Art. 6.1&6.2)

Rég. CUM: Égout sanitaire Art.10 / Égout pluvial Art.11

Qualité Eau Potable: Rég. Pâtes & Papiers (Art.104) / Rég. Pâtes & Papiers (Art.112) / Municipal / Non-municipalité

Instructions spéciales

Remarque: Pour les échantillons d'eau potable soumis à la réglementation - S.V.P utilisez le formulaire client rattaché à l'eau potable

Délais requis

S.V.P nous aviser à l'avance en cas de projet urgent

Délai Régulier — *(Sera applicable si le délai de l'urgence n'est pas précisé)*

Délai Régulier = 5 Jours ouvrables pour la plupart des analyses.

S.V.P Veuillez noter que le délai pour certaines analyses telles que la DBO5 et les Dioxines/Furannes est > 5 jours - Contactez votre chargé de projets pour les détails.

Délai rapide (Si applicable à tous les échantillons)

Date Requise: _____ Heure Requise: _____

Veuillez noter que tout échantillon reçu après 15H00, sera considéré comme reçu le lendemain (jour ouvrable) à 9H09.

Conservez les échantillons en milieu froid (< 10 oC) de l'échantillonnage à la livraison chez Maxxam

	Étiquette codebar de l'échantillon	Identification de l'échantillon	Date d'échantillonn	Heure	Matrice	Eau potable réglementée ? (O / N)	Métaux filtrés sur le terrain O/N	Benzène, toluène, éthylbenzène, xylène	Coliformes fécaux	Dureté							# of Bottles	Commentaires
1		PZ-01	18-8-1		Sout			X	X	X							10	
2		~~PZ-02~~																
3		PZ-03	18-8-1		Sout			X	X	X							10	
4		~~PZ-05~~																
5		PZ-06	18-8-1		Sout			X	X	X							10	
6		DUP	18-8-1		Sout			X	X	X							10	
7																		
8																		
9																		
10																		

* DESSAISI PAR: (Signature)	Date: (AAAA/MM/JJ)	Heure	REÇU PAR: (Signature)	Date: (AAAA/MM/JJ)	Heure	Contenants utilisés et non soumis	Réservé au laboratoire		
Michael Fregon	18-8-8		VLU DAW 123	2018/08/09	12:40		Cour Délai de ☐	Température (°C) de Réception 10, 12, 9	Sceau légal intact sur le glacière ☐ Oui ☐ Non

* SAUF ACCORD CONTRAIRE PASSÉ PAR ÉCRIT, LES SERVICES COMPRIS DANS CETTE CHAÎNE DE RESPONSABILITÉS SONT SOUMIS AUX CONDITIONS GÉNÉRALES STANDARD DE MAXXAM. PAR LA SIGNATURE DE CETTE CHAÎNE DE RESPONSABILITÉS, VOUS CONFIRMEZ QUE VOUS AVEZ PRIS CONNAISSANCE DES CONDITIONS GÉNÉRALES ET QUE VOUS LES ACCEPTEZ TELLES QU'ELLES SE PRÉSENTENT AU WWW.MAXXAM.CA/TERMS.

* IL EST DE LA RESPONSABILITÉ DE LA PERSONNE RAPPORTANT L'ÉCHANTILLON DE S'ASSURER DE L'EXACTITUDE DU BORDEREAU DE TRANSMISSION. UN MANQUEMENT À CETTE PROCÉDURE PEUT SE TRADUIRE PAR UN RETARD DANS LE DÉLAI ANALYTIQUE.

Blanc: Maxxam — Jaune: Client

EXPEDIÉS WT1573 ICE: yes

APPENDIX H CLIMATE IMPACT ASSESSMENT

Proposed Nemaska Landfill Climate Impact Assessment

FINAL REPORT

Prepared for:

Cree Nation of Nemaska

Prepared by:

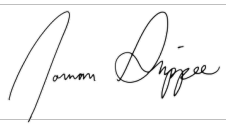
Stantec Consulting Ltd.

167020077-300-102-CC-R-0001-0
October 30, 2023

The conclusions in the Report titled *Future Nemaska Landfill Climate Impact Assessment* are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

Stantec has assumed all information received from Cree Nation of Nemaska (the "Client") and third parties in the preparation of the Report to be correct. While Stantec has exercised a customary level of judgment or due diligence in the use of such information, Stantec assumes no responsibility for the consequences of any error or omission contained therein.

This Report is intended solely for use by the Client in accordance with Stantec's contract with the Client. While the Report may be provided to applicable authorities having jurisdiction and others for whom the Client is responsible, Stantec does not warrant the services to any third party. The report may not be relied upon by any other party without the express written consent of Stantec, which may be withheld at Stantec's discretion.

PREPARED BY:	Norman Shippee, Ph.D.	
VERIFIED BY:	Frédéric Gauthier	
REVISED BY:	Julien Rosset, M.A.A.	

Revision	Description	Author	Quality Check	Independent Review
0	Final	N. Shippee	F. Gauthier	J. Rosset

Table of Contents

1.0 INTRODUCTION 1
1.1 BACKGROUND 1
1.2 RESSOURCES USED FOR THIS DOCUMENT 2
1.3 LIMITATIONS 2
1.4 METHODOLOGY 2
1.5 TIME HORIZON 5
1.6 PLAUSIBLE CLIMATE SCENARIOS 5

2.0 CURRENT AND FUTURE CLIMATE 7
2.1 OBSERVATIONS RELATED TO RECENT CLIMATE CHANGES AND CURRENT CLIMATE 7
2.2 OBSERVATIONS RELATED TO FUTURE CLIMATE CHANGES 8
2.2.1 Temperature 8
2.2.2 Rainfall 8
2.2.3 Snow 9

3.0 POTENTIAL IMPACTS OF CLIMATE CHANGES ON LANDFILL INFRASTRUCTURE AND OPERATIONS 10
3.1 TEMPERATURE 10
3.2 PRECIPITATION 10
3.3 STRONG WINDS 10

4.0 RISK ASSESSMENT 12
4.1 PROPOSED INFRASTRUCTURE 12
4.2 CLIMATE CHANGES 14
4.3 RISK EVALUATION 15
4.4 CLIMATE RISKS PROFILE 17
4.5 OTHER RISK ASSESSMENT CONSIDERATIONS 21
4.5.1 Permafrost 21
4.5.2 Wildfires 21
4.5.3 Site Surroundings 22
4.5.4 Third Party Interactions 22
4.6 RESULTS AND RECOMMENDATIONS 23
4.7 CONCLUSIONS 23

5.0 REFERENCES 24

LIST OF TABLES

Table 1 Observed Direct and Indirect Climatic Changes 7
Table 2 List of Project Components Being Assessed 12
Table 3 Impact Criteria 13
Table 4 Severity of Impacts Rating Scale 13
Table 5 Probability Rating Scale Based on Climate Event Occurrence 14
Table 6 Current and Future Probability Rating for Selected Climate Variables 15
Table 7 Risk Classification 17

Table 8 Climate Impacts and Risk Ratings 18
Table 9 Past and projected changes of key climate parameters in Eeyou Istchee James Bay (Source: State of Climate Change and Adaptation Knowledge for the Eeyou Istchee James Bay Territory, Ouranos (2017).....A.2pendix A
Table 10 Average Change in Average Daily Mean Temperature from 1981-2010 Baseline, RCP 8.5, Nemaska .....Apendix B
Table 11 Average Change in Average Maximum Daily Temperature from 1981-2010 Baseline, RCP 8.5, Nemaska .....Apendix B
Table 12 Average Change in Average Minimum Daily Temperature from 1981-2010 Baseline, RCP 8.5, Nemaska .....Apendix B
Table 13 Average Percent Change in total annual and seasonal Precipitation from 1981-2010 Baseline, RCP 8.5, Nemaska .....Apendix B
Table 14 Historical “Ungaged” Precipitation Event Accumulation IDF data (mm) – 51.68 °N, -76.26°E.....Apendix B
Table 15 Projected Precipitation Event Accumulation IDF data (mm) and Percent Change from Historical (%),RCP 8.5, 2020 (2011-2040)Apendix B
Table 16 Projected Precipitation Event Accumulation IDF data (mm) and Percent Change from Historical, RCP 8.5, 2050 (2041-2070) .....Apendix B
Table 17 Projected Precipitation Event Accumulation IDF data (mm) and Percent Change from Historical, RCP 8.5, 2080 (2071-2100) .....Apendix B
Table 18 Average Annual Number of Frost-Free Days, Nemaska, RCP 8.5 . Apendix B
Table 19 Average Annual Length of Frost-Free Period, Nemaska, RCP 8.5. Apendix B

LIST OF FIGURES

Figure 1 Illustration of the risk assessment process..... 4
Figure 2 Historical CO_2 emissions for 1980-2017 and projected emissions trajectories to 2100 for the four Representative Concentration Pathway (RCP) scenarios (Smith and Myers 2018). 6
Figure 3 Risk Rating Structure 16
Figure 4 Historical CO_2 emissions for 1980-2017 and projected emissions trajectories until 2100 for the four RCP scenarios. Current global greenhouse gas emissions correspond with the RCP 8.5 trajectory. Figure from Smith and Myers, 2018. ..... Apendix B.2
Figure 5 Annual Temporal Average – Mean Daily Temperature (RCP 8.5)..... Apendix B.2
Figure 6 Annual Temporal Average – Maximum Daily Temperature (RCP 8.5)... Apendix B
Figure 7 Annual Temporal Average – Minimum Daily Temperature (RCP 8.5).... Apendix B
Figure 8 Annual Total Precipitation – Historical Temporal Total and Projected 30-year Mean (RCP 8.5)..... Apendix B

LIST OF APPENDICES

APPENDIX A CLIMATE CHANGE STATE OF KNOWLEDGE
A1 State of Current Knowledge

APPENDIX B CLIMATE PROFILE
B1 Introduction
B2 Temperature
- B2-1 Mean Temperature
- B2-2 Maximum Temperature
- B2-3 Minimum Temperature

B3 Precipitation
- B3-1 Total Annual & Seasonal Accumulation
- B3-2 Intensity-Duration-Frequency (IDF)

B4 Frost-Free Days

Abbreviations

CNN	Cree Nation of Nemaska
GHG	Greenhouse Gas
ICLR	Institute for Catastrophic Loss Reduction
IDF	Intensity-Duration-Frequency
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
RCP	Representative Concentration Pathway
SDBJ	Société de Développement de la Baie-James
UNEP	United Nations Environment Programme
WMO	World Meteorological Organization

1.0 INTRODUCTION

1.1 BACKGROUND

The objective is to perform a high-level assessment of risks to the proposed infrastructure due to meteorological events based on future climate projections in the area. The methodology used for this assessment is inspired from Infrastructure Canada's Climate Lens Guidance (Infrastructure Canada 2019), an accepted methodology for the assessment of climate risks.

As a first step, we catalogued the components that could be exposed and affected by meteorological events. In collaboration with the project team, we defined the infrastructure assets that were the subject of the assessment (access road, landfill itself, operations).

Current climate trends were obtained from Environment Canada's weather stations in proximity of the infrastructure being assessed. Stantec used state-of-the-art analytical tools to develop trends for a wide range of climate parameters, including precipitation, temperatures, and wind. We produced future climate projections for the area and complemented our analysis with information available in the published literature. Future climate projections were based on the Intergovernmental Panel on Climate Change (IPCC) greenhouse gas (GHG) emissions scenarios. Our experience in climate risks assessments of built and natural infrastructure is to use the Representative Concentration Pathway (RCP) 8.5 since global GHG emissions in the past years are closer to these projections (see Appendix B). The recent IPCC Special Report on Global Warming of 1.5ºC (October 8, 2018) supports the selection of the RCP 8.5 for this assessment.

We identified meteorological events that could cause structural or functional failures, or losses in levels of service. This climate information, combined with knowledge that the constructed assets will be in new condition and good working order, were used to determine the vulnerability of the assets to the current climate. This vulnerability was then reassessed to allow for potential changes in the severity of impacts if similar or stronger meteorological events were to happen in the future – within the project's intended lifespan and assuming proper operational maintenance procedures keep the assets in good condition.

Risks to the infrastructure were determined from the current and future climate events with respect to selected performance criteria such as structural integrity, functionality, and operational issues. Once the risk profile for the assets under consideration was developed, Stantec identified the impacts an asset failure would have on the community and on the environment.

1.2 RESSOURCES USED FOR THIS DOCUMENT

The present document provides a synthesis of various climate sources used to assess historical trends, observations, and future climate projections in the area of the proposed landfill.

The main sources for the information presented in this document are:

- Environment and Climate Change Canada weather station;
- Environment and Climate Change Canada and Natural Resources Canada gridded interpolated observational data (NRCANmet);
- Pacific Climate Impacts Consortium (PCIC) Climate Explorer;
- Environment and Climate Change Canada downscaled climate scenarios for Canada;
- State of Climate Change and Adaptation Knowledge for the Eeyou Istchee Bay Territory, Ouranos (2017);
- FNQLSDI, Portrait of First Nations Challenges in Terms of Infrastructure and Emergency Management in the Face of Climate Change (2017); and
- University of Western Ontario, Institute for Catastrophic Loss Reduction (ICLR), computerized Intensity-Duration-Frequency (IDF) generator- see http://www.idf-cc-uwo.ca/.

1.3 LIMITATIONS

This climate change impacts assessment was completed using the best information available to the assessment team at the time of the study. The focus of the assessment presented in this report is on the proposed Nemaska Landfill Site.

Since the Project is at the conceptual design phase, this study is a high-level assessment of the future climate risks to the proposed assets grouped, as needed, based on their function and vulnerability to climate events.

The climate data and trends (current and future projections) used in this study were obtained from various sources, and the analysis was performed by Stantec climatologists at a level of detail commensurate to the assessment. Cross-verification between climate information sources was conducted where possible to identify potential discrepancies between the data sources used. Uncertainty in the climate data collected was considered while performing this assessment, based on the team's knowledge of the study region and depending on the analysed climate impact on infrastructure.

1.4 METHODOLOGY

The methodology used to assess the future climate impacts on the proposed landfill and associated infrastructure was designed to identify the potential risks associated with future changes in climate and extreme weather events. The objective was to perform a high-level assessment of risks to the Project infrastructure due to extreme weather and climate uncertainty based on current climate and future climate projections in the area. This could include but would not be limited to impacts due to changes in temperature, precipitation, and wind.

The process used in this assessment aligns with International Organization for Standardization (ISO) 31000:2018 Risk Management Framework and ISO 14090:2019 Adaptation to Climate Change. The general intent of these methodologies is to identify relevant climate variables and relevant infrastructure responses, develop a risk evaluation matrix, and assign risk ratings to each infrastructure-climate interaction. This includes an estimate of the severity of climate impacts on the infrastructure systems (i.e., deterioration, damage, or destruction) to enable the identification of higher risk components and the nature of the impacts from the climate change threat. This information can be used to make informed engineering judgments on what components require adaptation as well as how to adapt them e.g., design adjustments, changes to operational or maintenance procedures.

The methodology used in this assessment of climate risks to the proposed landfill site is summarized below in Figure 1.

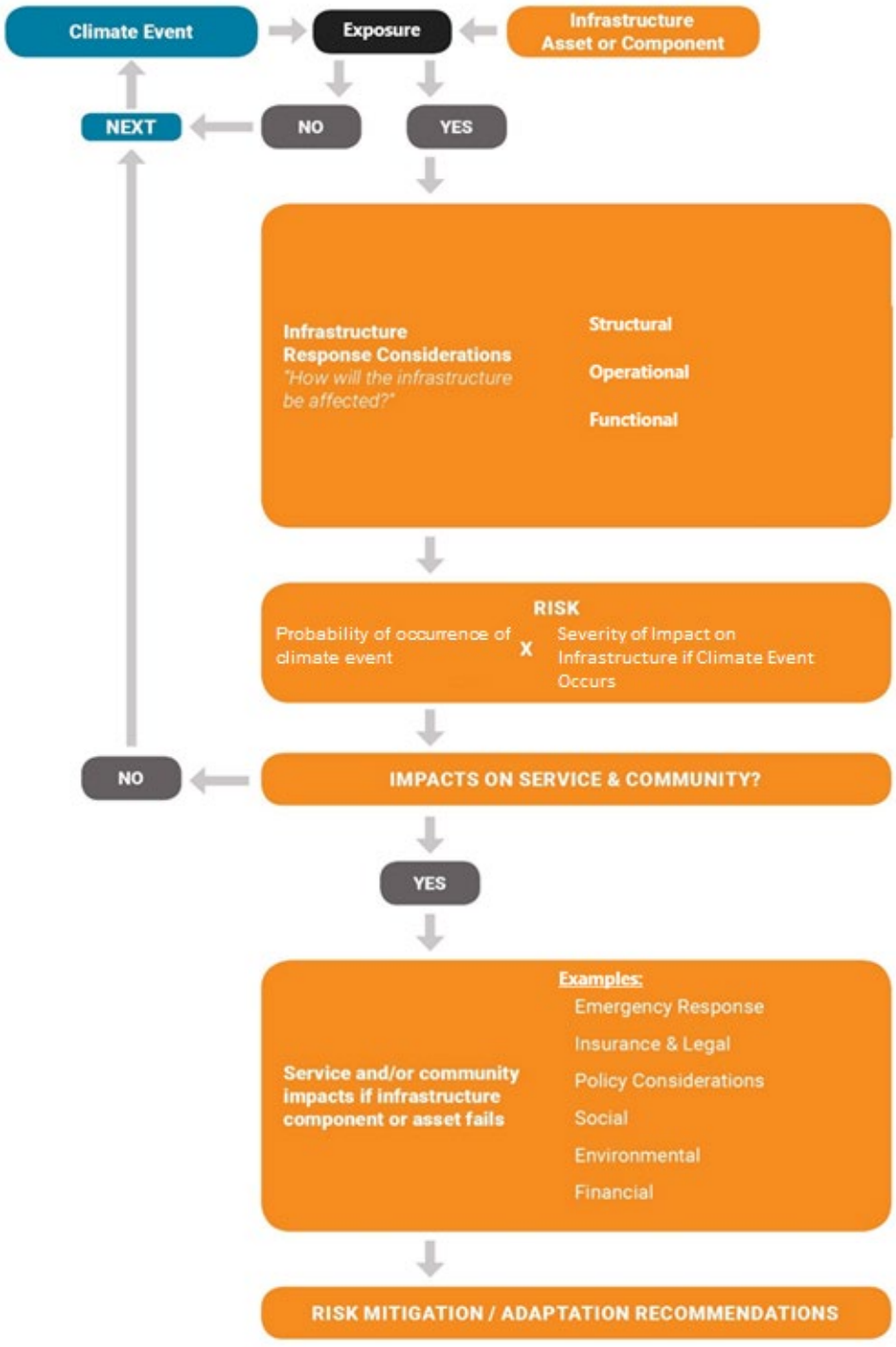


Figure 1 Illustration of the risk assessment process

1.5 TIME HORIZON

Depending on standard operational practices, the expected lifespan of the proposed Nemaska landfill site is 35 to 45 years. In order to represent the climate at the end of the useful life of the facility (operational lifespan), the future climate scenario in this study will be projected to the 2050, which corresponds with the 30-year period between 2041 and 2070. To help inform planning and operations following the closure of the proposed Nemaska Landfill, projections for the 2080 (2071-2100) have also been presented.

1.6 PLAUSIBLE CLIMATE SCENARIOS

Climate modelling uses various GHGemissions scenarios, known as RCPs, to project future climate variables under different concentrations and rates of release of GHGs to the atmosphere, as well as different global energy balances.

Various future trajectories of GHG emissions are possible depending on the global mitigation efforts in the coming years. RCPs are established by the IPCC, the international body for assessing the science related to climate change. The IPCC was set up in 1988 by the World Meteorological Organization (WMO) and United Nations Environment Programme (UNEP) to provide policymakers with regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation (IPCC 2014).

The IPCC has set four GHG emissions scenarios through RCPs. RCP 8.5 is the internationally recognized most pessimistic - “business as usual” GHG emissions scenario. Other GHG emissions scenarios represent more substantial and sustained reductions in GHG emissions: RCP 6, 4.5 and 2.6 (Figure 2). For example, the RCP 2.6 emissions scenario may be achievable with extensive adoption of biofuels/renewable energy and large-scale changes in global consumption habits, along with carbon capture and storage. RCP 2.6 is representative of a scenario that aims to keep global warming below 2°C above pre-industrial temperatures. RCP 4.5 is considered the ‘medium stabilization’ scenario where global mitigation efforts result in intermediate levels of GHG emissions (IPCC 2014).

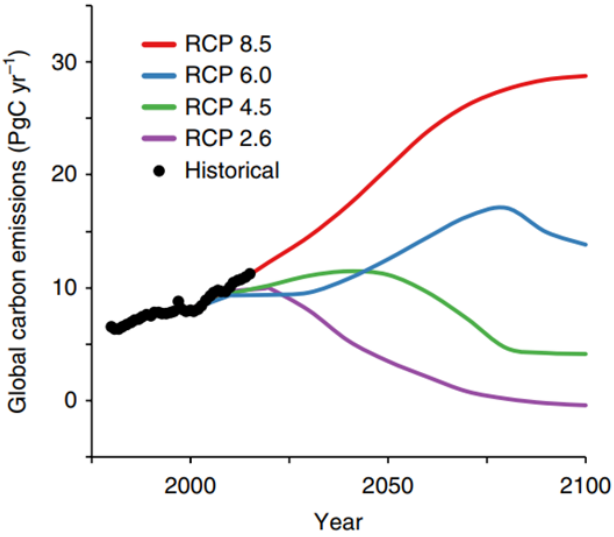


Figure 2 **Historical CO_2 emissions for 1980-2017 and projected emissions trajectories to 2100 for the four Representative Concentration Pathway (RCP) scenarios (Smith and Myers 2018).**

Although some progress has been made, current estimates of GHG emissions are still close to following the RCP 8.5 path and thus this assessment is based on climate parameters estimated under the RCP 8.5 scenario. The recent IPCC Special Report on Global Warming of 1.5 ºC (IPCC 2018) supports this selection.

2.0 CURRENT AND FUTURE CLIMATE

2.1 OBSERVATIONS RELATED TO RECENT CLIMATE CHANGES AND CURRENT CLIMATE

The results of Stantec's investigation in the current climate and recent climate change trends in the Nemaska area are detailed in Appendix B. Nemaska falls in the Boreal Shield Ecozone of Canada. This subarctic climate is characterized by relatively short summers with prolonged periods of daylight and cool temperatures, and winters that are long and very cold. Mean summer temperatures range between 6°C and 11°C, mean winter temperatures range between -11°C and -24.5°C east of Hudson Bay, and [mean annual precipitation] ranges 500mm-800mm.[1] The Nemaska area falls within the region classified by Natural Resources Canada as having "Isolated Patches of Permafrost with ice wedges" which is defined as having 0-10% of land area underlain by permafrost.[2]

Stantec's climate projection research indicated that in recent decades the area has seen an increase in temperatures in all seasons, an increase in rainfall in all seasons, and a decrease in snowfall, particularly in the fall and spring months. Stantec's research into these general trends are detailed in Appendix B, while they are compared to an Ouranos 2017 report titled State of Climate Change and Adaptation Knowledge for the Eeyou Istchee James Bay Territory, in Appendix A. In Stantec's experience, it is important to verify observational trends with local community representatives, where possible. Variability in firsthand weather reports can be expected given that people form their memories from different experiences. For example, the severity of a rainstorm will be remembered differently by someone who was outside during the storm as opposed to someone who maybe spent that time indoors. As part of another project to increase the Cree Nation of Nemaska (CNN) resilience to climate change, community members were asked to provide observations related to climate. This information was used to complement scientific data. Table 1 shows community member's input.

Table 1 Observed Direct and Indirect Climatic Changes

DIRECT Climatic Changes	INDIRECT Climatic Changes
Increased Temperature	- Heat wave (44˚C) - Hotter summers - Longer summers - Big forest fires, with dense smoke above the fire and lightning on top - Warmer water temperatures - More freeze-thaw cycles.

[1] A National Ecological Framework for Canada: Attribute Data. Marshall, I.B., Schut, P.H., and Ballard, M. 1999. Agriculture and Agri-Food Canada, Research Branch, Centre for Land and Biological Resources Research, and Environment Canada, State of the Environment Directorate, Ecozone Analysis Branch, Ottawa/Hull.

[2] The National Atlas of Canada 5th Edition: Her Majesty the Queen in Right of Canada, Department of Energy, Mines and Resources, 1995

DIRECT Climatic Changes	INDIRECT Climatic Changes
Decreased Temperature	- Cold snaps - Colder winter - Longer winter.
Variable Precipitation (increased and decreased)	- Spring runoff/flooding - Big, but short, downpour - Freezing rain (lots) - More snow and more wet.
Extremes	- Drought - Straight line winds (pockets of air) - High winds - Increase in storm intensity. Storms produce more damage. - Tornado in the Saint-Félicien and Chibougamau area.

2.2 OBSERVATIONS RELATED TO FUTURE CLIMATE CHANGES

2.2.1 Temperature

The data and literature show that the air temperature is warming and will continue to increase; seasonal increases vary, with the strongest increase in Winter, followed by Spring and Autumn (see Appendix B for seasonal data).

Frost free days (Appendix B) are expected to increase significantly as shown below.

- Historical 1984 - 2013 average frost-free days: 151
- Projected RCP 8.5 2020 average frost-free days: 164
- Projected RCP 8.5 2050 average frost-free days: 181
- Projected RCP 8.5 2080 average frost-free days: 198

2.2.2 Rainfall

Winter rain events show an increased occurrence in recent years. The data shows slight increases in rainfall in the Spring and Autumn. Summer rainfall shows a slight decrease (Appendix B).

Ouranos (2017) indicates “+13-20% and more extreme precipitation. High uncertainty about the amplitude of the increase and regional variability.” The IDF curves generated using the ICLR Computerized IDF Generator confirm the above statement and show significant increases in extreme precipitation. For example:

- The intensity of a 50-yr return, 30 minutes storm is projected to increase by 31 % (current: 76.8 mm/hr; future: 100.3 mm/hr) by the 2080.
- The intensity of a 100-yr return, 10 minutes storm is projected to increase by 51 % (current: 147.6 mm/hr; future: 194.3 mm/hr) by the 2080.

The above also points to an increase in the frequency of rain events. In the example of the 50-yr return rainfall above, it is projected this event will have a return period of less than 25 years in the future.

2.2.3 Snow

Ouranos (2017) reports “Decrease in snow cover and duration in the North and change of its characteristics. Large year-to-year variability and likelihood of differing snow trends across the region (potential increase in the South)”.

3.0 POTENTIAL IMPACTS OF CLIMATE CHANGES ON LANDFILL INFRASTRUCTURE AND OPERATIONS

This section provides a brief discussion on the main climatic and weather-related impacts that are anticipated to cause impact on the proposed landfill infrastructure and operations at the proposed Nemaska landfill site.

3.1 TEMPERATURE

Changing temperature regimes are likely to result in a number of effects to the local environment, such as potential impacts to permafrost soils, changes in the biochemical activity in waste material and surrounding soils, and possible changes to local hydrology and hydrogeology. A high-level review of potential impacts to the proposed landfill development and operation due to changing temperature patterns are summarized below:

- Altered decomposition rates within the landfill and surrounding soils;
- Increased odor and pest activity may cause more challenging working environments for site operators and other nearby activities;
- Higher insect activity, which are a potential vector for infectious diseases;
- Alteration of seasonal freeze and thaw periods (i.e. fall and spring) may result in changes to local hydrological and hydrogeological patterns and possible changes to leachate production rates; and
- Increased stress on vegetation and planting in the project area, which may also have on impact of the stability of slopes due to potential increased erosion.

3.2 PRECIPITATION

Projected changes in precipitation patterns in the area have the potential to produce a wide range of impacts to the local environmental conditions, including flood risks, changes to hydrology and hydrogeological systems, and soil stability. A high-level review of possible impacts to the proposed landfill due to projected changes in local precipitation are as follows:

- Increased ponding or flooding risks;
- Altered decomposition rates within the landfill and surrounding soils;
- Altered hydrological and hydrogeological patterns and possible changes to leachate production rates; and
- Increase slope stability and/or erosion risks.

3.3 STRONG WINDS

Projected changes in the strength and frequency of strong wind events in the northern regions could impact a number of environmental factors. An increase in daily wind gusts is projected into the 2050 (Ouranos 2017). Potential impacts to the proposed landfill due to an increase in the strength and frequency of high wind gusts includes:

- The generation of blowing dust, debris, and litter;



- The dispersion of odors from the landfill site;
- Potential impacts to the Hydro-Québec electrical transmission lines, located adjacent to the site; and
- Hazardous working conditions for personnel and for the operation of high-profile heavy equipment.

4.0 RISK ASSESSMENT

The following subsections provide an overview of impact severity (should a climate event occur), the probability of a climate variable occurring, and risk evaluation. The results of this assessment of risk will then be summarized in Sections 4.4 and 4.6.

4.1 PROPOSED INFRASTRUCTURE

The Project consisted of the development of a proposed landfill site to be located along Route du Nord, approximately 6 km southeast of the Nemaska community. The infrastructure assessed in this study is therefore associated with the proposed landfill, its construction, operation activities, and the surrounding environment. The Project infrastructure systems were grouped into the categories as presented in Table 2.

Table 2 List of Project Components Being Assessed

Infrastructure Category	Infrastructure Element
Access Road	Access road
	Ditches and roadway drainage
Waste Disposal Site	Onsite heavy equipment
	Onside drainage
	Uncovered waste
	Covered waste
	In-situ soil
	Stockpiled soil
	Cover material
	Leachate
Staff	Operations Staff
Site Surroundings	Wetlands
	Wildlife
	Forests
Third Party Interactions	Site Access: Rte du Nord owner (Hydro-Quebec)
	Site Access: Rte du Nord operator (SDBJ*)
	Hydro-Quebec transmission line and corridor

* SDBJ: Société de développement de la Baie-James

The means by which impacts occur on an exposed asset is considered through three “Impact Criteria”, as described in Table 3: structural integrity, operations and maintenance, and functionality. These performance criteria help to define how an exposed asset is impacted by a given climate event and provides a framework for considering the potential impacts of climate and extreme weather events on the Project’s components.

Table 3 Impact Criteria

Impact Criteria	Criteria Description	Examples of Impact Response
Structural Integrity	The climate event results in physical damage or deterioration to the infrastructure component.	- Component Failure - Component Deterioration - Increased Loading / Stress - Change in Materials Performance - Increased Insurance Claims/Needs
Operations & Maintenance (O&M)	The effect the climate event will have on the operations and other staff to perform their tasks, on additional inspections, maintenance and repairs to maintain the infrastructure performing to its intended capacity and level of service.	- Occupational Safety, Health & Safety - Reduced Serviceability - Increased Maintenance / Replacement Cycles and Frequencies - Increased Operation and Maintenance Cost - Change in Operational Performance
Functionality	The climate event results in a reduction in the capacity of the infrastructure component to perform its design function at its original/current condition.	- Violation of Policies and Procedures - Reduced User / Tennant Comfort - Public/Occupant Health and Safety Hazard - Temporary or Permanent Loss of Capacity

The extent to which damages or loss of service occurs on a particular asset and the subsequent impacts on the Project components are captured by a severity index, which rates the impact of select climate events on exposed infrastructure. This is presented as a 5-point scale (1 = 'insignificant' and 5 = 'catastrophic'), as presented in Table 4.

Table 4 Severity of Impacts Rating Scale

Severity Score	Severity Rating	Criteria / Comments
1	Insignificant	- No serious impact from a weather event - Repaired through regular operations and maintenance cycle
2	Minor	- Repair possible by local expertise - Costs covered by regular operations and maintenance cycle - No loss of service
3	Moderate	- Some damage to infrastructure - Extra costs and labour required to complete repairs - Assistance required from outside of the community for repairs - Some loss of service
4	Major	- Significant damage to infrastructure - Significant extra costs and labour required to complete repairs - Requires parts, services from outside of the community, and additional funding outside of capital and O&M budget allocation - Significant loss of service
5	Catastrophic	- Complete loss of the asset after a weather event - Repair not possible, replacement of component required - Extended period of loss of service, requiring alternative service arrangements for the community



The above performance criteria and severity ratings were used in conjunction with the probability of climate event occurrence (Section 4.2) to develop the risk rating for a particular climate impact, as discussed under Section 4.3.

4.2 CLIMATE CHANGES

The trends indicated for each climate parameter are based on the change in probability from the current climate to the future climate. For this assessment, a rating scale of 1 to 5 for the probability (likelihood) of a climate event occurring was adopted (Table 5). The probability score is assigned based on the evaluation of historical occurrences and future climate projections for each climate variable.

Table 5 Probability Rating Scale Based on Climate Event Occurrence

Score	Probability of occurrence	
	Description	Return period
1	Highly unlikely	1 in 100 years
	Improbable	
2	Remotely possible	1 in 20 years
3	Possible	1 in 10 years
	Occasional	
4	Somewhat likely	1 in 5 years
	Normal	
5	Likely	> 1 in 2.5 years
	Frequent	

Climate parameters and respective intensity thresholds selected for this assessment are presented in Table 6. The intensity thresholds were selected based on local extreme conditions and industry thresholds. Table 6 also presents the probability (likelihood) rating for each climate parameters in the current and future projected (2080) climates.

Table 6 Current and Future Probability Rating for Selected Climate Variables

Parameter Type	Climate Parameter	Parameter Threshold	Trend	Probability Scores		
				Baseline (1981 - 2010)	Projections (2050)	Projections (2080)
Temperature	High Maximum Temperatures	Tmax >= 30°C	→	5	5	5
	Heat Waves	Heat Waves	↗	4	5	5
	Increasing Mean Temperature	Overall increase (years warmer than 1981 - 2010 mean)	↗	4	5	5
	Low Temperatures	Very cold days (-30°C or less)	↘	5	4	3
Precipitation	Heavy Rainfall	50-yr storm	↗	2	2	3
	Increasing Mean Precipitation	Overall increase (more than 1981-2010 mean)	↗	4	4	5
Winds	High Wind Gusts	70 km/hr gusts	→	5	5	5
	Extreme Wind Gusts	90 km/hr gusts	→	5	5	5
Miscellaneous	Permafrost Degradation	Decreasing number of freezing days (currently 2200 freezing days on average)	↘	3	4	5

Probabilities of climate variable occurrence are used to help define the risk rating as per Section 4.3.

4.3 RISK EVALUATION

A Risk Rating can be developed for each climate-infrastructure interaction by assigning each a severity rating and a climate parameter probability rating. In this assessment, the Risk Rating is defined as the product of two rating schemes as in the formula below.

Risk Rating = Probability Rating x Severity Rating

- **Probability rating:** a rating that represents the probability (likelihood) of occurrence of a climate event above a selected threshold, ranging from 1 (highly unlikely) to 5 (likely)

- **Severity of impacts rating:** a rating of the impacts on the infrastructure asset or component should the climate event occur, ranging from 1 (insignificant) to 5 (catastrophic)

Risks are evaluated under current climate conditions to establish a baseline; future risks are assessed considering future (projected) climate changes. It is assumed that the proposed landfill infrastructure and other associated infrastructure and activities included in this assessment will undergo maintenance and repairs in the future as necessary to maintain them in a state of good repair and thus at a similar level of vulnerability to climate events as they are in the current climate. The vulnerability of the assets will increase if they are allowed to deteriorate thus increasing the risks to climate events. The deterioration of

the Project components is not considered in this assessment, i.e., the severity of impacts rating remains constant in current and future climate conditions.

The calculation of risk through the product of the probability and the severity ratings provides numerical risk ratings from 0-25, as shown in Figure 3. The extents of this risk rating structure range from 'Negligible' to 'Extreme' risks. Shock and stress situations represent special cases when severity is high and probability is low and when severity is low and probabilities are high, respectively. 'Shock' events are defined as rare, extreme and rapid/sudden-onset extremes conditions, causing an acute impact. 'Stress' events are defined as slow onset or "creeping" threats, causing chronic impacts.

Severity Rating							
	Catastrophic	**5**	**Shock**	10	15	20	25
	Major	**4**	4	8	12	16	20
	Moderate	**3**	3	6	9	12	15
	Minor	**2**	2	4	6	8	10
	Insignificant	**1**	1	2	3	4	**Stress**
			1	**2**	**3**	**4**	**5**
			Highly Unlikely (Improbable)	**Remotely Possible**	**Probable (Occasional)**	**Somewhat Likely (Normal)**	**Likely (Frequent)**
			Probability Rating				

Figure 3 Risk Rating Structure

Impacts of climate change on assets can include structural damage, reduced service life of assets and their components, and increased stress to systems and operations. These impacts can, for example, result in higher repair and maintenance costs, loss of asset value, strain on resources and may cause service interruptions.

Risk classifications, as defined in Figure 3, are presented in Table 7 along with their respective descriptions and level of risk treatment recommended.

Table 7 Risk Classification

Risk Classification	Risk Rating	Description of Risk	Risk Treatment
Negligible	1,2	• No permanent damage. • No service disruption occurs.	Risks do not require further consideration
Low	3,4,6	• Minor asset/equipment damage. • Minor service disruption may be possible. • No permanent damage. • Minor repairs or restoration expected.	Controls likely, but not required.
Moderate	5,8,9	• Expected limited damage to asset or to equipment components. • Minor repairs and some equipment replacement may be required. • Brief service disruption may be possible.	Some controls required to reduce risks to lower levels. Risk to be monitored for changes over time.
High	10,12, 15,16	• May result in significant permanent damage; or loss of asset or component that may require complete replacement. • More lengthy service disruption may be possible.	High priority control measures required.
Extreme	20,25	• May result in significant permanent damage; or loss of asset or component that may require complete replacement. • Significant service disruptions may be possible.	Immediate controls required.

4.4 CLIMATE RISKS PROFILE

The risk evaluation process described in the above sections was used to apply the probabilities of climate event occurrence and risk ratings for each climate-infrastructure interaction that were calculated. This was done both for the current climate as well as the future climate, which for this assessment is represented by the 30-year period around 2050 (2041-2070) and 2080 (2071-2100). Future risks assume that assets will be well maintained and in good condition, else the risk will be greater.Table 8 provides a summary of 'Moderate', 'High' and 'Extreme' rated risks. In order to focus the risk profile, climate-infrastructure interactions that yielded a 'Negligible' risk rating (i.e. a rating of 0) or a 'Low' risk rating (i.e. a rating of 3, 4, or 6) are assumed to not require further consideration and have not been identified in Table 8.

Table 8 Climate Impacts and Risk Ratings

Climate Parameter and Threshold	Infrastructure Element	Infrastructure Response	Impact	Risk Rating Legend: N L M H E Current Climate	Risk Rating Future Climate (2050/2080)	Potential Mitigation Measure
N: Negligible	L: Low		M: Moderate	H: High		E: Extreme
↑: Increasing Trend			↓: Decreasing Trend			↔: Stable Trend
High Max Temperature (Tmax ≥ 30°C)	Operational Staff	Functionality	Heat stress on site attendants and operators.	10	10 (↔)	Consider the incorporation of a shelter in the site design. Allow for frequent water breaks. Ensure use of clothing and PPE that is breathable.
Heat Waves	Operational Staff	Functionality	Heat stress on site attendants and operators.	12	15 (↑)	
Low Temperatures (< 30°C)	Heavy Equipment	Functionality	Equipment may not perform optimally and there is a potential for stress on certain components (for example: battery, engine, starter).	5	4 (↓)	Inspect and lubricate equipment before the winter season each year to ensure that machinery is in good working order.
	Operations Staff	Functionality	Cold stress on attendants and operators.	10	8 (↓)	Consider the incorporation of a heated shelter in the site design and allow for frequent breaks.
Heavy Rainfall (50-year storm)	Access Road	Structural Integrity O&M Functionality	Potential for ponding/flooding, channelization, or washouts under heavy rainfall events.	8	8 (↔)	Frequently inspect drainage systems for blockages and effective operation. Regrade roadway as needed.
	On-site Drainage	O&M Functionality	Potential for drainage issues to occur, including ponding, high water table, and contamination of runoff	8	8 (↔)	Frequently inspect drainage systems for blockages and effective operation. Inspect landfill edges and adjacent environment for signs

Climate Parameter and Threshold	Infrastructure Element	Infrastructure Response	Impact	Risk Rating Legend: N L M H E Current Climate	Risk Rating Future Climate (2050/2080)	Potential Mitigation Measure
N: Negligible	L: Low		M: Moderate	H: High		E: Extreme
↑: Increasing Trend			↓: Decreasing Trend			↔: Stable Trend
			under heavy rainfall events. Erosion of final cover at end of life.			of contaminated runoff or seepage.
Increased Mean Precipitation	Leachate	O&M	Increased leachate generation and high water table with increased mean precipitation	8	8 (↔)	Maintain environmental monitoring program to continually monitor the groundwater quality migrating off-site. Upon site closure, select a low-permeability cover material if leachate concentration is an issue.
Wind Gusts (High: 70 km/h) (Extreme: 90 km/h)	Heavy Equipment	Functionality	Strong wind gusts on high-profile equipment on potentially uneven or unstable soil could be hazardous.	High: 10 Extreme: 15	High: 10 Extreme: 15 (↔)	Limit the use of heavy equipment during high wind events, particularly on high or steep grades and uneven or unsettled terrain.
	Uncovered Waste	O&M	Wind-blown waste could result in litter scattering throughout the site and potentially beyond site limits.	High: 10 Extreme: 15	High: 10 Extreme: 15 (↔)	Cover waste at appropriate time intervals to minimize to amount of exposed waste. Monitor weather and cover loose waste if high winds are forecasted.
	Stockpiled Soil	O&M	Wind-blown sandy debris could result in the suspension of particulates in the air and could be a risk to	High: 10 Extreme: 15	High: 10 Extreme: 15 (↔)	Limit the height of material stockpiles to lower their profile.

Climate Parameter and Threshold	Infrastructure Element	Infrastructure Response	Impact	Risk Rating Legend: N L M H E Current Climate	Risk Rating Future Climate (2050/2080)	Potential Mitigation Measure
N: Negligible	L: Low		M: Moderate	H: High		E: Extreme
↑: Increasing Trend			↓: Decreasing Trend			↔: Stable Trend
			human and environmental health.			
	Operations Staff	Functionality	Strong winds could present health and safety challenges to on-site workers.	High: 5 Extreme: 10	High: 5 Extreme: 10 (↔)	Exercise caution when working in windy conditions. Cover exposed waste and pick up loose debris that could blow and potentially cause injury during high wind events.
	Hydro-Québec Transmission Line and Corridor	Structural Integrity O&M Functionality	Third-party risk; see Section 4.5.4.	High: 5 Extreme: 10	High: 5 Extreme: 10 (↔)	Third-party risk; see Section 4.5.4.
Permafrost Degradation	Route du Nord	Structural Integrity O&M Functionality	Third-party risk; see Section 4.5.4.	9	12 (↑)	Third-party risk; see Section 4.5.4.
	Hydro-Québec Transmission Line and Corridor	Structural Integrity	Third-party risk; see Section 4.5.4.	6	8 (↑)	Third-party risk; see Section 4.5.4.

4.5 OTHER RISK ASSESSMENT CONSIDERATIONS

There are some potential climate impacts to the proposed Nemaska Landfill project that are not easily described using a risk assessment format. These impacts are further discussed below.

4.5.1 Permafrost

Although the landfill site is not affected by permafrost, there could be isolated patches creating potential impacts of permafrost degradation on third party services. As described previously, the National Atlas of Canada 5th Edition for Permafrost in Canada indicates the Nemaska region to be on the boundary between two permafrost zones:

- Isolated Patches with Ice Wedges, with 0-10% of land area underlain by permafrost; and
- Sporadic Discontinuous Permafrost with Ice Wedges, with 10-50% of land area underlain by permafrost.

By this definition, it seems possible that permafrost conditions may exist; however, in sporadic discontinuous permafrost zones it is common that permafrost only persists in peatlands.[3] Peatlands are present immediately to the south of the proposed landfill site.

4.5.2 Wildfires

An impact not included in the risk matrix is the occurrence of fires. In the context of this project, there could be potential impacts of both wildfires and waste fires at the landfill site. Although wildfires and waste fires themselves are not considered climate events, future conditions due to climate change may increase the risk of fires.

Based on the assumption that fires are most prevalent in hot and dry conditions, the temperature and precipitation projections for summers in the future climate are valuable in assessing this risk. As shown in Appendix A, mean summer temperatures are projected to continue increasing, which may result in greater surface evaporation and drier soil/vegetation conditions. Furthermore, as shown in Appendix B, summer is the only season with a very small projected increase across all future periods. Based on the fact that future summers in the Nemaska area are projected to become hotter and receive little increase in precipitation, conditions susceptible to fires can be expected to increase.

There are other variables that contribute to fires which are more difficult to project in future climate conditions. One example is how the local vegetation may react to new climate conditions or if new species that are more fire prone migrate from the South. Changes in vegetation type and density that may be more susceptible to fire were outside the scope of this assessment.

[3] Government of Northwest Territories – Environment and Natural Resources, 13. Permafrost, 2014, https://www.enr.gov.nt.ca/en/state-environment/13-permafrost, Accessed 4Dec2018.

4.5.3 Site Surroundings

The site selected for the development of the proposed Nemaska landfill is located on a well-drained till ridge (drumlin) with a generally thin surface layer of organic matter (Poly-Géo 2017). The site area and near vicinity are generally comprised of intermixed shrubland and open deciduous forest (Québec Breeding Bird Atlas 2013). Tree cover at the site is generally comprised of jack pine and black spruce at varying densities (Poly-Géo 2017). Jack pine and black spruce populations are highly sensitive to fire cycles; longer wildfire intervals will reduce jack pine populations, while increased intervals will reduce black spruce populations (Le Goff and Sirois 2004). As discussed in Section 4.5.2, conditions susceptible to fires are expected to increase in the future, resulting in a potential loss of black spruce habitat in the area.

Ecological niche modelling estimates a total of 49 % of the land area in Northern Quebec to experience a species turnover of greater than 80 % as a result of species loss and movement due to climate change by the 2080 projection period (Berteaux et al. 2018). Species loss and movement due to range shifting under climate change is projected to have significant impacts on native wildlife populations due to changes in habitat suitability in Northern Québec. Although significant changes to community dynamics are expected, net species populations are anticipated to increase in northern areas as general species movement tends to be northward with average warming temperatures (Berteaux et al. 2018).

Changes to flora and fauna in the vicinity of the proposed landfill site could expose landfill site users and operators to new dangers and challenges including nuisance wildlife and new vectors for disease.

4.5.4 Third Party Interactions

The northern extents of the selected site boarders the Route du Nord highway and an electrical transmission line and corridor. The highway is owned by Hydro-Québec and is operated by the SDBJ and the transmission line and corridor are owned and operated by Hydro-Québec. Although these assets are not under the same jurisdictional control as those directly associated with the proposed landfill site, their management and any damages to these assets could significantly impact the operation of the landfill site.

Climate impacts to the highway, such as excessive snow or ice accumulation without proper maintenance could limit landfill site access and could result in hazardous conditions for users or operators attending the site. Physical damages such as roadway washouts could have similar impacts.

The electrical transmission line to the north of the selected site could be vulnerable to high winds and freezing rain events. Significant wind and freezing precipitation events could have damaging impacts on steel electrical transmission towers and conductors and could result in the swaying or galloping of conductors. Additionally, if permafrost is present in the vicinity of the tower foundations, its degradation could result in structural instability of the transmission towers. Complete collapse or line breakage could produce an ignition source for wildfires in the area.

4.6 RESULTS AND RECOMMENDATIONS

The proposed infrastructure and assets assessed under the projected effects of climate change in the Nemaska area were determined to be most at risk from increases in temperature and wind gusts. There were nine infrastructure-climate interactions that were assessed to have high risk ratings.

The greatest climate change threat to the project was determined to be the projected increase in frequency of heat waves on site attendants and operations personnel and the increase in the frequency of wind gusts on the operation of high-profile heavy equipment and on wind-blown dust and debris.

Exercising caution when working in challenging heat or windy conditions by taking frequent water breaks and seeking shelter as needed will be required to protect the workers at the site. High winds can present challenges while operating heavy equipment with a high profile. During high wind events, the use of heavy equipment, particularly on unstable or steep ground, should be limited. Additionally, exposed waste should be covered prior to a forecasted period of high wind gusts to limit the scattering of debris and litter. Stockpiles of soil and cover material should be limited in height to reduce the blowing of dust and suspension of particulates.

Following the closure of the Nemaska Landfill site, many vulnerabilities discussed in this report will remain through the contaminating lifespan of the site. Those relating to operator health and safety will ebb, however, an environmental monitoring and site inspection program as well as maintenance of the landfill cover, should remain active following site closure to ensure environmental compliance and the integrity of the landfill cover in consideration of the climate risks identified in this assessment.

4.7 CONCLUSIONS

This report is intended to inform design and operations considerations for the proposed Nemaska Landfill Site.

The future climate projections used in this report are based on the most conservative global GHG emissions scenarios produced by the international IPCC: the RCP 8.5. This scenario for the future climate projections analysis was selected based on past measurements of global GHG emissions which are in line with these projections.

The projected change to the local climate that will have impacts on the landfill is the projected increase of heat wave conditions and increasing high wind gust events. Annual and seasonal temperatures are also expected to increase, which may have impacts on the potential acceleration of waste decomposition. Increases in temperature may also affect the local soil conditions due to permafrost degradation on infrastructures that are not under the responsibility of CNN.

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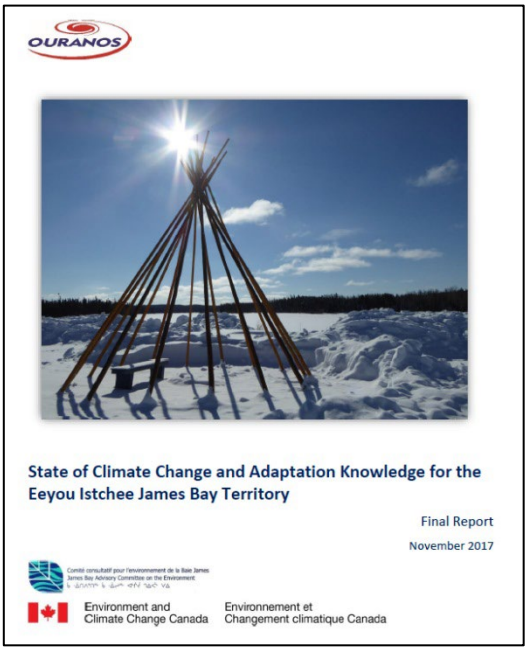
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Appendix A CLIMATE CHANGE STATE OF KNOWLEDGE

A1 STATE OF CURRENT KNOWLEDGE

The table below presents a summary of the past trends, observations and projected (2050) trends for the Eeyou Istchee Bay territory. In general (extract from the report):

- "Annual mean air temperature in the region has warmed by 1.5°C in the last 35 years with a sharp winter warming of 2-3°C.
- Different models project an increase in rainfall while snow cover will decrease thawing earlier.
- The Cree have noticed an increase in the frequency of lightning storms and flooding, weather has become less predictable and seasons are shifting.
- In James Bay, sea surface temperature is rising, sea ice is retreating rapidly, and climate models project a higher river discharge in James Bay potentially modifying water properties and dynamics in the Bay."



"These physical changes lead to impacts on the natural and built environment and entail a plethora of socio-economic and cultural repercussions.

- At the ecosystem level, local observers and scientific research report more southern species on the territory, the modification of phenological cycles, an increase in natural disturbances such as pests and invasive species and more frequent forest fires, as well as changes in the quality and availability of wildlife and plants used in traditional food systems.
- From a health perspective, changes in land access, accidents on the ice due to hazardous ice conditions, alteration of subsistence activities, traditional knowledge transfer, as well as the increase in diseases like diabetes and obesity, linked to changes in diet and food security, represent significant health risks and threaten Cree culture, identity, and well-being.
- In terms of infrastructure and industry, more frequently observed climate hazards can challenge current asset design, construction, operation, and maintenance leading to additional risks and costs for communities.
- The tourism sector, especially the cultural economy and outdoor tourism, is also vulnerable to climate change.

While the majority of climate change-induced effects in Eeyou Istchee James Bay appear to be negative, climate change may also be beneficial for some sectors if activities are adapted proactively."

Table 9 Past and projected changes of key climate parameters in Eeyou Istchee James Bay (Source: State of Climate Change and Adaptation Knowledge for the Eeyou Istchee James Bay Territory, Ouranos (2017)

Parameter	Past trend	Cree observations	Projected trend (2050)	Comments
Air temperature	↑	↑	↑	+3.6°C warming of mean temperature, 5.5°C in the winter. High regional and
Rainfall	↑	↑	↑	+13-20% and more extreme precipitation. High uncertainty about the amplitude of the increase and
Snow	↓	↓	↓	Decrease in snow cover and duration in the North and change of its characteristics. Large year-to-year variability and likelihood of differing snow trends across
Extreme weather events	↑	↑	↑	Weather has become more unpredictable. The intensity and frequency of extreme weather events (e.g. flooding or storms)
Sea ice extent	↓	↓	↓	For every 1°C increase sea ice extent decreases by 14%. 50% loss of ice thickness. Freeze-up and breakup will occur 3-4 weeks later and earlier,
Sea surface temperature	↑	Unobserved or undocumented	↑	+ 1-1.5° or 0.22±0.08°C/decade
River discharge	↑	↑	↑	+2-15%, but significant variability due to hydro-electric flow modifications. Earlier onset of maximum river discharge.
Lake/river ice	↓	↓	↓	Ice forms later in autumn and melts earlier in spring.

Appendix B CLIMATE PROFILE

B1 INTRODUCTION

When developing a profile of the historic climate of an area, the most valuable data is typically temperature, precipitation, and wind data collected from nearby weather stations. When defining a location's "current" climate it is typical to look at the weather patterns of the last 30 years only – although viewing the data from several decades ago can be useful in understanding long term trends. Furthermore, not all weather stations have complete data sets and their years of operation vary significantly; many no longer in operation. Thus, the challenge becomes finding weather station data that has been collecting complete information for the past 30 years but is also central to the location in question.

For the Nemaska area the closest weather station is approximately 175 km kilometers away at Eastmain (ID: 7092305). In addition to this distance being too far for confidently assuming similar weather patterns to Nemaska, Eastmain is situated on the coast of James Bay. Large bodies of water such as James Bay can cause significant variations on weather patterns, when compared to inland areas. Furthermore the Eastmain weather station only collected climate data from 1960 to 1993, which does not provide a "current" representation of the climate. When defining a location's "current" climate it is typical to look at the weather patterns of the last 30 years only – although viewing the data from several decades ago can be useful in understanding long term trends. Thus, the challenge becomes finding weather station data that has been collecting complete information for the past 30 years but is also central to the location in question. The closest station with a recent and complete 30-year data set is at La Grande Riviere Airport (ID: 7093715) which is approximately 240 km from Nemaska and collected data from 1976 to 2012. Nemaska. The data availability and time range, including the age of the data are factors in choosing which data to use for which application.

Future projections are based on the IPCC RCP[4] 8.5 scenario, which is characterized by increasing greenhouse gas emissions over time, representative of scenarios in the literature that lead to high greenhouse gas concentration levels[5]. RCP8.5 is commonly referred to as the "business-as-usual" emissions scenario as current greenhouse gas emissions correspond with the RCP 8.5 trajectory (Figure 4).

[4] RCP: Representative Concentration Pathways – a greenhouse gas concentration (not emissions) trajectories adopted by the Intergovernmental Panel on Climate Change (IPCC) for its fifth Assessment Report (AR5) in 2014.
[5] By comparison, RCP 4.5 is a stabilization scenario in which total radiative forcing is stabilized shortly after 2100 while RCP 2.6 emission pathway is representative of scenarios that lead to very low greenhouse gas concentration levels.

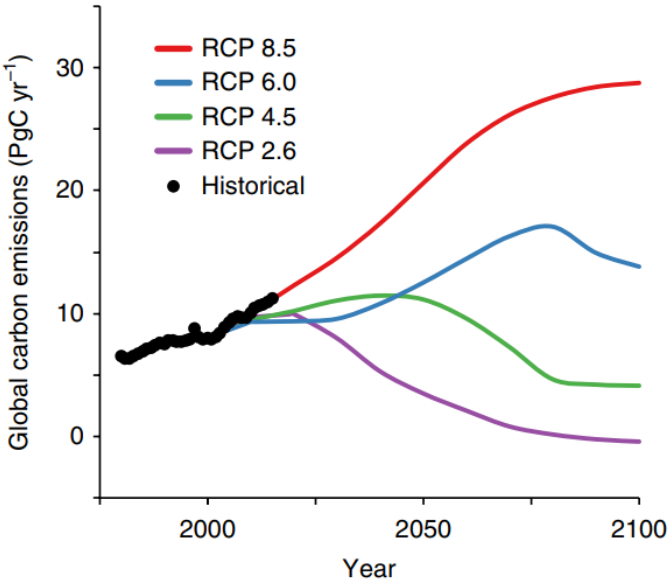


Figure 4 **Historical CO_2 emissions for 1980-2017 and projected emissions trajectories until 2100 for the four RCP scenarios. Current global greenhouse gas emissions correspond with the RCP 8.5 trajectory. Figure from Smith and Myers, 2018[6].**

The IPCC is the international body for assessing the science related to climate change. The IPCC was set up in 1988 by the WMOand UNEPto provide policymakers with regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation.

IPCC assessments provide a scientific basis for governments at all levels to develop climate related policies, and they underlie negotiations at the UN Climate Conference – the United Nations Framework Convention on Climate Change (UNFCCC). The assessments are policy-relevant but not policy-prescriptive: they may present projections of future climate change based on different scenarios and the risks that climate change poses and discuss the implications of response options, but they do not tell policymakers what actions to take.

Future climate projections were generated using statistically downscaled climate scenarios developed by the Pacific Climate Impacts Consortium (PCIC). These projections were developed from Global Climate Models from the Coupled Model Intercomparison Project Phase 5 (CMIP5; Taylor et al., 2012[7]), which provided climate projections for the IPCC's Fifth Assessment Report (IPCC, 2013[8]). The downscaled

[6] Smith, M.R. and S.S. Myers. 2018. Impact of anthropogenic CO_2 emissions on global human nutrition. *Nature Climate Change*, 8: 834-839.

[7] Taylor, K.E., R.J. Stouffer, and G.A. Meehl, 2012: An Overview of CMIP5 and the Experiment Design. Bull. Amer. Meteor. Soc., 93, 485–498, https://doi.org/10.1175/BAMS-D-11-00094.1

[8] IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp, doi:10.1017/CBO9781107415324.

projections provide daily output Canada-wide at a spatial resolution of 300 arc seconds (~10 km) for the simulated time period of 1950-2100.

Climate is usually defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of meteorological variables such as temperature, precipitation and wind over a period of time, typically 30 years.[9] Future climate projections for the RCP 8.5 scenario were performed for the following 30-yr periods:

- 2020: 2011 to 2040
- 2050: 2041 to 2070
- 2080: 2071 to 2100

[9] World Meteorological Organization, 2017: Commission for Climatology: Frequently Asked Questions. http://www.wmo.int/pages/prog/wcp/ccl/faqs.php (accessed Sept.28,2018)

B2 TEMPERATURE

The following subsections present historical and future projected temperature regimes for the Nemaska area. Data presented as mean, maximum, and minimum are provided as a compilation of historical data (orange columns), the last climate normal which corresponds to the average values between 1981 and 2010 (red columns), and the future projected normals (gray columns). Projected values are listed as 30-year averages for the 2020 (2011-2040), 2050 (2041-2070), and the 2080 (2071-2100). The average change in temperature values between the baseline (1981-2010) and future projected averages are summarized below.

B2-1 Mean Temperature

Table 10 Average Change in Average Daily Mean Temperature from 1981-2010 Baseline, RCP 8.5, Nemaska

Season	1981-2010 (°C)	Average Change in Mean Temperature from 1981-2010 Baseline (°C)		
		2020	2050	2080
Annual	-1.2	1.5	3.6	6.3
Winter	-18.3	2.1	5.0	8.3
Spring	-2.9	1.2	3.1	5.9
Summer	13.9	1.2	3.1	5.6
Autumn	2.4	1.4	3.1	5.4

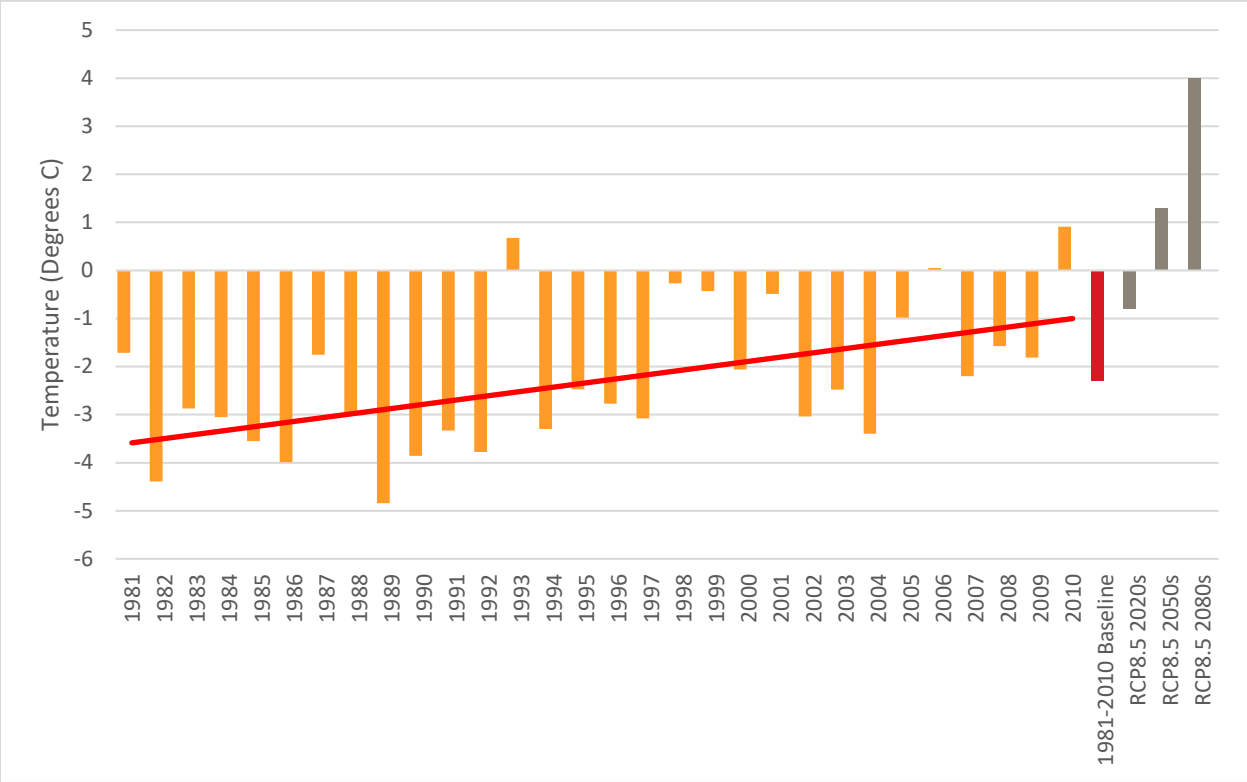


Figure 5 **Annual Temporal Average – Mean Daily Temperature (RCP 8.5)**

B2-2 Maximum Temperature

Table 11 **Average Change in Average Maximum Daily Temperature from 1981-2010 Baseline, RCP 8.5, Nemaska**

Season	1981-2010 (°C)	Average Change in Maximum Temperature from 1981-2010 Baseline (°C)		
		2020	2050	2080
Annual	4.2	1.4	3.3	5.8
Winter	-12.7	1.9	4.2	7.0
Spring	3.3	1.1	2.7	5.2
Summer	19.7	1.4	3.3	5.7
Autumn	6.1	1.3	3.0	5.3

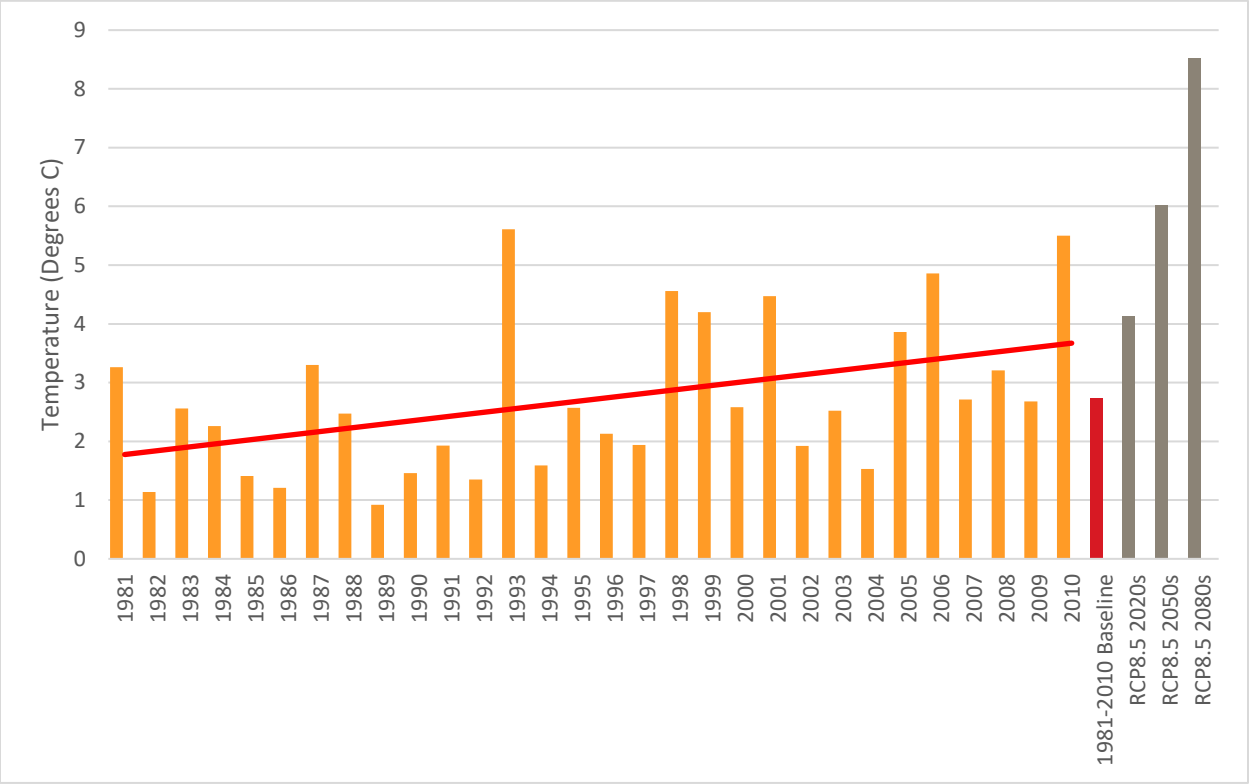


Figure 6 Annual Temporal Average – Maximum Daily Temperature (RCP 8.5)

B2-3 Minimum Temperature

Table 12 Average Change in Average Minimum Daily Temperature from 1981-2010 Baseline, RCP 8.5, Nemaska

Season	1981-2010 (°C)	Average Change in Minimum Temperature from 1981-2010 Baseline (°C)		
		2020	2050	2080
Annual	-6.4	1.5	3.8	6.8
Winter	-23.8	2.4	5.7	9.6
Spring	-8.9	1.2	3.5	6.6
Summer	8.1	1.2	3.1	5.5
Autumn	-1.4	1.4	3.2	5.6

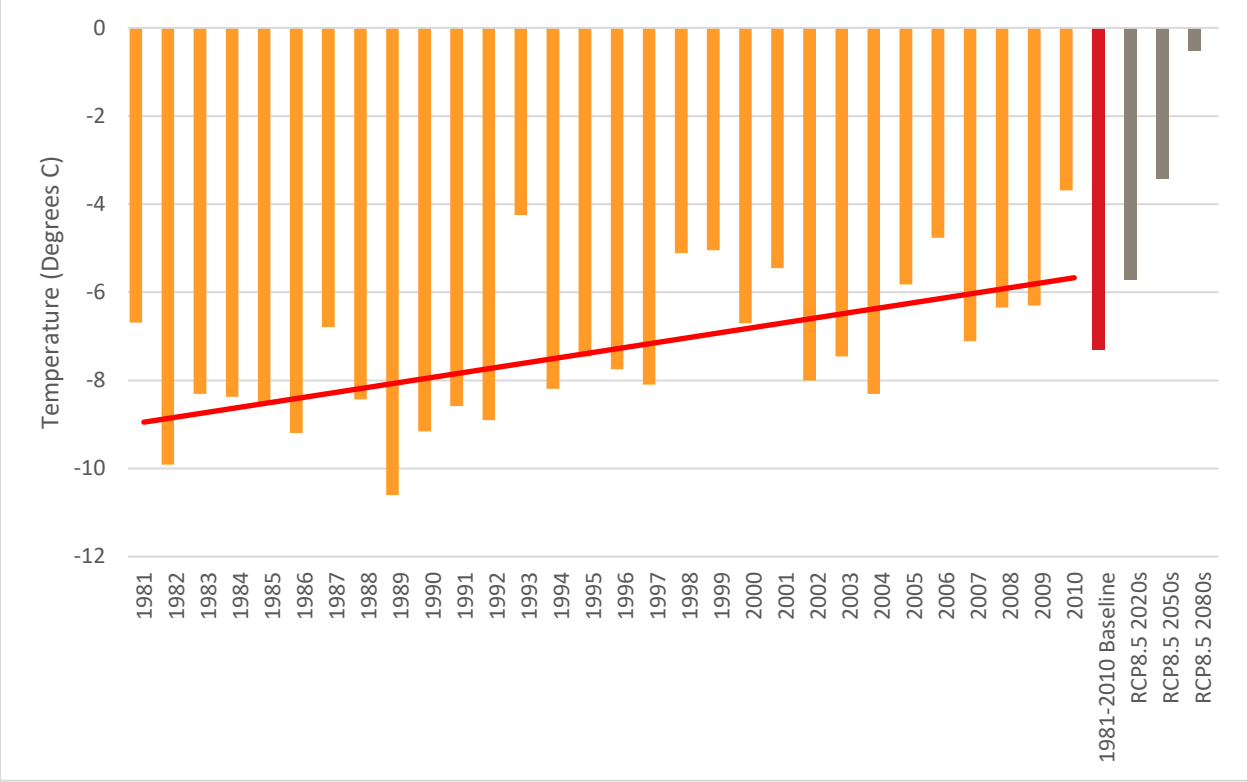


Figure 7 Annual Temporal Average – Minimum Daily Temperature (RCP 8.5)

B3 PRECIPITATION

The following subsections present historical and future projected precipitation data for the Nemaska area. Data relating to annual and seasonal total precipitation as well as rain and snowfall are provided as a compilation of historical data (orange columns) and where available, the last climate normal which corresponds to the average values between 1981 and 2010 (red columns) and the future projected normals (gray columns). Projected values are listed as 30-year averages for the 2020 (2011-2040), 2050 (2041-2070), and the 2080 (2071-2100). The average change in precipitation between the baseline (1981-2010) and future projected averages are summarized below.

B3-1 Total Annual & Seasonal Accumulation

Table 13 Average Percent Change in total annual and seasonal Precipitation from 1981-2010 Baseline, RCP 8.5, Nemaska

Season	1981-2010 (mm)	Average Percent Change in Total Precipitation from 1981-2010 Baseline (%)		
		2020	2050	2080
Annual	759	4.8	12.0	18.8
Winter	126	10.1	25.5	43.6
Spring	128	5.3	15.9	26.3
Summer	253	1.7	3.1	2.5
Autumn	252	5.5	12.6	19.4

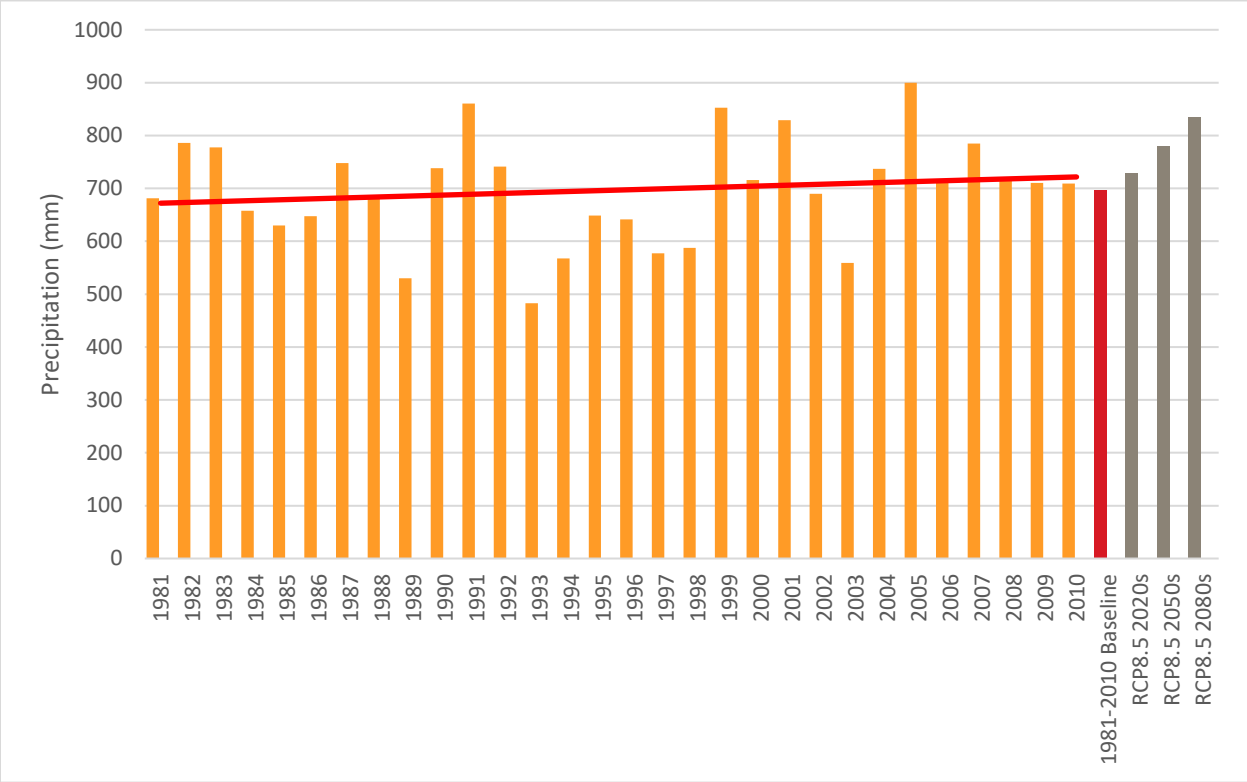


Figure 8 **Annual Total Precipitation – Historical Temporal Total and Projected 30-year Mean (RCP 8.5)**

B3-2 Intensity-Duration-Frequency (IDF)

Total precipitation amount (mm) in specific time intervals (5 minutes to 24 hours) for various return periods (2 years to 100 years), i.e. IDFdata, are provided. IDF data relates short-duration, high rainfall intensity with its frequency of occurrence. Evaluating historic and projected IDF data provides insight into how the intensity, duration, and frequency of precipitation events will change under future climate conditions.

Due to data coverage restrictions in the Nemaska region, IDF data is not available from a weather station within a reasonable distance of the project location. Therefore, the use of “ungauged” historical IDF data, calculated through interpolation between Environment Canada weather stations and gridded climate datasets available in the region, are provided. Projections for future climate IDF data are available based on results from 24 Global Circulation Models that simulate future climate conditions. The projected IDF data presented here is based on bias-corrected results from 9 downscaled climate models under the RCP 8.5 emission scenario from the Pacific Climate Impacts Consortium. The “ungauged” interpolations and projections are published by the ICLRat Western University, London, Ontario.

Historic and projected total precipitation amount (mm) in specific time interval (5 minutes to 24 hours) for various return periods (2 years to 100 years) are provided below for the ungauged location nearest to Nemska.

Table 14 Historical “Ungaged” Precipitation Event Accumulation IDF data (mm) – 51.68 °N, -76.26°E

T (years)	2	5	10	25	50	100
5 min	5.57	8.59	10.63	13.2	15.09	16.92
10 min	7.22	11.01	13.84	17.81	21.07	24.6
15 min	8.7	13.29	17.18	23.32	28.96	35.69
30 min	11.41	17.51	22.66	30.84	38.42	46.89
1 h	14.75	21.52	26.75	34.24	40.39	46.89
2 h	19.83	27.04	32.09	38.76	43.84	48.92
6 h	28.19	37.96	44.99	54.54	62.15	70.18
12 h	35.03	45.61	52.47	61.04	67.39	73.76
24 h	41.46	53.05	59.97	67.95	73.39	78.43

Table 15 Projected Precipitation Event Accumulation IDF data (mm) and Percent Change from Historical (%),RCP 8.5, 2020 (2011-2040)

T (years)	2		5		10		25		50		100	
	Total (mm)	% Change	Total (mm)	% Change	Total (mm)	% Change	Total (mm)	% Change	Total (mm)	% Change	Total (mm)	% Change
5 min	5.97	7.2%	9.38	9.2%	11.52	8.4%	14.52	10.0%	16.75	11.0%	18.82	11.2%
10 min	7.75	7.3%	12.02	9.2%	15	8.4%	19.58	9.9%	23.4	11.1%	27.37	11.3%
15 min	9.33	7.2%	14.51	9.2%	18.62	8.4%	25.64	9.9%	32.15	11.0%	39.7	11.2%
30 min	12.24	7.3%	19.11	9.1%	24.55	8.3%	33.9	9.9%	42.65	11.0%	52.16	11.2%
1 h	15.82	7.3%	23.49	9.2%	28.98	8.3%	37.65	10.0%	44.84	11.0%	52.16	11.2%
2 h	21.27	7.3%	29.51	9.1%	34.78	8.4%	42.61	9.9%	48.67	11.0%	54.42	11.2%
6 h	30.24	7.3%	41.44	9.2%	48.75	8.4%	59.97	10.0%	69	11.0%	78.06	11.2%
12 h	37.58	7.3%	49.79	9.2%	56.85	8.3%	67.11	9.9%	74.82	11.0%	82.05	11.2%
24 h	44.48	7.3%	57.9	9.1%	64.98	8.4%	74.71	9.9%	81.47	11.0%	87.24	11.2%

Table 16 Projected Precipitation Event Accumulation IDF data (mm) and Percent Change from Historical, RCP 8.5, 2050 (2041-2070)

T (years)	2		5		10		25		50		100	
	Total (mm)	% Change	Total (mm)	% Change	Total (mm)	% Change	Total (mm)	% Change	Total (mm)	% Change	Total (mm)	% Change
5 min	6.34	13.8%	9.7	12.9%	12.19	14.7%	15.35	16.3%	17.74	17.6%	20.22	19.5%
10 min	8.22	13.9%	12.43	12.9%	15.87	14.7%	20.71	16.3%	24.78	17.6%	29.4	19.5%
15 min	9.9	13.8%	15.01	12.9%	19.7	14.7%	27.11	16.3%	34.06	17.6%	42.65	19.5%
30 min	12.99	13.8%	19.77	12.9%	25.98	14.7%	35.85	16.2%	45.18	17.6%	56.04	19.5%
1 h	16.79	13.8%	24.3	12.9%	30.67	14.7%	39.81	16.3%	47.5	17.6%	56.04	19.5%
2 h	22.58	13.9%	30.53	12.9%	36.8	14.7%	45.07	16.3%	51.56	17.6%	58.46	19.5%
6 h	32.09	13.8%	42.87	12.9%	51.58	14.6%	63.42	16.3%	73.09	17.6%	83.86	19.5%
12 h	39.89	13.9%	51.5	12.9%	60.15	14.6%	70.97	16.3%	79.26	17.6%	88.14	19.5%
24 h	47.21	13.9%	59.9	12.9%	68.75	14.6%	79.01	16.3%	86.31	17.6%	93.72	19.5%



Table 17 Projected Precipitation Event Accumulation IDF data (mm) and Percent Change from Historical, RCP 8.5, 2080 (2071-2100)

T (years)	2		5		10		25		50		100	
	Total (mm)	% Change	Total (mm)	% Change	Total (mm)	% Change	Total (mm)	% Change	Total (mm)	% Change	Total (mm)	% Change
5 min	6.63	19.0%	10.58	23.2%	13.24	24.6%	16.65	26.1%	19.7	30.6%	22.27	31.6%
10 min	8.59	19.0%	13.56	23.2%	17.23	24.5%	22.45	26.1%	27.51	30.6%	32.38	31.6%
15 min	10.35	19.0%	16.37	23.2%	21.39	24.5%	29.4	26.1%	37.81	30.6%	46.96	31.6%
30 min	13.58	19.0%	21.57	23.2%	28.22	24.5%	38.87	26.0%	50.15	30.5%	61.71	31.6%
1 h	17.55	19.0%	26.51	23.2%	33.31	24.5%	43.17	26.1%	52.73	30.6%	61.71	31.6%
2 h	23.6	19.0%	33.31	23.2%	39.97	24.6%	48.86	26.1%	57.24	30.6%	64.38	31.6%
6 h	33.55	19.0%	46.76	23.2%	56.03	24.5%	68.76	26.1%	81.14	30.6%	92.35	31.6%
12 h	41.7	19.0%	56.18	23.2%	65.34	24.5%	76.95	26.1%	87.99	30.6%	97.06	31.6%
24 h	49.35	19.0%	65.34	23.2%	74.68	24.5%	85.66	26.1%	95.81	30.5%	103.21	31.6%

The above results indicate an increase in precipitation accumulation that can be expected for essentially all rainfall events at the nearest grid point to the Nemaska region. Under RCP 8.5, the projected percentage increase from the historical period for precipitation events range from 7.2% to 11.2% for the 2020 (2011-2040), 13.8% to 19.5% for the 2050 (2041-2070), and 19.0% to 31.6% for the 2080 (2071-2100).



B4 FROST-FREE DAYS

Table 17 below shows the current (baseline) average annual frost-free[10] days and the projected (RCP 8.5) changes. Table 18 shows the current (baseline) average length of the frost-free season[11] and the projected (RCP 8.5) changes.

Table 18 Average Annual Number of Frost-Free Days, Nemaska, RCP 8.5

Number of Frost-Free Days	
Period	**RCP 8.5**
Baseline (Historical 1981-2010)	151
2020	165
2050	183
2080	199

Table 19 Average Annual Length of Frost-Free Period, Nemaska, RCP 8.5

Number of Frost-Free Days	
Period	**RCP 8.5**
Baseline (Historical 1981-2010)	96
2020	119
2050	139
2080	160

[10] Definition of Frost-Free Days: The number of frost-free days is calculated based on the number of Frost Days, the number of days when the daily minimum temperature is less than 0°C (Source: Environment and Climate Change Canada).

[11] Definition of Frost-Free Season: The approximate length of the growing season, during which there are no freezing temperatures to kill or damage plants; calculated based on the number of days between the date of the last spring frost and the date of the first fall frost (Source: Environment and Climate Change Canada).

APPENDIX I FLORISTIC AND BIOPHYSICAL DATA

Table I-1 Site description of each sampling station

	WL ID	WL01	WL02A		WL02B	WL03		WL04	WL05 A		
Section 1 - Identification	Station ID	S05	S23	S71	S72	S39	S40	S41	S55	S58	S59
	Date (yyyy-mm-dd)	2019-09-03	2019-09-03	2019-09-04	2019-09-04	2019-09-04	2019-09-04	2019-09-04	2019-09-04	2019-09-04	2019-09-04
	Evaluator name	Martin Demers	Anne Keough	Anne Keough	Martin Demers	Martin Demers	Martin Demers	Martin Demers	Martin Demers	Martin Demers	Anne Keough
	Latitude (dg.dddddd)	51,636499	51,638548	51,638424	51,638865	51,638322	51,638215	51,638382	51,641860	51,640720	51,640114
	Longitude (dg.dddddd)	-76,225129	-76,224576	-76,223994	-76,223636	-76,218644	-76,219136	-76,217655	-76,211647	-76,212484	-76,212237
Section 2 - General description	Context	Wetland	Wetland	Wetland	Wetland	Wetland	Wetland	Wetland	Wetland	Wetland	Wetland
	Situation	Top of slope	Mid slope	Mid slope	Bottom of slope	Bottom of slope	Bottom of slope	Bottom of slope	Flat	Flat	Flat
	Shape of terrain	Concave	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular
	Presence of depressions	No	No	No	No	No	No	No	No	No	No
	Is the vegetation disturbed?	No	No	No	No	No	No	No	No	No	No
	Is the soil disturbed?	No	No	No	No	No	No	No	No	No	No
	Is the hydrology disturbed?	No	No	No	No	No	No	No	No	No	No
	Is it an anthropic environment?	No	No	No	No	No	No	No	No	No	No
	Is the site affected by a beaver dam?	No	No	No	No	No	No	No	No	No	No
	Type of disturbance	None	None	None	None	None	None	None	None	None	None
	Presence of invasive alien species	None	None	None	None	None	None	None	None	None	None
Section 3 - Hydrology	Standing water (%)	No	No	No	No	No	No	No	Yes - 5	No	No
	Hydrological connection	None	None	None	None	None	None	None	Intermittent Watercourse	Intermittent Watercourse	None
	Type of hydrological connection	No stream	No stream	No stream	No stream	No stream	No stream	No stream	At the edge of a watercourse or body of water	At the edge of a watercourse or body of water	No stream
	Primary indicators	Water saturation in the first 30 cm	None	Water saturation in the first 30 cm	Water saturation in the first 30 cm	Water saturation in the first 30 cm	Water saturation in the first 30 cm	Water saturation in the first 30 cm	Water saturation in the first 30 cm	Water saturation in the first 30 cm	Water saturation in the first 30 cm
	Secondary indicators	None	None	None	None	None	None	None	None	None	None
Section 4 - Soil	Organic horizon (cm)	50	15	10	45	2	10	25	50	50	30
	Type of organic horizon	Fibric	Humic	Mesic	Mesic	Fibric	Mesic	Mesic	Mesic	Mesic	Mesic
	Depth of bedrock (if observed) (cm)	N/A	N/A	20	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Depth of water table (cm)	N/A	N/A	N/A	N/A	N/A	N/A	25	N/A	15	N/A
	Class of drainage	Very poorly drained	Poorly drained	Imperfect	Very poorly drained	Imperfect	Imperfect	Imperfect	Poorly drained	Very poorly drained	Poorly drained
	Oblical drainage	No	Yes	Yes	No	No	No	No	No	No	No
	Soil profile - Depth (cm)	0 - 50	0 - 15 / 15 - 20	0 - 10	0 - 45	0 - 2 / 2 - 35	0 - 10 / 10 - 20	0 - 25 / 25 - 35	0 - 30 / 30 - 50	0 - 50	0 - 30
	Soil profile - Proportion of gravel, pebbles or blocks (%)	0	0 / 0	0	0	0 / 0	0 / 15-20	0 / 0-5	0 / 0	0	0
	Soil profile - Type	Fibric organic matter	Fibric organic matter / Coarse sand	Mesic organic matter	Mesic organic matter	Fibric organic matter / Sandy loam	Mesic organic matter / Coarse sand	Mesic organic matter / Sandy loam	Fibric organic matter / Mesic organic matter	Mesic organic matter	Mesic organic matter
	Soil profile - Matrix color	N/A	- / -	-	-	- / 10YR 4/3	- / -	- / -	- / -	-	-
	Soil profile - Mottles color	No mottles	No mottles / No mottles	No mottles	No mottles	No mottles / No mottles	No mottles / No mottles	No mottles / No mottles	No mottles / No mottles	No mottles	No mottles
Synthesis	Typical wetland vegetation?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Hydrological indicators test positive?	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Presence of hydromorphic soil?	Yes	No	No	Yes	No	No	Yes	Yes	Yes	Yes
	Is this station a wetland?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Type of wetland or terrestrial environment?	Peatland	Shrubby swamp	Shrubby swamp	Peatland	Swamp	Swamp	Peatland	Peatland	Peatland	Peatland
Notes		Leatherleaf open peatland	Common Labrador tea shrub		Common Labrador tea and leatherleaf peatland	Common Labrador tea and leatherleaf shrubby swamp	Common Labrador tea and leatherleaf shrubby swamp	Common Labrador tea and leatherleaf peatland	Common Labrador tea and leatherleaf peatland		

Table I-1 Site description of each sampling station

	WL ID	WL05A						WL05 B		WL05 C		WL05 D			
	Station ID	**S60**	**S61**	**S62**	**S69**	**S70**		**S56**	**S57**	**S64**	**S66**	**S63**			
Section 1 - Identification	**Date (yyyy-mm-dd)**	2019-09-04	2019-09-04	2019-09-04	2019-09-04	2019-09-04		2019-09-04	2019-09-04	2019-09-04	2019-09-04	2019-09-04			
	Evaluator name	Martin Demers	Anne Keough	Anne Keough	Martin Demers	Martin Demers		Anne Keough	Anne Keough	Anne Keough	Anne Keough	Martin Demers			
	Latitude (dg.dddddd)	51,640284	51,639620	51,638792	51,638316	51,638457		51,641347	51,640697	51,638001	51,637681	51,639561			
	Longitude (dg.dddddd)	-76,213645	-76,213024	-76,214236	-76,215277	-76,216061		-76,211581	-76,211617	-76,214907	-76,216377	-76,214110			
Section 2 - General description	**Context**	Wetland	Riverine	Wetland	Wetland	Wetland		Riverine	Wetland	Wetland	Wetland	Wetland			
	Situation	Flat	Flat	Flat	Flat	Flat		Bottom of slope	Flat	Flat	Flat	Bottom of slope			
	Shape of terrain	Regular	Regular	Regular	Regular	Regular		Regular	Regular	Regular	Regular	Regular			
	Presence of depressions	No	No	No	No	No		No	No	No	No	No			
	Is the vegetation disturbed?	No	No	No	No	No		No	No	No	No	No			
	Is the soil disturbed?	No	No	No	No	No		No	No	No	No	No			
	Is the hydrology disturbed?	No	No	No	No	No		No	No	No	No	No			
	Is it an anthropic environment?	No	No	No	No	No		No	No	No	No	No			
	Is the site affected by a beaver dam?	No	No	No	No	No		No	No	No	No	No			
	Type of disturbance	None	None	None	None	None		None	None	None	None	None			
	Presence of invasive alien species	None	None	None	None	None		None	None	None	None	None			
Section 3 - Hydrology	**Standing water (%)**	No	No	No	No	No		No	No	No	No	No			
	Hydrological connection	None	Permanent watercourse	None	None	None		None	None	None	None	None			
	Type of hydrological connection	No stream	Crossed by a stream	No stream	No stream	No stream		No stream	No stream	No stream	No stream	No stream			
	Primary indicators	Water saturation in the first 30 cm	Water saturation in the first 30 cm	Water saturation in the first 30 cm	Water saturation in the first 30 cm Smell of sulfur	Water saturation in the first 30 cm		None	Water saturation in the first 30 cm	Water saturation in the first 30 cm	Water saturation in the first 30 cm	Water saturation in the first 30 cm			
	Secondary indicators	None	None	None	None	None		None	None	None	None	None			
Section 4 - Soil	**Organic horizon (cm)**	60	30	10	60	35		50	30	5	5	5			
	Type of organic horizon	Mesic	Humic	Mesic	Mesic	Mesic		Fibric	Fibric	Fibric	N/A	Fibric			
	Depth of bedrock (if observed) (cm)	60	N/A	25	N/A	N/A		N/A	N/A	5	15	N/A			
	Depth of water table (cm)	5	N/A	N/A	0	5		N/A	N/A	N/A	N/A	20			
	Class of drainage	Very poorly drained	Poorly drained	Poorly drained	Very poorly drained	Very poorly drained		Poorly drained	Very poorly drained	Poorly drained	Imperfect	Imperfect			
	Oblical drainage	No	No	No	No	No		No	No	No	No	No			
	Soil profile - Depth (cm)	0 - 60	0 - 30	10 - 25	0 - 60	0 - 35	35 - 45	0 - 50	0 - 30	0 - 5	5 - 15	0 - 5	5 - 15	15 - 30	30 - 40
	Soil profile - Proportion of gravel, pebbles or blocks (%)	0	0	25-30	0	0	50-55	0	0	0	0	0	0	0	0
	Soil profile - Type	Mesic organic matter	Mesic organic matter	Sandy loam	Mesic organic matter	Mesic organic matter	Sandy loam	Fibric organic matter	Fibric organic matter	Organic matter Fibric	Podzol	Fibric organic matter	Sandy loam		
	Soil profile - Matrix color	-	-	-	-	-	-	-	-	-	-	-	2.5Y 6/4	10YR 4/3	10YR 5/3
	Soil profile - Mottles color	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles			
Synthesis	**Typical wetland vegetation?**	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes			
	Hydrological indicators test positive?	Yes	Yes	Yes	Yes	Yes		No	Yes	Yes	Yes	Yes			
	Presence of hydromorphic soil?	Yes	Yes	No	Yes	Yes		Yes	Yes	No	No	No			
	Is this station a wetland?	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes			
	Type of wetland or terrestrial environment?	Peatland	Peatland	Peatland	Peatland	Peatland		Peatland	Peatland	Swamp	Swamp	Peatland			
Notes		Common Labrador tea and leatherleaf peatland						Common Labrador tea peatland		Common Labrador tea shrub		Common Labrador tea and leatherleaf peatland			

Table I-1 Site description of each sampling station

	WL ID	WL05D		WL06		WL07B	WL07A			WL08				WL09		WL10	
Section 1 - Identification	Station ID	S65	S67	S73	S74	S02	S75			S76		S77		S79		S80	
	Date (yyyy-mm-dd)	2019-09-04	2019-09-04	2019-09-05	2019-09-05	2019-09-03	2019-09-05			2019-09-05		2019-09-05		2019-09-05		2019-09-05	
	Evaluator name	Martin Demers	Martin Demers	Martin Demers	Anne Keough	Anne Keough	Anne Keough			Anne Keough		Martin Demers		Martin Demers		Martin Demers	
	Latitude (dg.dddddd)	51,639266	51,638918	51,636695	51,636948	51,636580	51,636865			51,636130		51,636076		51,636064		51,636710	
	Longitude (dg.dddddd)	-76,215479	-76,215002	-76,228818	-76,228605	-76,227424	-76,226974			-76,226607		-76,225652		-76,224301		-76,223245	
Section 2 - General description	Context	Wetland	Wetland	Wetland	Wetland	Terrestrial	Wetland			Wetland		Wetland		Wetland		Wetland	
	Situation	Flat	Flat	Flat	Flat	Bottom of slope	Flat			Bottom of slope		Mid slope		Mid slope		Flat	
	Shape of terrain	Regular	Regular	Regular	Regular	Regular	Regular			Regular		Regular		Regular		Regular	
	Presence of depressions	No	No	No	No	No	No			No		No		No		No	
	Is the vegetation disturbed?	No	No	No	No	No	No			No		No		No		No	
	Is the soil disturbed?	No	No	No	No	No	No			No		No		No		No	
	Is the hydrology disturbed?	No	No	No	No	No	No			No		No		No		No	
	Is it an anthropic environment?	No	No	No	No	No	No			No		No		No		No	
	Is the site affected by a beaver dam?	No	No	No	No	No	No			No		No		No		No	
	Type of disturbance	None	None	None		None	None			None		None		None		None	
	Presence of invasive alien species	None	None	None	None	None	None			None		None		None		None	
Section 3 - Hydrology	Standing water (%)	No	No	No	No	No	No			No		No		No		No	
	Hydrological connection	None	None	None	Ditch	None	Ditch			None		None		None		None	
	Type of hydrological connection	No stream	No stream	No stream	No stream	No stream	No stream			No stream		No stream		No stream		No stream	
	Primary indicators	Water saturation in the first 30 cm	Water saturation in the first 30 cm	Water saturation in the first 30 cm	Water saturation in the first 30 cm	None	Water saturation in the first 30 cm			Water saturation in the first 30 cm		Water saturation in the first 30 cm		Water saturation in the first 30 cm		Water saturation in the first 30 cm	
	Secondary indicators	None	None	None	None	None	None			None		None		None		None	
Section 4 - Soil	Organic horizon (cm)	25	20	35	35	5	25			20		30		40		60	
	Type of organic horizon	Mesic	Mesic	Mesic	Mesic	Fibric	Mesic			Humic		Mesic		Mesic		Mesic	
	Depth of bedrock (if observed) (cm)	25	20	N/A	N/A	20	N/A			N/A		N/A		N/A		60	
	Depth of water table (cm)	N/A	10	10	N/A	N/A	N/A			N/A		N/A		N/A		20	
	Class of drainage	Imperfect	Imperfect	Poorly drained	Poorly drained	Good	Imperfect			Poorly drained		Imperfect		Poorly drained		Imperfect	
	Oblical drainage	No	No	No	No	No	No			No		No		No		No	
	Soil profile - Depth (cm)	0 - 25	0 - 20	0 - 35	35 - 40	0 - 35	0 - 20	0 - 5	15 - 20	20 - 30	0 - 20	20 - 30	0 - 30	30 - 35	0 - 15	15 - 40	0 - 25	25 - 60
	Soil profile - Proportion of gravel, pebbles or blocks (%)	0	5-10	0	70-75	0	5 - 20	0	0	0	0	0	0	75-80	0	0	0	0
	Soil profile - Type	Mesic organic matter	Mesic organic matter	Mesic organic matter	Coarse sand	Mesic organic matter	Podzol	Fibric organic matter	Mesic organic matter	Humic organic matter	Humic organic matter	Coarse sandy loam	Mesic organic matter	Verry coarse sand	Fibric organic matter	Mesic organic matter	Fibric organic matter	Mesic organic matter
	Soil profile - Matrix color	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Soil profile - Mottles color	No mottles	No mottles	No mottles		No mottles	No mottles			No mottles		No mottles			No mottles		No mottles	
Synthesis	Typical wetland vegetation?	Yes	Yes	Yes	Yes	Yes	Yes			Yes		Yes			Yes		Yes	
	Hydrological indicators test positive?	Yes	Yes	Yes	Yes	No	Yes			Yes		Yes			Yes		Yes	
	Presence of hydromorphic soil?	Yes	Yes	Yes	Yes	No	Yes			Yes		Yes			Yes		Yes	
	Is this station a wetland?	Yes	Yes	Yes	Yes	Yes	Yes			Yes		Yes			Yes		Yes	
	Type of wetland or terrestrial environment?	Peatland	Peatland	Peatland	Peatland	Wooded swamp	Peatland			Peatland		Peatland			Peatland		Peatland	
Notes		Common Labrador tea and leatherleaf peatland		Common Labrador tea and leatherleaf peatland		Common Labrador tea and jack pine wooded swamp	Common Labrador tea and leatherleaf peatland			Common Labrador tea and leatherleaf peatland					Common Labrador tea and leatherleaf peatland		Common Labrador tea and leatherleaf peatland	

Table I-1 Site description of each sampling station

	WL ID	TE01		TE02					TE03				
	Station ID	**S01**	**S03**	**S04**	**S06**	**S07**	**S08**	**S78**	**S09**	**S10**	**S11**	**S12**	**S13**
Section 1 - Identification	**Date (yyyy-mm-dd)**	2019-09-03	2019-09-03	2019-09-03	2019-09-03	2019-09-03	2019-09-03	2019-09-05	2019-09-03	2019-09-03	2019-09-03	2019-09-03	2019-09-03
	Evaluator name	Anne Keough	Martin Demers	Anne Keough	Martin Demers	Anne Keough	Anne Keough	Martin Demers	Martin Demers	Anne Keough	Martin Demers	Anne Keough	Martin Demers
	Latitude (dg.dddddd)	51,636953	51,636323	51,636822	51,636641	51,636321	51,636906	51,636114	51,637373	51,638416	51,638990	51,639580	51,640161
	Longitude (dg.dddddd)	-76,228170	-76,225758	-76,226205	-76,223977	-76,223224	-76,222237	-76,225084	-76,221183	-76,220174	-76,219156	-76,218882	-76,219172
Section 2 - General description	**Context**	Terrestrial	Terrestrial	Terrestrial	Terrestrial	Terrestrial	Wetland	Terrestrial	Terrestrial	Terrestrial	Terrestrial	Wetland	Terrestrial
	Situation	Mid slope	Mid slope	Flat	Top of slope	Flat	Flat	Top of slope	Bottom of slope	Flat	Top of slope	Flat	Mid slope
	Shape of terrain	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular
	Presence of depressions	No	No	No	No	No	No	No	No	No	No	No	No
	Is the vegetation disturbed?	No	No	No	No	No	No	No	No	No	No	No	No
	Is the soil disturbed?	No	No	No	No	No	No	No	No	No	No	No	No
	Is the hydrology disturbed?	No	No	No	No	No	No	No	No	No	No	No	No
	Is it an anthropic environment?	No	No	No	No	No	No	No	No	No	No	No	No
	Is the site affected by a beaver dam?	No	No	No	No	No	No	No	No	No	No	No	No
	Type of disturbance	None	None	None	None	None	None	None	None	None	None	None	None
	Presence of invasive alien species	None	None	None	None	None	None	None	None	None	None	None	None
Section 3 - Hydrology	**Standing water (%)**	No	No	No	No	No	No	No	No	No	No	No	No+AZ20:BC22
	Hydrological connection	None	None	None	None	None	None	None	None	None	None	None	None
	Type of hydrological connection	No stream	No stream	No stream	No stream	No stream	No stream	No stream	No stream	No stream	No stream	No stream	No stream
	Primary indicators	None	None	None	None	None	None	None	None	None	None	None	None
	Secondary indicators	None	None	None	None	None	None	None	None	None	None	None	None
Section 4 - Soil	**Organic horizon (cm)**	0	5	0	5	0	10	5	0	5	0	5	0
	Type of organic horizon	N/A	Fibric	N/A	Fibric	N/A	Fibric	Fibric	Fibric	Fibric	N/A	Fibric	Fibric
	Depth of bedrock (if observed) (cm)	10	5	15	50	10	10	5	N/A	5	N/A	15	N/A
	Depth of water table (cm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Class of drainage	Good	Rapid	Moderately well drained	Rapid	Good	Moderately well drained	Rapid	Rapid	Rapid	Rapid	Good	Rapid
	Oblical drainage	No	No	No	No	No	No	No	No	No	No	No	No
	Soil profile - Depth (cm)	0 - 10	0 - 5	0 - 15	0-5 / 10-50	0 - 10	0 - 10	0 - 5	0 - 30	0-5	0 - 45	0 - 15	0 - 30
	Soil profile - Proportion of gravel, pebbles or blocks (%)	0-5	0-10	0-10	0-5 / 5-10	0-5	0	0	0	0	0	0	0
	Soil profile - Type	Podzol	Organic matter on bedrock	Podzol	Fibric organic matter / Podzol	Podzol	Fibric organic matter	Fibric organic matter	Podzol	Organic matter on bedrock	Sandy loam	Podzol	Podzol
	Soil profile - Matrix color	-	-	-	- / -	-	-	-	-	-	-	-	-
	Soil profile - Mottles color	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles
Synthesis	**Typical wetland vegetation?**	No	No	No	No	No	No	No	No	No	No	No	No
	Hydrological indicators test positive?	No	No	No	No	No	No	No	No	No	No	No	No
	Presence of hydromorphic soil?	No	No	No	No	No	No	No	No	No	No	No	No
	Is this station a wetland?	No	No	No	No	No	No	No	No	No	No	No	No
	Type of wetland or terrestrial environment?	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments
Notes		Jack pine forest with sheep laurel		Black spruce stand with sheep laurel			Black spruce stand with sheep laurel		Jack pine forest with sheep laurel			Jac	

Table I-1 Site description of each sampling station

	WL ID	TE03			TE03						TE03				
	Station ID	**S14**	**S20**	**S21**	**S22**	**S27**	**S28**		**S29**	**S30**	**S31**	**S32**	**S33**		**S34**
Section 1 - Identification	**Date (yyyy-mm-dd)**	2019-09-03	2019-09-03	2019-09-03	2019-09-03	2019-09-04	2019-09-04		2019-09-04	2019-09-04	2019-09-04	2019-09-04	2019-09-04		2019-09-04
	Evaluator name	Anne Keough	Martin Demers	Anne Keough	Martin Demers	Anne Keough	Martin Demers		Anne Keough	Martin Demers	Anne Keough	Anne Keough	Martin Demers		Anne Keough
	Latitude (dg.dddddd)	51,640929	51,638981	51,639523	51,638589	51,642470	51,642236		51,641893	51,641207	51,641478	51,640907	51,640368		51,640725
	Longitude (dg.dddddd)	-76,218249	-76,222166	-76,220578	-76,223204	-76,214640	-76,213750		-76,215369	-76,215394	-76,216121	-76,216413	-76,216631		-76,217448
Section 2 - General description	**Context**	Wetland	Terrestrial	Terrestrial	Terrestrial	Wetland	Terrestrial		Wetland	Terrestrial	Wetland	Terrestrial	Terrestrial		Terrestrial
	Situation	Flat	Flat	Flat	Mid slope	Flat	Flat		Flat	Flat	Flat	Flat	Flat		Flat
	Shape of terrain	Regular	Regular	Regular	Regular	Regular	Regular		Regular	Regular	Regular	Regular	Regular		Regular
	Presence of depressions	No	No	No	No	No	No		No	No	No	No	No		No
	Is the vegetation disturbed?	Yes	No	No	No	No	No		No	No	No	Yes	No		Yes
	Is the soil disturbed?	No	No	No	No	No	No		No	No	No	No	No		No
	Is the hydrology disturbed?	No	No	No	No	No	No		No	No	No	No	No		No
	Is it an anthropic environment?	No	No	No	No	No	No		No	No	No	No	No		No
	Is the site affected by a beaver dam?	No	No	No	No	No	No		No	No	No	No	No		No
	Type of disturbance	Chemin accès tests sol	None	None	None	None	None		None	None	Coupe pour excavation	Coupe pour accès test sol	None		Coupe pour accès
	Presence of invasive alien species	None	None	None	None	None	None		None	None	None	None	None		None
Section 3 - Hydrology	**Standing water (%)**	No	No	No	No	No	No		No	No	No	No	No		No
	Hydrological connection	None	None	None	None	None	None		None	None	None	None	None		None
	Type of hydrological connection	No stream	No stream	No stream	No stream	No stream	No stream		No stream	No stream	No stream	No stream	No stream		No stream
	Primary indicators	None	None	None	None	None	None		None	None	None	None	None		None
	Secondary indicators	None	None	None	None	None	None		None	None	None	None	None		None
Section 4 - Soil	**Organic horizon (cm)**	5	5	5	5	0	5		0	10	0	0	5		0
	Type of organic horizon	Fibric	Fibric	Fibric	Fibric	N/A	Fibric		N/A	Fibric	N/A	N/A	Fibric		N/A
	Depth of bedrock (if observed) (cm)	10	15	N/A	20	10	N/A		10	20	5	N/A	N/A		10
	Depth of water table (cm)	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A		N/A
	Class of drainage	Good	Rapid	Good	Rapid	Good	Rapid		Good	Rapid	Good	Good	Rapid		Good
	Oblical drainage	No	No	No	No	No	No		No	No	No	No	No		No
	Soil profile - Depth (cm)	0 - 10	0 - 15	0 - 30	0 - 20	0 - 10	0 - 5	10 - 30	0 - 10	0 - 10 / 10 - 20	0 - 5	0 - 30	0 - 5	5 - 40	0 - 10
	Soil profile - Proportion of gravel, pebbles or blocks (%)	0	0	0	0	0	0	0	0	0 / 0	0	0	0	5-10	0
	Soil profile - Type	Podzol	Podzol	Podzol	Podzol	Podzol	Fibric organic matter	Podzol	Podzol	Fibric organic matter / Coarse sand	Podzol	Podzol	Fibric organic matter	Fine sand	Podzol
	Soil profile - Matrix color	-	-	-	-	-	-	-	-	- / -	-	-	-	Brun/orange	-
	Soil profile - Mottles color	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles		No mottles	No mottles	No mottles	No mottles	No mottles		No mottles
Synthesis	**Typical wetland vegetation?**	No	No	No	No	No	No		No	No	No	No	No		No
	Hydrological indicators test positive?	No	No	No	No	No	No		No	No	No	No	No		No
	Presence of hydromorphic soil?	No	No	No	No	No	No		No	No	No	No	No		No
	Is this station a wetland?	No	No	No	No	No	No		No	No	No	No	No		No
	Type of wetland or terrestrial environment?	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments		Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments		Terrestrial environments
Notes		k pine forest with sheep laurel			Jack pine forest with sheep laurel						Jack pine forest with sheep laurel				

Table I-1 Site description of each sampling station

	WL ID		TE03						TE03						
	Station ID	**S35**	**S36**	**S37**	**S38**	**S43**	**S44**	**S45**	**S46**	**S47**	**S48**	**S49**	**S50**	
Section 1 - Identification	**Date (yyyy-mm-dd)**	2019-09-04	2019-09-04	2019-09-04	2019-09-04	2019-09-04	2019-09-04	2019-09-04	2019-09-04	2019-09-04	2019-09-04	2019-09-04	2019-09-04	
	Evaluator name	Anne Keough	Martin Demers	Anne Keough	Anne Keough	Martin Demers	Anne Keough	Anne Keough	Martin Demers	Anne Keough	Martin Demers	Anne Keough	Martin Demers	
	Latitude (dg.dddddd)	51,640184	51,639878	51,639536	51,639135	51,639466	51,638865	51,639508	51,639812	51,640143	51,640174	51,640758	51,640640	
	Longitude (dg.dddddd)	-76,217507	-76,218326	-76,217483	-76,217652	-76,216848	-76,216464	-76,215869	-76,216383	-76,214718	-76,215805	-76,213972	-76,215188	
Section 2 - General description	**Context**	Terrestrial	Terrestrial	Terrestrial	Terrestrial	Terrestrial	Wetland	Terrestrial	Terrestrial	Terrestrial	Terrestrial	Terrestrial	Terrestrial	
	Situation	Flat	Flat	Flat	Flat	Mid slope	Mid slope	Mid slope	Flat	Mid slope	Top of slope	Mid slope	Mid slope	
	Shape of terrain	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	
	Presence of depressions	No	No	No	No	No	No	No	No	No	No	No	No	
	Is the vegetation disturbed?	Yes	No	No	No	No	No	Yes	No	No	No	No	No	
	Is the soil disturbed?	No	No	No	No	No	No	No	No	No	No	No	No	
	Is the hydrology disturbed?	No	No	No	No	No	No	No	No	No	No	No	No	
	Is it an anthropic environment?	No	No	No	No	No	No	No	No	No	No	No	No	
	Is the site affected by a beaver dam?	No	No	No	No	No	No	No	No	No	Yes	No	No	
	Type of disturbance	Coupe	None	None	None	None	None	Accès	None	None	None	None	None	
	Presence of invasive alien species	None	None	None	None	None	None	None	None	None	None	None	None	
Section 3 - Hydrology	**Standing water (%)**	No	No	No	No	No	No	No	No	No	No	No	No	
	Hydrological connection	None	None	None	None	None	None	None	None	None	None	None	None	
	Type of hydrological connection	No stream	No stream	No stream	No stream	No stream	No stream	No stream	No stream	No stream	No stream	No stream	No stream	
	Primary indicators	None	None	None	None	None	None	None	None	None	None	None	None	
	Secondary indicators	None	None	None	None	None	None	None	None	None	None	None	None	
Section 4 - Soil	**Organic horizon (cm)**	0	5	0	5	5	5	0	2	5	15	2	15	
	Type of organic horizon	N/A	Fibric	N/A	Fibric	Fibric	Fibric	N/A	N/A	Fibric	Fibric	Fibric	Fibric	
	Depth of bedrock (if observed) (cm)	5	N/A	N/A	N/A	N/A	15	5	15	5	N/A	3	N/A	
	Depth of water table (cm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
	Class of drainage	Good	Rapid	Good	Good	Rapid	Moderately well drained	Good	Rapid	Good	Rapid	Good	Rapid	
	Oblical drainage	No	No	No	No	No	Yes	No	No	No	No	No	No	
	Soil profile - Depth (cm)	0 - 5	0 - 5 / 5 - 35	0 - 30	0 - 30	0 - 5 / 5 - 20	0 - 15	0 - 5	0 - 2 / 2 - 15	0 - 5	0 - 15 / 15 - 35	0 - 3	0 - 15 / 15 - 30	
	Soil profile - Proportion of gravel, pebbles or blocks (%)	0	0 / 0	0	0	0 / 25-30	0	0	0 / 35-40	0	0 / 0	0	0 / 0	
	Soil profile - Type	Podzol	Fibric organic matter / Podzol	Podzol	Podzol	Fibric organic matter / Coarse sand	Podzol	Podzol	Fibric organic matter / Coarse sand	Fibric organic matter	Fibric organic matter / Podzol	Podzol	Fibric organic matter / Podzol	
	Soil profile - Matrix color	-	- / -	-	-	- / -	-	-	- / -	-	- / -	-	- / -	
	Soil profile - Mottles color	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles	No mottles	
Synthesis	**Typical wetland vegetation?**	No	No	No	No	No	Yes	No	No	No	No	No	No	
	Hydrological indicators test positive?	No	No	No	No	No	No	No	No	No	No	No	No	
	Presence of hydromorphic soil?	No	No	No	No	No	No	No	No	No	No	No	No	
	Is this station a wetland?	No	No	No	No	No	No	No	No	No	No	No	No	
	Type of wetland or terrestrial environment?	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments	
Notes			Jack pine forest with sheep laurel					Jack pine forest with sheep laurel						

Table I-1 Site description of each sampling station

	WL ID	TE03					TE04							TE05	
	Station ID	**S51**	**S52**		**S53**	**S54**	**S68**	**S15**		**S16**	**S18**	**S19**	**S26**		**S17**	**S25**
Section 1 - Identification	**Date (yyyy-mm-dd)**	2019-09-04	2019-09-04		2019-09-04	2019-09-04	2019-09-04	2019-09-03		2019-09-03	2019-09-03	2019-09-03	2019-09-04		2019-09-03	2019-09-04
	Evaluator name	Anne Keough	Martin Demers		Anne Keough	Anne Keough	Anne Keough	Martin Demers		Anne Keough	Anne Keough	Anne Keough	Martin Demers		Martin Demers	Anne Keough
	Latitude (dg.dddddd)	51,641292	51,641093		51,641610	51,641968	51,637733	51,641706		51,642257	51,641659	51,640625	51,643179		51,643034	51,643826
	Longitude (dg.dddddd)	-76,213511	-76,214580		-76,214348	-76,212990	-76,217697	-76,217268		-76,216080	-76,218653	-76,220565	-76,213448		-76,216274	-76,212926
Section 2 - General description	**Context**	Terrestrial	Terrestrial		Terrestrial	Terrestrial	Terrestrial	Terrestrial		Wetland	Terrestrial	Terrestrial	Terrestrial		Terrestrial	Terrestrial
	Situation	Mid slope	Top of slope		Flat	Flat	Mid slope	Flat		Flat	Mid slope	Mid slope	Mid slope		Mid slope	Flat
	Shape of terrain	Regular	Regular		Regular	Regular	Regular	Regular		Regular	Regular	Regular	Regular		Regular	Regular
	Presence of depressions	No	No		No	No	No	No		No	No	No	No		No	No
	Is the vegetation disturbed?	No	No		Yes	No	No	No		No	No	No	No		No	No
	Is the soil disturbed?	No	No		No	No	No	No		No	No	No	No		No	No
	Is the hydrology disturbed?	No	No		No	No	No	No		No	No	No	No		No	No
	Is it an anthropic environment?	No	No		No	No	No	No		No	No	No	No		No	No
	Is the site affected by a beaver dam?	No	No		No	No	No	No		No	No	No	No		No	No
	Type of disturbance	None	None		Accès	None	None	None		None	None	None	None		None	None
	Presence of invasive alien species	None	None		None	None	None	None		None	None	None	None		None	None
Section 3 - Hydrology	**Standing water (%)**	No	No		No	No	No	No		No	No	No	No		No	No
	Hydrological connection	None	None		None	None	None	None		None	None	None	None		None	None
	Type of hydrological connection	No stream	No stream		No stream	No stream	No stream	No stream		No stream	No stream	No stream	No stream		No stream	No stream
	Primary indicators	None	None		None	None	None	None		None	None	None	None		None	None
	Secondary indicators	None	None		None	None	None	None		None	None	None	None		None	None
Section 4 - Soil	**Organic horizon (cm)**	1	5		5	5	2	10		5	3	10	2		0	0
	Type of organic horizon	Fibric	Fibric		Fibric	Fibric	Fibric	Fibric		Fibric	Fibric	Fibric	Fibric		N/A	N/A
	Depth of bedrock (if observed) (cm)	2	N/A		10	10	20	20		10	8	15	10		0	5
	Depth of water table (cm)	N/A	N/A		N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A		N/A	N/A
	Class of drainage	Good	Rapid		Good	Good	Good	Rapid		Good	Good	Good	Rapid		Rapid	Good
	Oblical drainage	No	No		No	No	No	No		No	No	No	No		No	No
	Soil profile - Depth (cm)	0 - 2	0 - 5	5 - 30	0 - 10	0 - 10	0 - 20	0 - 10	10 - 20	0 - 10	0 - 8	0 - 15	0 - 2	2 - 10	0 - 30	0 - 5
	Soil profile - Proportion of gravel, pebbles or blocks (%)	0	0	0	0	0	0-5	0	0	0	0	0	0	10-15	0	0
	Soil profile - Type	Podzol	Fibric organic matter	Podzol	Podzol	Podzol	Coarse sandy loam	Fibric organic matter	Podzol	Podzol	Podzol	Podzol	Fibric organic matter	Coarse sandy loam	Podzol	Podzol
	Soil profile - Matrix color	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Soil profile - Mottles color	No mottles	No mottles		No mottles	No mottles	No mottles	No mottles		No mottles	No mottles	No mottles	No mottles		No mottles	No mottles
Synthesis	**Typical wetland vegetation?**	No	No		No	No	No	No		No	No	No	No		No	No
	Hydrological indicators test positive?	No	No		No	No	No	No		No	No	No	No		No	No
	Presence of hydromorphic soil?	No	No		No	No	No	No		No	No	No	No		No	No
	Is this station a wetland?	No	No		No	No	No	No		No	No	No	No		No	No
	Type of wetland or terrestrial environment?	Terrestrial environments	Terrestrial environments		Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments		Terrestrial environments	Terrestrial environments	Terrestrial environments	Terrestrial environments		Terrestrial environments	Terrestrial environments
Notes		Jack pine forest with sheep laurel					Jack pine forest with sheep laurel	Black spruce stand with jack pine and sheep laurel							Speckled alder and velvet-leaved blueberry shrub	

Table I-1 Site description of each sampling station

	WL ID	TE06	TE07
Section 1 - Identification	Station ID	S24	S42
	Date (yyyy-mm-dd)	2019-09-04	2019-09-04
	Evaluator name	Martin Demers	Anne Keough
	Latitude (dg.dddddd)	51,644668	51,638139
	Longitude (dg.dddddd)	-76,212637	-76,217105
Section 2 - General description	Context	Terrestrial	Wetland
	Situation	Flat	Mid slope
	Shape of terrain	Regular	Regular
	Presence of depressions	No	No
	Is the vegetation disturbed?	No	No
	Is the soil disturbed?	No	No
	Is the hydrology disturbed?	No	No
	Is it an anthropic environment?	No	No
	Is the site affected by a beaver dam?	No	No
	Type of disturbance	None	None
	Presence of invasive alien species	None	None
Section 3 - Hydrology	Standing water (%)	No	No
	Hydrological connection	None	None
	Type of hydrological connection	No stream	No stream
	Primary indicators	None	None
	Secondary indicators	None	None
Section 4 - Soil	Organic horizon (cm)	3	5
	Type of organic horizon	Fibric	Fibric
	Depth of bedrock (if observed) (cm)	N/A	N/A
	Depth of water table (cm)	N/A	N/A
	Class of drainage	Rapid	Good
	Oblical drainage	No	No
	Soil profile - Depth (cm)	0 - 30	0 - 30
	Soil profile - Proportion of gravel, pebbles or blocks (%)	0	0
	Soil profile - Type	Podzol	Podzol
	Soil profile - Matrix color	-	-
	Soil profile - Mottles color	No mottles	No mottles
Synthesis	Typical wetland vegetation?	No	No
	Hydrological indicators test positive?	No	No
	Presence of hydromorphic soil?	No	No
	Is this station a wetland?	No	No
	Type of wetland or terrestrial environment?	Terrestrial environments	Terrestrial environments
Notes		Jack pine forest with sheep laurel	Black spruce stand with sheep laurel

Table I-2B Floristic compositon of sampling stations in terrestial environments

VEGETATIVE LAYER	ENGLISH NAME	FRENCH NAME	LATIN NAME	HYDRIC STATUS	TE01				TE02								
				Station ID	S01		S03		S04		S06		S07		S08		S
				Percent coverage (%)	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute
Tree layer	paper birch	bouleau à papier	*Betula papyrifera*	NI													
	black spruce	épinette noire	*Picea mariana*	FACH					20	**66,7**	10	**100,0**	25	**71,4**	15	**60,0**	5
	jack pine	pin gris	*Pinus banksiana*	NI	40	**100,0**	10	**100,0**	10	**33,3**			10	**28,6**	10	**40,0**	10
				Percent coverage of tree layer (%)	**40**	**100**	**10**	**100**	**30**	**100**	**10**	**100**	**35**	**100**	**25**	**100**	**15**
Shrub layer	speckled alder	aulne rugueux	*Alnus incana ssp. rugosa*	FACH**			15	14,7			15	25,4	30	**54,5**	75	**178,6**	5
	velvet-leaved blueberry	bleuet fausse-myrtille	*Vaccinium myrtilloides*	NI	5	5,6	5	4,9	10	11,1	10	**16,9**	35	**63,6**	20	**47,6**	10
	glandular birch	bouleau glanduleux	*Betula glandulosa*	FACH							5	8,5			2	4,8	10
	pin cherry	cerisier de Pennsylvanie	*Prunus pensylvanica*	NI									10	18,2	10	**23,8**	
	black spruce	épinette noire	*Picea mariana*	FACH	5	5,6	5	4,9			2	3,4	10	18,2	5	11,9	
	sheep laurel	kalmia à feuilles étroites	*Kalmia angustifolia*	NI	75	**83,3**	75	**73,5**	60	**66,7**	20	**33,9**			5	11,9	80
	northern Labrador tea	petit thé du Labrador	*Rhododendron tomentosum*	NI													
	jack pine	pin gris	*Pinus banksiana*	NI			2	2,0									5
	Bebb's willow	saule de Bebb	*Salix bebbiana*	FACH					15	16,7	2	3,4					5
	pussy willow	saule discolore	*Salix discolor*	FACH													
	common Labrador tea	thé du Labrador	*Rhododendron groenlandicum*	OBL****	5	5,6			5	5,6	5	8,5					
				Percent coverage of shrub layer (%)	**90**	**100**	**102**	**100**	**90**	**100**	**59**	**100**	**55**	**100,0**	**42**	**100,0**	**115**
Herbaceous layer	yellow clintonia	clintonie boréale	*Clintonia borealis*	NI			2										10
	trailing arbutus	épigée rampante	*Epigaea repens*	NI	1												
	stiff clubmoss	lycopode innovant	*Lycopodium annotinum*	NI							2		5	5,3			
	wild lily-of-the-valley	maïanthème du Canada	*Maianthemum canadense*	NI													
	mountain cranberry	petite airelle	*Vaccinium vitis-idaea*	NI													
	bunchberry	quatre-temps	*Cornus canadensis*	NI	1		5										
	sphagnum sp.	sphaignes sp.	*Sphagnum sp.*	FACH***					85	85,0			80	84,2			
	lichen sp.	lichen sp.	*Lichen sp.*	NI***					15	15,0			10	10,5			
				Percent coverage of herbaceous layer (%)	**2**		**7**		**100**		**2**		**95**	**100**	**0**		**10**
Dominance test				Number of dominant OBL or FACH species	0		0		1		1		1		1		
				Number of dominant NI species	2		2		2		2		2		3		
				Is the vegetation dominated by hydrophytes	No		No		No		No		No		No		N
Synthesis				Typical wetland vegetation?	No		No		No		No		No		No		N
				Hydrological indicators test positive?	No		No		No		No		No		No		N
				Presence of hydromorphic soil?	No		No		No		No		No		No		N
				Is this station a wetland?	No		No		No		No		No		No		N

Legend

Hydric status: OBL = obligate wetland plant of meridional Quebec, FACH = facultative wetland plant of meridional Quebec or NI = No indicator plant of meridional Quebec

Dominant species: Species for which relative percent coverage is identified in **bold black** are dominant species : with a relative 20% coverage or more, and/or species for which cumulative relative percent coverage within a vegetative layer allow to reach a relative 50% coverage of this layer.

* Relative percent coverage is calculated for all vegetative layers that cover 10% or more of the sampling station.

** Speckled alder being ubiquitous in both wetlands and terrestrial environments, it was not included in the dominance calculation.

*** Since these invascular species were not identified with the species, they were not included in the dominance calculation

**** Species considered facultative wetland plant in this study

Table I-2B Floristic compositon of sampling stations in terrestial environments

VEGETATIVE LAYER	ENGLISH NAME	FRENCH NAME	LATIN NAME	HYDRIC STATUS		TE03											
				Station ID	78	S09		S10		S11		S12		S13		S14	
				Percent coverage (%)	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *
Tree layer	paper birch	bouleau à papier	*Betula papyrifera*	NI													
	black spruce	épinette noire	*Picea mariana*	FACH	**33,3**					2	11,8	5	**33,3**	5	**33,3**	5	**25,0**
	jack pine	pin gris	*Pinus banksiana*	NI	**66,7**	15	**100,0**	15	**100,0**	15	**88,2**	10	**66,7**	10	**66,7**	15	**75,0**
				Percent coverage of tree layer (%)	100	15	100	15	100	17	100	15	100	15	100	20	100
Shrub layer	speckled alder	aulne rugueux	*Alnus incana ssp. rugosa*	FACH**	4,3					5	8,1	25	29,4	10	10,0		
	velvet-leaved blueberry	bleuet fausse-myrtille	*Vaccinium myrtilloides*	NI	8,7	10	13,0	5	16,7	5	8,1			10	10,0		
	glandular birch	bouleau glanduleux	*Betula glandulosa*	FACH	8,7	5	6,5										
	pin cherry	cerisier de Pennsylvanie	*Prunus pensylvanica*	NI								5	5,9				
	black spruce	épinette noire	*Picea mariana*	FACH		5	6,5	5	16,7							5	5,3
	sheep laurel	kalmia à feuilles étroites	*Kalmia angustifolia*	NI	**69,6**	45	**58,4**	20	**66,7**	50	**80,6**	55	**64,7**	80	**80,0**	90	**94,7**
	northern Labrador tea	petit thé du Labrador	*Rhododendron tomentosum*	NI													
	jack pine	pin gris	*Pinus banksiana*	NI	4,3	5	6,5			2	3,2						
	Bebb's willow	saule de Bebb	*Salix bebbiana*	FACH	4,3	2	2,6										
	pussy willow	saule discolore	*Salix discolor*	FACH													
	common Labrador tea	thé du Labrador	*Rhododendron groenlandicum*	OBL****		5	6,5										
				Percent coverage of shrub layer (%)	100	77	100	30	100	62	100	85	100	100	100	95	100
Herbaceous layer	yellow clintonia	clintonie boréale	*Clintonia borealis*	NI	**100,0**												
	trailing arbutus	épigée rampante	*Epigaea repens*	NI													
	stiff clubmoss	lycopode innovant	*Lycopodium annotinum*	NI													
	wild lily-of-the-valley	maïanthème du Canada	*Maianthemum canadense*	NI													
	mountain cranberry	petite airelle	*Vaccinium vitis-idaea*	NI													
	bunchberry	quatre-temps	*Cornus canadensis*	NI													
	sphagnum sp.	sphaignes sp.	*Sphagnum sp.*	FACH***								65	86,7			75	83,3
	lichen sp.	lichen sp.	*Lichen sp.*	NI***				95	100,0			10	13,3			15	16,7
				Percent coverage of herbaceous layer (%)	100	0		95	100	0		75	100	0		90	100
Dominance test			Number of dominant OBL or FACH species		1	0		0		0		1		1		1	
			Number of dominant NI species		3	2		2		2		2		2		2	
Synthesis			Is the vegetation dominated by hydrophytes		No	No		No		No		No		No		No	
			Typical wetland vegetation?		No	No		No		No		No		No		No	
			Hydrological indicators test positive?		No	No		No		No		No		No		No	
			Presence of hydromorphic soil?		No	No		No		No		No		No		No	
			Is this station a wetland?		No	No		No		No		No		No		No	

Legend

Hydric status: OBL = obligate wetland plant of meridional Quebec, FACH = facultative wetland plant of meridional Quebec or NI = No indicator plant of meridion

Dominant species: Species for which relative percent coverage is identified in **bold black** are dominant species : with a relative 20% coverage or more, and/or speci

* Relative percent coverage is calculated for all vegetative layers that cover 10% or more of the sampling station.

** Speckled alder being ubiquitous in both wetlands and terrestrial environments, it was not included in the dominance calculation.

*** Since these invascular species were not identified with the species, they were not included in the dominance calculation

**** Species considered facultative wetland plant in this study

Table I-2B Floristic compositon of sampling stations in terrestial environments

VEGETATIVE LAYER	ENGLISH NAME	FRENCH NAME	LATIN NAME	HYDRIC STATUS			TE03										
				Station ID	S20		S21		S27		S28		S29		S30		S
				Percent coverage (%)	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute
Tree layer	paper birch	bouleau à papier	*Betula papyrifera*	NI													
	black spruce	épinette noire	*Picea mariana*	FACH			5	**20,0**			2	11,8					
	jack pine	pin gris	*Pinus banksiana*	NI	20	**100,0**	20	**80,0**	20	**100,0**	15	**88,2**	20	**100,0**	15	**100,0**	20
				Percent coverage of tree layer (%)	**20**	**100**	**25**	**100**	**20**	**100**	**17**	**100**	**20**	**100**	**15**	**100**	**20**
Shrub layer	speckled alder	aulne rugueux	*Alnus incana ssp. rugosa*	FACH**					10	9,5	10	9,5	15	15,0	10	10,3	10
	velvet-leaved blueberry	bleuet fausse-myrtille	*Vaccinium myrtilloides*	NI					15	14,3	10	9,5	10	10,0			5
	glandular birch	bouleau glanduleux	*Betula glandulosa*	FACH													
	pin cherry	cerisier de Pennsylvanie	*Prunus pensylvanica*	NI			5	5,6			5	4,8					
	black spruce	épinette noire	*Picea mariana*	FACH							5	4,8					
	sheep laurel	kalmia à feuilles étroites	*Kalmia angustifolia*	NI	80	**97,6**	75	**83,3**	80	**76,2**	75	**71,4**	70	**70,0**	80	**82,5**	80
	northern Labrador tea	petit thé du Labrador	*Rhododendron tomentosum*	NI													
	jack pine	pin gris	*Pinus banksiana*	NI	2	2,4							5	5,0			
	Bebb's willow	saule de Bebb	*Salix bebbiana*	FACH			10	11,1							2	2,1	
	pussy willow	saule discolore	*Salix discolor*	FACH													
	common Labrador tea	thé du Labrador	*Rhododendron groenlandicum*	OBL****											5	5,2	
				Percent coverage of shrub layer (%)	**82**	**100**	**90**	**100**	**105**	**100**	**105**	**100**	**100**	**100**	**97**	**100**	**95**
Herbaceous layer	yellow clintonia	clintonie boréale	*Clintonia borealis*	NI													
	trailing arbutus	épigée rampante	*Epigaea repens*	NI													
	stiff clubmoss	lycopode innovant	*Lycopodium annotinum*	NI													
	wild lily-of-the-valley	maïanthème du Canada	*Maianthemum canadense*	NI													
	mountain cranberry	petite airelle	*Vaccinium vitis-idaea*	NI													
	bunchberry	quatre-temps	*Cornus canadensis*	NI													
	sphagnum sp.	sphaignes sp.	*Sphagnum sp.*	FACH***			10	20,0					5	6,7			
	lichen sp.	lichen sp.	*Lichen sp.*	NI***			40	80,0	65	100,0			70	93,3			75
				Percent coverage of herbaceous layer (%)	**0**		**50**	**100**	**65**	**100**	**0**		**75**	**100**	**0**		**75**
Dominance test			Number of dominant OBL or FACH species		0		1		0		0		0		0		
			Number of dominant NI species		2		2		2		2		2		2		
			Is the vegetation dominated by hydrophytes		No		No		No		No		No		No		N
Synthesis			Typical wetland vegetation?		No		No		No		No		No		No		N
			Hydrological indicators test positive?		No		No		No		No		No		No		N
			Presence of hydromorphic soil?		No		No		No		No		No		No		N
			Is this station a wetland?		No		No		No		No		No		No		N

Legend

Hydric status: OBL = obligate wetland plant of meridional Quebec, FACH = facultative wetland plant of meridional Quebec or NI = No indicator plant of meridion

Dominant species: Species for which relative percent coverage is identified in **bold black** are dominant species : with a relative 20% coverage or more, and/or speci

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Table I-2B Floristic compositon of sampling stations in terrestial environments

VEGETATIVE LAYER	ENGLISH NAME	FRENCH NAME	LATIN NAME	HYDRIC STATUS	TE03											
				Station ID	31	S32		S33		S34		S35		S36		S37	
				Percent coverage (%)	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *
Tree layer	paper birch	bouleau à papier	*Betula papyrifera*	NI												
	black spruce	épinette noire	*Picea mariana*	FACH											5	**20,0**
	jack pine	pin gris	*Pinus banksiana*	NI	**100,0**	20	**100,0**	10	**100,0**	20	**100,0**	20	**100,0**	10	**100,0**	20	**80,0**
				Percent coverage of tree layer (%)	100	20	100	10	100	20	100	20	100	10	100	25	100
Shrub layer	speckled alder	aulne rugueux	*Alnus incana ssp. rugosa*	FACH**	10,5	10	13,3	15	16,7	10	10,5	20	**23,5**	15	15,8	30	**31,6**
	velvet-leaved blueberry	bleuet fausse-myrtille	*Vaccinium myrtilloides*	NI	5,3	5	6,7	5	5,6	15	15,8	5	5,9	10	10,5		
	glandular birch	bouleau glanduleux	*Betula glandulosa*	FACH													
	pin cherry	cerisier de Pennsylvanie	*Prunus pensylvanica*	NI				10	11,1								
	black spruce	épinette noire	*Picea mariana*	FACH													
	sheep laurel	kalmia à feuilles étroites	*Kalmia angustifolia*	NI	**84,2**	60	**80,0**	60	**66,7**	70	**73,7**	60	**70,6**	70	**73,7**	65	**68,4**
	northern Labrador tea	petit thé du Labrador	*Rhododendron tomentosum*	NI													
	jack pine	pin gris	*Pinus banksiana*	NI													
	Bebb's willow	saule de Bebb	*Salix bebbiana*	FACH													
	pussy willow	saule discolore	*Salix discolor*	FACH													
	common Labrador tea	thé du Labrador	*Rhododendron groenlandicum*	OBL****													
				Percent coverage of shrub layer (%)	100	75	100	90	100	95	100	85	100	95	100	95	100
Herbaceous layer	yellow clintonia	clintonie boréale	*Clintonia borealis*	NI													
	trailing arbutus	épigée rampante	*Epigaea repens*	NI													
	stiff clubmoss	lycopode innovant	*Lycopodium annotinum*	NI													
	wild lily-of-the-valley	maïanthème du Canada	*Maianthemum canadense*	NI													
	mountain cranberry	petite airelle	*Vaccinium vitis-idaea*	NI													
	bunchberry	quatre-temps	*Cornus canadensis*	NI													
	sphagnum sp.	sphaignes sp.	*Sphagnum sp.*	FACH***													
	lichen sp.	lichen sp.	*Lichen sp.*	NI***	100,0	90	100,0			90	100,0	90	100,0			80	100,0
				Percent coverage of herbaceous layer (%)	100	90	100	0		90		90	100	0		80	100
Dominance test			Number of dominant OBL or FACH species		0	0		0		0		0		0		1	
			Number of dominant NI species		2	2		2		2		2		2		2	
Synthesis			Is the vegetation dominated by hydrophytes		No	No		No		No		No		No		No	
			Typical wetland vegetation?		No	No		No		No		No		No		No	
			Hydrological indicators test positive?		No	No		No		No		No		No		No	
			Presence of hydromorphic soil?		No	No		No		No		No		No		No	
			Is this station a wetland?		No	No		No		No		No		No		No	

Legend

Hydric status: OBL = obligate wetland plant of meridional Quebec, FACH = facultative wetland plant of meridional Quebec or NI = No indicator plant of meridion

Dominant species: Species for which relative percent coverage is identified in **bold black** are dominant species : with a relative 20% coverage or more, and/or speci

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Table I-2B Floristic compositon of sampling stations in terrestial environments

VEGETATIVE LAYER	ENGLISH NAME	FRENCH NAME	LATIN NAME	HYDRIC STATUS					TE03								
				Station ID	S38		S43		S44		S45		S46		S47		S
				Percent coverage (%)	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute
Tree layer	paper birch	bouleau à papier	*Betula papyrifera*	NI													
	black spruce	épinette noire	*Picea mariana*	FACH	10	**33,3**			5	**33,3**	15	**42,9**	5	**16,7**	10	**28,6**	5
	jack pine	pin gris	*Pinus banksiana*	NI	20	**66,7**	25	**100,0**	10	**66,7**	20	**57,1**	25	**83,3**	25	**71,4**	30
				Percent coverage of tree layer (%)	**30**	**100**	**25**	**100**	**15**	**100**	**35**	**100**	**30**	**100**	**35**	**100**	**35**
Shrub layer	speckled alder	aulne rugueux	*Alnus incana ssp. rugosa*	FACH**	35	**38,0**	10	9,3			35	**29,9**	15	14,4			30
	velvet-leaved blueberry	bleuet fausse-myrtille	*Vaccinium myrtilloides*	NI			10	9,3	15	**20,0**	5	4,3	5	4,8	5	5,6	10
	glandular birch	bouleau glanduleux	*Betula glandulosa*	FACH					5	6,7							
	pin cherry	cerisier de Pennsylvanie	*Prunus pensylvanica*	NI	5	5,4					2	1,7	2	1,9			
	black spruce	épinette noire	*Picea mariana*	FACH		0,0			5	6,7			2	1,9			5
	sheep laurel	kalmia à feuilles étroites	*Kalmia angustifolia*	NI	50	**54,3**	85	**79,4**	20	**26,7**	75	**64,1**	80	**76,9**	75	**83,3**	60
	northern Labrador tea	petit thé du Labrador	*Rhododendron tomentosum*	NI													
	jack pine	pin gris	*Pinus banksiana*	NI			2	1,9									
	Bebb's willow	saule de Bebb	*Salix bebbiana*	FACH					10	13,3					10	11,1	
	pussy willow	saule discolore	*Salix discolor*	FACH													
	common Labrador tea	thé du Labrador	*Rhododendron groenlandicum*	OBL****	2	2,2			20	**26,7**							5
				Percent coverage of shrub layer (%)	**92**	**100**	**107**	**100**	**75**	**100**	**117**	**100**	**104**	**100**	**90**	**100**	**110**
Herbaceous layer	yellow clintonia	clintonie boréale	*Clintonia borealis*	NI													
	trailing arbutus	épigée rampante	*Epigaea repens*	NI													
	stiff clubmoss	lycopode innovant	*Lycopodium annotinum*	NI													
	wild lily-of-the-valley	maïanthème du Canada	*Maianthemum canadense*	NI											2	2,1	
	mountain cranberry	petite airelle	*Vaccinium vitis-idaea*	NI													
	bunchberry	quatre-temps	*Cornus canadensis*	NI											5	5,2	
	sphagnum sp.	sphaignes sp.	*Sphagnum sp.*	FACH***	70	100,0			40	80,0	50	100,0			10	10,3	
	lichen sp.	lichen sp.	*Lichen sp.*	NI***					10	20,0					80	82,5	
				Percent coverage of herbaceous layer (%)	**70**	**100**	**0**		**50**	**100**	**50**	**100**	**0**		**97**	**100**	**0**
Dominance test				Number of dominant OBL or FACH species	1		0		2		1		1		1		
				Number of dominant NI species	2		2		3		2		2		2		
				Is the vegetation dominated by hydrophytes	No		No		No		No		No		No		N
Synthesis				Typical wetland vegetation?	No		No		Yes		No		No		No		N
				Hydrological indicators test positive?	No		No		No		No		No		No		N
				Presence of hydromorphic soil?	No		No		No		No		No		No		N
				Is this station a wetland?	No		No		Yes		No		No		No		N

Legend

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Table I-2B Floristic compositon of sampling stations in terrestial environments

VEGETATIVE LAYER	ENGLISH NAME	FRENCH NAME	LATIN NAME	HYDRIC STATUS	TE03											
				Station ID	48	S49		S50		S51		S52		S53		S54	
				Percent coverage (%)	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *
Tree layer	paper birch	bouleau à papier	*Betula papyrifera*	NI													
	black spruce	épinette noire	*Picea mariana*	FACH	14,3	10	**33,3**	5	16,7	10	**28,6**	2	16,7	15	**37,5**	5	14,3
	jack pine	pin gris	*Pinus banksiana*	NI	**85,7**	20	**66,7**	25	**83,3**	25	**71,4**	10	**83,3**	25	**62,5**	30	**85,7**
				Percent coverage of tree layer (%)	100	30	100	30	100	35	100	12	100	40	100	35	100
Shrub layer	speckled alder	aulne rugueux	*Alnus incana ssp. rugosa*	FACH**	**27,3**	10	9,8	15	15,0	10	10,0	10	9,7	20	19,0	35	**38,0**
	velvet-leaved blueberry	bleuet fausse-myrtille	*Vaccinium myrtilloides*	NI	9,1	5	4,9	5	5,0			10	9,7	5	4,8	15	16,3
	glandular birch	bouleau glanduleux	*Betula glandulosa*	FACH													
	pin cherry	cerisier de Pennsylvanie	*Prunus pensylvanica*	NI		2	2,0					1	1,0	5	4,8	2	2,2
	black spruce	épinette noire	*Picea mariana*	FACH	4,5					5	5,0						
	sheep laurel	kalmia à feuilles étroites	*Kalmia angustifolia*	NI	**54,5**	85	**83,3**	75	**75,0**	80	**80,0**	80	**77,7**	75	**71,4**	40	**43,5**
	northern Labrador tea	petit thé du Labrador	*Rhododendron tomentosum*	NI													
	jack pine	pin gris	*Pinus banksiana*	NI						5	5,0	2	1,9				
	Bebb's willow	saule de Bebb	*Salix bebbiana*	FACH													
	pussy willow	saule discolore	*Salix discolor*	FACH													
	common Labrador tea	thé du Labrador	*Rhododendron groenlandicum*	OBL****	4,5			5	5,0								
				Percent coverage of shrub layer (%)	100	102	100	100	100	100	100	103	100	105	100	92	100
Herbaceous layer	yellow clintonia	clintonie boréale	*Clintonia borealis*	NI													
	trailing arbutus	épigée rampante	*Epigaea repens*	NI													
	stiff clubmoss	lycopode innovant	*Lycopodium annotinum*	NI													
	wild lily-of-the-valley	maïanthème du Canada	*Maianthemum canadense*	NI						2	3,0						
	mountain cranberry	petite airelle	*Vaccinium vitis-idaea*	NI						5	7,5						
	bunchberry	quatre-temps	*Cornus canadensis*	NI						5	7,5						
	sphagnum sp.	sphaignes sp.	*Sphagnum sp.*	FACH***		45	100,0			40	59,7			5	7,7	15	100,0
	lichen sp.	lichen sp.	*Lichen sp.*	NI***						15	22,4			60	92,3		
				Percent coverage of herbaceous layer (%)		45	100	0		67	100	0		65	100	15	100
Dominance test				Number of dominant OBL or FACH species	0	1		0		1		0		1		0	
				Number of dominant NI species	2	2		2		2		2		2		2	
Synthesis				Is the vegetation dominated by hydrophytes	No	No		No		No		No		No		No	
				Typical wetland vegetation?	No	No		No		No		No		No		No	
				Hydrological indicators test positive?	No	No		No		No		No		No		No	
				Presence of hydromorphic soil?	No	No		No		No		No		No		No	
				Is this station a wetland?	No	No		No		No		No		No		No	

Legend

Hydric status: OBL = obligate wetland plant of meridional Quebec, FACH = facultative wetland plant of meridional Quebec or NI = No indicator plant of meridion

Dominant species: Species for which relative percent coverage is identified in **bold black** are dominant species : with a relative 20% coverage or more, and/or speci

* Relative percent coverage is calculated for all vegetative layers that cover 10% or more of the sampling station.

** Speckled alder being ubiquitous in both wetlands and terrestrial environments, it was not included in the dominance calculation.

*** Since these invascular species were not identified with the species, they were not included in the dominance calculation

**** Species considered facultative wetland plant in this study

Table I-2B Floristic compositon of sampling stations in terrestial environments

VEGETATIVE LAYER	ENGLISH NAME	FRENCH NAME	LATIN NAME	HYDRIC STATUS			TE04										
				Station ID	S68		S15		S16		S18		S19		S26		S
				Percent coverage (%)	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute
Tree layer	paper birch	bouleau à papier	*Betula papyrifera*	NI													2
	black spruce	épinette noire	*Picea mariana*	FACH			15	**60,0**	15	**75,0**	20	**80,0**	20	**80,0**	10	**66,7**	
	jack pine	pin gris	*Pinus banksiana*	NI	35	**100,0**	10	**40,0**	5	**25,0**	5	**20,0**	5	**20,0**	5	**33,3**	5
				Percent coverage of tree layer (%)	**35**	**100**	**25**	**100**	**20**	**100**	**25**	**100**	**25**	**100**	**15**	**100**	**7**
Shrub layer	speckled alder	aulne rugueux	*Alnus incana ssp. rugosa*	FACH**			15	**20,8**	15	18,8	15	16,7	15	13,6	25	**22,9**	70
	velvet-leaved blueberry	bleuet fausse-myrtille	*Vaccinium myrtilloides*	NI	5	7,1									10	9,2	25
	glandular birch	bouleau glanduleux	*Betula glandulosa*	FACH													5
	pin cherry	cerisier de Pennsylvanie	*Prunus pensylvanica*	NI													2
	black spruce	épinette noire	*Picea mariana*	FACH	5	7,1	5	6,9	15	18,8			15	13,6	2	1,8	2
	sheep laurel	kalmia à feuilles étroites	*Kalmia angustifolia*	NI	60	**85,7**	50	**69,4**	65	**81,3**	75	**83,3**	80	**72,7**	70	**64,2**	10
	northern Labrador tea	petit thé du Labrador	*Rhododendron tomentosum*	NI													
	jack pine	pin gris	*Pinus banksiana*	NI													2
	Bebb's willow	saule de Bebb	*Salix bebbiana*	FACH											2	1,8	
	pussy willow	saule discolore	*Salix discolor*	FACH			2	2,8									2
	common Labrador tea	thé du Labrador	*Rhododendron groenlandicum*	OBL****													5
				Percent coverage of shrub layer (%)	**70**	**100**	**72**	**100**	**80**	**100**	**90**	**100**	**110**	**100**	**109**	**100**	**53**
Herbaceous layer	yellow clintonia	clintonie boréale	*Clintonia borealis*	NI													
	trailing arbutus	épigée rampante	*Epigaea repens*	NI	5	5,3											
	stiff clubmoss	lycopode innovant	*Lycopodium annotinum*	NI													
	wild lily-of-the-valley	maïanthème du Canada	*Maianthemum canadense*	NI													
	mountain cranberry	petite airelle	*Vaccinium vitis-idaea*	NI													
	bunchberry	quatre-temps	*Cornus canadensis*	NI													
	sphagnum sp.	sphaignes sp.	*Sphagnum sp.*	FACH***					80	100,0	80	97,6	75	100,0			
	lichen sp.	lichen sp.	*Lichen sp.*	NI***	90	94,7					2	2,4					
				Percent coverage of herbaceous layer (%)	**95**	**100**	**0**		**80**	**100**	**82**	**100**	**75**	**100**	**0**		**0**
Dominance test				Number of dominant OBL or FACH species	0		1		1		1		1		1		
				Number of dominant NI species	2		2		2		2		2		2		
				Is the vegetation dominated by hydrophytes	No		No		No		No		No		No		N
Synthesis				Typical wetland vegetation?	No		No		No		No		No		No		N
				Hydrological indicators test positive?	No		No		No		No		No		No		N
				Presence of hydromorphic soil?	No		No		No		No		No		No		N
				Is this station a wetland?	No		No		No		No		No		No		N

Legend

Hydric status: OBL = obligate wetland plant of meridional Quebec, FACH = facultative wetland plant of meridional Quebec or NI = No indicator plant of meridion

Dominant species: Species for which relative percent coverage is identified in **bold black** are dominant species : with a relative 20% coverage or more, and/or speci

* Relative percent coverage is calculated for all vegetative layers that cover 10% or more of the sampling station.

** Speckled alder being ubiquitous in both wetlands and terrestrial environments, it was not included in the dominance calculation.

*** Since these invascular species were not identified with the species, they were not included in the dominance calculation

**** Species considered facultative wetland plant in this study

Table I-2B Floristic compositon of sampling stations in terrestial environments

VEGETATIVE LAYER	ENGLISH NAME	FRENCH NAME	LATIN NAME	HYDRIC STATUS	TE05			TE06		TE07	
				Station ID	17	S25		S24		S42	
				Percent coverage (%)	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *
Tree layer	paper birch	bouleau à papier	*Betula papyrifera*	NI							
	black spruce	épinette noire	*Picea mariana*	FACH				2	11,8	25	**62,5**
	jack pine	pin gris	*Pinus banksiana*	NI		5		15	**88,2**	15	**37,5**
				Percent coverage of tree layer (%)		5		17	100	40	100
Shrub layer	speckled alder	aulne rugueux	*Alnus incana ssp. rugosa*	FACH**	**132,1**	20	**16,4**		0,0	45	**64,3**
	velvet-leaved blueberry	bleuet fausse-myrtille	*Vaccinium myrtilloides*	NI	**47,2**	20	**16,4**	10	12,7	10	14,3
	glandular birch	bouleau glanduleux	*Betula glandulosa*	FACH	9,4						
	pin cherry	cerisier de Pennsylvanie	*Prunus pensylvanica*	NI	3,8						
	black spruce	épinette noire	*Picea mariana*	FACH	3,8	5	4,1	5	6,3		
	sheep laurel	kalmia à feuilles étroites	*Kalmia angustifolia*	NI	**18,9**	60	**49,2**	60	**75,9**	15	**21,4**
	northern Labrador tea	petit thé du Labrador	*Rhododendron tomentosum*	NI				2	2,5		
	jack pine	pin gris	*Pinus banksiana*	NI	3,8	10	8,2	2	2,5		
	Bebb's willow	saule de Bebb	*Salix bebbiana*	FACH		5	4,1				
	pussy willow	saule discolore	*Salix discolor*	FACH	3,8						
	common Labrador tea	thé du Labrador	*Rhododendron groenlandicum*	OBL****	9,4	2	1,6				
				Percent coverage of shrub layer (%)	100,0	122	100	79	100	70	100
Herbaceous layer	yellow clintonia	clintonie boréale	*Clintonia borealis*	NI							
	trailing arbutus	épigée rampante	*Epigaea repens*	NI							
	stiff clubmoss	lycopode innovant	*Lycopodium annotinum*	NI							
	wild lily-of-the-valley	maïanthème du Canada	*Maianthemum canadense*	NI							
	mountain cranberry	petite airelle	*Vaccinium vitis-idaea*	NI							
	bunchberry	quatre-temps	*Cornus canadensis*	NI				10	**100,0**	5	14,3
	sphagnum sp.	sphaignes sp.	*Sphagnum sp.*	FACH***						30	85,7
	lichen sp.	lichen sp.	*Lichen sp.*	NI***		75	100,0				
				Percent coverage of herbaceous layer (%)		75	100	10	100	35	100
Dominance test				Number of dominant OBL or FACH species	0	0		0		1	
				Number of dominant NI species	2	2		3		2	
				Is the vegetation dominated by hydrophytes	No	No		No		No	
Synthesis				Typical wetland vegetation?	No	No		No		No	
				Hydrological indicators test positive?	No	No		No		No	
				Presence of hydromorphic soil?	No	No		No		No	
				Is this station a wetland?	No	No		No		No	

Legend

Hydric status: OBL = obligate wetland plant of meridional Quebec, FACH = facultative wetland plant of meridional Quebec or NI = No indicator plant of meridion

Dominant species: Species for which relative percent coverage is identified in **bold black** are dominant species : with a relative 20% coverage or more, and/or speci

* Relative percent coverage is calculated for all vegetative layers that cover 10% or more of the sampling station.

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*** Since these invascular species were not identified with the species, they were not included in the dominance calculation

**** Species considered facultative wetland plant in this study

Table I-2A Floristic compositon of sampling stations in wetlands

STRATE	ENGLISH NAME	FRENCH NAME	LATIN NAME	HYDRIC STATUS	WL01		WL02A				WL02B		WL03			
				Station ID	S05		S23		S71		S72		S39		S40	
				Percent coverage (%)	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *
Tree layer	black spruce	épinette noire	*Picea mariana*	FACH**			2				2					
	tamarack	mélèze laricin	*Larix laricina*	FACH												
	jack pine	pin gris	*Pinus banksiana*	NI			5		5		5		2		5	
				Percent coverage of tree layer (%)			7		5		7		2		5	
Shrub layer	speckled alder	aulne rugueux	*Alnus incana ssp. rugosa*	FACH**												
	highbush blueberry	bleuet en corymbe	*Vaccinium corymbosum*	FACH												
	velvet-leaved blueberry	bleuet fausse-myrtille	*Vaccinium myrtilloides*	NI			2	2,8								
	glandular birch	bouleau glanduleux	*Betula glandulosa*	FACH					2	2,4	2	2,2			10	9,5
	leatherleaf	cassandre caliculé	*Chamaedaphne calyculata*	OBL	**40**	**66,7**	5	6,9	**25**	**30,5**	**35**	**39,3**	**25**	**29,4**	**35**	**33,3**
	pin cherry	cerisier de Pennsylvanie	*Prunus pensylvanica*	NI												
	black spruce	épinette noire	*Picea mariana*	FACH**			5	6,9	5	6,1	10	11,2	5	5,9	10	9,5
	pale bog laurel	kalmia à feuilles d'andromède	*Kalmia polifolia*	OBL			5	6,9	5	6,1					5	4,8
	sheep laurel	kalmia à feuilles étroites	*Kalmia angustifolia*	NI			20	**27,8**	10	12,2			10	11,8	5	4,8
	jack pine	pin gris	*Pinus banksiana*	NI	5	8,3	20	**27,8**	15	18,3	2	2,2	10	11,8	5	4,8
	Bebb's willow	saule de Bebb	*Salix bebbiana*	FACH							5	5,6				
	common Labrador tea	thé du Labrador	*Rhododendron groenlandicum*	OBL****	15	**25,0**	15	**20,8**	20	**24,4**	35	**39,3**	35	**41,2**	35	**33,3**
				Percent coverage of shrub layer (%)	60	100	72	100	82	100	89	100	85	100	105	100
Herbaceous layer	aster sp.	aster sp.	*Aster sp.*	NI												
	small cranberry	canneberge commune	*Vaccinium oxycoccos*	OBL												
	few-seeded sedge	carex oligosperme	*Carex oligosperma*	OBL	**35**	**87,5**										
	few-flowered sedge	carex pauciflore	*Carex pauciflora*	OBL												
	Carex sp.	carex sp.	*Carex sp.*													
	three-seeded sedge	carex trisperme	*Carex trisperma*	OBL					2	1,7						
	cloudberry	chicouté	*Rubus chamaemorus*	FACH			10	**20,8**	10	8,3	5	**35,7**				
	yellow clintonia	clintonie boréale	*Clintonia borealis*	NI			2	4,2								
	trailing arbutus	épigée rampante	*Epigaea repens*	NI			2	4,2								
	fireweed	épilobe à feuilles étroites	*Chamerion angustifolium*	NI												
	grass family sp.	Graminée sp.	*Graminée sp.*	NI												
	tussock cottongrass	linaigrette à large gaine	*Eriophorum vaginatum*	OBL	5	12,5										
	stiff clubmoss	lycopode innovant	*Lycopodium annotinum*	NI												
	wild lily-of-the-valley	maïanthème du Canada	*Maianthemum canadense*	NI												
	bluegrass	Pâturin sp.	*Poa sp.*	NI												
	sedge	pétasite palmé	*Petasites frigidus var. palmatus*	FACH							2	14,3				
	woodland horsetail	prêle des bois	*Equisetum sylvaticum*	FACH					2	1,7	5	**35,7**				
	bunchberry	quatre-temps	*Cornus canadensis*	NI			2	4,2	5	4,1	2	14,3				
	goldthread	savoyane	*Coptis trifolia*	NI												
	black-girdled bulrush	scirpe à ceinture noire	*Scirpus atrocinctus*	FACH			2	4,2								
	three-leaved false Solomon's seal	smilacine trifoliée	*Maianthemum trifolium*	OBL					2	1,7						
	sphagnum sp.	sphaignes sp.	*Sphagnum sp.*	FACH***			30	**62,5**	55	**45,5**						
	lichen sp.	lichen sp.	*Lichen sp.*	NI***					45	**37,2**						
	bog goldenrod	verge d'or des marais	*Solidago uliginosa*	OBL												
				Percent coverage of herbaceous layer (%)	40	100	48	100	121	100	14	100	0		0	
Dominance test				Number of dominant OBL or FACH species	3		2		2		4		2		2	
				Number of dominant NI species	0		2		0		0		0		0	
				Is the vegetation dominated by hydrophytes	Yes, >10% OBL		Yes		Yes, >10% OBL		Yes, >10% OBL		Yes, >10% OBL		Yes, >10% OBL	
Synthesis				Typical wetland vegetation?	Yes		Yes		Yes		Yes		Yes		Yes	
				Hydrological indicators test positive?	Yes		No		Yes		Yes		Yes		Yes	
				Presence of hydromorphic soil?	Yes		No		No		Yes		No (2cm)		No (10cm)	
				Is this station a wetland?	Yes		Yes		Yes		Yes		Yes		Yes	

Legend

Hydric status: OBL = obligate wetland plant of meridional Quebec, FACH = facultative wetland plant of meridional Quebec or NI = No indicator plant of meridional Quebec

Dominant species: Species for which relative percent coverage is identified in **bold black** are dominant species : with a relative 20% coverage or more, and/or species for which cumulative relative percent coverage within a vegetative layer allow to reach a relative 50% coverage of this layer.

* Relative percent coverage is calculated for all vegetative layers that cover 10% or more of the sampling station.

** Speckled alder being ubiquitous in both wetlands and terrestrial environments, it was not included in the dominance calculation.

*** Since these invascular species were not identified with the species, they were not included in the dominance calculation

**** Species considered facultative wetland plant in this study

Table I-2A Floristic compositon of sampling stations in wetlands

STRATE	ENGLISH NAME	FRENCH NAME	LATIN NAME	HYDRIC STATUS	WL04		WL05A									
				Station ID	S41		S55		S58		S59		S60		S61	
				Percent coverage (%)	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *
Tree layer	black spruce	épinette noire	*Picea mariana*	FACH**			5				10	**100,0**				
	tamarack	mélèze laricin	*Larix laricina*	FACH											5	
	jack pine	pin gris	*Pinus banksiana*	NI	2								5			
				Percent coverage of tree layer (%)	**2**		**5**		**0**		**10**	**100**	**5**		**5**	
Shrub layer	speckled alder	aulne rugueux	*Alnus incana ssp. rugosa*	FACH**												
	highbush blueberry	bleuet en corymbe	*Vaccinium corymbosum*	FACH												
	velvet-leaved blueberry	bleuet fausse-myrtille	*Vaccinium myrtilloides*	NI	5	4,8										
	glandular birch	bouleau glanduleux	*Betula glandulosa*	FACH	10	9,5	5	4,5	5	5,3						
	leatherleaf	cassandre caliculé	*Chamaedaphne calyculata*	OBL	**20**	**19,0**	**65**	**59,1**	**40**	**42,1**	**10**	**20,0**	**30**	**33,3**	**15**	**15,0**
	pin cherry	cerisier de Pennsylvanie	*Prunus pensylvanica*	NI												
	black spruce	épinette noire	*Picea mariana*	FACH**	5	4,8	10	9,1	10	10,5	15	**30,0**	10	11,1	30	**30,0**
	pale bog laurel	kalmia à feuilles d'andromède	*Kalmia polifolia*	OBL	**10**	**9,5**			**10**	**10,5**			**10**	**11,1**	5	5,0
	sheep laurel	kalmia à feuilles étroites	*Kalmia angustifolia*	NI												
	jack pine	pin gris	*Pinus banksiana*	NI	5	4,8	5	4,5	10	10,5			10	11,1	15	15,0
	Bebb's willow	saule de Bebb	*Salix bebbiana*	FACH												
	common Labrador tea	thé du Labrador	*Rhododendron groenlandicum*	OBL****	50	**47,6**	25	**22,7**	20	**21,1**	25	**50,0**	30	**33,3**	35	**35,0**
				Percent coverage of shrub layer (%)	**105**	**100**	**110**	**100**	**95**	**100**	**50**	**100**	**90**	**100**	**100**	**100**
Herbaceous layer	aster sp.	aster sp.	*Aster sp.*	NI												
	small cranberry	canneberge commune	*Vaccinium oxycoccos*	OBL							5	3,1			2	1,8
	few-seeded sedge	carex oligosperme	*Carex oligosperma*	OBL					**10**	**83,3**			5	**31,3**		
	few-flowered sedge	carex pauciflore	*Carex pauciflora*	OBL							**35**	**21,9**				
	Carex sp.	carex sp.	*Carex sp.*												5	4,6
	three-seeded sedge	carex trisperme	*Carex trisperma*	OBL												
	cloudberry	chicouté	*Rubus chamaemorus*	FACH			5	**50,0**			25	15,6			10	9,2
	yellow clintonia	clintonie boréale	*Clintonia borealis*	NI			2	**20,0**					2	12,5		
	trailing arbutus	épigée rampante	*Epigaea repens*	NI												
	fireweed	épilobe à feuilles étroites	*Chamerion angustifolium*	NI												
	grass family sp.	Graminée sp.	*Graminée sp.*	NI												
	tussock cottongrass	linaigrette à large gaine	*Eriophorum vaginatum*	OBL					2	16,7	5	3,1			**20**	**18,3**
	stiff clubmoss	lycopode innovant	*Lycopodium annotinum*	NI												
	wild lily-of-the-valley	maïanthème du Canada	*Maianthemum canadense*	NI												
	bluegrass	Pâturin sp.	*Poa sp.*	NI												
	sedge	pétasite palmé	*Petasites frigidus var. palmatus*	FACH									5	**31,3**		
	woodland horsetail	prêle des bois	*Equisetum sylvaticum*	FACH			3	**30,0**								
	bunchberry	quatre-temps	*Cornus canadensis*	NI									2	12,5	2	1,8
	goldthread	savoyane	*Coptis trifolia*	NI												
	black-girdled bulrush	scirpe à ceinture noire	*Scirpus atrocinctus*	FACH												
	three-leaved false Solomon's seal	smilacine trifoliée	*Maianthemum trifolium*	OBL											5	4,6
	sphagnum sp.	sphaignes sp.	*Sphagnum sp.*	FACH***							70	**43,8**			30	**27,5**
	lichen sp.	lichen sp.	*Lichen sp.*	NI***							20	12,5			35	**32,1**
	bog goldenrod	verge d'or des marais	*Solidago uliginosa*	OBL									2	12,5		
				Percent coverage of herbaceous layer (%)	**0**	**0**	**10**	**100**	**12**	**100**	**160**	**100**	**16**	**100**	**109**	**100**
Dominance test				Number of dominant OBL or FACH species	3		4		4		4		5		3	
				Number of dominant NI species	0		1		0		0		0		0	
				Is the vegetation dominated by hydrophytes	Yes, >10% OBL		Yes, >10% OBL		Yes, >10% OBL		Yes, >10% OBL		Yes, >10% OBL		Yes, >10% OBL	
Synthesis				Typical wetland vegetation?	Yes		Yes		Yes		Yes		Yes		Yes	
				Hydrological indicators test positive?	Yes		Yes		Yes		Yes		Yes		Yes	
				Presence of hydromorphic soil?	No (25 cm)		Yes (55 cm)		Yes		Yes		Yes		Yes	
				Is this station a wetland?	Yes		Yes		Yes		Yes		Yes		Yes	

Legend

Hydric status: OBL = obligate wetland plant of meridional Quebec, FACH = facultative wetland plant of meridional Quebec or NI = No indicator plant of meridional Quebec

Dominant species: Species for which relative percent coverage is identified in **bold black** are dominant species : with a relative 20% coverage or more, and/or species for which cu

* Relative percent coverage is calculated for all vegetative layers that cover 10% or more of the sampling station.

** Speckled alder being ubiquitous in both wetlands and terrestrial environments, it was not included in the dominance calculation.

*** Since these invascular species were not identified with the species, they were not included in the dominance calculation

**** Species considered facultative wetland plant in this study

Table I-2A Floristic compositon of sampling stations in wetlands

STRATE	ENGLISH NAME	FRENCH NAME	LATIN NAME	HYDRIC STATUS					WL05A		WL05B				WL	
				Station ID	S62		S69		S70		S56		S57		S64	
				Percent coverage (%)	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *
Tree layer	black spruce	épinette noire	*Picea mariana*	FACH**							20	**100,0**	20	**100,0**		
	tamarack	mélèze laricin	*Larix laricina*	FACH												
	jack pine	pin gris	*Pinus banksiana*	NI	5				2						2	
				Percent coverage of tree layer (%)	**5**		**0**		**2**		**20**	**100**	**20**	**100**	**2**	
Shrub layer	speckled alder	aulne rugueux	*Alnus incana ssp. rugosa*	FACH**					2	2,0						
	highbush blueberry	bleuet en corymbe	*Vaccinium corymbosum*	FACH												
	velvet-leaved blueberry	bleuet fausse-myrtille	*Vaccinium myrtilloides*	NI									15	14,3	5	5,1
	glandular birch	bouleau glanduleux	*Betula glandulosa*	FACH	5	4,2	5	5,9	5	5,1					2	2,0
	leatherleaf	cassandre caliculé	*Chamaedaphne calyculata*	OBL	**10**	**8,3**	**50**	**58,8**	**30**	**30,3**	**10**	**11,1**			5	5,1
	pin cherry	cerisier de Pennsylvanie	*Prunus pensylvanica*	NI											2	2,0
	black spruce	épinette noire	*Picea mariana*	FACH**	10	8,3	5	5,9	10	10,1	15	16,7	20	19,0	10	10,1
	pale bog laurel	kalmia à feuilles d'andromède	*Kalmia polifolia*	OBL	5	4,2			5	5,1	5	5,6	**10**	**9,5**		
	sheep laurel	kalmia à feuilles étroites	*Kalmia angustifolia*	NI			5	5,9	5	5,1						
	jack pine	pin gris	*Pinus banksiana*	NI	20	16,7	10	11,8	10	10,1					35	**35,4**
	Bebb's willow	saule de Bebb	*Salix bebbiana*	FACH					2	2,0						
	common Labrador tea	thé du Labrador	*Rhododendron groenlandicum*	OBL****	70	**58,3**	10	11,8	30	**30,3**	60	**66,7**	60	**57,1**	40	**40,4**
				Percent coverage of shrub layer (%)	**120**	**100**	**85**	**100**	**99**	**100**	**90**	**100**	**105**	**100**	**99**	**100**
Herbaceous layer	aster sp.	aster sp.	*Aster sp.*	NI	2	2,1										
	small cranberry	canneberge commune	*Vaccinium oxycoccos*	OBL									5	3,7		
	few-seeded sedge	carex oligosperme	*Carex oligosperma*	OBL												
	few-flowered sedge	carex pauciflore	*Carex pauciflora*	OBL												
	Carex sp.	carex sp.	*Carex sp.*													
	three-seeded sedge	carex trisperme	*Carex trisperma*	OBL	5	5,2										
	cloudberry	chicouté	*Rubus chamaemorus*	FACH			5	**25,0**	10	**83,3**	15	13,0				
	yellow clintonia	clintonie boréale	*Clintonia borealis*	NI	5	5,2			2	16,7						
	trailing arbutus	épigée rampante	*Epigaea repens*	NI											2	2,0
	fireweed	épilobe à feuilles étroites	*Chamerion angustifolium*	NI												
	grass family sp.	Graminée sp.	*Graminée sp.*	NI												
	tussock cottongrass	linaigrette à large gaine	*Eriophorum vaginatum*	OBL			**15**	**75,0**					**35**	**25,9**		
	stiff clubmoss	lycopode innovant	*Lycopodium annotinum*	NI											2	2,0
	wild lily-of-the-valley	maïanthème du Canada	*Maianthemum canadense*	NI											2	2,0
	bluegrass	Pâturin sp.	*Poa sp.*	NI											2	2,0
	sedge	pétasite palmé	*Petasites frigidus var. palmatus*	FACH											2	2,0
	woodland horsetail	prêle des bois	*Equisetum sylvaticum*	FACH											2	2,0
	bunchberry	quatre-temps	*Cornus canadensis*	NI											2	2,0
	goldthread	savoyane	*Coptis trifolia*	NI											2	2,0
	black-girdled bulrush	scirpe à ceinture noire	*Scirpus atrocinctus*	FACH												
	three-leaved false Solomon's seal	smilacine trifoliée	*Maianthemum trifolium*	OBL							5	4,3			5	5,0
	sphagnum sp.	sphaignes sp.	*Sphagnum sp.*	FACH***	5	5,2					95	**82,6**	80	**59,3**	15	**14,9**
	lichen sp.	lichen sp.	*Lichen sp.*	NI***	80	**82,5**							15	11,1	65	**64,4**
	bog goldenrod	verge d'or des marais	*Solidago uliginosa*	OBL												
				Percent coverage of herbaceous layer (%)	**97**	**100**	**20**	**100**	**12**	**100**	**115**	**100**	**135**	**100**	**101**	**100**
Dominance test				Number of dominant OBL or FACH species	2		3		3		2		3		1	
				Number of dominant NI species	0		0		0		0		0		1	
				Is the vegetation dominated by hydrophytes	Yes, >10% OBL		Yes, >10% OBL		Yes, >10% OBL		Yes, OBL >10%		Yes, OBL >10%		Yes	
Synthesis				Typical wetland vegetation?	Yes		Yes		Yes		Yes		Yes		Yes	
				Hydrological indicators test positive?	Yes		Yes		Yes		No		Yes		Yes	
				Presence of hydromorphic soil?	No		Yes		Yes		Yes		Yes		No	
				Is this station a wetland?	Yes		Yes		Yes		Yes		Yes		Yes	

Legend

Hydric status: OBL = obligate wetland plant of meridional Quebec, FACH = facultative wetland plant of meridional Quebec or NI = No indicator plant of meridional Quebec

Dominant species: Species for which relative percent coverage is identified in **bold black** are dominant species : with a relative 20% coverage or more, and/or species for which cu

* Relative percent coverage is calculated for all vegetative layers that cover 10% or more of the sampling station.

** Speckled alder being ubiquitous in both wetlands and terrestrial environments, it was not included in the dominance calculation.

*** Since these invascular species were not identified with the species, they were not included in the dominance calculation

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Table I-2A Floristic compositon of sampling stations in wetlands

STRATE	ENGLISH NAME	FRENCH NAME	LATIN NAME	HYDRIC STATUS	05C		WL05D		WL05D		WL05D		WL06		WL06	
				Station ID	S66		S63		S65		S67		S73		S74	
				Percent coverage (%)	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *
Tree layer	black spruce	épinette noire	*Picea mariana*	FACH**												
	tamarack	mélèze laricin	*Larix laricina*	FACH												
	jack pine	pin gris	*Pinus banksiana*	NI	5		15	**100,0**	5		10	**100,0**	10	**100,0**	20	**100,0**
				Percent coverage of tree layer (%)	5		15	100	5		10	100	10	100	20	100
Shrub layer	speckled alder	aulne rugueux	*Alnus incana ssp. rugosa*	FACH**	10	8,3	2	2,2			5	5,4	10	9,5	15	12,8
	highbush blueberry	bleuet en corymbe	*Vaccinium corymbosum*	FACH												
	velvet-leaved blueberry	bleuet fausse-myrtille	*Vaccinium myrtilloides*	NI	5	4,2		0,0							2	1,7
	glandular birch	bouleau glanduleux	*Betula glandulosa*	FACH	5	4,2	20	**21,7**	5	5,3	10	10,9			5	4,3
	leatherleaf	cassandre caliculé	*Chamaedaphne calyculata*	OBL	5	4,2	**40**	**43,5**	**35**	**37,2**	**15**	**16,3**	**20**	**19,0**	**15**	**12,8**
	pin cherry	cerisier de Pennsylvanie	*Prunus pensylvanica*	NI												
	black spruce	épinette noire	*Picea mariana*	FACH**	15	12,5	5	5,4	5	5,3	5	5,4			5	4,3
	pale bog laurel	kalmia à feuilles d'andromède	*Kalmia polifolia*	OBL									5	4,8		
	sheep laurel	kalmia à feuilles étroites	*Kalmia angustifolia*	NI	10	8,3	5	5,4	5	5,3	10	10,9	5	4,8	5	4,3
	jack pine	pin gris	*Pinus banksiana*	NI	15	12,5			2	2,1	2	2,2	5	4,8	10	8,5
	Bebb's willow	saule de Bebb	*Salix bebbiana*	FACH	10	8,3			2	2,1						
	common Labrador tea	thé du Labrador	*Rhododendron groenlandicum*	OBL****	55	**45,8**	20	**21,7**	40	**42,6**	45	**48,9**	60	**57,1**	60	**51,3**
				Percent coverage of shrub layer (%)	120	108,3	92	100	94	100	92	100	105	100	117	100
Herbaceous layer	aster sp.	aster sp.	*Aster sp.*	NI												
	small cranberry	canneberge commune	*Vaccinium oxycoccos*	OBL												
	few-seeded sedge	carex oligosperme	*Carex oligosperma*	OBL												
	few-flowered sedge	carex pauciflore	*Carex pauciflora*	OBL												
	Carex sp.	carex sp.	*Carex sp.*													
	three-seeded sedge	carex trisperme	*Carex trisperma*	OBL												
	cloudberry	chicouté	*Rubus chamaemorus*	FACH									2			
	yellow clintonia	clintonie boréale	*Clintonia borealis*	NI			2		2		2	14,3				
	trailing arbutus	épigée rampante	*Epigaea repens*	NI												
	fireweed	épilobe à feuilles étroites	*Chamerion angustifolium*	NI									2			
	grass family sp.	Graminée sp.	*Graminée sp.*	NI												
	tussock cottongrass	linaigrette à large gaine	*Eriophorum vaginatum*	OBL												
	stiff clubmoss	lycopode innovant	*Lycopodium annotinum*	NI												
	wild lily-of-the-valley	maïanthème du Canada	*Maianthemum canadense*	NI					2		2	14,3				
	bluegrass	Pâturin sp.	*Poa sp.*	NI												
	sedge	pétasite palmé	*Petasites frigidus var. palmatus*	FACH					2							
	woodland horsetail	prêle des bois	*Equisetum sylvaticum*	FACH							10	**71,4**				
	bunchberry	quatre-temps	*Cornus canadensis*	NI	2	2,6	5						5		2	
	goldthread	savoyane	*Coptis trifolia*	NI	2	2,6										
	black-girdled bulrush	scirpe à ceinture noire	*Scirpus atrocinctus*	FACH												
	three-leaved false Solomon's seal	smilacine trifoliée	*Maianthemum trifolium*	OBL	2	2,6										
	sphagnum sp.	sphaignes sp.	*Sphagnum sp.*	FACH***	10	13,2										
	lichen sp.	lichen sp.	*Lichen sp.*	NI***	60	78,9										
	bog goldenrod	verge d'or des marais	*Solidago uliginosa*	OBL												
				Percent coverage of herbaceous layer (%)	76	100	7		6		14	100	9		2	
Dominance test				Number of dominant OBL or FACH species	1		3		2		3		2		2	
				Number of dominant NI species	0		1		0		1		1		1	
				Is the vegetation dominated by hydrophytes	Yes		Yes, OBL >10%		Yes, OBL >10%		Yes, OBL >10%		Yes, OBL >10%		Yes, OBL >10%	
Synthesis				Typical wetland vegetation?	Yes		Yes		Yes		Yes		Yes		Yes	
				Hydrological indicators test positive?	Yes		Yes		Yes		Yes		Yes		Yes	
				Presence of hydromorphic soil?	No		No		Yes		Yes		Yes		Yes	
				Is this station a wetland?	Yes		Yes		Yes		Yes		Yes		Yes	

Legend

Hydric status: OBL = obligate wetland plant of meridional Quebec, FACH = facultative wetland plant of meridional Quebec or NI = No indicator plant of meridional Quebec

Dominant species: Species for which relative percent coverage is identified in **bold black** are dominant species : with a relative 20% coverage or more, and/or species for which cu

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Table I-2A Floristic compositon of sampling stations in wetlands

STRATE	ENGLISH NAME	FRENCH NAME	LATIN NAME	HYDRIC STATUS	WL07B		WL07A		WL08				WL09		WL10	
				Station ID	S02		S75		S76		S77		S79		S80	
				Percent coverage (%)	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *	Absolute	Relative *
Tree layer	black spruce	épinette noire	*Picea mariana*	FACH**	10	**28,6**										
	tamarack	mélèze laricin	*Larix laricina*	FACH												
	jack pine	pin gris	*Pinus banksiana*	NI	25	**71,4**	5		2		2		5			
				Percent coverage of tree layer (%)	35	100	5		2		2		5		0	
Shrub layer	speckled alder	aulne rugueux	*Alnus incana ssp. rugosa*	FACH**	**20**	28,6	5	7,7			10	8,9				
	highbush blueberry	bleuet en corymbe	*Vaccinium corymbosum*	FACH					10	**10,9**						
	velvet-leaved blueberry	bleuet fausse-myrtille	*Vaccinium myrtilloides*	NI							5	4,5				
	glandular birch	bouleau glanduleux	*Betula glandulosa*	FACH	15	**21,4**	5	7,7	5	5,4			5	5,2		
	leatherleaf	cassandre caliculé	*Chamaedaphne calyculata*	OBL			**15**	**23,1**	**10**	**10,9**	**35**	**31,3**	**40**	**41,2**	**30**	**35,3**
	pin cherry	cerisier de Pennsylvanie	*Prunus pensylvanica*	NI	5	7,1					2	1,8				
	black spruce	épinette noire	*Picea mariana*	FACH**			10	15,4	10	**10,9**	10	8,9	5	5,2	10	11,8
	pale bog laurel	kalmia à feuilles d'andromède	*Kalmia polifolia*	OBL					2	2,2	**10**	**8,9**			5	5,9
	sheep laurel	kalmia à feuilles étroites	*Kalmia angustifolia*	NI	10	14,3	5	7,7	15	16,3	10	8,9	5	5,2	10	11,8
	jack pine	pin gris	*Pinus banksiana*	NI			5	7,7	20	**21,7**	5	4,5	2	2,1	5	5,9
	Bebb's willow	saule de Bebb	*Salix bebbiana*	FACH												
	common Labrador tea	thé du Labrador	*Rhododendron groenlandicum*	OBL****	20	**28,6**	20	**30,8**	20	**21,7**	25	**22,3**	40	**41,2**	25	**29,4**
				Percent coverage of shrub layer (%)	70	100	65	100	92	100	112	100	97	100	85	100
Herbaceous layer	aster sp.	aster sp.	*Aster sp.*	NI					2	**13,3**						
	small cranberry	canneberge commune	*Vaccinium oxycoccos*	OBL					2	**13,3**						
	few-seeded sedge	carex oligosperme	*Carex oligosperma*	OBL												
	few-flowered sedge	carex pauciflore	*Carex pauciflora*	OBL												
	Carex sp.	carex sp.	*Carex sp.*													
	three-seeded sedge	carex trisperme	*Carex trisperma*	OBL					5	**33,3**						
	cloudberry	chicouté	*Rubus chamaemorus*	FACH							10	**100,0**	10	**100,0**		
	yellow clintonia	clintonie boréale	*Clintonia borealis*	NI			2		2	**13,3**						
	trailing arbutus	épigée rampante	*Epigaea repens*	NI												
	fireweed	épilobe à feuilles étroites	*Chamerion angustifolium*	NI												
	grass family sp.	Graminée sp.	*Graminée sp.*	NI					2	**13,3**						
	tussock cottongrass	linaigrette à large gaine	*Eriophorum vaginatum*	OBL												
	stiff clubmoss	lycopode innovant	*Lycopodium annotinum*	NI												
	wild lily-of-the-valley	maïanthème du Canada	*Maianthemum canadense*	NI												
	bluegrass	Pâturin sp.	*Poa sp.*	NI												
	sedge	pétasite palmé	*Petasites frigidus var. palmatus*	FACH												
	woodland horsetail	prêle des bois	*Equisetum sylvaticum*	FACH												
	bunchberry	quatre-temps	*Cornus canadensis*	NI			2		2	**13,3**						
	goldthread	savoyane	*Coptis trifolia*	NI												
	black-girdled bulrush	scirpe à ceinture noire	*Scirpus atrocinctus*	FACH												
	three-leaved false Solomon's seal	smilacine trifoliée	*Maianthemum trifolium*	OBL												
	sphagnum sp.	sphaignes sp.	*Sphagnum sp.*	FACH***												
	lichen sp.	lichen sp.	*Lichen sp.*	NI***												
	bog goldenrod	verge d'or des marais	*Solidago uliginosa*	OBL												
				Percent coverage of herbaceous layer (%)	0		4		15	100	10	100	10	100	0	
Dominance test				Number of dominant OBL or FACH species	2		2		5		4		3		2	
				Number of dominant NI species	1		0		5		0		0		0	
				Is the vegetation dominated by hydrophytes	Yes		Yes, OBL >10%		Yes, OBL >10%		Yes, OBL >10%		Yes, OBL >10%		Yes, OBL >10%	
Synthesis				Typical wetland vegetation?	Yes		Yes		Yes		Yes		Yes		Yes	
				Hydrological indicators test positive?	No		Yes		Yes		Yes		Yes		Yes	
				Presence of hydromorphic soil?	No		Yes		No (20)		Yes		Yes		Yes	
				Is this station a wetland?	Yes		Yes		Yes		Yes		Yes		Yes	

Legend

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Dominant species: Species for which relative percent coverage is identified in **bold black** are dominant species : with a relative 20% coverage or more, and/or species for which cu

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**** Species considered facultative wetland plant in this study

Massicotte, Julie

De: Gagnon, Jonathan <Jonathan.Gagnon@environnement.gouv.qc.ca>
Envoyé: 5 mai 2020 09:38
À: Rosset, Julien; Ladevèze, Pierre; Auger, Isabelle; Diouf, Ismaïla; Breton, Johanne; Guérin, Émilie; Ablain, Maud
Cc: Massicotte, Julie; Keough, Anne; Honnet, Christelle
Objet: Re: Préparation de l'étude d'impacts - Nouveau LEET Nemaska

Bonjour, j'apporte en rouge une petite nuance dans le texte.

Bonne journée à tous et toutes,

Jonathan Gagnon

De : Rosset, Julien <Julien.Rosset@stantec.com>
Envoyé : 5 mai 2020 08:49
À : Ladevèze, Pierre <pierre.ladeveze@environnement.gouv.qc.ca>; Auger, Isabelle <Isabelle.Auger@environnement.gouv.qc.ca>; Diouf, Ismaïla <Ismaila.Diouf@environnement.gouv.qc.ca>; Breton, Johanne <Johanne.Breton@environnement.gouv.qc.ca>; Gagnon, Jonathan <Jonathan.Gagnon@environnement.gouv.qc.ca>; Guérin, Émilie <Emilie.Guerin@environnement.gouv.qc.ca>; Ablain, Maud <Maud.Ablain@environnement.gouv.qc.ca>
Cc : Massicotte, Julie <Julie.Massicotte@stantec.com>; Keough, Anne <Anne.Keough@stantec.com>; Honnet, Christelle <Christelle.Honnet@stantec.com>
Objet : RE: Préparation de l'étude d'impacts - Nouveau LEET Nemaska

Bonjour à tous,

Nous vous remercions pour l'appel de la semaine passée et votre disponibilité.

Cela a permis de passer à travers les résultats de l'étude de caractérisation écologique du site visé pour le développement du futur lieu d'enfouissement en tranchée de Nemaska.

Globalement, les interprétations faites par les biologistes de Stantec sont conformes à l'approche du ministère. La liste ci-dessous récapitule les points plus détaillés :

- Il est juste d'accorder au thé du Labrador le statut d'espèce indicatrice facultative des milieux humides au lieu d'obligée
- Une association végétale composée d'épinette noire et de thé du Labrador pourrait être qualifiée de milieu terrestre malgré le fait que l'épinette et le thé du Labrador sont deux espèces indicatrices de milieux humides. Il faudrait toutefois s'assurer de l'absence de sols hydromorphes.

- Le critère consistant à considérer comme une tourbière tous les milieux comportant 20 cm de matière organique et plus est jugé acceptable. Toutefois, cette matière organique doit être composée de sphaigne ou être colonisé majoritairement par de la sphaigne.
- Des fiches terrain devraient être soumises avec l'étude. Toutefois, Stantec utilise des tablettes pour la collecte des données terrain, dont le logiciel génère les données terrain sous forme de tableaux préformatés. Des photos terrain des stations et des tests pédologiques, ainsi que les éventuels commentaires réalisés pourraient être présentés

Nous poursuivons l'élaboration de l'étude d'impact et du design préliminaire.
Nous avons également bien pris note de la directive qui nous sommes en train d'analyser afin de nous assurer de couvrir l'ensemble des exigences. Nous prendrons contact avec vous dans le cas où certaines demandes seraient à préciser.

N'hésitez pas à nous contacter si besoin.
Merci et bonne journée!

Julien Rosset B.Sc., M.A.A.
Directeur d'expertise, Gestion des matières résiduelles
Services environnementaux

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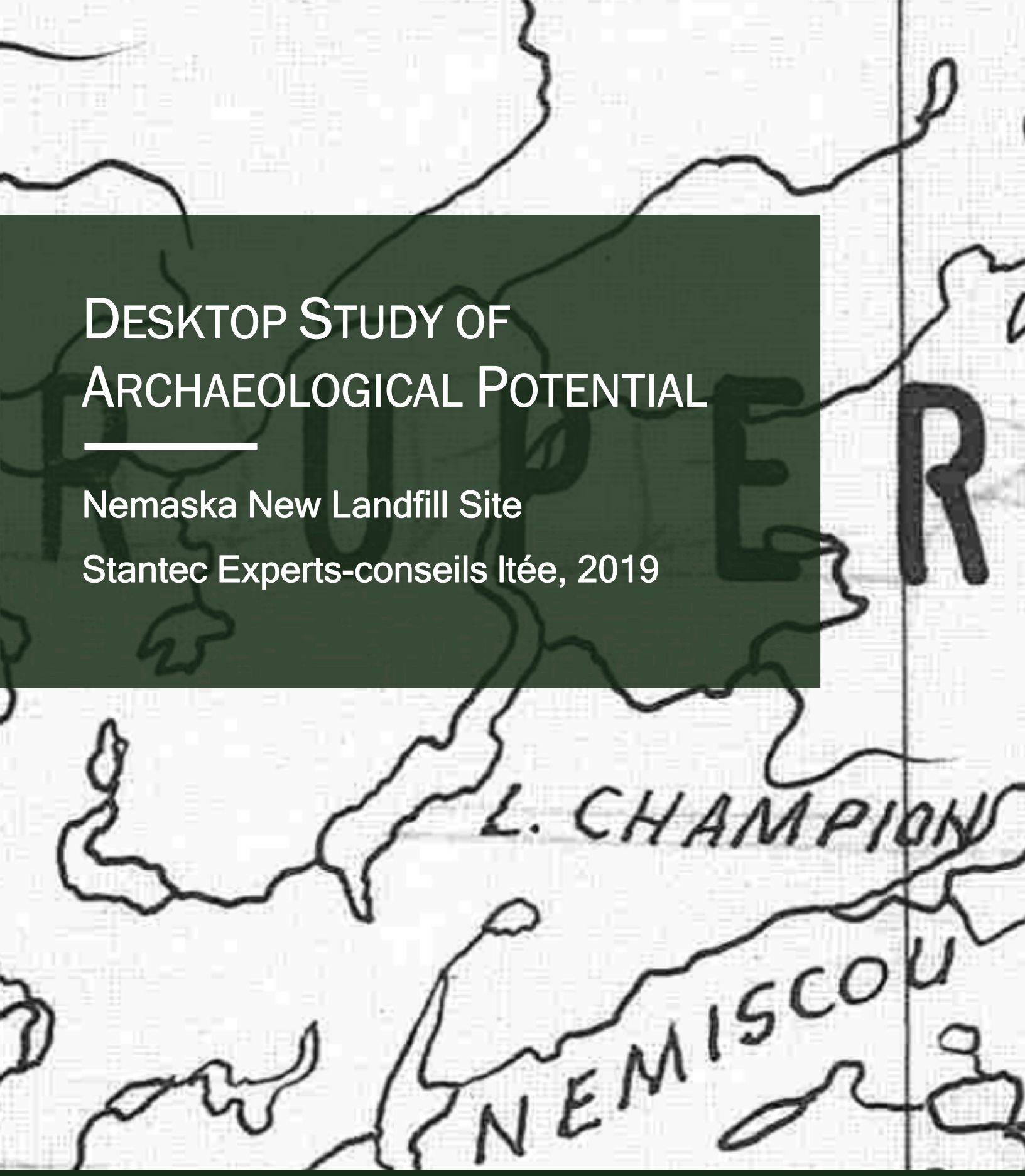
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APPENDIX J ARCHAEOLOGICAL STUDY

Desktop Study of Archaeological Potential

Nemaska New Landfill Site

Stantec Experts-conseils ltée, 2019



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Executive Summary

This report entails a desktop study of archaeological potential conducted for Stantec Experts-conseils ltée and its client, the Cree Nation of Nemaska. The study evaluates the risk that archaeological sites may be impacted by the planned infrastructures of the Nemaska New Landfill Site Project. It covers an area of 579,434 m^2, encompassing all project infrastructures, located at km 306 of Route du Nord, about five kilometres south of Nemaska.

Research conducted for this study revealed that the level of archaeological potential is low to moderate and that the only moderate zone (#1) will not be affected by the planned infrastructures. Consequently, impact risks on archaeological heritage is low and measures of impact mitigation will not be necessary under the current layout of the planned infrastructures.

It is thus recommended that the Cree Nation of Nemaska and its consultant, Stantec Experts-conseils ltée, should proceed without further constraint regarding the archaeological heritage. However, if plans should change to encompass zone # 1 of moderate archaeological potential, field survey including visual inspection and test pits should be carried out to confirm the risk of impact. Test pits surfaces should be minimally of 900 cm^2 and spaced at regular intervals of no more than 15 m over the totality of the impacted section of zone # 1.

Table of Contents

Executive Summary i
Table of Contents ii
List of Figures iii
List of Tables iv
Production Team v
1. Introduction 1
1.1. Outline of the Nemaska New Landfill Site Project 1
1.2. Scope and objectives of the study 1
1.3. Structure of the report 1
2. Methodology 4
2.1. Study area 4
2.2. Documentary research 4
2.3. Geospatial database 5
2.4. Determination of archaeological potential 5
3. Environmental and Culture-Historical Overview 7
3.1. Environmental overview 7
3.2. Culture-historical overview 12
4. Analysis of Archaeological Potential 16
5. Risk Assessment 18
6. Conclusions and Recommendations 19
Bibliography 20
Appendix A – Technical File Content (DVD) 23

List of Figures

Figure 1 : Location of study area....3
Figure 2 : Geography of study area....8
Figure 3 : Lake Ojibway before its final drainage and position of the ice front at about 8000 BP (Veillette 1994)....10
Figure 4 : Tyrrell Sea shoreline regression from 7000 BP to present day, illustrated by the succession of pale to dark gray areas (text in red has been added by the author for clarity) (Pendea et al. 2010) 11
Figure 5 : Vegetal cover at 6000 and 4000 BP (Richard and Grondin 2009) 12
Figure 6 : Archaeological potential of study area 17

List of Tables

Table 1: Attributes retained for the analysis of archaeological potential.....6
Table 2: Determination of the level of archaeological potential.....6
Table 3: Zones of archaeological potential.....16

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1. Introduction

The Cree Nation of Nemaska and its consultant, Stantec Experts-conseils ltée, are planning the development of a new landfill site, at km 306 of Route du Nord (Figure 1). At this location, environmental impact assessments must be carried out with respect to legal obligations defined in the Environment Quality Act (EQA, Q-2, r.25) and the JBNQA (section 22). Archaeological heritage is a required component of the assessment.

1.1. Outline of the Nemaska New Landfill Site Project

The project consists of the excavation of a continuous trench to a depth of 4 to 9 m, along the south flank of an elongated drumlin, on the south side of Route du Nord. Construction of a berm around the trench, to increase the landfill capacity, and installation of a fence on top of the berm are also part of the project. An access road linking the site to Route du Nord will be constructed as well. The map of Figure 1 shows three alternative scenarios under evaluation. In addition to these planned infrastructures, excavated soils will need to be deposited in specific areas and heavy machinery is likely to circulate over the planned infrastructure and its surroundings. The total surface covered by these infrastructures and activities is 204,000 m^2.

Construction activities and long-term use of the site will most certainly impact ground surface down to a possible depth of 9 m. Archaeological heritage is a fragile resource with sites most often buried up to 30 cm below the surface. In northern regions, such as the Eeyou Istchee (Cree territory), artifacts can even lay directly on top of the ground. The Nemaska New Landfill Site consequently poses a risk to archaeological heritage that may be within its proximity.

1.2. Scope and objectives of the study

This desktop archaeological study will provide a general estimation of the archaeological heritage potentially present within a study area of 579,434 m^2, encompassing all project infrastructures with a 500 m buffer around them (Figure 1). It will also propose strategies to mitigate the impact of the project on this heritage. More specifically, the study will 1) characterize archaeological potential of the study area, 2) define impact risks of the project on archaeological heritage, and 3) propose measures to mitigate impacts, if necessary.

No field investigation was carried out due to winter conditions. Conclusions and recommendations formulated at the end of the report take this limitation into consideration.

1.3. Structure of the report

This report is divided into five main sections. Firstly, the methodology underlying this study is explained. Secondly, a general overview of the environmental and historical context of the study area is provided. Thirdly, archaeological potential is defined, based on available data. Fourth, the risk that construction activities may impact archaeological heritage is assessed. The final section

provides conclusions and recommendations regarding measures capable of mitigating the impact of the project in zones of archaeological potential. A DVD containing the technical file is attached to the back page of the report. It contains relevant archives, ArcGIS source files, maps, and a PDF version of this report.

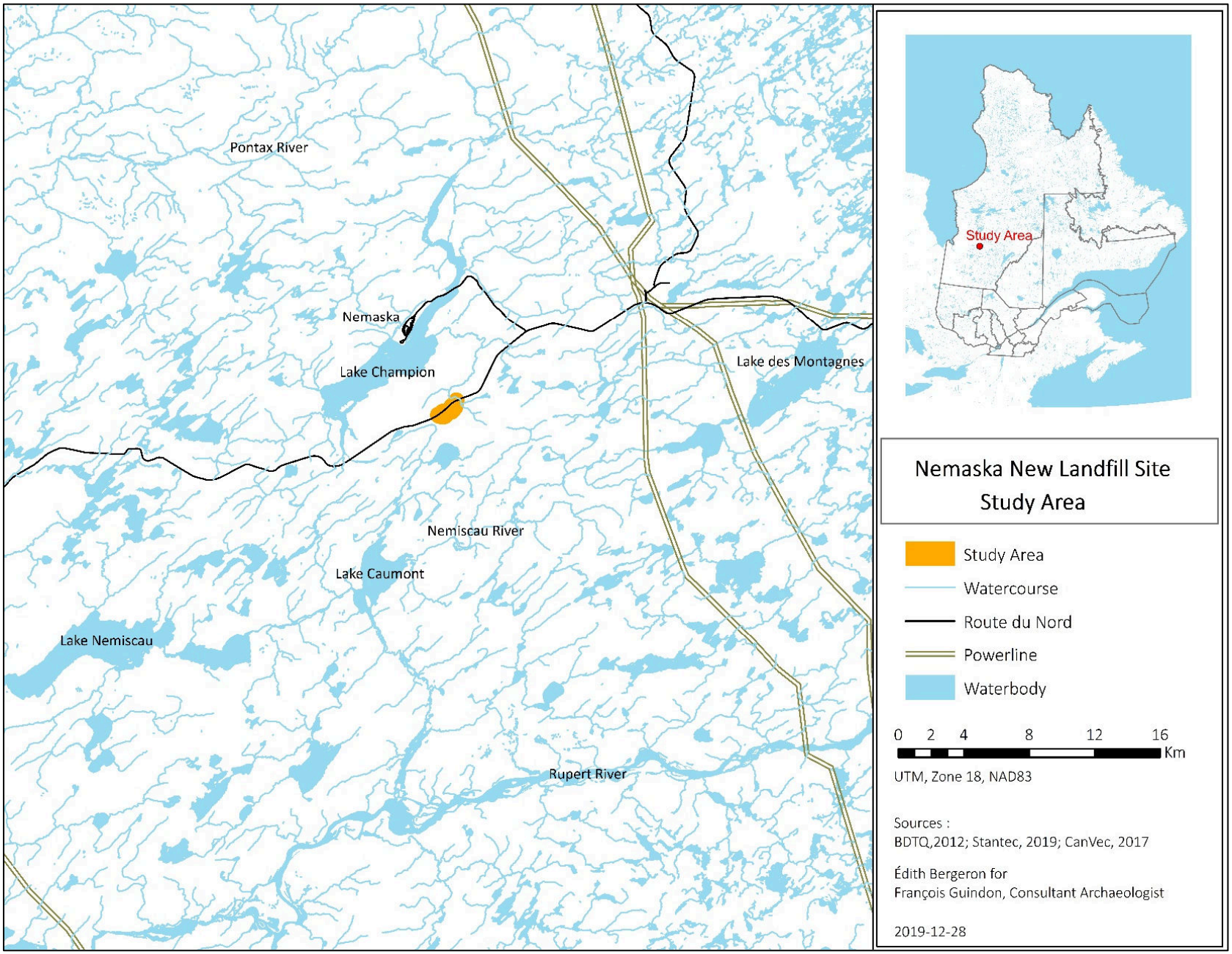


Figure 1 : Location of study area

2. Methodology

An assessment of archaeological potential consists of evaluating the possibility that archaeological traces may be present within a given territory. This estimation goes beyond available field research as it defines the level of likeliness that documented and undocumented archaeological heritage may be present. In the context of land development, such as the Nemaska New Landfill Site, risks of impacting the archaeological heritage can then be assessed and measures of mitigation proposed accordingly. Potential adjustments to the development project will provide more favourable conditions for archaeological heritage protection, if required.

Historical, cultural and natural features served as a basis for segmenting the area into distinct zones of varying levels of archaeological potential. This investigation was carried out through 1) archival and documentary research, 2) constitution of a geospatial database, and then by 3) dividing the study area into zones of archaeological potential.

2.1. Study area

The space covered by this investigation, also designated as the study area, is defined as a buffer of 500 m around the projected landfill and access roads. It covers 579,434 m^2 of category III land in the James Bay and Northern Quebec Agreement (JBNQA), 5 km south of the community of Nemaska.

2.2. Documentary research

Sources listed below were searched with the objective of locating all previous archaeological fieldworks, archaeological traces, places of cultural significance, as well as any previous development and land disturbances.

- Bibliothèque numérique en archéologie
- Inventaire des sites archéologiques du Québec (ISAQ)
- National air photo Library (NAP)
- Greffe de l'arpenteur général du Québec (GAGQ)
- Bibliothèques et Archives nationales du Québec (BAnQ)
- Library and Archives Canada (LAC)
- Published sources regarding regional history, ethnology and archaeology
- Local land-users' accounts gathered by Stantec's anthropologist

In addition, historical changes in the natural environment can influence human occupation and land-use. It was thus essential to consider past and present environmental conditions to accurately assess the archaeological potential of the study area. Published sources regarding past and present environmental settings were consequently consulted to outline the environmental history of the study area. The following sources were used:

- Infrastructure géomatique ouverte (IGO) données écoforestières
- Système d'information géominière of Québec (SIGÉOM)
- Published literature about past and contemporary environment
- Data provided by Stantec's anthropologist and environmental services

The environmental and cultural history file is presented in the following section.

No on-site validation was carried-out because of winter conditions preventing accurate visual inspections.

2.3. Geospatial database

Documentary research can provide a vast amount of information about the occupation of a given territory. Following documentary research, a geospatial database was built in ArcGIS and centralised available information. This helped locating elements of interest, as well as disturbances negatively affecting the archaeological potential.

2.4. Determination of archaeological potential

Zones of archaeological potential were defined based on all available information synthesised in the culture-historical file, as well as the geospatial database. Data deemed favourable or unfavourable to human occupation, including indigenous and non-indigenous groups, was cross-referenced to define zones with nil, low, moderate or high archaeological potential. In the ArcGIS geospatial database, each level of archaeological potential forms a distinct layer containing the polygons of corresponding zones of potential. Low or nil potential is generally considered insufficient to recommend measures of mitigation. With moderate and high archaeological potential, adapted measures of mitigation are generally recommended.

Attributes favourable or unfavourable to human occupation vary depending on the cultural affiliation of occupying groups. For the broad region encompassing southern James Bay, only First Nation and Euro-Canadian groups have been historically present. Table 1 outlines the attributes used in the analysis, corresponding to criteria commonly used in Quebec archaeology (e.g. Denton 1976; Laliberté 1976; 1977). Selected criteria helped determining if conditions of occupation were suitable or unsuitable, thus suggesting the potential presence of campsites, portages, permanent settlements, industries, transportation or communication networks, to name some possibilities. Table 2 outlines how the level of potential was established, depending on the cultural affiliation of the potential occupation. Results are summarized in a table, and a map is presented in the analysis section of this report.

TABLE 1: ATTRIBUTES RETAINED FOR THE ANALYSIS OF ARCHAEOLOGICAL POTENTIAL			
First Nation		**Euro-Canadian**	
Favourable attributes	**Unfavourable attributes**	**Favourable attributes**	**Unfavourable attributes**
➢ Classified heritage site ➢ Known archaeological site or contemporary features (e.g. campsite, portage, storage area) ➢ Proximity to a watercourse, water body or converging watercourses (contemporary or ancient) ➢ Good soil drainage ➢ Homogenous soils ➢ Regular topography ➢ Potential geological resource site	➢ Soil disturbance ➢ Contemporary or historical development ➢ Poor drainage ➢ Irregular topography	➢ Classified heritage site or building ➢ Known archaeological site ➢ Historical site or building ➢ Proximity to a contemporary or ancient watercourse or water body ➢ Proximity to a historical communication infrastructure (e.g. road, telegraph, railway) ➢ Regular topography ➢ Good soil drainage	➢ Lack of historical data about human occupation ➢ Soil disturbance ➢ Recent land development (after 1950)

TABLE 2: DETERMINATION OF THE LEVEL OF ARCHAEOLOGICAL POTENTIAL		
Level of potential	**First Nation**	**Euro-Canadian**
Nil	Soil disturbance negating any possibility of an archaeological trace	Unfavourable attributes negating any possibility of an archaeological trace
Low	One favourable attribute, significantly unfavourable attributes or uncertain information	Uncertain information, major soil disturbance or recent construction likely affecting soil integrity
Moderate	Multiple favourable attributes or one significant attribute combined with one or multiple unfavourable attributes	Multiple favourable attributes combined with minor soil disturbance or with recent construction possibly affecting soil integrity
High	Multiple favourable attributes, presence of a known archaeological site or heritage site, with few or no unfavourable attributes	Multiple favourable attributes, known archaeological or heritage site, without recent disturbance or construction affecting its integrity

3. Environmental and Culture-Historical Overview

The study area has seen a rich succession of events shaping its archaeological heritage. Main components of this history include changes to the natural environment and changes to societies occupying this territory.

3.1. Environmental overview

Contemporary and past environmental conditions help with understanding the natural factors that influenced human occupation through time.

3.1.1.Contemporary landscape

The study area is situated within the ecological region of *Coteaux du lac Assinica*, dominated by the western spruce-moss forest. Its climate is subpolar to continental with very low precipitation, thus explaining a high frequency of forest fires. It has a subdued topography with few hills. Higher grounds are found in the north and south of the study area, with low hills of 260 to 270 m in altitude, covered by an open jack pine forest. The northern hill is in fact an elongated drumlin where till is more than 20 m thick. This is the surface targeted for the landfill site. Lowest surfaces of 240 m border a small river at the southwest limit of the study area, whereas a marshy area drained by a permanent creek occupies its northeast (Figure 2). Caribou is found in the area. Major water bodies and water courses are located nearby, including Lake Champion (3 km north) at the headwater of Pontax River, and Nemiscau River (6 km southeast), reaching Lake Nemiscau on the Rupert River (Figure 1). Surficial deposits are mostly made of till. Glaciolacustrine deposits are not reported (Blouin and Berger 2004; Ministère des Forêts, de la Faune et des Parcs 2019; Poly-Géo Inc. 2017; Stantec Consulting Ltd. 2018).

3.1.2. Geology

The bedrock geology of the study area is of interest because of reported rock outcrops that may have been of interest to First Nation occupants. It is part of the Superior Province, La Grande Subprovince, and includes mostly igneous rocks, such as granite, granodiorite, pegmatite, gabbro, and basalt. Paragneiss, a sedimentary rock, is also present (Ministère de l'Énergie et des Ressources naturelles 2019). Basalt and, to a lesser degree, gabbro can show clastic properties and have been transformed into knapped and polished stone tools by northern First Nations (e.g. Archéo-Mamu Côte-Nord 2018; Letendre 2015). A large (>900 m^2) Gabbro outcrop is reported for the Caumont mafic-ultramafic suite, on a low hill, 260 m south-east of the study area (Figure 2). On the same hill, a basalt outcrop, also of fair size (>900 m^2), is in the Lac des Montagnes Group 1, 175 m south of the former, also outside the study area (Figure 2). Both locations constitute points of interest from an archaeological perspective but are not at risk with the current limits of the planned infrastructures. They should, however, be inspected by an archaeologist if plans change to encompass the hill where the outcrops are located.

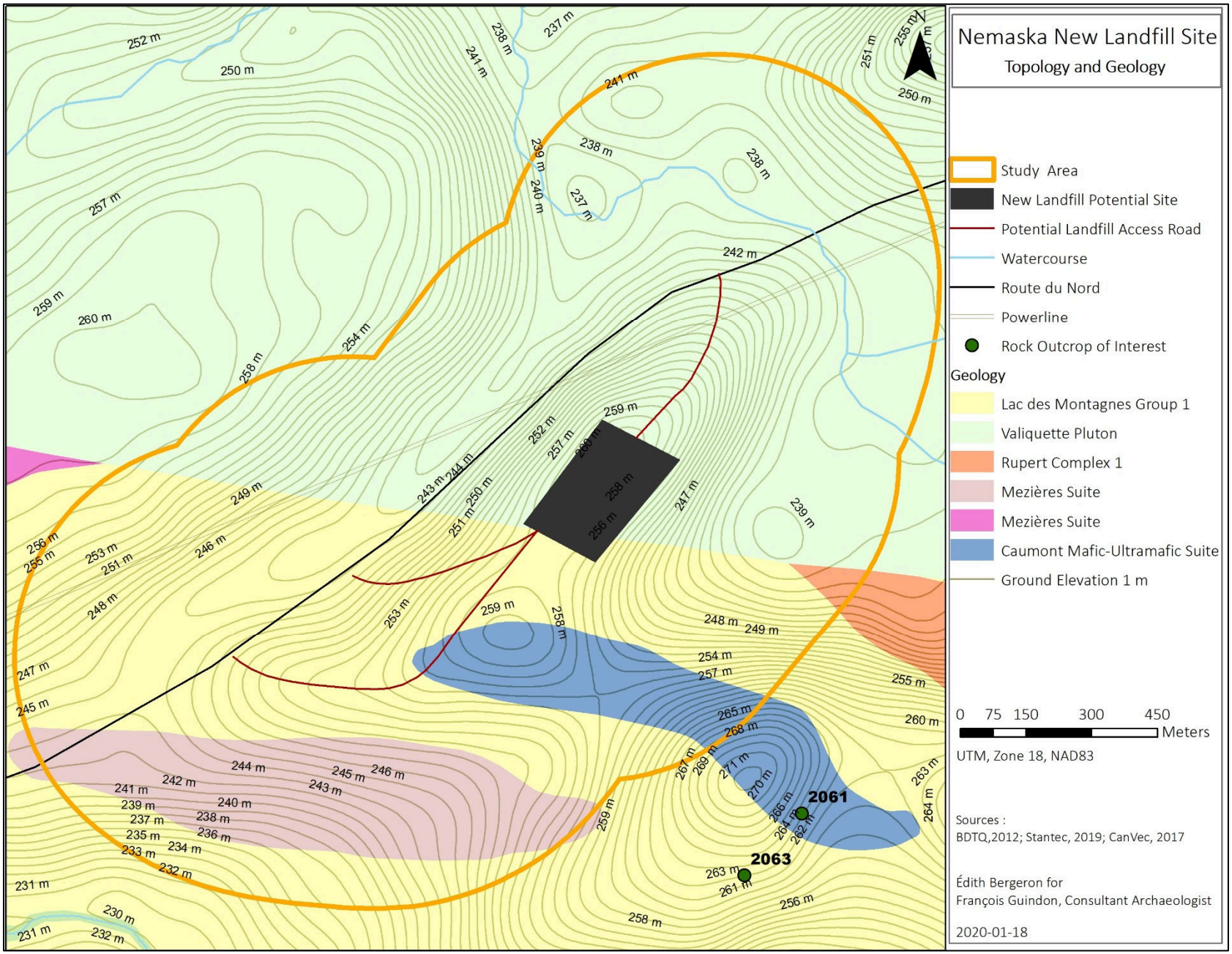


Figure 2 : Geography of study area

3.1.3. Environmental history

The contemporary configuration of the natural environment is the result of climate and environmental evolution since the end of the last glacial era. Until about 8500 - 7900 before present (BP), the study area may still have been covered by a glacier (Figure 3). Melt water accumulated at its southern margin and formed the Ojibway proglacial lake, which reached a maximum level of about 460 m near the study area. Sudden drainage occurred between 8400 and 8000 BP, once the melting ice front that prevented water drainage opened a northern passage. Water levels then receded to a maximum of 250 m above current sea level, in southern regions of James Bay, and up to 290 m at the longitude of the Sakami moraine, north of the study area. Saltwater penetrated to form the Tyrrell Sea, which bordered the ice front on its northeast. Maximum levels may have remained until 7500 - 7000 BP. Around 6500 BP, it receded to 175 m above current sea level and the glacier was almost completely gone (Fréchette et al. 2018; Richard 1979; Rousseau 2015; Roy et al. 2010; Veillette 1994) (Figure 4). Inland proglacial lake levels are uncertain after the Tyrrell Sea episode. Available data for the EM-1 area[1] suggests that terrains occupied by human groups reached decreasing levels over time as lake and river waters receded (Letendre 2015; Plourde 2015).

Vegetation may have colonized the study area only after water levels were low enough for land to emerge. According to this chronology, this may only have been possible sometime during the 8000 - 6000 BP interval, when water levels decreased. Around 8000 BP, a shrub or forest tundra colonized regions near the glacier. Around 6000 BP, the vegetal cover was denser and climate warmer than today by about 1-2 °C. A dense black spruce forest was found on the east side of the Tyrrell Sea (Figure 5). Fir, tamarack, birch, poplar, and aspen were also more common than today. Between 5000 - 4500 BP, a major climate shift occurred. The relatively dryer and warmer climate became cooler, wetter and the days were not as sunny. This was the beginning of the Neoglacial period. Climate cooling continued with minor climatic shifts and led to contemporary environmental configurations by 2000 BP (Fréchette et al. 2018; Richard and Grondin 2009; Rousseau 2015).

[1] The Eastmain-1 hydroelectric development includes a 603 km^2 reservoir, a dam and associated weirs as well as a 480 MW power station. Extensive archaeological surveys and digs were conducted prior to the impoundment of the reservoir, from 2002 to 2005.

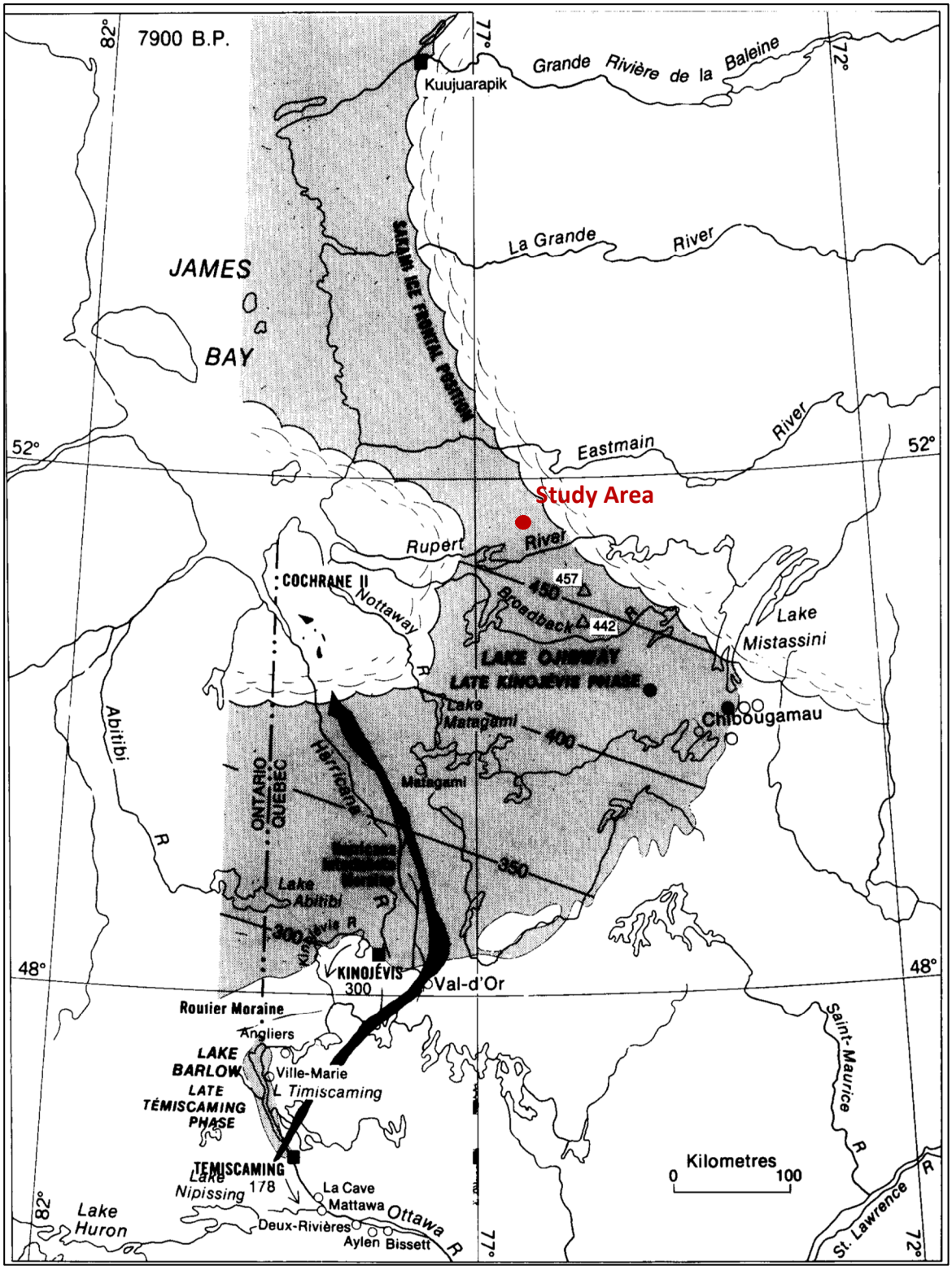


Figure 3 : Lake Ojibway before its final drainage and position of the ice front at about 8000 BP (Veillette 1994)

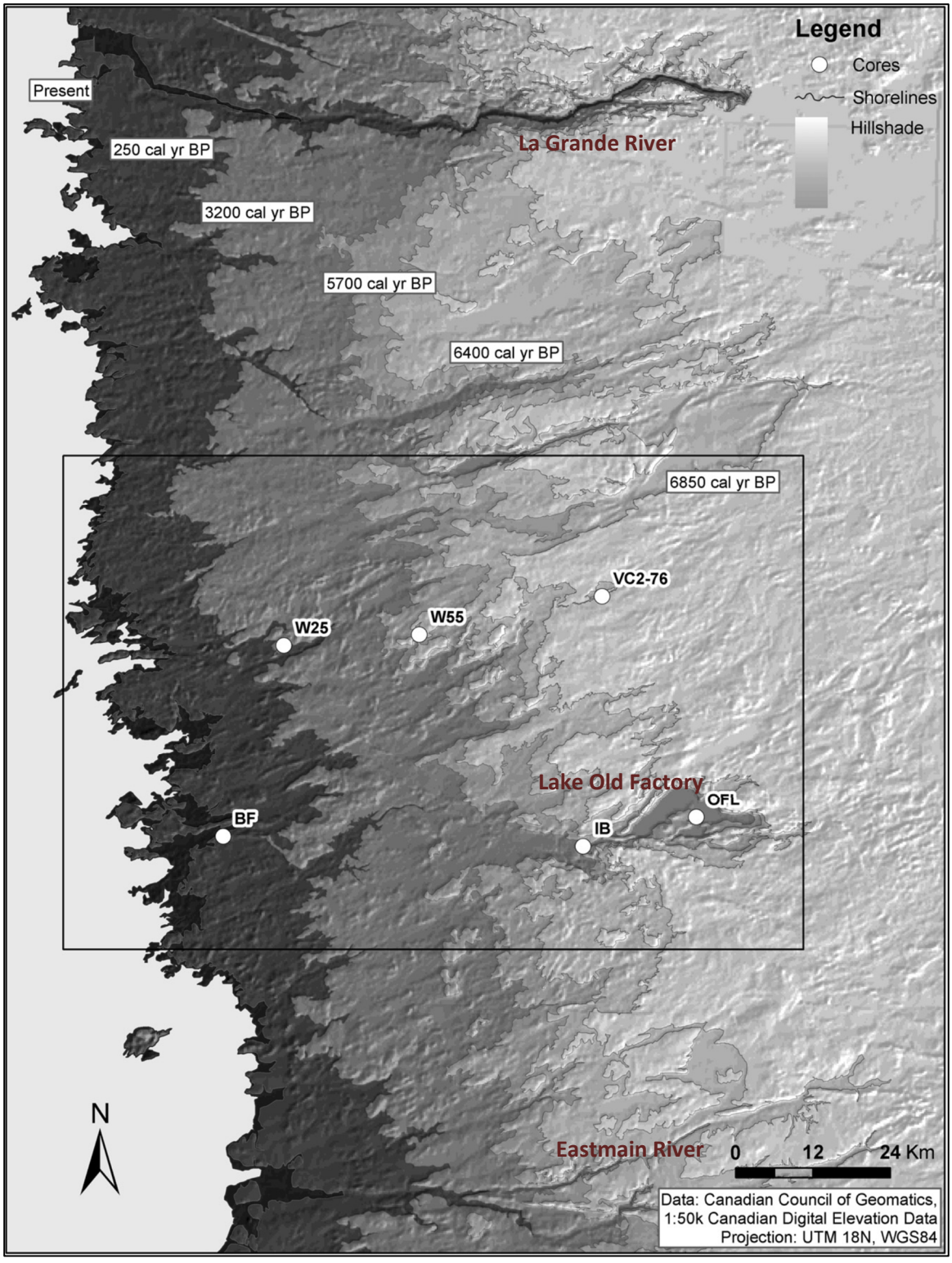


Figure 4 : Tyrrell Sea shoreline regression from 7000 BP to present day, illustrated by the succession of pale to dark gray areas (text in red has been added by the author for clarity) (Pendea et al. 2010)

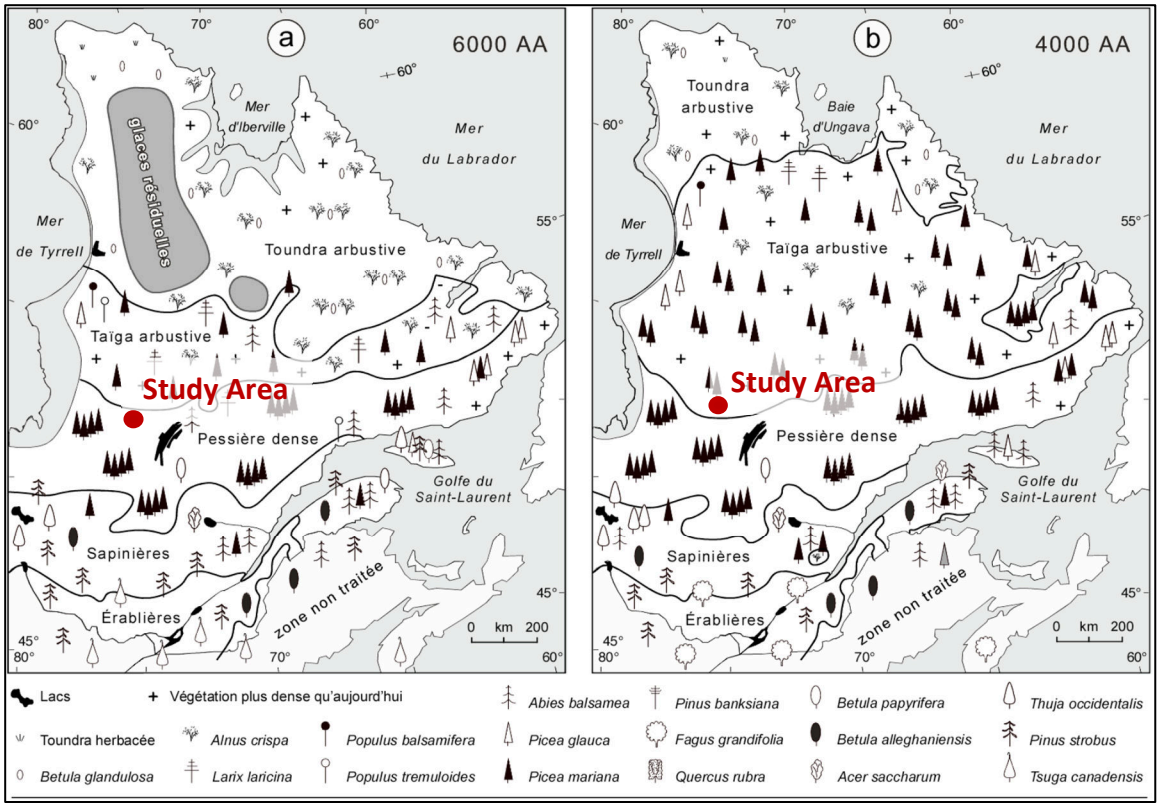


Figure 5 : Vegetal cover at 6000 and 4000 BP (Richard and Grondin 2009)

3.2. Culture-historical overview

The brief cultural history of the region that follows includes changes in land-use patterns, which can help identifying areas of interest for human occupation.

3.2.1.First Nations

The earliest occupants of the study area are First Nations but the earliest human presence in eastern James Bay is uncertain. Paleoenvironmental history suggests that human groups cannot have colonized the vicinity of the study area before 8000 BP, when the land was still covered by ice and a proglacial lake. Environmental conditions rapidly evolving between 8000 and 6000 BP may have offered suitable conditions for human occupation, including a tundra or taiga hosting a fauna that human groups could harvest, including land mammals, fish, birds, and plants. Environmental information, however, remains imprecise and recent archaeological research provides more clues to how far in time human presence may go back and how it transformed.

Recent archaeological research along the Eastmain River attests that lands near the study area were occupied by at least 5400 BP (Denton 2012; Letendre 2015). Human groups likely arrived from southern and eastern regions, already freed from the ice, and already occupied by human groups (McCaffrey 2006). Coastal areas were occupied by at least 4500 - 4000 BP at the height of the Broadback and Rupert rivers (Izaguirre et al. 2017). Stone tools were mostly made of locally acquired quartz, but Mistassini quartzite rapidly surpassed quartz in importance, particularly

between 3600 and 3000 BP. Other locally available materials, such as slate, were also used (Izaguirre et al. 2017).

Known human occupations are rare to uncommon until 2000 BP thus suggesting sporadic human presence until then. Some locations seem to become focal points in the occupation of the land, as shown by recurring visits. Sites also cover very small surfaces, pointing to small groups visiting the area. At the beginning of the period, cultural influences from Labrador (Maritime Archaic) are more obvious. However, from 3000 BP, local groups have stronger ties with southern regions and participate in the Meadowood interaction sphere or the Blackduck archaeological culture. These ties are particularly obvious in the south, while influences of Labrador cultures remain in the north (Denton 2012; Letendre 2015).

From about 2000 BP, human occupation intensified, especially in southern regions of eastern James Bay. This is suggested by the higher number of known archaeological sites, covering larger surfaces and with larger elongated dwellings. Summer gathering sites, covering large spaces, are also numerous. The Chisheyatishiskâu site, at the confluence of the Rupert River and Mistikawâsh River, is the largest known archaeological site of eastern James Bay (St-Germain and Courtemanche 2015; Denton 2012; McCaffrey 2006; 2011). Population increase and larger group sizes may have been permitted by the exploitation of a larger spectrum of animal species. Sites are generally located on points of land projecting into water courses or bodies, sheltered from northern winds (Plourde 2015). Rock art, such as the impressive paintings of Lake Nemiscau, may also date back to this period (Arsenault 1995; 2008; Vaillancourt 2008). There is general agreement amongst archaeologists that the contemporary Eeyou-Eenou (Cree) tradition began around 2000 BP.

Lithic styles remained until first contacts with Europeans. Mistassini quartzite was the most used material for stone tools, but its frequency varied regionally. Projectile points were made with lateral notches and show lanceolate or foliate forms. Their size decreased over time to become unequivocal arrowheads. Ceramic objects, however, constitute a significant addition to the material culture. Laurel pottery and a later, perhaps locally made, style of punctuated pottery, as well as Huron-Wendat smoking pipes and pottery, were found in the region St-Lawrence Iroquoian pottery may also be present. Beaver was a staple for groups of southern regions, including the study area.

During the 17th Century, the first contacts with Europeans occurred. Earlier contacts may have happened by interposed interactions, through existing trade networks conveying European goods to the Eeyou Istchee – the Cree territory. However, the arrival of Henry Hudson in 1611 AD marked the beginning of slow, but significant changes to the regional social landscape and local technology, largely induced by the development of the fur trade. Stone tools remained in use until the 18th-19th centuries, while items such as glass beads, metal kettles, steel axes, firearms, and metal needles were gradually adopted (Denton 1994; 2012; 2015; Francis and Morantz 1983). Indigenous ceramics were not used anymore. Nonetheless, the material, social and spiritual transformations affecting First Nations present in the area remained relatively minor until the

twentieth century, when their territory became more accessible to outsiders and governments began interfering with local lifeways (Guindon 2013).

After 1945, the Federal and, subsequently, the Provincial governments began to take considerable interest in the indigenous populations of the country. Programs established during the period, though sometimes sustained local lifeways, largely degraded indigenous well-being. Policies and institutions responded to a general objective of social engineering attempting to turn indigenous peoples, such as the Eeyou-Eenou, into Euro-Canadians (Morantz 2002). The Nemaska Cree, who occupied the vicinity of the study area, rapidly abandoned their semi-nomadic way of life. Their village, originally located on the shores of Lake Nemiscau, about 40 km southwest of the study area, mostly remained a seasonal settlement for them. With the closing of the Hudson's Bay Company post in 1970, they scattered between Waskaganish, Waswanipi, and Mistissini. They reunified with the foundation of their current village of Lake Champion, in 1975, five kilometres northwest of the study area (Girard 2012b; Salisbury 1986). Cree Elders, however, suggest that planned hydroelectric development forced them away. The community became connected by road in 1991, with the construction of Route du Nord, passing through the study area (Girard 2012a).

Based on the ISAQ database, no archaeological site affiliated to First Nations is reported for the study area (Ministère de la Culture et des Communications 2019). In fact, no archaeological research has been conducted within that space, based on that same database.

The local tallyman was interviewed during preliminary phases of the project. He did not have any knowledge of a culturally significant site within the study area. He also said that the place is not commonly used for hunting or fishing (Stantec Consulting Ltd. 2018; 2019).

Archival research did not reveal any clues about possible First Nations occupation within the study area. The small river running to its southeast could have been used as a passage between the Nemiscau and Pontax watersheds, but this does not necessarily imply any use of the neighbouring lands, such as the study area. O'Sullivan, in his survey report of 1906, even suggests that the Nemiscau River was only used as a secondary canoe route to Nichikun, when Spring and Fall freshets prevented navigation on the Rupert River (O'Sullivan 1906).

3.2.2.Euro-Canadian occupation

After the initial incursion of Henry Hudson by sea, in 1611, over 50 years passed for the next Europeans to visit Eeyou Istchee. French archives mention that a fort was built on the Nemiscau or Rupert River in 1661, but the information remains doubtful. In 1663, Guillaume Couture, Pierre Duquet, and Jean Langlois lead an expedition of 44 canoes from New France and reached Lake Nemiscau, then known as a major trading place. They returned to New France after trading with local occupants. The first inland trade post of Eeyou Istchee was established at Lake Nemiscau in 1685, under the leadership of Zacharie Jolliet, hired by the newly formed Compagnie du Nord. The same company opened a second post on the same lake in 1695, which remained in operation until the company was dissolved in 1700. The Hudson's Bay Company followed with its first post

at Lake Nemiscau, active from 1794 to 1799 and then from 1802 to 1809. The North West Company also ran its own post on the same lake from 1804 to 1806 (Francis and Morantz 1983). During the 20th century, the Hudson's Bay Company maintained a post at Lake Nemiscau, from sometime before 1908 until 1970 (Archives of Manitoba 2019). Revillon Frères also briefly had a post in activity from 1927 (Morantz 2002). There was thus Euro-Canadian activity near the study area since at least 1663 AD.

Euro-Canadian presence neighbouring the study area includes Hydro-Quebec's Nemiscau camp and mining camps, which were built in recent years. However, archival research did not reveal any Euro-Canadian development within the study area before the 1990s. A 1978 map shows Route du Nord passing through the study area, but this most likely is a planned layout (Bureau Arpenteur Général 1978). As already mentioned, Route du Nord was built in 1991 (Girard 2012a). Research conducted in the ISAQ database does not report any archaeological site affiliated to Euro-Canadian occupation within the study area (Ministère de la Culture et des Communications 2019).

4. Analysis of Archaeological Potential

The study area has been divided into two distinct zones of archaeological potential (Table 3, Figure 6). Zone # 1 encompasses a low elongated rocky hill reaching outside the study area, at its southeast periphery. Outcrops of basalt and gabbro are reported for this zone and may have been of interest to First Nation occupants for making stone tools. No landfill infrastructure is planned to be built there. Zone # 2 comprises most of the study area and has low archaeological potential because of many unfavourable attributes for human occupation and known disturbances.

TABLE 3: ZONES OF ARCHAEOLOGICAL POTENTIAL

ID	Level of potential	Cultural affiliation	Northing (UTM 18)	Easting (UTM 18)	Surface area (m^2)	Favourable attributes	Unfavourable attributes
01	Moderate	First Nation	5721211	416028	>1,200,000	➢ Potential geological resource ➢ Dry higher grounds	➢ Irregular topography ➢ No historical document mentioning Euro-Canadian presence
02	Low	First Nation	5721874	415588	2,418,133	➢ Some dry higher grounds	➢ Irregular topography ➢ Poor drainage for most of the area ➢ Road and powerline likely associated to land disturbance ➢ No historical document mentioning Euro-Canadian presence

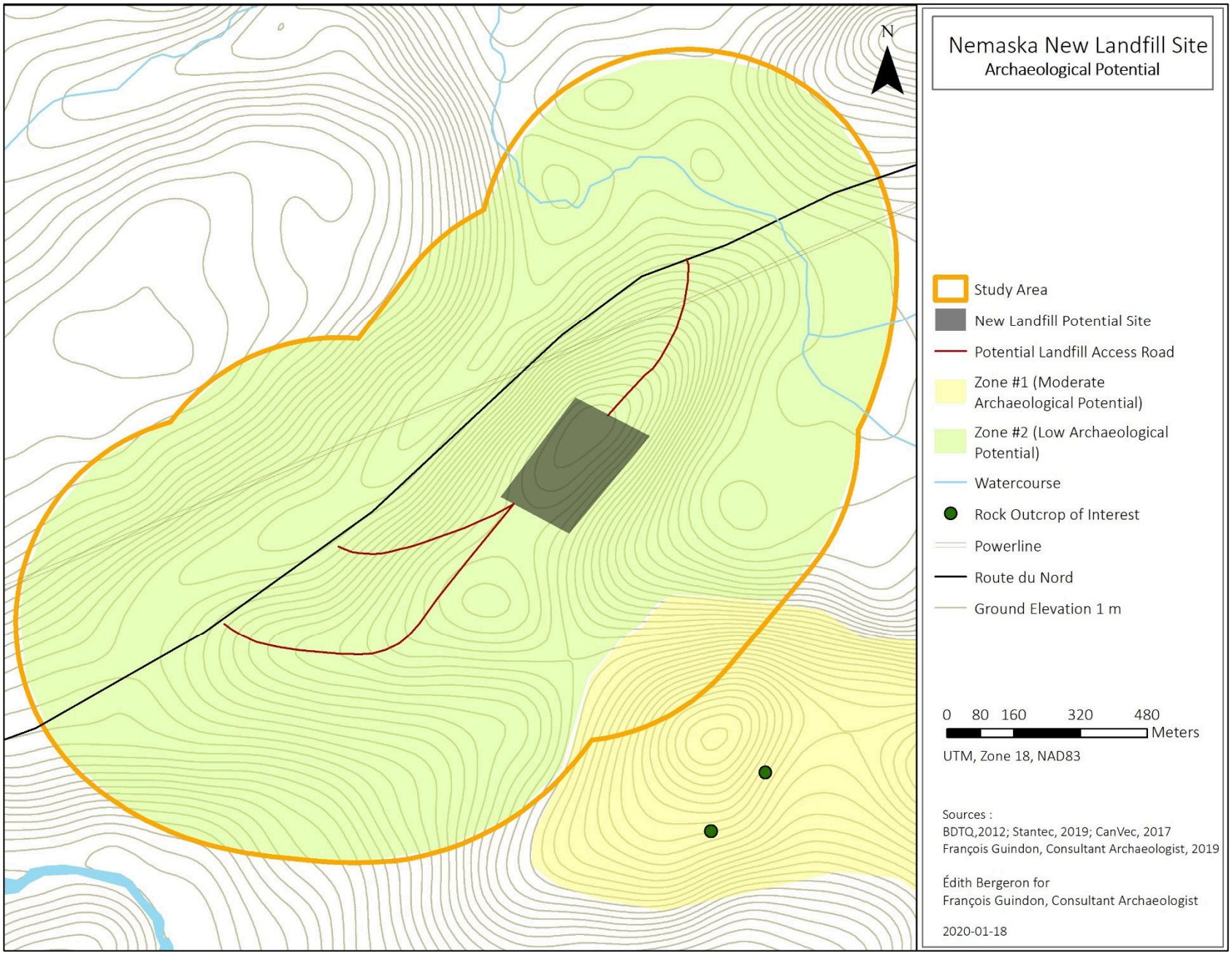


Figure 6 : Archaeological potential of study area

5. Risk Assessment

The study area will be impacted by planned infrastructures for the new landfill site of Nemaska. These infrastructures will cause disturbances to the ground, up to 9 m below the surface. Any archaeological site present within the impacted area will be affected. However, most of the study area has low archaeological potential and there is no known archaeological site close to it. Zone # 1, to the southeast limit of the area, has moderate potential, but is far from the planned infrastructure.

Impact risks on archaeological heritage are thus insufficient to recommend any further mitigation within the study area. However, if plans for the site layout would change to encompass zone # 2, where potential is moderate, a site inspection, including surface observation and test pits at regular intervals, would be recommended to confirm the risk.

6. Conclusions and Recommendations

This desktop archaeological study aimed to estimate the archaeological potential of an area of 579,434 m^2, encompassing a 500 m buffer around the project infrastructures of the new landfill site of Nemaska (Figure 1). Impact mitigation strategies also had to be proposed if it was established that archaeological heritage would be at risk. However, research conducted for this study revealed that the level of archaeological potential is low to moderate and that the only moderate zone (# 1) will not be affected by the planned infrastructures. Consequently, measures of mitigation for archaeological heritage will not be necessary for the study area under the current layout of planned infrastructures.

It is thus recommended that the Cree Nation of Nemaska and its consultant, Stantec Experts-conseils ltée, should proceed without further constraint regarding archaeological heritage. However, if plans should change to encompass zone # 1 of moderate archaeological potential (Figure 6), field survey including visual inspection and test pits should be carried out to confirm the risk of impact. Test pits surfaces should be minimally of 900 m^2 and spaced at regular intervals of no more than 15 m over the totality of the impacted area of zone # 1.

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Appendix A – Technical File Content (DVD)

APPENDIX K GHG EMISSIONS REPORT

Rapport d’identification et de quantification des émissions de gaz à effet de serre attribuables au projet de lieu d’enfouissement en tranchée de Nemaska

RAPPORT FINAL

Préparé pour :

Communauté crie de Nemaska

Préparé par :

Stantec Experts-conseils ltée

167020077-300-105-EN-R-0001-0

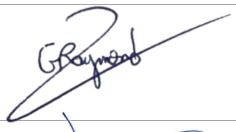
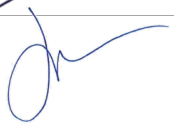
24 mai 2024

Registre d’approbation

Les conclusions du Rapport, intitulé *Rapport d’identification et de quantification des émissions de gaz à effet de serre attribuables au projet de lieu d’enfouissement en tranchée de Nemaska* reflètent l’opinion professionnelle de Stantec au moment de la rédaction du Rapport et concernent la portée du mandat décrite dans le Rapport. Les opinions contenues dans ce document sont basées sur les conditions et les informations existantes au moment de la publication du document et ne tiennent compte d’aucune modification ultérieure. Le Rapport ne concerne que le projet pour lequel les services de Stantec ont été retenus et l’objectif énoncé pour lequel le Rapport a été préparé. Le Rapport ne doit pas être utilisé afin de modifier ou de prolonger le projet, ou à tout autre fin ou projet, et toute utilisation non autorisée par quiconque est aux risques de ce dernier.

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Révision	Description	Auteur	Vérification qualité	Revue indépendante
0	Rapport final	G. de Raymond-Cahuzac	J. Rosset	s.o.

Table des matières

1.0 INTRODUCTION 1

2.0 DESCRIPTION DU PROJET 2
2.1 LOCALISATION ET CARACTÉRISTIQUES 2
2.2 PHASES DU PROJET 3
2.3 VARIANTE ÉTUDIÉE 3

3.0 IDENTIFICATION DES SOURCES D'ÉMISSION 4
3.1 PHASE DE CONSTRUCTION 4
3.1.1 Systèmes de combustion fixes 5
3.1.2 Système de combustion mobile 5
3.1.3 Transport des matériaux de construction, des matériaux d'excavation et de remblais 5
3.1.4 Déboisement 6
3.2 PHASE D'OPÉRATION 6
3.2.1 Systèmes de combustion fixes 7
3.2.2 Systèmes de combustion mobiles 7
3.2.3 Transport d'amendement et autres matériaux 7
3.2.4 Enfouissement des matières organiques 8
3.3 PHASE DE FERMETURE 8
3.3.1 Systèmes de combustion fixes 9
3.3.2 Système de combustion mobile 9
3.3.3 Transport des matériaux de construction, des matériaux d'excavation et de remblais 9
3.4 PHASE DE GESTION POST-FERMETURE 10
3.4.1 Systèmes de combustion fixes 10
3.4.2 Système de combustion mobile 10
3.4.3 Transport des matériaux de construction, des matériaux d'excavation et de remblais 11

4.0 QUANTIFICATION DES SOURCES D'ÉMISSION 12
4.1 FACTEURS D'ÉMISSIONS 12
4.2 RÉSULTATS 12

5.0 PLAN DE RÉDUCTION DES GES 15
5.1 PHASE DE CONSTRUCTION 15
5.2 PHASE D'OPÉRATION 15
5.3 PHASE DE FERMETURE 15
5.4 PHASE DE GESTION POST-FERMETURE 15
5.5 TOTAL POTENTIEL DE RÉDUCTION D'ÉMISSIONS DE GES 16

6.0 PLAN DE SURVEILLANCE 17

7.0 LIMITES ET INCERTITUDES 19

8.0 RÉFÉRENCES 20

LISTE DES TABLEAUX

Tableau 1 Systèmes de combustion fixe en phase de construction....5
Tableau 2 Systèmes de combustion mobile en phase de construction....5
Tableau 3 Transport des matériaux de construction, des matériaux d'excavation et de remblais en phase de construction....6
Tableau 4 Systèmes de combustion mobiles en phase d'opération....7
Tableau 5 Transport d'amendement et autres matériaux en phase d'opération....8
Tableau 6 Systèmes de combustion fixe en phase de fermeture....9
Tableau 7 Systèmes de combustion mobile en phase de fermeture....9
Tableau 8 Transport des matériaux de construction, des matériaux d'excavation et de remblais en phase de fermeture....9
Tableau 9 Systèmes de combustion mobile en phase de gestion post-fermeture....10
Tableau 10 Transport des matériaux de construction, des matériaux d'excavation et de remblais en phase de gestion postfermeture....11
Tableau 11 Émissions de GES par source d'émission LEET....13
Tableau 12 Émissions de GES par phase LEET....13
Tableau 13 Émissions de GES par source d'émission LET....13
Tableau 14 Émissions de GES par phase LET....14
Tableau 15 Émissions de GES au niveau national, provincial et sectoriel....14
Tableau 16 Total potentiel réduction émissions GES....16
Tableau 17 Plan de surveillance....17

LISTE DES FIGURES

Figure 1 Emplacement du futur LEET (Site 4) – Image tirée de l'étude « Site selection and baseline study for a new landfill site in Nemaska »....2

LISTE DES ANNEXES

ANNEXE A FACTEURS ÉMISSIONS GES

ANNEXE B RÉSULTATS DÉTAILLÉS ÉMISSIONS GES

Résumé

Le lieu d'enfouissement en tranchée (LEET) de la Communauté crie de Nemaska arrive au maximum de sa capacité et un nouveau lieu d'enfouissement doit être construit. Pour ce faire, une étude d'impact social et environnemental est réalisée. Dans le cadre de cette étude, la Direction générale de l'évaluation environnementale et stratégique du ministère de l'Environnement et de la Lutte contre les Changements climatiques (MELCC) a émis une directive pour ce projet (Directive 3214-16-079, janvier 2020). Une évaluation des gaz à effet de serre (GES) générés pendant l'ensemble des phases du projet est requise. Les émissions liées aux variantes technologiques et de lieu doivent également être estimées.

Le choix technologique s'est arrêté sur un LEET, et non un lieu d'enfouissement technique (LET). Cela est lié aux contraintes d'opérations supplémentaires et à un coût d'investissement élevé avec le LET. Cependant, les émissions de GES d'un LET ont été également estimées dans le présent rapport en accord avec les demandes de la directive d'évaluer les variantes technologiques. Le captage du biogaz n'est pas inclus dans les hypothèses du LET, le site étant trop petit pour que ça soit exigé par la réglementation. Les deux principales différences entre les deux conceptions concernent la présence d'une géomembrane pour rendre le sol imperméable, et le captage et traitement du lixiviat sur site.

Les sources d'émission identifiées sont classées selon quatre phases du projet : construction, opération, fermeture, et post-exploitation. Pour chaque phase, les sources sont présentées par catégorie : systèmes de combustion fixes, systèmes de combustion mobiles, transport, déboisement, et enfouissement des matières organiques. Les indications de la Directive du MELCCFP concernant le calcul des émissions ont été suivies.

Au total, pour l'ensemble des phases du projet pour la variante LEET, près de 63 438 tonnes équivalentes de CO_2 seraient émises dans l'atmosphère. La majeure partie des émissions est en lien avec l'enfouissement des matières organiques (MO). Cela compte pour plus de 90 % des émissions, de la construction à la post-exploitation. Concernant la variante LET, c'est près de 64 799 tonnes équivalentes de CO_2 qui seraient émises. La différence s'explique principalement par les émissions liées au traitement du lixiviat pendant les opérations et en post-exploitation. Le transport des matières compte pour moins de 2 % des émissions.

Un plan de réduction des GES est prévu pour chaque phase du projet. Concernant l'enfouissement des MO, il est proposé de mettre en place un programme de compostage dans la communauté. Celui-ci permettrait d'éviter l'émission de près de 33 000 tonnes équivalentes CO2 sur les 35 ans d'exploitation. La sélection d'entrepreneurs locaux et l'utilisation des matériaux en place permettront également une légère diminution de la génération de GES lors des phases de construction et de fermeture.

Finalement, un plan de surveillance est prévu afin de suivre les données supportant la quantification des GES émis et les réductions mises en œuvre. Il consistera à collecter et consigner périodiquement des informations pour pouvoir estimer les émissions de GES liées au projet.

Abréviations

CH_4	Méthane
CO_2	Dioxyde de carbone
$eqCO_2$	Équivalent dioxyde de carbone
GES	Gaz à effet de serre
GIEC	Groupe d'experts intergouvernemental sur l'évolution du climat
GMR	Gestion des matières résiduelles
LEET	Lieu d'enfouissement en tranchée
LET	Lieu d'enfouissement technique
MELCCFP	Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs
MO	Matières organiques
N_2O	Protoxyde d'azote
REIMR	Règlement sur l'enfouissement et l'incinération des matières résiduelles

1.0 INTRODUCTION

La Nation crie de Nemaska souhaite développer un nouveau lieu d'enfouissement en tranchée (LEET) puisque son LEET actuel arrive bientôt au maximum de sa capacité. Le nouveau LEET (le projet) accueillera les matières résiduelles de la communauté de Nemaska, du camp d'Hydro-Québec ainsi que certaines matières résiduelles de Nemaska Lithium.

Dans le cadre de l'évaluation sociale et environnementale du projet, la Direction générale de l'évaluation environnementale et stratégique du ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP) a émis une directive (Directive 3214-16-079, janvier 2020) qui définit la portée et l'étendue de l'étude. Une évaluation des gaz à effet de serre (GES) générés pendant l'ensemble des phases du projet est requise. Les émissions liées aux variantes technologiques et de lieux doivent également être estimées.

Le présent présente donc l'identification des sources et la quantification des GES lors des différentes phases du projet, ainsi qu'un plan de réduction et un plan de surveillance des GES pendant le projet.

Ce rapport étant réalisé avant la mise en application du projet, les réductions de GES qui y sont présentées sont des prévisions.

2.0 DESCRIPTION DU PROJET

2.1 LOCALISATION ET CARACTÉRISTIQUES

Le futur LEET se situe en terre de catégorie III, à environ 17 km de la communauté, près du kilomètre 306 de la Route du Nord (site 4 dans la figure 1).

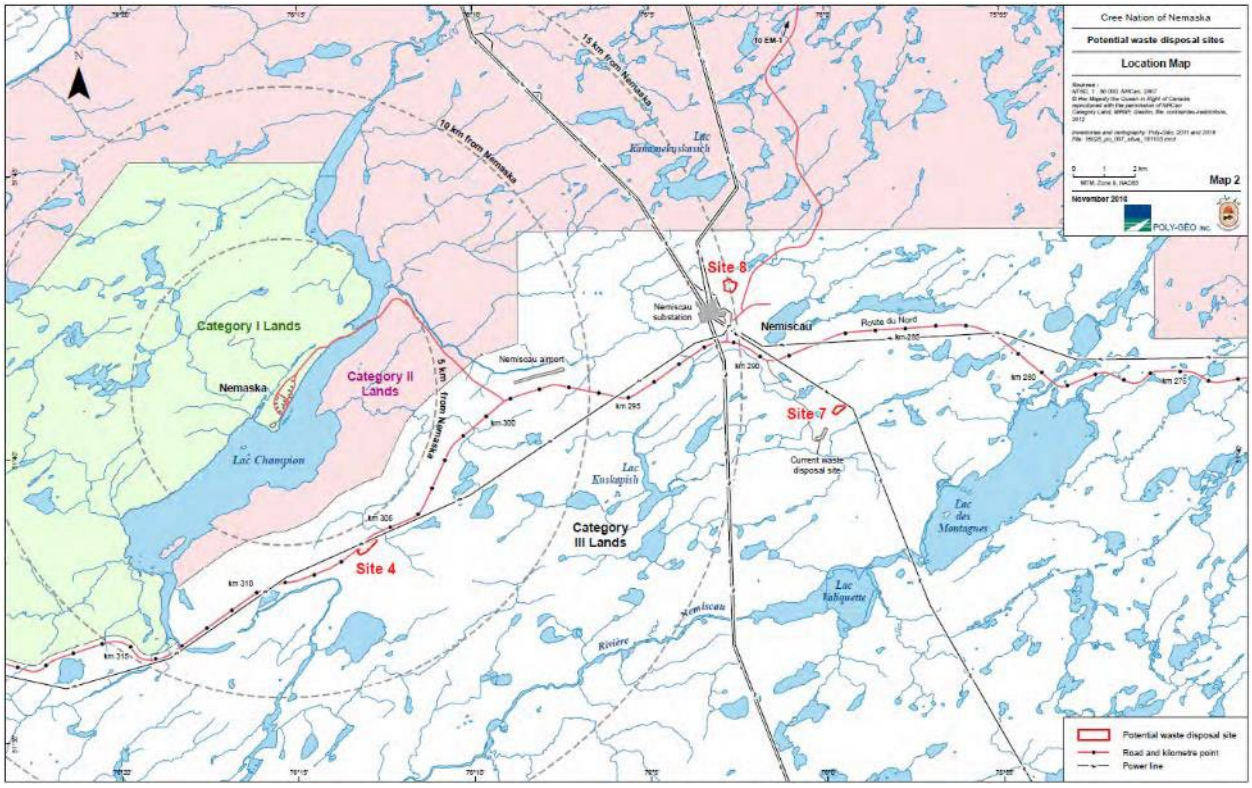


Figure 1 Emplacement du futur LEET (Site 4) – Image tirée de l'étude « Site selection and baseline study for a new landfill site in Nemaska »

Il s'agit d'un lieu d'enfouissement d'une superficie utile au sol prévue de 25 575 m^2, construit par excavation du sol en place et création de bermes sur les contours. Il est prévu la construction d'une unique tranchée, dite tranchée continue, plutôt que des petites tranchées annuelles, afin d'optimiser la capacité d'enfouissement et les opérations.

Lors du processus de sélection de sites, neuf sites ont été initialement considérés. Trois sites avaient des caractéristiques physiques satisfaisantes (topographie, distance aux cours d'eau, etc.) et ont été analysés en détail (Sites 4, 8 et 9 sur la figure 1). Un site s'est avéré trop petit et un autre site a présenté des contraintes opérationnelles supplémentaires. Le site 4 a donc été choisi pour la mise en place du LEET. Le futur site est à 17 km de la communauté, contre 22 km pour l'actuel.

L'opération d'un lieu d'enfouissement en tranchée selon le règlement sur l'enfouissement et l'incinération des matières résiduelles (REIMR) consiste à enfouir les matières résiduelles dans une tranchée, les compacter et les recouvrir au moins une fois par semaine de mai à octobre avec des sols excavés. Un

lieu d'enfouissement en tranchée, contrairement à un lieu d'enfouissement technique (LET), ne possède pas de membrane en fond de tranchée ni sur la couverture finale, les lixiviats et le biogaz ne sont pas récupérés.

2.2 PHASES DU PROJET

Le projet comporte les phases suivantes (excluant les étapes préalables d'autorisation et d'appels d'offres) :

- Une phase de construction, de 16 semaines environ, incluant le déboisement et la préparation du site;
- Une phase d'opération estimée à 35 ans, selon les projections de quantités de matières à enfouir;
- Une phase de fermeture du site, de 4 semaines environ, qui consiste à installer la couverture finale lorsque la tranchée est remplie et à la végétaliser;
- Une phase de gestion post-fermeture d'une durée minimale de 5 ans (en conformité avec le REIMR), qui consiste principalement à assurer un suivi annuel de la qualité des eaux souterraines en périphérie du site et à maintenir la couverture finale en bon état. Dans la pratique, la durée de gestion post-fermeture va généralement durer entre 20 et 30 ans, selon l'évolution de la qualité des eaux souterraines. Une période de 30 ans a été retenue pour le calcul des GES dans cette étude.

2.3 VARIANTE ÉTUDIÉE

En préparation de l'étude d'impact, une étude a été réalisée afin de comparer la mise en place et l'opération d'un LEET et d'un LET, la communauté envisageant les deux options. Il a été conclu que la mise en place d'un LET représentait des contraintes d'opération supplémentaires et un coût d'investissement très élevé par rapport au LEET. La communauté a décidé de mettre en place un LEET.

Les émissions de GES d'un LET ont été estimées dans le présent rapport. En conformité avec le REIMR, le LET considéré ne comportait pas de captage du biogaz, étant donné les faibles quantités de matières résiduelles enfouies. La récupération des lixiviats était cependant prise en compte, avec le traitement in situ des lixiviats dans des bassins aérés.

3.0 IDENTIFICATION DES SOURCES D'ÉMISSION

3.1 PHASE DE CONSTRUCTION

Comme indiqué à la section 2.2, il a été considéré 16 semaines maximales de travaux de construction, par comparaison à des chantiers de construction de LEET dans d'autres communautés. Certains équipements ont été considérés comme utilisés pendant toute la durée des travaux (chargeuses, camions), d'autres équipements étant utilisés pendant une partie des travaux uniquement (excavatrices, niveleuse, bouteur, rouleau compacteur). La construction du LEET inclut les activités suivantes :

- Mobilisation / démobilisation des équipements et du personnel;
- Apport de matériaux granulaires sur le site;
- Déboisement et préparation du site;
- Construction du chemin d'accès au LEET;
- Excavation de la tranchée et déplacement des matériaux excavés sur le site;
- Construction des bermes autour de la tranchée;
- Installation d'une clôture et barrière en entrée de site.

Le transport et l'installation de deux mégas dômes situés au LEET actuel ont également été considérés dans les sources d'émission. Ces dômes seront démontés pour être remontés au futur LEET et serviront pour l'entreposage du compacteur à déchets et des équipements divers.

Il est également considéré le trajet d'un surveillant de chantier venant de Val-d'Or et sa présence sur le site pendant toute la durée des travaux.

La conception de la tranchée est prévue pour pouvoir réutiliser tous les matériaux excavés sur place, soit pour la construction des bermes, soit comme matériau de recouvrement pendant la phase d'opération. Aucun matériau granulaire ne sort du chantier. De la terre végétale sera en revanche apportée au site pour la couverture finale de la tranchée.

Par ailleurs, pour la variante technologique (LET), des activités supplémentaires sont à prévoir : apport et installation de membranes pour assurer l'étanchéité de la tranchée, et construction d'un réseau de collecte et drainage des lixiviats, ainsi que d'une station de pompage et de traitement pour les lixiviats. Quatre semaines de travaux ont donc été ajoutées en fonction.

3.1.1 Systèmes de combustion fixes

Tableau 1 Systèmes de combustion fixe en phase de construction

Équipement	Utilisation	Hypothèse
Génératrice diesel	Éclairage et ordinateur de la roulotte de chantier	1 litre par heure

3.1.2 Système de combustion mobile

Pour chaque équipement mobile, la consommation moyenne de carburant en litres par heure a été calculée à partir de la puissance motrice indiquée par le fournisseur pour un modèle couramment utilisé et notamment utilisé pour des travaux similaires dans une autre communauté.

Tableau 2 Systèmes de combustion mobile en phase de construction

Équipement	Utilisation	Hypothèse
Chargeuse	Préparation du site, chargement et déchargement de matériaux granulaires et sols excavés	81 litres / heure
Niveleuse	Préparation du site	29 litres / heure
Excavatrice 1	Préparation du site, construction de la tranchée et des fossés	65 litres / heure
Excavatrice 2	Préparation du site, construction de la tranchée et des fossés	73 litres / heure
Excavatrice 3	Préparation du site, construction de la tranchée et des fossés	35 litres / heure
Bouteur	Préparation du site, construction de la tranchée et du chemin d'accès	39 litres / heure
Rouleau compacteur	Construction de la tranchée et du chemin d'accès	28 litres / heure
Véhicule à essence (pick-up)	Déplacement sur le site du surveillant de chantier	10 litres / 100 km

3.1.3 Transport des matériaux de construction, des matériaux d'excavation et de remblais

Afin de calculer le nombre de trajets nécessaires en camion 10 roues pour le transport des matériaux, une masse volumique habituellement observée a été utilisée pour chaque type de matériaux granulaires et pour la terre végétale.

Les fournisseurs de membranes et clôture ainsi que le fournisseur de mégadômes ont été contactés afin d'estimer le nombre de trajets nécessaires en fardier pour apporter le matériel au chantier de construction.

Il a également été considéré que les équipements de construction venaient pour moitié de la communauté (17 km) et pour moitié de Val-d'Or (650 km), ne pouvant à ce stade pas confirmer si l'entrepreneur retenu pour la construction sera local ou non. La provenance des matériaux est censée être la communauté de Nemaska.

Tableau 3 Transport des matériaux de construction, des matériaux d'excavation et de remblais en phase de construction

Équipement	Utilisation	Hypothèse
Fardier (maximum 30 tonnes de charges)	Transport des équipements, du matériel et des mégas dômes au site	35 litres / 100 km
Camion 10 roues (maximum 16 tonnes de charges)	Transport des matériaux granulaires jusqu'au site	100 litres / heure
Camion 12 roues (maximum 20 tonnes de charges)	Transport des matériaux granulaires sur le site	100 litres / heure
Camion articulé (maximum 35 tonnes de charges)	Transport des matériaux granulaires sur le site	93 litres / heure

3.1.4 Déboisement

Les dimensions du LEET sont basées sur les plans et devis préliminaires réalisés pour l'étude d'impact et représentent une utilisation maximale du site. Ainsi, un maximum de 8,67 ha sera déboisé pour la construction du LEET (et 8,74 ha s'il s'agit d'un LET). De plus, la construction du chemin d'accès par la communauté sera d'une longueur de 450 m et 7 m de large. Il comprendra une aire de dégagement d'une largeur de 6 mètres avec fossé de chaque côté.

3.2 PHASE D'OPÉRATION

La phase d'opération du LEET inclut les activités suivantes :

- Collecte et transport des matières résiduelles au LEET;
- Déneigement du chemin d'accès et de la zone de travail dans la tranchée, en hiver;
- Procédure d'enfouissement : déchargement des matières, mise en place, compaction puis recouvrement hebdomadaire avec des matériaux entreposés sur le site;
- Nettoyage du site, entretien des fossés et du chemin d'accès;
- Échantillonnage des puits d'observation trois fois par an (exclu des estimations de GES, l'échantillonnage étant réalisé par un prestataire de services).

Il n'est pas prévu de chauffer les mégadômes.

Par ailleurs, pour la variante LET, l'opération de la station de pompage et de traitement des lixiviats s'ajoute aux autres activités. De plus, le recouvrement des matières devient quotidien.

Les opérations vont se dérouler sur une durée de 35 ans selon les données de conception.

3.2.1 Systèmes de combustion fixes

Il n'y a pas de système de combustion fixe identifié à ce stade de l'étude pour un LEET. Concernant le LET, une génératrice diesel a été considérée pour les besoins de la station de pompage et de traitement des lixiviats.

3.2.2 Systèmes de combustion mobiles

Pour chaque équipement mobile, la consommation moyenne de carburant en litres par heure a été calculée à partir de la puissance motrice indiquée par le fournisseur pour un modèle couramment utilisé et notamment utilisé pour des travaux similaires dans une autre communauté.

Concernant le compacteur à déchets, les caractéristiques du modèle actuel de la communauté de Nemaska ont été considérées.

Il a été considéré un nombre d'heures d'utilisation de chargeur plus élevé pour la procédure d'opération du LET comparé à l'opération du LEET, étant donné que la fréquence de recouvrement des matières est quotidienne au lieu d'être hebdomadaire.

Le chemin d'accès au LEET (ou LET) est remis à niveau annuellement (apport de matériaux granulaires au site), et déneigé en hiver.

Tableau 4 Systèmes de combustion mobiles en phase d'opération

Équipement	Utilisation	Hypothèse
Chargeuse	Chargement, déchargement de matériaux de recouvrement. Opération de la tranchée et nettoyage du site	36 litres / heure
Niveleuse	Mise à niveau du chemin d'accès	29 litres / heure
Déneigeuse	Déneigement hivernal du chemin d'accès et de la zone de travail	47 litres / heure
Bouteur	Recouvrement hebdomadaire des matières, gestion des matériaux de recouvrement	39 litres / heure
Compacteur à déchets (reste sur le site en permanence)	Placement et compaction des déchets dans la tranchée	59 litres / heure

3.2.3 Transport d'amendement et autres matériaux

Le nombre de kilomètres entre la communauté et le LEET prévu ont été considérés, de même que le kilométrage moyen des rues de la communauté pour la tournée de collecte quotidienne. Une consommation moyenne en litres par kilomètre a été appliquée pour le camion de collecte, en différenciant les types d'utilisation du camion : en mode collecte et en mode transport. Cinq collectes par semaine sont actuellement effectuées par la communauté.

Le chemin d'accès au LEET (ou LET) est remis à niveau annuellement (apport de matériaux granulaires au site), et déneigé en hiver.

Tableau 5 Transport d'amendement et autres matériaux en phase d'opération

Équipement	Utilisation	Hypothèse
Camion 10 roues	Transport de matériaux granulaires jusqu'au site pour mise à niveau annuelle du chemin d'accès	100 litres / heure
Camion collecte en mode collecte	Collecte des matières résiduelles au sein de la communauté	100 litres / 100 km
Camion collecte en mode transport	Transport des matières résiduelles de la communauté au lieu d'enfouissement	40 litres / 100 km

3.2.4 Enfouissement des matières organiques

Les tonnages de matières résiduelles enfouies ont été calculés dans le cadre de l'étude d'impact. L'étude de caractérisation effectuée en 2012 sur les matières résiduelles de Nemaska a montré qu'environ 68,2 % des matières résiduelles enfouies sont des matières organiques : (résidus alimentaires, résidus verts, papiers/cartons. Ce pourcentage a été appliqué pour déterminer les tonnages de matières organiques enfouies.

Une moyenne des tonnages annuels enfouis sur les 35 ans de la phase d'opération a été calculée et utilisée comme intrant pour les estimations d'émissions de GES. Cela donne une moyenne de 750 tonnes par an de matière organique. Cela ne comprend pas le potentiel de réduction des émissions de GES que pourrait représenter l'introduction de nouvelles pratiques de tri et de valorisation, comme le compostage et le recyclage.

3.3 PHASE DE FERMETURE

La fermeture du LEET inclut les activités suivantes :

- Mobilisation / démobilisation des équipements et du personnel;
- Apport de matériaux sur le site;
- Mise en place de la couverture finale sur la tranchée.

Par ailleurs, pour la variante LET, il est à prévoir en plus l'apport et l'installation de membranes pour assurer l'étanchéité de la couverture finale.

Les équipements requis pour la phase de fermeture ont été identifiés par similitude avec des travaux de fermeture de LEET dans d'autres communautés autochtones. Il est prévu que les travaux de fermeture durent quatre semaines pour le LEET, et six semaines pour le LET.

3.3.1 Systèmes de combustion fixes

Tableau 6 Systèmes de combustion fixe en phase de fermeture

Équipement	Utilisation	Hypothèse
Génératrice diesel	Éclairage et ordinateur de la roulotte de chantier	1 litre par heure

3.3.2 Système de combustion mobile

Pour chaque équipement mobile, la consommation moyenne de carburant en litres par heure a été calculée à partir de la puissance motrice indiquée par le fournisseur pour un modèle couramment utilisé et notamment utilisé pour des travaux similaires dans une autre communauté.

Tableau 7 Systèmes de combustion mobile en phase de fermeture

Équipement	Utilisation	Hypothèse
Chargeuse	Chargement et déchargement de matériaux granulaires et terre	81 litres / heure
Excavatrice 2	Construction de la couverture finale	73 litres / heure
Bouteur	Construction de la couverture finale	39 litres / heure
Véhicule à essence (pick-up)	Déplacement sur le site du surveillant de chantier	10 litres / 100 km

3.3.3 Transport des matériaux de construction, des matériaux d'excavation et de remblais

Afin de calculer le nombre de trajets nécessaires en camion 10 roues pour le transport des matériaux, une masse volumique habituellement observée a été utilisée pour chaque type de matériaux granulaires et pour la terre végétale.

Il a également été considéré que les équipements de construction venaient pour moitié de la communauté (17 km) et pour moitié de Val-d'Or (650 km), ne pouvant à ce stade pas confirmer si l'entrepreneur retenu pour la construction sera local ou non. La provenance des matériaux est censée être la communauté de Nemaska.

Tableau 8 Transport des matériaux de construction, des matériaux d'excavation et de remblais en phase de fermeture

Équipement	Utilisation	Hypothèse
Fardier (maximum 30 tonnes de charges)	Transport des équipements et du matériel	35 litres / 100 km
Camion 10 roues (maximum 16 tonnes de charges)	Transport des matériaux granulaires et terre végétale jusqu'au site	100 litres / heure

3.4 PHASE DE GESTION POST-FERMETURE

La phase de gestion post-fermeture du LEET inclut les activités suivantes :

- Nettoyage du site, entretien des fossés et du chemin d'accès;
- Maintenance de la couverture finale;
- Échantillonnage des puits d'observation trois fois par an.

Par ailleurs, pour la variante LET, l'opération de la station de pompage et de traitement des lixiviats se poursuit. Le déneigement du chemin d'accès est dans ce cas nécessaire pour assurer un accès en tout temps.

Une durée de 30 ans a été retenue pour la phase de gestion post-fermeture.

3.4.1 Systèmes de combustion fixes

Il n'y a pas de système de combustion fixe identifié à ce stade de l'étude pour un LEET. Concernant le LET, une génératrice diesel a été considérée pour les besoins de la station de pompage et de traitement des lixiviats pendant la phase de gestion post-fermeture.

3.4.2 Système de combustion mobile

Pour chaque équipement mobile, la consommation moyenne de carburant en litres par heure a été calculée à partir de la puissance motrice indiquée par le fournisseur pour un modèle couramment utilisé et notamment utilisé pour des travaux similaires dans une autre communauté.

Le chemin d'accès est remis à niveau annuellement, cependant le déneigement ne s'effectue que pour la variante LET (pour accéder à la station de traitement des lixiviats). La maintenance de la couverture finale nécessite également l'apport de terre végétale et des travaux de réensemencement (environ 10 % de la surface de la couverture finale est réensemencée tous les ans).

Tableau 9 Systèmes de combustion mobile en phase de gestion post-fermeture

Équipement	Utilisation	Hypothèse
Chargeuse	Chargement, déchargement de matériaux	81 litres / heure
Niveleuse	Mise à niveau du chemin d'accès	29 litres / heure
Véhicule à essence (pick-up)	Déplacement sur le site pour l'échantillonnage des puits	10 litres / 100 km

3.4.3 Transport des matériaux de construction, des matériaux d'excavation et de remblais

Afin de calculer le nombre de trajets nécessaires en camion 10 roues pour le transport des matériaux, une masse volumique habituellement observée a été utilisée pour chaque type de matériaux granulaires et pour la terre végétale.

La provenance des matériaux est censée être la communauté de Nemaska.

Tableau 10 Transport des matériaux de construction, des matériaux d'excavation et de remblais en phase de gestion post-fermeture

Équipement	Utilisation	Hypothèse
Camion 10 roues (maximum 16 tonnes de charges)	Transport de matériaux granulaires jusqu'au site pour mise à niveau annuelle du chemin d'accès et de la couverture finale du site	100 litres / heure

4.0 QUANTIFICATION DES SOURCES D'ÉMISSION

Pour chacune des phases, les émissions de GES ont été estimées pour une année standard.

4.1 FACTEURS D'ÉMISSIONS

Les indications de la Directive concernant le calcul des émissions ont été suivies :

- Les facteurs d'émissions pour les systèmes de combustion fixes sont issus du tableau 1-3 de l'annexe A.2 du Règlement sur la déclaration obligatoire de certaines émissions de contaminants dans l'atmosphère;
- Les facteurs d'émissions pour les systèmes de combustion mobiles sur site sont issus du tableau de la section B.2 de la Directive, ils proviennent du Rapport d'inventaire national (RIN) 1990-2016, Partie II, tableau A6-12 – Emission Factors for Energy Mobile Combustion Sources;
- Les facteurs d'émissions pour les systèmes de combustion mobiles sont également utilisés pour les émissions liées aux activités de transport;
- Les facteurs d'émissions pour le déboisement sont issus des tableaux 4.4 et 4.7 du Refinement to the 2006 IPPC Guidelines for National Greenhouse Gas Inventories, Volume 4. Il a été considéré un climat de type boréal et une forêt de conifères;
- Des conditions standards ont été utilisées pour les émissions liées à l'enfouissement des matières organiques. Les équations et les facteurs d'émissions sont issus de l'outil de calcul du MELCCFP pour quantifier les émissions de gaz à effet de serre des projets de compostage du Programme de traitement des matières organiques par biométhanisation et compostage. Cet outil inclut la quantification des émissions liées aux matières organiques enfouies.

La conversion des tonnes de CH_4 et de N_2O en tonnes équivalent CO_2 est basée sur les potentiels de réchauffement planétaire du CH_4 et du N_2O indiqués dans le quatrième rapport du Groupe d'experts intergouvernemental sur l'évolution du climat (GIEC) : 25 fois pour le CH_4 et 298 fois pour le N_2O.

L'ensemble des facteurs d'émissions est présenté à l'annexe A.

4.2 RÉSULTATS

Les résultats détaillés sont présentés à l'annexe B. Les tableaux suivants récapitulent les principaux résultats pour chaque variante technologique.

Tableau 11 Émissions de GES par source d'émission LEET

Sources d'émission	CO_2 (tonnes)	CH_4 (tonnes)	N_2O (tonnes)	Tonnes équivalentes CO_2
Déboisement [2]	1 305,58	-	-	1 305,58
Systèmes de combustion fixes	1,08	0,00	0,00	1,13[1]
Systèmes de combustion mobiles[2]	2 789,83	0,16	1,15	3 137,17
Transport de matériaux	1 140,91	0,05	0,06	1 161,20
Enfouissement des matières organiques	-	2 313,31	-	57 832,64
Total	5 237,40	2 313,51	1,22	63 437,73

[1] Les quantités de CH_4 et N_2O étant arrondies au centième de tonnes les totaux peuvent ne pas correspondre aux chiffres présentés

[2] Les émissions liées aux équipements utilisés pour le déboisement sont incluses dans les émissions des systèmes de combustion mobiles

Tableau 12 Émissions de GES par phase LEET

Phase	CO_2 (tonnes)	CH_4 (tonnes)	N_2O (tonnes)	Tonnes équivalentes CO_2
Construction	1 758,00	0,03	0,18	1 811,55
Opérations – 35 ans	3 122,73	2 313,47	0,91	61 229,78
Fermeture	97,42	0,01	0,03	107,02
Gestion post-fermeture – 30 ans	259,25	0,01	0,10	289,38
Total	5 237,40	2 313,51	1,22	63 437,73

Tableau 13 Émissions de GES par source d'émission LET

Sources d'émission	CO_2 (tonnes)	CH_4 (tonnes)	N_2O (tonnes)	Tonnes équivalentes CO_2
Déboisement [2]	1 316,13	-	-	1 316,13
Systèmes de combustion fixes	1,52	0,00	0,00	1,59[1]
Systèmes de combustion mobiles[2]	3 976,50	0,22	1,64	4 471,58
Transport de matériaux	1 156,10	0,05	0,07	1 176,77
Enfouissement des matières	-	2 313,31	-	57 832,64
Total	6 450,24	2 313,58	1,71	64 798,71

[1] Les quantités de CH_4 et N_2O étant arrondies au centième de tonnes les totaux peuvent ne pas correspondre aux chiffres présentés

[2] Les émissions liées aux équipements utilisés pour le déboisement sont incluses dans les émissions des systèmes de combustion mobiles

Tableau 14 Émissions de GES par phase LET

Phase	CO_2 (tonnes)	CH_4 (tonnes)	N_2O (tonnes)	Tonnes équivalentes CO_2
Construction	2 000,91	0,04	0,27	2 081,87
Opérations – 35 ans	3 556,33	2 313,49	1,09	61 717,46
Fermeture	104,58	0,01	0,03	114,94
Gestion post-fermeture – 30 ans	788,42	0,04	0,32	884,43
Total	6 450,24	2 313,58	1,71	64 798,71

Une comparaison est effectuée avec les émissions d'équivalent CO_2 provinciales, fédérales et sectorielles.

Tableau 15 Émissions de GES au niveau national, provincial et sectoriel

Périmètre	Canada	GMR au Canada	Québec	GMR au Québec
Valeur 2021 en tonnes équivalente CO_2	670	47,0	77,56	4,02
Contribution du projet (%)	0,000 9 %	0,001 3 %	0,008 2 %	0,157 8 %
Source	Environnement et Changement climatique Canada, 2023	Environnement et Changement climatique Canada, 2023	MELCCFP, 2023	MELCCFP, 2023

On constate que le projet a un impact réduit, voire négligeable.

5.0 PLAN DE RÉDUCTION DES GES

5.1 PHASE DE CONSTRUCTION

En phase de construction, les systèmes de combustion mobiles sont la source d'émission de GES la plus importante. Il est possible de réduire les émissions de GES si les équipements utilisés par l'entrepreneur choisi pour réaliser les travaux sont déjà présents dans la communauté. Le kilométrage des fardiers et des camions utilisés pour le transport des équipements sera réduit.

La conception de la tranchée vise par ailleurs à optimiser l'utilisation des matériaux en place et à limiter les quantités de matériaux granulaires et de terre végétale à apporter au site.

5.2 PHASE D'OPÉRATION

En phase d'opération, il est possible de réduire les émissions de GES en enfouissant moins de matières organiques et fibreuses, ce poste étant le plus gros générateur de GES sur l'ensemble du projet (plus de 90 %).

La mise en place d'un programme de compostage et de recyclage dans la communauté est prévue à moyen terme. Ces actions permettront de limiter les quantités annuelles de matières organiques et fibreuses enfouies. Le gain potentiel de GES, si 60 % des matières organiques (objectif provincial) sont compostées ou recyclées, est estimé à environ 33 000 tonnes eqCO_2 sur 35 ans d'opération. Cela représenterait une diminution des émissions de GES liées à la dégradation naturelle des matières d'environ 57 %. Cependant ce gain ne prend pas en compte les émissions de GES supplémentaires liées à la construction et l'exploitation de la plateforme de compostage, ni au transport et au recyclage des matières fibreuses. Elles sont attendues être marginales en comparaison au gain relatif à la valorisation de la matière à la place de son enfouissement.

En parallèle et à court terme, la communauté va également organiser des activités de sensibilisation des résidents concernant le gaspillage alimentaire.

Le transport de matériaux sera limité puisque les matériaux issus de l'excavation seront entreposés sur place et réutilisés pour le recouvrement hebdomadaire.

Il serait également possible de réduire la fréquence de collecte qui est de cinq par semaine à ce jour (une par jour). On pourrait imaginer une collecte par flux chaque semaine : matières recyclables, matières organiques, autres. On arriverait donc à un total de trois collectes par semaine. Cela représenterait un gain potentiel de GES d'environ.

5.3 PHASE DE FERMETURE

Les solutions pour la phase de fermeture sont équivalentes à la phase de construction.

5.4 PHASE DE GESTION POST-FERMETURE

Il n'y a pas de solution identifiée à ce jour en phase de gestion post-fermeture.

5.5 TOTAL POTENTIEL DE RÉDUCTION D'ÉMISSIONS DE GES

Le tableau 16 montre que le potentiel de réduction de GES principal est la mise en place de programmes de recyclage et compostage afin de récupérer les matières organiques enfouies, grandes génératrices de méthane.

Tableau 16 Total potentiel réduction émissions GES

Mesure	Tonnes équivalentes CO_2 évitables sur 35 ans
Compostage et recyclage	33 035,65
Réduction de la fréquence de collecte	252,71
Équipements locaux pour les travaux de construction et de fermeture	5,34
Total	**33 293,69**

6.0 PLAN DE SURVEILLANCE

Afin de suivre les données supportant la quantification des GES émis et les réductions mises en œuvre, un plan de surveillance est requis. Il consistera à collecter et consigner périodiquement des informations pour pouvoir estimer les émissions de GES liées au projet.

La Nation crie de Nemaska devra mettre en place une base de données pour la compilation des données de suivi fournies par les services de gestion des matières résiduelles. Un superviseur sera responsable de la compilation et de vérifier la transmission et la cohérence des données.

L'ensemble des données collectées dans le cadre du plan de surveillance sera conservé pour un minimum de cinq ans sous format électronique.

Advenant l'impossibilité de collecter une donnée spécifique à la période requise, une note devra être inscrite à la base de données justifiant cette absence de donnée. Lors de la période suivante, le responsable de la collecte de cette donnée devra dans l'ordre :

- Chercher à collecter la valeur de cette donnée pour la période se terminant et la période précédente ;
- À défaut d'en être capable, estimer la valeur de la donnée manquante de la période précédente à partir de la valeur de la donnée collectée pour la période en cours se terminant et de la valeur de la donnée collectée il y a deux périodes. Une note devra être inscrite à la base de données concernant cette valeur afin d'identifier clairement qu'il s'agit d'une estimation et non d'une donnée mesurée.

Les paramètres suivis sont présentés au tableau 11.

Tableau 17 Plan de surveillance

Catégorie	Type de données	Unité	Source des données	Fréquence
Équipements de combustion mobiles et transport de matériaux	Consommation de diesel pour : chargeuse	Litres/an	Factures	Annuelle
	Consommation de diesel pour : compacteur à déchets	Litres/an	Factures	Annuelle
	Consommation de diesel pour : niveleuse	Litres/an	Factures	Annuelle
	Consommation de diesel pour : déneigeuse	Litres/an	Factures	Annuelle
	Kilométrage du camion 10 roues pour apport de matériaux au site	Km/an	Odomètre	Annuelle
	Kilométrage du camion de collecte pour collecte	Km/an	Odomètre	Annuelle
	Kilométrage du camion de collecte pour transport des matières au site	Km/an	Odomètre	Annuelle
Équipements de combustion fixes (non prévu actuellement)	Consommation de diesel	Litres/an	Factures	Annuelle

Catégorie	Type de données	Unité	Source des données	Fréquence
Enfouissement des matières organiques et fibreuses	Quantité de matières organiques enfouies	Tonnes/an	Estimation (nombre de camions de collecte, composition moyenne)	Annuelle
Déboisement (phase de construction)	Nombre d'hectares déboisés	Hectares	Factures	Annuelle

Par ailleurs, il pourrait être pertinent pour la communauté de réaliser une étude de caractérisation du flux entrant sur le site d'enfouissement en moyenne tous les cinq ans afin d'estimer au mieux la part des matières organiques dans les matières enfouies. En lien, le suivi des quantités récupérées pour le recyclage et le compostage serait également intéressant.

7.0 LIMITES ET INCERTITUDES

Étant donné que la mise en place du projet est au stade de conception préliminaire et étude d'impact, nous estimons que l'incertitude des résultats des calculs d'émissions de GES est raisonnable.

Selon le principe d'exactitude, chaque fois que cela a été possible, les données réelles directes ont été préférées aux données calculées ou aux données théoriques : c'est le cas pour les kilométrages des collectes, la consommation moyenne des camions. La composition des matières résiduelles est également basée sur les résultats d'une étude de caractérisation spécifique à la communauté de Nemaska (2012). Concernant les activités de construction, les durées de fonctionnement des équipements envisagés (selon des travaux de construction similaires dans d'autres communautés) ont été calculées de manière conservatrice.

Les réductions de GES ont également été estimées de la manière la plus réaliste possible, considérant l'historique de gestion des matières résiduelles de la communauté et sa volonté affirmée d'améliorer la situation notamment en développant des programmes de détournement des matières de l'enfouissement.

8.0 RÉFÉRENCES

Directive 3214-16-079 pour le projet d'aménagement d'un nouveau site d'enfouissement à Nemaska par la Nation crie de Nemaska, Direction générale de l'évaluation environnementale et stratégique, ministère de l'Environnement et de la Lutte contre les Changements climatiques. Janvier 2020

Règlement sur la déclaration obligatoire de certaines émissions de contaminants dans l'atmosphère, Loi sur la Qualité de l'Environnement, chapitre Q-2, r 15. Décembre 2020

Rapport d'inventaire national (RIN) 1990-2016, Partie II, tableau A6-12 – Emission Factors for Energy Mobile Combustion Sources. 2019

Refinement to the 2006 IPPC Guidelines for National Greenhouse Gas Inventories, Volume 4. 2019

Outil de calcul pour quantifier les émissions de gaz à effet de serre des projets de compostage du Programme de traitement des matières organiques par biométhanisation et compostage. 2019

Guide de quantification des émissions de gaz à effet de serre. Ministère de l'Environnement et de la Lutte contre les changements climatiques. 2019

Annexe A FACTEURS ÉMISSIONS GES

ANNEXE A : TABLEAUX DES PARAMÈTRES ET DES FACTEURS D'ÉMISSION DE GES

Potentiels de réchauffement planétaire du GIEC – Horizon 100 ans

Tableau 20. Potentiels de réchauffement planétaire (PRP) pour certains GES

GES	Formule chimique	PRP du deuxième rapport du GIEC	PRP du quatrième rapport du GIEC
Gaz carbonique	CO_2	1	1
Méthane	CH_4	21	25
Oxyde de diazote	N_2O	310	298
Hexafluorure de soufre	SF_6	23 900	22 800
Trifluorure d'azote	NF_3	–	17 200

Source : 2007, GIEC

Tableau 21. Facteurs d'émission pour les activités de transport

Méthode de quantification	**1**	**Source**	**1 à 2 et 5 à 7**
Paramètres/facteurs	**Description**		
$F_{GES}\, V_{CAR_i} V_j Tra$	Facteur d'émission par type de GES pour chaque type de carburant fossile i et de véhicule j		
Facteurs d'émission : transport routier		**Valeur**	**Unité**
Véhicules lourds à moteur diesel (dispositif perfectionné)		2 690	g CO_2/litre
		0,11	g CH_4/litre
		0,151	g N_2O/litre
Véhicules lourds à essence (catalyseur à trois voies)		2 316	g CO_2/litre
		0,068	g CH_4/litre
		0,2	g N_2O/litre
Véhicules au gaz naturel		1,9	g CO_2/litre
		9E-03	g CH_4/litre
		6E-05	g N_2O/litre
Références	Environnement Canada. Tableau A6-11. Coefficients d'émission pour les sources de combustion mobiles du secteur de l'énergie. *Rapport d'inventaire national 1990-2013 : sources et puits de gaz à effet de serre,* Partie 2.		

Tableau 22. Facteurs d'émission pour la consommation de combustibles fossiles sur le site d'une installation

Méthode de quantification	**2**	**Source**	**10**
Paramètres/facteurs	**Description**		
$F_{GES}\ V_{COM_i}Opé$	Facteur d'émission par type de GES pour chaque type de combustible fossile i		
Facteurs d'émission : équipements fixes		**Valeur**	**Unité**
Diesel		2 663	g CO_2/litre
		0,133	g CH_4/litre
		0,400	g N_2O/litre
Gaz naturel – Usages industriels		1 878	g CO_2/m^3
		0,037	g CH_4/m^3
		0,033	g N_2O/m^3
Facteurs d'émission : équipements mobiles		**Valeur**	**Unité**
Véhicule au diesel		2 663	g CO_2/litre
		0,15	g CH_4/litre
		1,1	g N_2O/litre
Véhicule à essence		2 289	g CO_2/litre
		2,7	g CH_4/litre
		0,05	g N_2O/litre
Références	Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques. Tableau 1-3. Facteurs d'émission selon le type de combustible Tableau 27-1. Facteurs d'émission selon le type de combustible (équipements mobiles) Règlement sur la déclaration obligatoire de certaines émissions de contaminants dans l'atmosphère. Loi sur la qualité de l'environnement, chapitre Q-2, a. 2.2, 46.2, 115.27, 115.34 et 124.1.		

Tableau 23. Facteurs d'émission pour le traitement par compostage des matières organiques

Méthode de quantification	3	Source	12
Paramètres/ facteurs	**Description**	**Valeur**	**Unité**
$F_{CH_4}Q_{MOC}Comp$	Facteur d'émission de CH_4 pour le traitement par compostage de la matière organique	0,004	Tonnes CH_4/tonne Q_{MOC}
$F_{N_2O}Q_{MOC}Comp$	Facteur d'émission de N_2O pour le traitement par compostage de la matière organique	0,00024	Tonnes N_2O/tonne Q_{MOC}
Remarques	Les valeurs par défaut (base humide) proviennent des *Lignes directrices 2006 du GIEC pour les inventaires nationaux de GES*. Les émissions de CO_2 issues du traitement biologique qui sont d'origine biogène ne sont pas comptabilisées. À noter que la valeur pour le N_2O provient du neuvième rectificatif[1]. N.B. Le $F_{CH_4}Q_{MO}Comp$ peut être égal à zéro pour les portions de Q_{MOC} où les résultats des mesures de la teneur en oxygène du traitement par compostage sont supérieurs à 8 %[2]. L'information est demandée à l'onglet « Intrants 2 », source 12.		
Références	[1] *Lignes directrices 2006 du GIEC pour les inventaires nationaux de gaz à effet de serre*. Chapitre 4 : Traitement biologique des déchets solides, tableau 4.1, et neuvième rectificatif (version en anglais seulement : *9th Corrigenda for the 2006 IPCC Guidelines*). [2] III.AF. *Avoidance of methane emissions through excavating and composting of partially decayed municipal solid waste (MSW)*.		

Tableau 24. Facteurs d'émission pour le traitement anaérobie des eaux usées ou des lixiviats

Méthode de quantification	4	Source	13
Paramètres	**Description**	**Valeur**	**Unité**
B_O	Capacité de production de méthane maximal par défaut	0,36	t CH_4/ t DBO_5
FCM	Facteur de conversion du méthane	0 à 0,1	–
Remarque			
FCM	L'information est demandée à l'onglet « Intrants 2 », source 13.		
Références			
B_O	Environnement Canada. *Rapport d'inventaire national 1990-2013 : sources et puits de gaz à effet de serre*, Partie 2, Section : A3.6.2.1.		
FCM	GIEC. *Lignes directrices 2006 du GIEC pour les inventaires nationaux de gaz à effet de serre – Volume 5 : Déchets*, chapitre 6 : Traitement et rejet des eaux usées. Tableau 6.3 : Valeurs FCM par défaut pour les eaux usées domestiques.		

Tableau 25. Facteurs d'émission pour le traitement par enfouissement des matières organiques

Méthode de quantification	5 : 5a, 5b	Source	14
Paramètres	**Description**	**Valeur**	**Unité**
R	Fraction de CH_4 capté pour les lieux munis d'un système de captage	0,75	–
OX	Facteur d'oxydation	0,1 ou 0	–
FCM	Facteur de correction du CH_4	1	–
COD	Carbone organique dégradable	valeur par défaut ou caractérisation	Tonnes C/ tonne Q_{MOE}
COD_f	Fraction de COD qui peut se décomposer	0,6	–
F	Fraction de CH_4 dans les gaz d'enfouissement	0,5	–
Remarques			
R	Valeur par défaut de 75 %. L'utilisation d'une valeur différente doit être justifiée par le demandeur. L'information est demandée à l'onglet « Intrants 2 », source 14.		
OX	Valeur par défaut de 0,1. Cette valeur est de 0 pour les lieux d'enfouissement qui comportent une géomembrane couvrant l'ensemble de la zone d'enfouissement. L'information est demandée à l'onglet « Intrants 2 », source 14.		
FCM	Pour un lieu d'enfouissement géré.		
COD	Caractérisation des matières organiques pour l'équation de la section 6.1.5.2 : Pour les boues municipales et de fosses septiques, calculer la quantité à une siccité de 30 % et comptabiliser avec le paramètre C; Pour les boues industrielles, calculer la quantité à une siccité de 35 % et comptabiliser avec le paramètre E. L'information est demandée à l'onglet « Intrants 2 », source 14.		
Références			
R	USEPA		
OX	GIEC		
FCM	Environnement Canada. Équation A3-88 du *Rapport d'inventaire national 1990-2013 : sources et puits de gaz à effet de serre,* Partie 2.		
COD	Environnement Canada. Adapté de l'équation A3-89 du *Rapport d'inventaire national 1990-2013 : sources et puits de gaz à effet de serre,* Partie 2. GIEC. *Lignes directrices 2006 du GIEC pour les inventaires nationaux de gaz à effet de serre – Volume 5 : Déchets*, chapitre 2 : Production, composition et données de gestion des déchets, section 2.3.2 : Boues.		
COD_f	Environnement Canada. Équation A3-88 du *Rapport d'inventaire national 1990-2013 : sources et puits de gaz à effet de serre,* Partie 2.		
F	Environnement Canada. Équation A3-88 du *Rapport d'inventaire national 1990-2013 : sources et puits de gaz à effet de serre,* Partie 2.		

Tableau 26. Facteurs d'émission associés au traitement par incinération de la matière organique

Méthode de quantification	6 : 6a, 6b et 6c	Source	15
Paramètres/facteurs	**Description**		
$F_{N_2O}\ Q_{MOISB}Inc$ $F_{N_2O,CH_4}\ Q_{MOIB}\ Inc$	Facteurs d'émission associés au traitement par incinération de la matière organique		
Paramètres/facteurs	**Valeur**	**Unité**	
$F_{N_2O}\ Q_{MOISB}Inc$	0,148E-03	tonnes N_2O/tonne Q_{MOISB}	
$F_{N_2O}\ Q_{MOIB}\ Inc$	0,8E-03	tonnes N_2O/tonne Q_{MOIB}	
$F_{CH_4}\ Q_{MOIB}\ Inc$	1,6E-03	tonnes CH_4/tonne Q_{MOIB}	
Remarques	Les émissions de CO_2 issues du traitement par incinération qui sont d'origine biogène ne sont pas comptabilisées. Les émissions de CH_4 issues du traitement par incinération des matières organiques autres que les boues (Q_{MOISB}) sont considérées comme négligeables (Environnement Canada).		
Référence	Environnement Canada. Équations A3-100, A3-101 et A3-102 du *Rapport d'inventaire national 1990-2013 : sources et puits de gaz à effet de serre,* Partie 2.		

Tableau 27. Paramètres et facteurs d'émission pour la production de combustibles fossiles hors Québec

Méthode de quantification	7		Source	8b
Paramètres/facteurs	**Description**			
$F_{CO_2,CH_4,N_2O}\ V_{CF_i}ProdCF$	Facteurs d'émission pour la production du combustible fossile i hors Québec			
PCS_i	Pouvoir calorifique supérieur par type de combustible i			
Paramètres/facteurs	PCS_i	$F_{CO_2,CH_4,N_2O}\ V_{CF_i}ProdCF$		
Unité	MJ/litre (*MJ/m^3)	Tonnes CO_2/MJ	Tonnes CH_4/MJ	Tonnes N_2O/MJ
Diesel	38,3	7,893E-06	0,135E-06	0,179E-09
Essence	34,87	7,741E-06	0,135E-06	0,175E-09
Gaz naturel comprimé*	38,32	8,624E-06	0,160E-06	0,161E-09
Références	Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques. *Règlement sur la déclaration obligatoire de certaines émissions de contaminants dans l'atmosphère*. QC.1.7. Tableaux. Tableau 1-1. Pouvoirs calorifiques supérieurs selon le type de combustible.			
	Ressources naturelles Canada. *Modèle GHGenuis 4.03a*. Onglet « *Upstream results HHV* », adapté pour la production hors Québec : *Gasoline* : somme de C12 à C17+C19/2 *Hwy diesel* : somme de F12 à F17+F19/2 *CNG* : somme de R10 à R18			

Tableau 28. Paramètres et facteurs d'émissions pour la production et la distribution de combustibles fossiles au Québec

Méthode de quantification	**8**		**Sources**	**3 et 8a**
Paramètres/facteurs	**Description**			
$[F_{CO_2,CH_4,N_2O}\ V_{PP_i}ProdQc\ ]$ $[F_{CO_2,CH_4,N_2O}\ V_{GN}CompQc\ ]$	Facteurs d'émission pour la production et distribution de produits pétroliers et la compression du gaz naturel au Québec			
$PCS_i]$	Pouvoir calorifique supérieur par type de combustible i			
Paramètres/facteurs	PCS_i	$F_{CO_2,CH_4,N_2O}\ V_{PP_i}ProdQc$	$F_{CO_2,CH_4,N_2O}\ V_{GN}CompQc$	
Unité	MJ/litre (*MJ/m^3)	Tonnes CO_2/MJ	Tonnes CH_4/MJ	Tonnes N_2O/MJ
Diesel	38,3	9,297E-06	0,024E-06	0,562E-09
Essence	34,87	8,319E-06	0,022E-06	0,714E-09
Gaz naturel comprimé	38,32*	0,113E-06	0,004E-06	0,055E-09
Références	Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques. *Règlement sur la déclaration obligatoire de certaines émissions de contaminants dans l'atmosphère*. QC.1.7. Tableaux. Tableau 1-1. Pouvoirs calorifiques supérieurs selon le type de combustible.			
	Ressources naturelles Canada. *Modèle GHGenuis 4.03a*. Onglet « *Upstream results HHV* », adapté pour la production et la distribution de produits pétroliers et la compression du gaz naturel au Québec pour le CO_2 : *Gasoline* : somme de C59 à C61+C69/2 *Hwy diesel* : somme de F59 à F61+F69/2 *CNG* : R59			

Annexe B RÉSULTATS DÉTAILLÉS ÉMISSIONS GES

Projet name:	**New landfill**
Client	Cree Nation of Nemaska
Ref	167020077
Préparé par	Gilles de Raymond-Cahuzac le: 30/11/2023
Validé par	Julien Rosset le: 01/12/2023
Page	9
Type	**Calcul GES - Résumé**

GES total

	Scénario LEET						Variante LET					
	Tonnes CO2	**Tonnes CH4**	**Tonnes N2O**	**Tonnes éq. CO2**	**Tonnes éq. CO2**	**T.eq CO2 en % du total**	**Tonnes CO2**	**Tonnes CH4**	**Tonnes N2O**	**Tonnes éq. CO2**	**Tonnes éq. CO2**	**T.eq CO2 en % du total**
Phase de construction												
Systèmes de combustion fixes	0,75	0,00	0,00	0,78			1,12	0,00	0,00	1,17		
Systèmes de combustion mobiles	426,33	0,02	0,18	479,41			644,38	0,04	0,27	724,61		
Transport de matériaux	25,34	0,00	0,00	25,77			39,28	0,00	0,00	39,96		
Déboisement	1 305,58	-	-	1 305,58			1 316,13	-	-	1 316,13		
Total construction	**1 758,00**	**0,03**	**0,18**	**1 811,55**		**2,9%**	**2 000,91**	**0,04**	**0,27**	**2 081,87**		**3,2%**
Phase d'opération - annuel /35 ans					Opération 35 ans						Opération 35 ans	
Systèmes de combustion fixes	-	-	-	-			-	-	-	-		
Systèmes de combustion mobiles	58,59	0,00	0,02	65,88	2 305,93		70,98	0,00	0,03	79,81	2 793,51	
Transport de matériaux	30,63	0,00	0,00	31,18	1 091,21		30,63	0,00	0,00	31,18	1 091,31	
Enfouissement des matières	-	66,09	-	1 652,36	57 832,64		-	66,09	-	1 652,36	57 832,64	
Total opération - annuel	89,22	66,10	0,03	1 749,42			101,61	66,10	0,03	1 763,36		
Total opération - 35 ans	**3 122,73**	**2 313,47**	**0,91**	**61 229,78**		**96,5%**	**3 556,33**	**2 313,49**	**1,09**	**61 717,46**		**95,2%**
Phase de fermeture												
Systèmes de combustion fixes	0,33	0,00	0,00	0,35			0,40	0,00	0,00	0,42		
Systèmes de combustion mobiles	73,81	0,00	0,03	83,00			79,66	0,00	0,03	89,58		
Transport de matériaux	23,27	0,00	0,00	23,67			24,52	0,00	0,00	24,95		
Total fermeture	**97,42**	**0,01**	**0,03**	**107,02**		**0,2%**	**104,58**	**0,01**	**0,03**	**114,94**		**0,2%**
Phase de post-exploitation - annuel					Post-exploit 30 ans						Post-exploit 30 ans	
Systèmes de combustion fixes	-	-	-	-	-		-	-	-	-	-	
Systèmes de combustion mobiles	7,97	0,00	0,00	8,96	268,83		25,61	0,00	0,01	28,80	863,88	
Transport de matériaux	0,67	0,00	0,00	0,68	20,55		0,67	0,00	0,00	0,69	20,55	
Total post-exploitation - annuel	8,64	0,00	0,00	9,65			26,28	0,00	0,01	29,48		
Total post-exploitation - 30 ans	**259,25**	**0,01**	**0,10**	**289,38**		**0,5%**	**788,42**	**0,04**	**0,32**	**884,43**		**1,4%**
Total projet	**5 237,40**	**2 313,51**	**1,22**	**63 437,73**			**6 450,24**	**2 313,58**	**1,71**	**64 798,71**		

LEET	Tonnes CO2	Tonnes CH4	Tonnes N2O	Tonnes éq. CO2
Déboisement	1 305,58	-	-	1 305,58
Systèmes de combustion fixes	1,08	0,00	0,00	1,13
Systèmes de combustion mobiles	2 789,83	0,16	1,15	3 137,17
Transport de matériaux	1 140,91	0,05	0,06	1 161,20
Enfouissement des matières - 35 ans	-	2 313,31	-	57 832,64
TOTAL	**5 237,40**	**2 313,51**	**1,22**	**63 437,73**

LET	Tonnes CO2	Tonnes CH4	Tonnes N2O	Tonnes éq. CO2
Déboisement	1 316,13	-	-	1 316,13
Systèmes de combustion fixes	1,52	0,00	0,00	1,59
Systèmes de combustion mobiles	3 976,50	0,22	1,64	4 471,58
Transport de matériaux	1 156,10	0,05	0,07	1 176,77
Enfouissement des matières - 35 ans	-	2 313,31	-	57 832,64
TOTAL	**6 450,24**	**2 313,58**	**1,71**	**64 798,71**