WAPTUM

COMMUNITY DEVELOPMENT CONSULTING

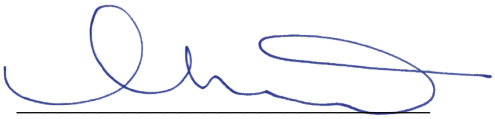
Notice of Intent
for a NEW LANDFILL in WEMINDJI

CREE NATION OF WEMINDJI

FINAL VERSION

Prepared and Reviewed by:

Genevieve Gagnon, M.Sc., CAPM®
Project Manager



Lauren Montpetit, Geog., EP, PMP
Chief Executive Officer

Project Ref.: 19-001113

Submitted: August 2019

WAPTUM

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1 OBJECT

The project in question is for a new landfill for the general disposal of solid wastes and incinerator ashes, which are defined as "residual materials" in the government literature[1].

According to the Environmental Quality Act (EQA), Schedule A, Section 1, all projects for the collection and disposal of residual materials (except mine tailings and hazardous materials) are automatically subject to the James Bay and Northern Quebec Agreement (JBNQA) and EQA, Section 22 review procedures.

The assessment shall follow the 5-step process outlined in Minister of Environment's brochure for the Environmental Assessment of Northern Projects[2] and all associated documents referred to therein. Accordingly, the present Notice of Intent has been prepared for submission to the Administrator, Mr. Isaac Voyageur, Regional Administrator, Cree Nation Government, ESIA Secretariat.

2 SUBJECT

2.1 PROPONENT

The Cree Nation of Wemindji is the sole proponent and legal landowner of the present project. A landfill is an essential service facility operated by the Band for the purposes of the management and disposal of residual materials accumulated in the community and on their territory.

The coordinates of the responsible parties representing the Proponent are:

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[1] Regulation on the burial and incineration of residual material (REIMR), EQA Chapter Q-2, r. 19, http://legisquebec.gouv.qc.ca/fr/pdf/cr/Q-2,%20R.%2019.pdf last retrieved by WAPTUM online on 2019-07-31

[2] Environmental Assessment of Northern Projects, MDDELCC, http://www.environnement.gouv.qc.ca/evaluations/mil-nordique/eval-nordique-en.pdf last retrieved by WAPTUM online on 2019-07-31

2.2 CONSULTANT

The Cree Nation of Wemindji hired the services of WAPTUM for the production of the present Notice of Intent (Project Notice) by Band Council Resolution 2019-048 issued on April 17, 2019.

The coordinates of the responsible parties representing the Consultant are:

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3 GOAL

The entire objective of the proposed project is to establish a new landfill for the long-term general disposal of solid wastes and incinerator ashes generated within the community and on its territory for at least the next 30 years.

The project is planned for construction during the summer of 2020, allowing for operations to begin in before the winter season.

3.1 URGENCY

A new landfill is an urgent priority for the CNW due to the loss of their waste incinerator building to fire in the fall of 2018.

One of the biggest planning impacts of the fire was the loss of the ability to incinerate waste before burial in landfill. In the past, the process of incinerating waste has reduced buried waste volumes by approximately 85%. Waste production calculations indicate that the community's existing landfill, previously estimated to have a remaining lifespan of up to 10 years, is now expected to be completely filled by the fall of 2020.

The CNW plans to replace their waste incinerator building with a new facility by 2021, however by that time the existing landfill will be full and ready for closure.

For these reasons, the CNW must now rush to open and begin operation of a new landfill site before winter 2020.

3.2 FUNDING

The project has been tabled for 2020-21 funding through the New Relationship Agreement which provides federal funding for community development projects, as per the Paix des Braves agreement.

Given that the project is subject to environmental and social impact assessment, the funding of the project will likely be held until it has been approved by the regulator.

4 PROJECT

The project consists of the establishment of a landfill on Category IA lands of the Cree Nation of Wemindji to satisfy the long-term waste disposal needs of the community. Preliminary studies showed that the landfill would need to accommodate up to an estimated volume of 94,000 m^3 of raw, unincinerated waste between 2021 and 2050 (30 years).

The existing landfill, which is approaching the end of its lifespan has received a mix of raw, unincinerated waste, and incinerated ash from a local waste incinerator. As discussed in section 3.1, the local incinerator facility was lost to fire in 2018 and is planned for replacement by 2021. It is thus planned that the new landfill will also receive a mix of raw, unincinerated waste and incinerated ash as well. As time goes on, it is expected that the percentage of unburned waste to incinerator ash will decrease. Should incineration be prioritized in the future, the same landfill volume could potentially accommodate over 100 years of community waste.[3]

Additional techniques to increase landfill lifespan are discussed in the Site Study and include improved recycling sorting practices, composting program initiation and the removal of ferrous metals from incinerator ash using a magnet system.

Additional space may be provided by the site through the use of the "mounding" technique, which allows for the extension of waste disposal above the ground surface using berms.

4.1 SITING

In order to identify feasible sites for the establishment of their new landfill, a Site Selection study for was completed in 2019[4]. The study focused in the area north of the community, particularly directed to the areas within the VC-10 trapline. This area, known as the Kakabat land, is accessible by a forestry type access road.

The reason for the exclusive direction of the study is due to the opinion of the VC-11 tallyman that the lands to the east of the community are over-exploited. The over-exploitation referenced by the Tallyman in this regard refers to the following infrastructures and developments currently located to the east of the community: power station, mini-dam, waste management facilities, former landfill, existing landfill, granular material deposits under exploitation, the access road to the James Bay highway, offshoot access roads and trails, hydro corridor, etc.

[3] WAPTUM, 2019 – New Landfill Site Selection Study – Cree Nation of Wemindji – Ref: 18-001103 (see Appendix 3)

[4] WAPTUM, 2019 – New Landfill Site Selection Study – Cree Nation of Wemindji – Ref: 18-001103 (see Appendix 3)

The CNW cannot simply expand their existing site, not only for the reasons listed above, but also given the existing landfill location upstream of a new (2009) intake of freshwater to the local drinking water treatment plant, located nearby, along the Maquatua River.

Following air photo interpretation in the area north of the community, four principal sites (identified as sites A, B, C & D) were identified and evaluated as part of the Site Selection study. A map showing the evaluated sites is provided in Appendix 1 and the matrix table used for site analysis and comparison is provided in Appendix 2.

The reader is directed to the study for details of the site selection and for a complete understanding of the siting requirements and evaluation process. The complete study report is provided in Appendix 3.

The study concludes, on page 12:

"Of the unretained sites, Site A had the most favorable technical characteristics, however it is located directly on the path of the Kakabat access road, which is undesirable for community and operational purposes and would not allow for forest buffer zones to be established to separate the roadway from the trench.

Sites C and D were both interesting candidates, however they are located further from the community than Site B, rendering them of lesser interest due to access road requirements.

Overall, the results of the study strongly support the selection of Site B for the establishment of a new landfill due to its location, size, topography and soil characteristics. The site also meets most practical, environmental and social acceptability requirements."

The Site Selection study clearly establishes grounds for the selection of Site B over the alternate sites considered. The site itself is approximately 48,000 m^2 in area, with an expected useable area for landfill development of 40,000 m^2.

4.2 SCOPING

According to Section 87.3 the Regulation[5], the community is permitted operate an in-trench landfill. This landfill type allows for the burial of wastes in a dug trench and requires the installation of cover materials (soils), perimeter ditches, site security measures and groundwater monitoring systems. There are no specific measures described in the aforementioned Regulation to address the disposal of incinerator ash or the specific monitoring of its impacts on the environment.

The design of the landfill is planned to be done in phases, to evaluated as part of the detailed design process, which is to be guided by the ESIA, regulatory requirements and best practices in engineering and environmental sciences.

[5] Regulation respecting the landfilling and incineration of residual materials, CQLR c Q-2, r 19, <http://canlii.ca/t/530bg> last retrieved by WAPTUM online on 2019-07-23

Alternative landfill design types or treatment systems will be considered during the design process.

In order to establish a landfill at Site B, the existing access road must be extended along a path of approximately 1.5km in length (refer to map in Appendix 1). The road is to be designed to intersect with an existing access road, thus its design is planned to be done according to the same standards. The access road must thus accommodate two-way traffic, have a capacity to accommodate heavy vehicles, include sufficient infrastructures for the crossing of waterways and have an overall lifespan of 100 years or more.

It is relevant to note that the existing access road referred to above is the object of a previous ESIA study done for a local granular material project. [6] According to CNW representatives, the ESIA was approved by COMEX in 2017 and the detailed project design is underway.

4.3 OPERATION

The operation of the landfill is to be done exclusively by the Cree Nation of Wemindji's local staff who are tasked with the overall management of the site under the direction of the local Director of Environment. Staff are responsible for the burial and cover of wastes according to an established weekly schedule, for the safe operation of the site, for environmental sampling and reporting and for ensuring conformity to the Regulatory requirements.

The opening of landfill phases is to be done sequentially, following an optimized logic of excavation progress prescribed by the design to ensure optimal use of available site volumes.

The community currently provides members with a recycling collection program and have recently completed a pilot project for compost collection which showed very promising results. A 2017 study of community waste production showed that recyclable and compostable materials represented 33% and 43% of the waste stream respectively.[7] Increased participation in these programs are projected to reduce waste volumes sent for incineration or to landfill by an important margin. These programs are highly encouraged locally and are expected to contribute greatly to ensuring a long landfill lifespan.

4.4 CLOSURE

The closure of the landfill is planned to be done according to the requirements detailed in the Regulation. The re-use of the closed site for traditional activities, such as hunting grounds, or other purposes may be considered in the future.

[6] WAPTUM (formerly TMS Inc.), 2017 – Kakabat Granular Material Deposit – Environmental and Social Impact Assessment. Ref: 16-001044

[7] WAPTUM, 2019 – New Landfill Site Selection Study – Cree Nation of Wemindji – Ref: 18-001103

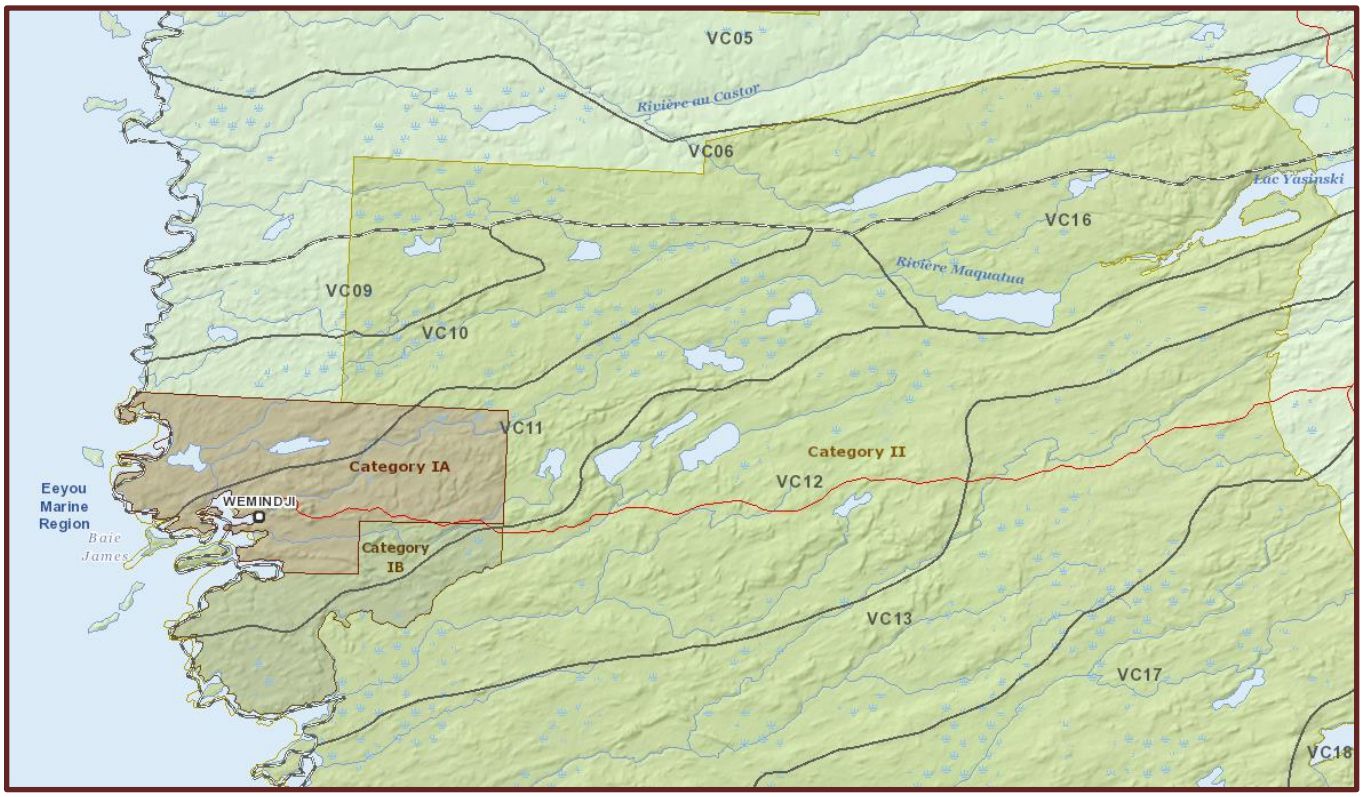
5 ENVIRONMENT

For the purposes of this document, the "receiving environment" of the project is defined to include all parts of an ecosystem, tangible or otherwise, that may be touched either directly or indirectly by the project. An overview of the total receiving environment of the project is provided in the subsections that follow.

5.1 LAND

Situated on the Hudson Bay geologic platform, the James Bay coastal region is one of the most dynamic coastlines in the world. Following the retreat of the Laurentide Ice Sheet beginning about 20,000 years ago, the land has been rising continually under the force of isostatic rebound. During the time of its retreat, fluvio-glacial and post-glacial sediments were deposited, making up the deposits found on the surface today. Known for the abundance of lakes, rivers and swamps, the James Bay region represents, overall, a complex fresh water system interlaced with rocky hills and granular deposits.

The project areas are located on Category 1A land of the Cree Nation of Wemindji, which spans an area of 326.6 km^2 between the Old Factory river and the Paint Hills Lake[8]. The



[8] http://www.rncan.gc.ca

Category 1A land is within the boundary of a Cree trap line administered by the family Kakabat (VC10) defined on the following map[9].

Figure 1: Eeyou Cree Traplines on Category 1A land of Wemindji (map from CTA[11])

5.2 FOREST

Wemindji is located in the taiga subzone of the boreal forest, characterized by its sparse spruce-lichen forest[10]. The forest has a low-density coniferous tree cover with extensive lichen groundcover. The diversity of vegetation varies due to multiple factors, including soil composition and depth, water and nutrient availability, drainage, temperature variation, wind exposure, topography and other environmental factors.

5.3 WATER

The Hudson Bay hydraulic basin is one of the largest fresh water reserves in the world. The east coast of James Bay is home to the mouths of several major rivers as well as to a variety of tributaries, lakes and wetlands. On a local scale, the receiving environment represents a large area to the north of the Maquatua River which drains surface water to James Bay along a series of watercourses and through numerous ponds, swamps and lakes.

5.4 CLIMATE

The James Bay region of Quebec falls within the subarctic climate zone, characterized by long cold winters and very short warm summers[11]. For most of the year, the region receives dominant winds from the west over James Bay. The strongest and most frequent winds come from the northwest and southwest, with speeds up to 40 km/hr.

Overall climate conditions in the region have presented a warming trend over the past century. Data for the past 30 years show average temperatures up to 3 degrees Celsius above the reference averages in the winter and up to 1.5 degrees Celsius in the summer[12]. Regional observations have further concluded changes in snow and ice conditions, changing weather patterns and extreme weather events causing a vast variety of environmental, ecological and human impacts[13].

5.5 WILDLIFE

The region is well-known for its wildlife. The presence of mammals like wolf, marten, otter, beaver, porcupine, fox, moose, bear are common. Fish species including pike, trout, walleye and white suckers are commonly identified in the lakes and streams. Bird species include White-Throated Sparrow, Hermit Thrush, Tetra of Canada, Gay of Canada, Sandpiper,

[9] http://www.creegeoportal.ca/cta/#

[10] https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/jpg/assess/2007/ch5/images/fig12_e.jpg

[11] https://www.britannica.com/science/Koppen-climate-classification

[12] Ouranos, 2018, pp 22- https://www.ouranos.ca/publication-scientifique/RapportEeyouIstchee_EN.pdf

[13] Call to Action - Climate Change Adaptation in Waskaganish - https://www.youtube.com/watch?v=WKk5U8ECtXM

Canada Tit, Ptarmagin. The area is also a migratory route for snow geese and Canada geese[14].

5.6 HUMAN

Numerous hunting and fishing spots in the region have been used by the Cree people since well before recorded history, and could potentially date back 4000 years, following glacial retreat. [15] Hunting and fishing camps are widely distributed over the land and have been established over generations.

Sites of archaeological interest have been identified in previous studies done in the area. Such sites include goose blinds, tipi rings and camp sites, most of which are interpreted to date within the past 60 years. A 2017 study showed that certain sites of higher elevation could have been accessible to humans (above water) around 1100 years ago.[16]

Areas of the natural environment have been perturbed by human activity. The village of Wemindji is an urban development home to over 1,500 people. The areas surrounding the community are accessible by access roads, rough seasonal trails and walking paths. Formal access roads often redirect the flow of surface water and cross intermittent or permanent watercourses.

Local sources of human environmental impacts include the local quarry and granular materials deposits, the local landfill, and contamination from residential, commercial, institutional, municipal and industrial sources within the community.

6 IMPACTS

The principal impacts of the landfill project can be appraised with a reasonable degree of confidence since the receiving environment is in relatively close proximity (approximately 1.5km) to sites studied during the ESIA process for the granular material and access road project referenced in section 4.2.

Based on a preliminary analysis, the development and operation of a landfill in the receiving environment can be expected to trigger the following potential impacts.

6.1 LAND

The principal impacts on the land are related to the deforestation of the site and access road and include soil erosion due to increased runoff from the landfill site and access road surfaces.

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[14] TMS Inc., 2017 – Kakabat Granular Material Deposit – Environmental and Social Impact Assessment. – Ref: 16-001044

[15] http://www.dfo-mpo.gc.ca/Library/314704-Ch11.pdf

[16] Cree Nation Government, 2017 – Archaeology Assessment Report - Kakabat area granular material project - Annex 3 – Ref: 16-001044

6.2 FOREST

The project and access road is expected to principally impact moss and lichen forest eco-systems which would require the removal of tree cover, lichen and plant species. Certain plant species found in the area are harvested for cultural, functional or medicinal uses, however the area is not a unique source and the species tend to be abundant in the region.

6.3 WATER

The access road is expected to cross a small wetland and intermittent stream. The area is likely to be considered as a wetland, which would include marsh, swamp and peat lands. The construction of wetland and intermittent stream crossings could cause environmental impacts associated with the disjunction of eco-systems and the introduction of turbidity and contamination from access road construction and use.

The runoff of rainwater collected in drainage ditches on the site is expected to result in erosion, turbidity and potential contamination to the environment. The leaching of contaminants from the landfill to the groundwater table is also expected. The impacts of both surface and groundwater contamination are measurable and accepted by the Regulation within the prescribed limits of environmental tolerance or natural attenuation.

6.4 CLIMATE

The project is not expected to have any measurable impact on the climate, however the normal wind patterns can be expected to produce relatively minor dust events from the deforested surface of the landfill and from access road use. Dust can also be expected during construction. In all events, the impacts from dust on the receiving environment are considered minimal or unmeasurable.

6.5 WILDLIFE

The impact of the project on mammals, fish and bird species can be described by the combined impact of habitat destruction from deforestation, dust, noise, traffic, erosion and contamination of the eco-system. Although these impacts could be considered to be of significance over a large area or in areas of threatened species, the project area is small, thus wildlife are expected to be impacted very minimally overall.

6.6 HUMAN

Land users rely on lands in the region for fishing, hunting, trapping, recreational and traditional activities. The 2017 ESIA study for the granular materials project noted the location of camps, hunting blinds, traditional sites and pristine environments / important eco-systems in the general area north of Wemindji. The receiving environment for the landfill project is located in an area which appears to be void of any of these features. This was confirmed by the Tallyman, Mr. Kakabat, during a site visit in 2019.

The opening of an access road to the new site would provide deeper access to the Tallyman's lands, which in the case of the granular material project was considered as a benefit of development.

To our knowledge, no archaeological sites have been identified in the area of the receiving environment. Further study would be required in order to identify sites and address potential development impacts.

7 CONSULTATION

The consultation process for new projects in Wemindji begins with the proposal of sites and project scopes to the community's Director of Environment and then to the Chief and Council. With their support, the local Tallymen are consulted to gauge their support for the project and to receive their concerns. Only with the support of the Tallyman will the project proceed to the planning stages.

In the case of this project, following the support of Chief and Council in 2019, the Tallyman, Jerry Kakabat, was consulted by the representatives of the local administration (the representatives of the Proponent identified in Section 2.1) who have reported his support for the project. During the site investigation process, the Tallyman, Mr. Kakabat, visited the the proposed site with the project team and confirmed that the site is not currently used for any human purposes and to his knowledge has not been in the past.

The community holds a local general assembly in August of each year, at which time the representatives of the local administration update the community members on local project planning and request feedback on project acceptability.

8 SCHEDULE

Due to the urgent nature of the project, construction must be completed before winter 2020 in order to replace the existing site which is expected to reach its full capacity at that time.

In order to reach this hard deadline, the following schedule must be respected:

- Landfill design options study (if required) – August, 2019
- ESIA Study – Fall, 2019
- Design of Plans & Specifications for Tender – Winter, 2019
- Tendering for Construction – Spring, 2020
- Construction – Summer, 2020
- Environmental Monitoring – Starting in Fall, 2020 – Ongoing

9 CONCLUSION

The Cree Nation of Wemindji submits their Notice of Intent to develop a new landfill for the long-term disposal of solid wastes and incinerator ashes produced in the community and on its territory. According to the Environmental Quality Act (EQA), Schedule A, Section 1, the project is automatically subject to the James Bay and Northern Quebec Agreement (JBNQA) and EQA, Section 22 review procedures.

Due to an urgent need to replace the existing landfill, which will reach its capacity in late 2020, the project needs to be constructed and ready for operation by the autumn of the same year.

Among a short list of potential sites, Site 3 has been selected as the most feasible. The site itself is approximately 48,000 m^2 in area, with an expected useable area for landfill development of 40,000 m^2 which, could maintain a lifespan of 20 to over 100 years, dependant entirely on disposal practices.

The site is located on pristine land approximately 5 kilometres to the north of the community. An existing access road reaches to within 1.5km of the site. A new access road of approximately 1.5km in length is proposed to extend to the new site. As permitted by law, the landfill can be designed as an in-trench type. According to the same law, site features, security and environmental monitoring measures, as well as operational practices and site closure measures are planned to be incorporated in to the project.

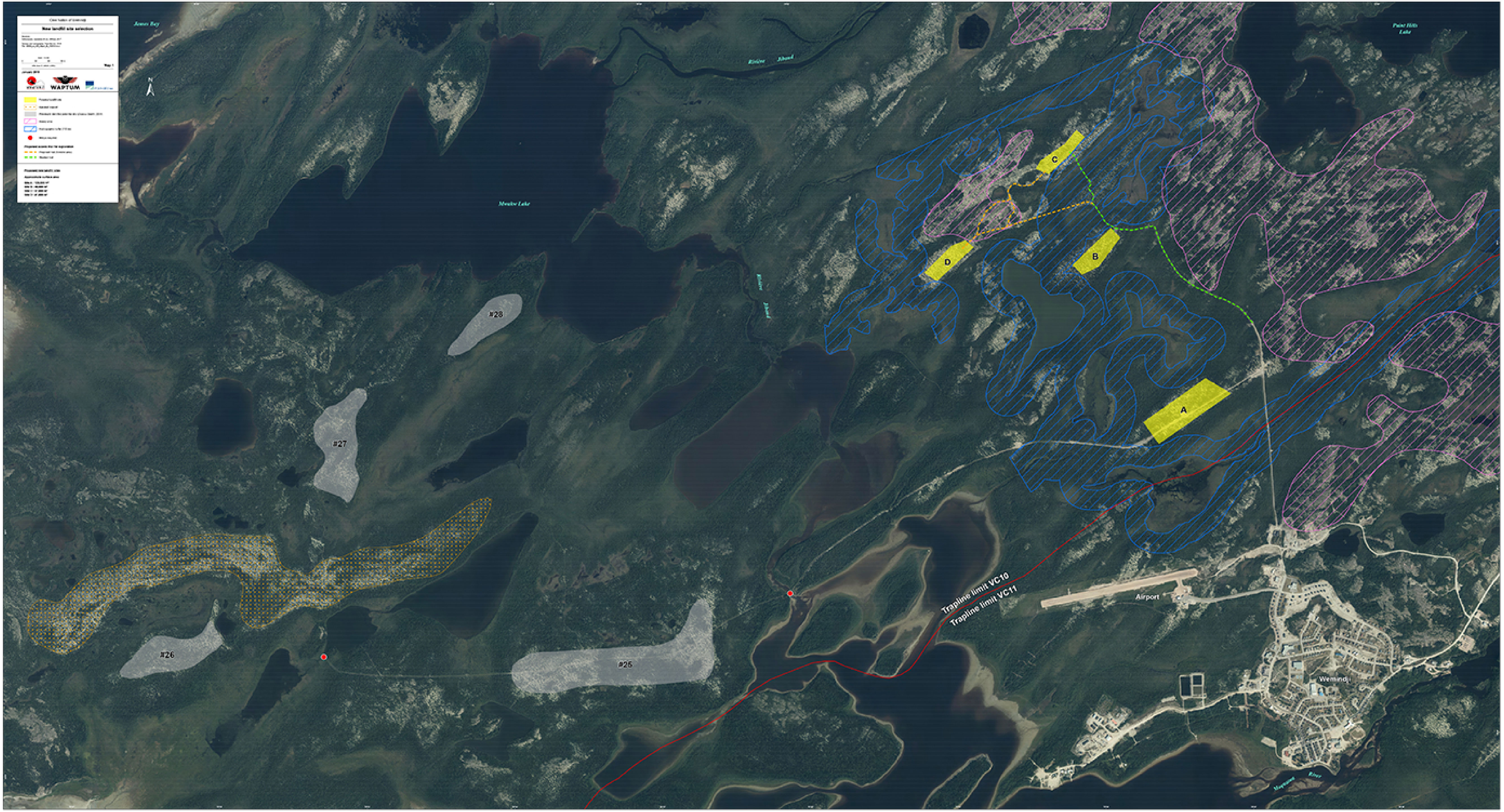
The principal impacts of the project include deforestation, soil erosion and surface and groundwater contamination. Additional impacts include dust and eco-system disruption. There is a risk that archeological sites may be located in the area.

The local Chief and Council and Tallyman have been consulted on the project and have shown their support.

The ESIA study, detailed design and tendering process must be completed and approved before Spring of 2020, since construction must be completed before winter 2020.

10 APPENDICES

10.1 APPENDIX 1 : Map of Potential Sites



New landfill site selection
WAPTUM
A
B
C
D
#25
#26
#27
#28
Trapline limit VC10
Trapline limit VC11
Airport
Wemindji

10.2 APPENDIX 2 : Preliminary Site Options Criteria Evaluation Matrix

Waptum Project Name : New Landfill Site Study
Waptum Project Number : 18-001103
Date : 2019-01-19

NEW LANDFILL SITE SELECTION TABLE

REGIONAL

Criteria	Excellent (3pts)	Good (2pts)	Marginal (1pt)	Importance	Site A Evaluaton	Mark A	Site B Evaluaton	Mark B	Site C Evaluaton	Mark C	Site D Evaluaton	Mark D	Site # 25	Mark # 25	Site # 26	Mark # 26	Site # 27	Mark # 27	Site # 28	Mark # 28	Comments
Distance from the community (km)	3	2-3 and 4-5	<2 to >5	3	1	3	3	9	2	6	2	6	1	3	1	3	1	3	1	3	
Urbain planning constraints	30 years +	15 to 30 years	0 to 15 years	3	1	3	3	9	3	9	3	9	1	3	1	3	2	6	3	9	To be confirmed with the Client
Distance between the incinerator and the site (km)	< 5	5-8	>8	3	3	9	3	9	2	6	2	6	1	3	1	3	1	3	1	3	
Campsite at proximity (km)	> 3	1-3	< 1	2	1	3	2	6	2	6	2	6	2	6	2	6	2	6	2	6	To be confirmed with the Client
Surface drainage at proximity of the site	Naturally drained	Dry (presence of ditch)	Waterlogged	1																	Site investigations required
Presence of rock nearby	No rock at proximity	Rock outside the bounderies of the site	Rock inside the bounderies	2	3	9	3	9	2	6	2	6	3	9	3	9	3	9	3	9	Site investigations required
Length of new access road (km)	0	0-6	> 6	2	3	9	2	6	2	6	2	6	1	3	1	3	1	3	1	3	
Length of new access road to deforest (km)	0	0-6	> 6	1	3	9	3	9	2	6	2	6	1	3	1	3	1	3	1	3	
Major construction required for the access (ei. Bridge)	0	0-$ 5,000,000	>$ 5,000,000	2	3	9	3	9	2	6	2	6	1	3	1	3	1	3	1	3	
Number of natural river to cross	< 1	2-6	> 6	3	3	9	3	9	3	9	3	9	3	9	2	6	2	6	2	6	

SITE

Surface area (m^2)	> 46,000	23,000-46,000	< 23,000	3	3	9	2	6	2	6	1	3	3	9	3	9	3	9	3	9	
Surface topography	Flat (av. 2%)	Undul (av 5%)	Highly irregular (>5%)	2																	Site investigations required
Soil permeability	Low	Medium	High	3																	Site investigations required
Groundwater depth (m)	> 5	3.6-5	< 3.6	3																	Site investigations required
Distance to watercourse (m)	> 500	300 - 500	150 - 300	1	2	6	1	3	1	3	1	3	3	9	3	9	3	9	3	9	
Density of vegetation	Low	Medium	High	1	2	6	2	6	2	6	2	6	1	3	1	3	1	3	1	3	
Hunting potential	Low	Medium	High	1	2	6	2	6	2	6	2	6	1	3	1	3	1	3	1	3	To be confirmed with the Client
Social Acceptability	High	Medium	Low	2	1	3	3	9	3	9	3	9	1	3	1	3	1	3	2	6	To be confirmed with the Client
Visibility from the access road / Easthetic	0-15%	15-50 %	> 80%	2	2	6	3	9	3	9	3	9	3	9	3	9	3	9	3	9	
Distance from an airfield (m)	> 8000	1000-8000	< 1000	2	2	6	2	6	2	6	2	6	3	9	3	9	3	9	3	9	
TOTAL MARK POINTS						**105**		**120**		**105**		**102**		**87**		**84**		**87**		**93**	

10.3 APPENDIX 3 : New Landfill Site Selection Study

WAPTUM

COMMUNITY DEVELOPMENT CONSULTING

NEW LANDFILL
SITE SELECTION STUDY

CREE NATION OF WEMINDJI

FINAL REPORT

Prepared and Reviewed by:

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Lauren Montpetit, Geog., EP, PMP
Chief Executive Officer

Project Ref.: 18-001103

Submitted: July 2019

WAPTUM

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1 CONTEXT

Following the loss of Wemindji's waste incinerator building to fire in the fall of 2018, the community developed an action plan for waste management operations identifying critical impacts and items requiring immediate intervention.

One of the biggest planning impacts of the fire was the loss of the ability to incinerate waste before burial in landfill. In Wemindji, the process of incinerating waste reduces buried waste volumes by approximately 85%. As such, the community's existing landfill, previously estimated to have a remaining lifespan of up to 10 years, would be completely filled within 2 years (by fall 2020).

The CNW cannot simply expand their existing site given its location upstream of the new drinking water intake. There have also been serious concerns expressed by the Tallyman and local members that the burial of incinerator ashes and other potential contaminants may cause adverse water quality conditions.

The CNW plans to replace their waste incinerator building with a new facility by 2021, however by that time the existing landfill will be full and ready for closure.

For these reasons, the CNW must now rush to open a new landfill site within 2 years (before winter 2020).

2 MANDATE

The Cree Nation of Wemindji hired the services of WAPTUM for the completion of a New Landfill Site Study based on the terms and conditions detailed in the proposal dated September 24, 2018. The mandate was granted according to Band Council Resolution 2018-172 issued on October 17, 2018.

The CNW requested that the study be focused in the area north of the community, particularly directed to the areas within the VC-10 trapline. This area, known as the Kakabat land, is accessible by a forestry type access road.

WAPTUM's mandate included the following elements and deliverables:

- Identification of site selection criteria, including environmental regulatory requirements, sizing and practical features, geographic and topographic constraints and social acceptability.
- Identification of sites using air photo interpretation technologies to determine geographic and environmental suitability.
- Evaluation of sites according to the selection criteria for consideration by the local Tallyman, CNW administration, and for selection by Chief & Council.
- Topographic surveying of the retained site.
- On-site investigation of the retained site by a geomorphologist and excavation of test pits to validate water table elevations and soil conditions via sampling and laboratory analysis for grain size and permeability.
- Soil study and site conditions report by the geomorphologist, including laboratory results and recommendations regarding technical suitability for development.
- Project study report providing a summary of all works completed on the project, input deliverables, study results and recommendations as to how to proceed with the next steps of the project.

Following the sequence of activities and deliverables listed in the preceding section, the project began with the evaluation of site selection criteria.

3 RESULTS

3.1 Selection Criteria

The identification of selection criteria was done as a collaboration between the CNW and WAPTUM, as each party provided essential guiding information to the process.

The CNW provided the political and practical context, including:

- The identification of the trapline VC-10 as feasible due to the pre-approval of the local Tallyman; and the refusal of the VC-11 trapline by its Tallyman.
- The practical requirement of the site location in proximity to the new Waste Management area, which the Client is also developing along the Kakabat road, to reduce travel distances for disposal of wastes.

WAPTUM provided the CNW's long-term waste disposal needs, environmental regulatory requirements, planning and practical context and overall geographic analysis including:

- The calculation of the CNW's long-term waste disposal needs based on existing waste characterization data, population growth and local operational practices.
- The identification of the precise regulatory requirements for the development of an in-trench landfill in the region.
- The identification of existing practical, archaeological and social acceptability information, as acquired from past experience on projects in the Kakabat area and in the community of Wemindji.
- The geographic analysis and preliminary identification of sites of interest based on preliminary air photo analysis, existing site information from other projects and knowledge of the area.

Technical requirements, including volume and area calculations for landfill space requirements as well as regulatory requirements are elaborated in the following sections.

3.1.1 Space Requirements

The evaluation of the space required for a new landfill was done using waste production data from a 2017 waste characterization study[1] which used population growth data for the community to determine long-term projected waste production. According to the 2017 study, the gross volume of waste produced in 2017 was estimated at 1,900 m3.

The table below summarizes the waste production projection for 30 years using a growth rate of 2.6% per year. It is assumed that the CNW will continue the use of their existing landfill until

[1] Stantec & WAPTUM, 2017 – Waste Characterization Study for Wemindji – WAPTUM ref: 17-001067

the end of 2020. Thus, the volume estimates for the new site start with the year 2021 and end in 2050 (30 years).

Table 1: CNW waste production volume estimates 2021-2050

	GROSS WASTE VOLUMES*		OPTIMAL WASTE VOLUMES**	
Time Period	**Raw (100%)**	**Incinerated (15%)*** **	**Raw (100%)**	**Incinerated (15%)*** **
2021-2030	23,697 m^3	3,554 m^3	14,982 m^3	2,247 m^3
2031-2040	30,631 m^3	4,595 m^3	14,250 m^3	2,138 m^3
2041-2050	39,594 m^3	5,939 m^3	18,420 m^3	2,763 m^3
30-YEAR TOTAL	**93,922 m^3**	**14,088 m^3**	**47,652 m^3**	**7,148 m^3**

* *Gross waste values consider no improvement on waste diversion since 2017 rates, which constitutes a very conservative estimate as it can be expected that the community should improve their practices over time through increased household participation in the recycling program, better diversion of household hazardous wastes and the use of the eco-centre for bulky and construction wastes. If initiated, a community-wide composting program could further reduce waste volumes by as much as 28%.*

*** Optimal waste values consider optimal participation (100%) in the local recycling program, complete diversion of household hazardous wastes and bulky and construction waste as well as the integration and optimal participation (100%) in a community-wide composting program starting no later than 2025. Contrary to the Gross Waste Volume estimates, the Optimal Waste Volume estimates are very liberal and will certainly not be realistically attainable.*

**** The volume of incinerated wastes could be further reduced by approximately 30% more through the removal of metal materials from the incinerator using a magnetic removal system.*

Although the community plans to operate a waste incinerator, resulting in the burial of mostly ashes, the calculations were done conservatively based on direct raw waste disposal. Although it is always the community's intention to bury only ashes in their landfill, due to equipment and maintenance issues, in the past the incinerator has been shut down for extended periods of time, leaving waste to be disposed on directly in the landfill.

For this reason, the future site is planned to accommodate for at least 20 years of direct raw waste burial, which translates to over 100 years if allocated to incinerator ash only.

Realistically we understand that the community's landfill use will be somewhere between these two extreme scenarios. For planning purposes, we used the higher estimate of 93,922 m^3, to which we must add the required volume of backfill, which is calculated to be 28,177 m^3 for a total volume of 122,098 m^3. Considering an average burial depth of 2.6 metres, a minimum site area of 46,961 m^2 is required.

3.1.2 Regulatory Requirements

Quebec's Environmental Quality Act includes a specific regulation that relates to landfilling and incineration practices for waste materials.[2] The specific siting requirements for a new in-trench landfill in the James Bay Region are provided by this regulation and listed as follows:

> *Section 88:*
>
> *(1) the minimum distance between the trench area and any watercourse or body of water must be 150 m.*
>
> *(2) the minimum distance between the trench area and any catchment installation for surface water or groundwater intended for human consumption must be 500 m. That requirement does not apply if the landfill is not likely to alter the quality of the water;*
>
> *(3) the bottom of the trenches must be at least 1 m above the rock and the groundwater level. Any lowering of the groundwater level by pumping, draining or otherwise is prohibited.*

Although written for Engineered landfills, according to Section 88 above, the following sections also apply to the siting of trench landfills.

> *Section 13:*
>
> *The disposal areas in an engineered landfill and the treatment system for leachate or water from those areas, other than surface water sediment basins, must be sited at a minimum distance of 1 km from any surface water or groundwater collection facility if the facility is used for the production of spring water or mineral water within the meaning of the Regulation respecting bottled water (chapter P-29, r. 2) or for the supply of a waterworks authorized under the Environment Quality Act (chapter Q-2).*

[2] Regulation respecting the landfilling and incineration of residual materials, CQLR c Q-2, r 19, <http://canlii.ca/t/530bg> last retrieved by WAPTUM online on 2019-07-23

Section 16:

The siting of an engineered landfill on land underneath which there is free groundwater having a high potential aquifer is prohibited.

For the purposes of this section, a "high potential aquifer" exists where at least 25 m3 of water per hour may be drawn on a permanent basis from the same well.

Section 18:

In order to mitigate the nuisances that an engineered landfill may generate and to allow for the carrying out of any necessary remedial measures, a buffer zone at least 50 m wide must be maintained on the perimeter of the landfill or the disposal areas and the leachate or water treatment system sites, other than surface water sediment basins, and if present, the biogas gas pumping system and the removal facility. The buffer zone must be an integral part of the engineered landfill.

A buffer zone must not have any watercourse or body of water within it. Its interior and exterior boundaries must be maintained so that they are capable of being located at all times.

Only activities necessary to access and monitor the facilities, and activities consistent with the purposes referred to in the first paragraph are permitted in a buffer zone. That restriction does not prevent the establishment of all or part of a buffer zone on an existing landfill, so long as the achievement of those purposes is not compromised.

Section 19:

The siting of an engineered landfill must take into account the inherent geotechnical constraints of the natural materials present and the synthetic materials used as well as the prevailing hydrogeological conditions that may be altered as a consequence of the proposed landfill siting.

The criteria were weighted based on their relative importance to the decision-making process. Potentially deal-breaking criterion were given the highest-level of importance (3), while criterion that could be worked around or potentially adapted to were given a medium (2) or low (1) importance.

The following table provides the complete list of site selection criteria alongside their importance values (1-3) and their descriptors.

Table 2: Landfill Selection Criteria

Criteria	Excellent (3pts)	Good (2pts)	Marginal (1pt)	Importance
Distance from the community (km)	3 km	2-3 and 4-5 km	<2 to >5 km	3
Urban planning constraints	30 years +	15 to 30 years	0 to 15 years	3
Distance between the incinerator and the site (km)	< 5 km	5-8 km	>8 km	3
Campsite at proximity (km)	> 3 km	1-3 km	< 1 km	2
Surface drainage at proximity of the site	Naturally drained	Dry (presence of ditch)	Waterlogged	1
Presence of rock nearby	No rock at proximity	Rock outside the bounderies of the site	Rock inside the bounderies	2
Length of new access road (km)	0 km	0-6 km	> 6 km	2
Length of new access road to deforest (km)	0 km	0-6 km	> 6 km	1
Major construction required for access (ie. Bridge)	$0	0-$ 5,000,000	>$ 5,000,000	2
Number of natural waterways to cross	< 1	2-6	> 6	3
Surface area (m^2)	> 46,000	23,000-46,000	< 23,000	3
Surface topography	Flat (av. 2%)	Undul (av 5%)	Highly irregular (>5%)	2
Soil permeability	Low	Medium	High	3
Groundwater depth (m)	> 5 m	3.6-5 m	< 3.6 m	3
Distance to watercourse (m)	> 500 m	300 – 500 m	150 – 300 m	1
Density of vegetation	Low	Medium	High	1
Hunting potential	Low	Medium	High	1
Social Acceptability	High	Medium	Low	2
Visibility from the access road / Easthetic	0-15%	15-50 %	> 80%	2
Distance from an airfield (m)	> 8000 m	1000-8000 m	< 1000 m	2

3.2 Air Photo Interpretation

Once the criteria were established, Poly-geo provided a detailed evaluation of the sites in the target area, including those pre-identified by WAPTUM, using air photo interpretation technology.

Four (4) sites were addressed, each identified on a map, which was printed and in extra-large scale and high-resolution for delivery to the Client. The map is provided in Appendix A and includes a legend outlining the basic regulatory and practical constraints such as distance to a water body and trapline limits.

3.3 Site Evaluation

The complete evaluation of sites was done by WAPTUM according to the selection criteria. The importance values for each criteria were used as multipliers in the evaluation process. In the end, Site B presented the highest overall evaluation score. Site B is located approximately 1.5km from the nearest section of the Kakabat road (without being directly beside the roadway, which Site A was noted to be).

A preliminary version of the criteria evaluation along with the site identification map was presented to CNW representatives Roderick Mamianskum and Stephanie Jonah on January 25, 2019 by Geneviève Gagnon of WAPTUM. An update letter and preliminary criteria evaluation table is provided in Appendix B. At the time of the meeting, the CNW confirmed the assumptions made in the table regarding social acceptability. According to Mr. Mamianskum, the CNW Council agreed with his recommendation to proceed with the study of Site B and thus authorized the next steps of the project to proceed.

3.4 Topographic Survey

Efforts were made to produce a digital topographic map using LIDAR data from government survey sources, however the retained Site B falls just outside of the data collection zone.

A complete topographic survey of site is planned for completion in 2019 and will be delivered to the Client for reference and engineering use during the production of design plans for landfill and site development. The survey will be done in a grid pattern over the entirety of the site by a surveyor using the GPS method.

3.5 On-Site Investigations

On-site investigations of the site were completed between May 5-9, 2019 by Poly-Geo. During the site investigations, 16 test pits were excavated on Site B for the purpose of identifying soil characteristics, groundwater depth and for soil sampling for laboratory analysis. The complete results of the on-site investigation and laboratory analysis can be found in the Poly-Geo report provided in Appendix C.

The results of the on-site study and laboratory testing confirmed that Site B was an excellent candidate for the development of a landfill due to suitable groundwater depths (averaging 4.2 metres deep) and low permeability soils.

3.6 Overall Analysis

Following the receipt of the Poly-Geo report, the WAPTUM team compiled and reviewed all information gathered during the project and consolidated the findings in a revised version of the site selection evaluation matrix. The final version is provided in Appendix D.

The final results of the evaluation matrix exercise confirm that Site B is rated highest, with 129 points overall. The site has an estimated useable surface area of over 40,000 m^2, which is in line with the project requirement of 122,098 m^3 considering a conservative average depth of burial of around 3 metres. As such, the site is confirmed to have the capacity to meet the CNW's landfilling needs for 20 to over 100 years depending on the rate of incineration.

The lifespan of the site could be further extended through the increase in participation of members in the local recycling and eco-centre programs, as well as through the initiation of a composting program. High participation rates in these areas could potentially cut the waste stream in half, which could theoretically serve to double the lifespan of the site.

4 CONCLUSIONS

Of the unretained sites, Site A had the most favorable technical characteristics, however it is located directly on the path of the Kakabat access road, which is undesirable for community and operational purposes and would not allow for forest buffer zones to be established to separate the roadway from the trench.

Sites C and D were both interesting candidates, however they are located further from the community than Site B, rendering them of lesser interest due to access road requirements.

Overall, the results of the study strongly support the selection of Site B for the establishment of a new landfill due to its location, size, topography and soil characteristics. The site also meets most practical, environmental and social acceptability requirements.

5 NEXT STEPS

Should the community accept to proceed with the development of their next landfill at Site 3, the following steps should be undertaken in the order presented.

The dates associated with each step consider the advancement of deliverables and of the approvals process according to regular delays. If delays are encountered, the schedule should be updated accordingly.

- Landfill design options study[3] - August, 2019
- ESIA Study – Fall, 2019
- Design of Plans & Specifications for Tender – Winter, 2019
- Tendering for Construction – Spring, 2020
- Construction – Summer, 2020
- Environmental Monitoring – Starting in Fall, 2020 – Ongoing

[3] The project is subject to Environmental & Social Impact Assessment. Before the process begins, a study of landfill design options is recommended in order to ensure that a complete outline of landfill design options and alternatives is provided and that all functional, environmental and social requirements of the project will be fulfilled. Selecting the right landfill technologies is also important to ensuring the satisfaction of the local Tallyman and community members with the environmental protection measures that will be proposed to be put in to place. Since the project will be subject to an ESIA Study, this document will provide the evidence needed to support the CNW's choice of landfill option and will ensure that environmental protections are planned for early in the design process. As discussed in Section 1 of this report, there have been concerns from local members and the VC-11 Tallyman regarding potential contamination from the burial of incinerator ashes. This subject is likely to come up during the ESIA process.

6 APPENDIX

6.1 Appendix A - Map of Potential Sites

Cree Nation of Wemindji
New landfill site selection
Sources:
Orthomosaic, resolution 30 cm, NRCan, 2017
Surveys and cartography: Poly-Géo inc. 2019
File: 18085_po_002_Map1_6k_190115.mxd
Scale : 1:6,000
0 100 200 300 m
UTM, Zone 17, NAD83 (CSRS)
Map 1
January 2019
Potential landfill site
Kakabat deposit
Previously identified potential site (Dessau-Soprin, 2004)
Rocky area
Hydrographic buffer (150 m)
Bridge required
Proposed access trail for exploration
Proposed trail (forested area)
Slashed trail
Proposed new landfill sites
Approximate surface area:
Site A : 125,000 m²
Site B : 48,000 m²
Site C : 37,000 m²
Site D : 41,000 m²
James Bay
Mwakw Lake
Rivière Jibaud
Paint Hills Lake
A
B
C
D
#25
#26
#27
#28
Airport
Trapline limit VC10
Trapline limit VC11
Wemindji
Maquatua River

6.2 Appendix B-1 - Preliminary Site Selection Letter

WAPTUM

January 18, 2019

Mr. Rod Mamianskum
Capital Projects Coordinator
Cree Nation of Wemindji
21 Hilltop Road, P.O. Box 60
Wemindji, QC
K0M 1L0

SUBJECT: New landfill site selection letter

Dear Mr. Mamianskum,

Waptum is pleased to present the new landfill site selection map and criteria analysis table prepared in accordance to the proposal named" Landfill Site Selection Study". Waptum worked in close collaboration with the professional firm Poly-Geo to produce an air photo interpretation of the Kakabat trapeline, Wemindji.

Therefore, our team selected four (4) potential sites titled A, B, C and D in addition to the sites identified by Dessau in 2004 (# 25, # 26, # 27 and #28). See their location on the New landfill site selection map.

In order to identify the best sites for a new landfill, a comparative table was created to better understand different characteristics of each site and determine their ranking in respect to environmental, economic and social criteria. Each criterion has been given an importance ranking from 1 to 3 depending on their level of impact on environment, construction costs or social aspects.

Based on those results, Site B obtained the highest rank, followed by sites C. See the results on the attached "New Landfill Selection Table".

With your approval, the two (2) highest marked sites will be selected for a soil study and topographic survey which will complete the New landfill Site Selection Study in spring 2019.

Sincerely,

Genevieve Gagnon, M.Sc., CAPM®
PMP
Project Manager

Lauren Montpetit, Geog., EP,

Chief Executive Officer

c.c. Stephanie Jonah, Director General, CNW

6.3 Appendix B-2 - Preliminary Site Options Criteria Evaluation Matrix

Waptum Project Name : New Landfill Site Study
Waptum Project Number : 18-001103
Date : 2019-01-19

NEW LANDFILL SITE SELECTION TABLE

REGIONAL

Criteria	Excellent (3pts)	Good (2pts)	Marginal (1pt)	Importance	Site A Evaluaton	Mark A	Site B Evaluaton	Mark B	Site C Evaluaton	Mark C	Site D Evaluaton	Mark D	Site # 25	Mark # 25	Site # 26	Mark # 26	Site # 27	Mark # 27	Site # 28	Mark # 28	Comments
Distance from the community (km)	3	2-3 and 4-5	<2 to >5	3	1	3	3	9	2	6	2	6	1	3	1	3	1	3	1	3	
Urbain planning constraints	30 years +	15 to 30 years	0 to 15 years	3	1	3	3	9	3	9	3	9	1	3	1	3	2	6	3	9	To be confirmed with the Client
Distance between the incinerator and the site (km)	< 5	5-8	>8	3	3	9	3	9	2	6	2	6	1	3	1	3	1	3	1	3	
Campsite at proximity (km)	> 3	1-3	< 1	2	1	3	2	6	2	6	2	6	2	6	2	6	2	6	2	6	To be confirmed with the Client
Surface drainage at proximity of the site	Naturally drained	Dry (presence of ditch)	Waterlogged	1																	Site investigations required
Presence of rock nearby	No rock at proximity	Rock outside the bounderies of the site	Rock inside the bounderies	2	3	9	3	9	2	6	2	6	3	9	3	9	3	9	3	9	Site investigations required
Length of new access road (km)	0	0-6	> 6	2	3	9	2	6	2	6	2	6	1	3	1	3	1	3	1	3	
Length of new access road to deforest (km)	0	0-6	> 6	1	3	9	3	9	2	6	2	6	1	3	1	3	1	3	1	3	
Major construction required for the access (ei. Bridge)	0	0-$ 5,000,000	>$ 5,000,000	2	3	9	3	9	2	6	2	6	1	3	1	3	1	3	1	3	
Number of natural river to cross	< 1	2-6	> 6	3	3	9	3	9	3	9	3	9	3	9	2	6	2	6	2	6	

SITE

Surface area (m^2)	> 46,000	23,000-46,000	< 23,000	3	3	9	2	6	2	6	1	3	3	9	3	9	3	9	3	9	
Surface topography	Flat (av. 2%)	Undul (av 5%)	Highly irregular (>5%)	2																	Site investigations required
Soil permeability	Low	Medium	High	3																	Site investigations required
Groundwater depth (m)	> 5	3.6-5	< 3.6	3																	Site investigations required
Distance to watercourse (m)	> 500	300 - 500	150 - 300	1	2	6	1	3	1	3	1	3	3	9	3	9	3	9	3	9	
Density of vegetation	Low	Medium	High	1	2	6	2	6	2	6	2	6	1	3	1	3	1	3	1	3	
Hunting potential	Low	Medium	High	1	2	6	2	6	2	6	2	6	1	3	1	3	1	3	1	3	To be confirmed with the Client
Social Acceptability	High	Medium	Low	2	1	3	3	9	3	9	3	9	1	3	1	3	1	3	2	6	To be confirmed with the Client
Visibility from the access road / Easthetic	0-15%	15-50 %	> 80%	2	2	6	3	9	3	9	3	9	3	9	3	9	3	9	3	9	
Distance from an airfield (m)	> 8000	1000-8000	< 1000	2	2	6	2	6	2	6	2	6	3	9	3	9	3	9	3	9	
TOTAL MARK POINTS						**105**		**120**		**105**		**102**		**87**		**84**		**87**		**93**	

6.4 Appendix C - Soil Study Report from Poly-Geo

WEMINDJI NEW LANDFILL SITE STUDY

POLY-GÉO INC.

Photo-interpretation and field investigations

Final technical report presented to WAPTUM

July 2019

SUMMARY

Authors and title (for referencing purposes):

Poly-Géo Inc. 2019**.** – **WEMINDJI NEW LANDFILL SITE STUDY**. Photo-interpretation and field investigations. Technical report presented to WAPTUM. 9 pages and 3 appendices.

Daniel Brosseau, M.Sc.
Intermediate Geomorphologist

Richard Lévesque, M.Sc.
Senior Geomorphologist

Version: Final
Date: July 15, 2019

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Report editing:
Sylvie Pomerleau

Poly-Géo Inc. ref. number: 18085

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INTRODUCTION 1

In November 2018, WAPTUM retained the services of Poly-Géo Inc. to identify potential sites for the new Wemindji landfill site using photo-interpretation. The study included field investigations to characterize one or more of the proposed sites in order to select the best site.

Following initial photo-interpretation work, a map[1] of four proposed sites (not included in this report) was compiled with other relevant general information such as rocky terrain, water network protective buffer, and local trapline limits. The map also incorporated external data such as the Kakabat deposit with access roads and future bridge location and previously identified potential sites (by another firm). The map was presented during a meeting held on December 5, 2018, with Mr. Rod Mamianskum (Capital Works of Wemindji) and Mrs. Geneviève Gagnon (WAPTUM) at our Saint-Lambert offices. Mr. Mamianskum and Mrs. Gagnon agreed to proceed and present the four (4) sites to the community. The discussions surrounding the project were held by the WAPTUM representative, who is acting as the liaison with community representatives.

Poly-Géo's role in the study was limited to identifying sites with good potential for the development of a new landfill, characterizing them from a geomorphological/geotechnical perspective through field investigations and providing project support to WAPTUM. WAPTUM is solely responsible for the *"environment"* and *"permitting"* components of the project; however, the required setbacks for water and wetlands are included in our analysis of the proposed sites.

This technical note provides a brief description of the work performed and presents the results of the field study and laboratory analyses and testing.

[1] ***Poly-Géo, January 2019.*** Cree Nation of Wemindji, New landfill site selection. Map 1, scale : 1: 6,000. Map provided to WAPTUM and the Cree Nation of Wemindji (Capital Works).

WORK PERFORMED

2

The mandate began with a meeting with the WAPTUM representative during which the basis for the project and the needs of the community were presented. Because of the geographic location and the geomorphological context, the search criteria for a new landfill site was based on the requirements of a trench-type landfill (TLF). These requirements are described in division 3 of the Regulation respecting the landfilling and incineration of residual materials of the Environment Quality Act (chapter Q-2, r. 19). According to the latter, there is no need for the presence of impermeable materials to retain the leachate. However, the bottom of trenches used for waste disposal must be at least 1 m above the rock and the groundwater level, and 150 m wide buffer zone must be maintained between water bodies and the perimeter of the landfill. Finally, following this study, alternative layouts and planning methods may be proposed by specialized firm.

As requested by the Wemindji authorities, the search for potential sites was limited to the Category I lands to the north of the community. Other sites could have been identified along the road leading to Wemindji but were not considered within the scope of this study. According to the data provided by the Client, the landfill site should have a life of at least 20 years, and according to the design criteria selected, it should cover an area of approximately 47,000 m² in order to accommodate at least 93,000 m^3 of solid waste based on a potential excavation depth of 2.6 m.

A review of the technical and scientific literature on the geomorphology and geology of the Wemindji area was carried out at the outset of the mandate. Potential sites were then identified by photo-interpretation from high-resolution (15 and 30 cm) digital colour aerial photographs taken for NRCan in 2017. The available LiDAR data were also analysed, but it only covered a small portion of the study area.

The aerial photos were analysed onscreen in 3D using Summit Evolution software in combination with the ArcGIS geographic information system for mapmaking.

The main criteria for the selection of potential TLF sites were as follows:

- well-drained ground composed of a thick layer (> 5 m) of materials with relatively low permeability (till)
- sites located north of Wemindji, in Category I lands and ideally within the VC-10 trapline
- minimum available surface area of 30,000 m², taking into account a 150 m wide buffer zone at the edge of water bodies
- absence of near-surface rock within the site boundaries
- deep water table (> 4-5 m)
- access road easily built and maintained.

Till deposits forming drumlins (whaleback forms aligned in the direction of ice flow) are generally well suited to the development of a TLF because their curved surface, which rises from a few to tens of metres above the surrounding terrain, promotes soil drainage even when the materials contain relatively high proportions of fine particles (< 80 µm). There are many drumlins in the Wemindji area and we focused on them during photo-interpretation to identify potential sites.

Four potential sites were identified by photo-interpretation (sites A, B, C and D), covering 125,000 m², 48,000 m², 37,000 m² and 42,000 m², respectively. They are outlined on map 1, on page 4.

Site A has the most favourable characteristics with respect to the physical environment. It has the largest surface area, its curved surface, which rises several metres above the surrounding terrain, allows for good drainage, the local water bodies are far enough away not to impinge on its exploitable surface area, and it is already accessible by a year-round road. It has constraints, however, related to its proximity to the community (less than 2 km from populated areas) and its social accessibility in general. In addition, the right-of-way for the future access road to the Kakabat sector borrow sources runs right across it.

The new landfill site selection table prepared by the Wemindji managers and the WAPTUM representative in spring 2019 indicated that, overall, site B showed the most favourable characteristics at the desk study stage and should be the priority for field investigations, with site C as a second choice if the field investigations failed to produce the anticipated results.

The location of test pits and the route of access trails to be used by the excavator during the field study were determined using 3D photo-interpretation. An effort was made to propose trails that avoided densely wooded areas as much as possible to minimize the impact of field activities on the vegetation. The location of the test pits and trails was submitted to the WAPTUM team for approval.

Field study

Field investigations were carried out by Daniel Brosseau, intermediate geomorphologist, from May 5 through May 9, 2019. The test pits were dug to an average depth of 5 m using a Komatsu PC200 LC crawler excavator.

The excavator accessed site B under its own power, using the existing road for the first half of the distance and driving on the natural surface for the second half (photo 1), for a total of about 3 km. In the second half of the trip, the presence of snow on the ground made it easy to cross narrow sections of ground with low bearing capacity.

Wherever possible, the excavator travelled in the least-wooded areas (photo 2) to minimize the need for tree-cutting. When tree cutting was necessary, the trees were felled using the excavator, without resorting to tree fellers. The areas selected for test pits were naturally very sparsely wooded.

Wemindji New Landfill Site Study

Location Map

Sources:

Orthophoto, resolution 30 cm, 2017

Surveys and cartography: Poly-Géo
File: 18085_po_003_Map1_190704.mxd

0 250 500 m

UTM, Zone 17, CSRS NAD83

Map 1

July 2019

WAPTUM

POLY-GÉO INC.

- Potential new landfill site
- Other proposed sites
- Slashed trail used with the shovel for site exploration
- Approximate limit of trapline *(VC10 and VC11)*
- PK 1 — Wemindji road kilometric point

Sixteen test pits were dug within the boundaries of site B. They ranged in depth from 4.8 to 6.1 m, average slightly more than 5 m. Each test pit was described in detail (types of material, sequence and thickness of layers, depth of water table when reached, etc.). Numerous photos were taken of the test pits and piles of excavated material and the pit coordinates were recorded using a portable GPS, accurate to within approximately 5 m.

Samples were collected from five pits for laboratory grain size analysis and permeability testing. The samples were shipped by Kepa Transport to SNC-Lavalin's laboratory in Val-d'Or, where grain size analyses were performed, while permeability tests were performed at SNC-Lavalin's laboratory in Longueuil. The results of the analyses and tests can be found in appendix 2, behind the test pit data sheets.

All pits were left open for a period of 24 to 48 hours to allow time for the groundwater level to stabilize. The water table was reached in seven pits, all in the northeast third of the site. It lay at a depth of 2.8 to 5.3 m, for an average of 4.2 m. All pits were filled before leaving the site, with the layer of topsoil set aside at the beginning of excavation carefully replaced. The groundwater level was measured at the end of the winter low-water period and is likely to be a few tens of centimetres higher in the spring and fall.

Office

Back at the office, all the photos taken in the field were filed in individual files linked to the various test pits. Appendix 3 contains a set of photos showing each pit and its pile of excavated material.

Descriptions of the test pits and the main analytical results were entered into data sheets using Geotec software (Sobek Technologies).

Maps were prepared showing an overview of the area around Wemindji and detailed information for site B. An orthomosaic map (NRCan, 2017) produced from aerial photographs taken in 2017 served as a base map.

As mentioned above, only site B was selected for detailed field characterization, with the field study to extend to site C in the event that site B did not meet the requirements. This did not prove to the case, and only site B was investigated.

Site B

Site B is located approximately 3.2 km north of Wemindji as the crow flies. The existing road will have to be extended some 1.5 km to reach the site. A broad analysis of the aerial photographs indicates that the road would cross wet ground with low bearing capacity over approximately 25% of its length (maps 1 and 2).

This study included the identification of streams and wetlands by photo-interpretation, using high-resolution (30 cm) aerial photographs taken in 2017. No field investigations were conducted to establish actual wetland sizes or streambeds. The boundaries of these protected areas will therefore have to be reviewed by a biologist or other environmental specialist during the ESIA study planned in Fall 2019.

Site B covers an area of 48,000 m² on the surface of a thick till deposit (drumlin) oriented NE-SW, which was deposited at the base of the moving continental glacier (ice sheet). The till that composes it is very compact and well-graded and thus not very permeable. The drumlin is approximately 700 m long by 250 m wide. It has a whaleback shape whose highest section rises about 10 metres above the surrounding terrain. The site is bordered to the southwest by an unnamed lake and on its other three sides by relatively flat terrain composed essentially of a layer of peat resting on poorly drained fine sediments of marine origin. The till is covered by a thin, discontinuous layer of gravelly sand from the surface washing of the till by the waves, currents and floating ice of the postglacial Tyrrell Sea. This washing occurred on the ancient seashores while the area was still partially flooded. The sea receded to the level of present-day James Bay as a result of the isostatic rise of the Earth's crust over several millennia.

The surface of the site is slightly undulating/hummocky, with observed changes in elevation of only a few metres. The sides of the drumlin are characterized by low (< 10%), fairly even slopes. The slopes within the boundaries of site B are even gentler. The entire surface of the site is wooded, but tree density ranges from low to medium (photo 2).

A permanent stream not shown on topographic map 33E/02 (1:50,000) was identified by photo-interpretation in the area northwest of the site. Its approximate route has been plotted on map 2, in appendix 1. Its presence, as well as that of the lake to the southwest, means that the usable area for TLF development is slightly smaller due to the 150 m buffer zone required between water bodies and the perimeter of the landfill. There does not appear to be a permanent stream on the southeastern side of site B, but field investigations are needed to check whether there might be one hidden by the dense forest of mature trees found there.

Exploration with the excavator took place on May 6, 7 and 8, 2019. A total of 16 pits were dug (map 2) within the proposed boundaries of site B. Pit depth ranged from 4.8 to 6.1 m. Generally, the site consists of a thin layer of gravelly sand (0.7 to 1.6 m) lying directly on the till. None of the pits reached bedrock. The test pit data sheets with detailed descriptions are presented in appendix 2.

The water table was observed in pits PU-B01, PU-B02, PU-B03, PU-B08, PU-B09, PU-B10 and PU-B11, all located in the northeast third of the site. At the time of the field surveys, the groundwater level lay at a depth of between 4.2 and 5.3 m, except in pits PU-B08 and PU-B10, where it was observed at a depth of 2.8 m and 3.2 m, respectively. The shallower depth is due to the fact that these two pits lie lower down on the side of the drumlin, closer to the level of the wooded peat bog at its foot.

Till samples for grain size analysis and permeability testing were collected at depths of 3.3 to 3.9 m from the following test pits: PU-B01, PU-B03, PU-B08, PU-B11 and PU-B13. Samples sent to the laboratory contained only the fraction passing 80 mm. The proportions of pebbles (80 to 300 mm) and boulders (> 300 mm) were estimated visually during pit excavation. Grain size analysis (LC 21-040) was performed on each of the samples. According to this analysis, the till matrix is composed of sand and silt, as well as silty sand. The proportion of fine particles (< 80 µm) ranged from 34% to 42%. The measured proportion of gravel was generally < 15%, and the proportion of pebbles and boulders was always less than 10%. The detailed results of grain size analysis are presented in appendix 2, behind the technical data sheet of the pit to which they relate.

Permeability tests (ASTM D2434-68) were performed on the samples taken from test pits PU-B01, PU-B03 and PU-B13. The method used was to saturate the materials and compact them to simulate *in situ* conditions. Permeability was then measured on a velocity and time scale. The permeability test results can also be found in appendix 2, behind the data sheet for the corresponding test pit. The permeability coefficients measured on the fraction of the samples from pits PU-B01, PU-B03 and PU-B13 passing 2 mm were 6.1×10^{-4} cm/s, 2.1×10^{-4} cm/s and 4.0×10^{-4} cm/s, respectively.

SUMMARY AND CONCLUSION 4

Potential sites for a new landfill *(trench landfill)* in Wemindji were identified by analysing aerial photographs, and field investigations were carried out on site B, which had been tentatively selected by the community. The main steps and results of the study are presented below:

- Four potential landfill sites (A, B, C and D) were identified by photo-interpretation. The boundaries of these sites were established based on the nature of the materials present, the estimated groundwater level, the slopes and the 150 m buffer zone required around water bodies. Based on the site analysis, the community selected site B for detailed characterization. The location of site B is shown on the attached map.
- Field investigations were conducted in early May 2019.
- Sixteen test pits were dug using a Komatsu PC200 LC excavator. The locations of the test pits were chosen to provide a full picture of the site. Pit depths ranged from 4.8 to 6.1 m. The stratigraphy of the deposit is generally characterized by a thin layer of sand (0.7 to 1.6 m) containing < 10% to 30% gravel lying directly on top of the till. None of the pits reached bedrock. Appendix 2 contains data sheets providing a detailed description of the test pits.
- Once dug out, the test pits were left open for 24 to 48 hours to allow the groundwater level, when reached, to stabilize. The depth of the water was then measured, and the pit was backfilled. Groundwater was observed in the following seven pits: PU-B01, PU-B02, PU-B03, PU-B08, PU-B09, PU-B10 and PU-B11 (map 2 in appendix 1). At the time of the field study, the groundwater level lay at a depth of 4.2 to 5.3 m, except in pits PU-B08 and PU-B10, where the depth was measured at 2.8 m and 3.2 m, respectively. The shallower groundwater depth at these locations is attributable to location of these two pits lower down on the side of the drumlin, closer to the level of the wooded peat bog at its foot.
- Till samples for granulometric analysis and permeability testing were collected at depths of 3.3 to 3.9 metres from the following pits: PU-B01, PU-B03, PU-B08, PU-B11 and PU-B13. The samples contained only the fraction passing 80 mm. The proportions of pebbles (80 to 300 mm) and boulders (> 300 mm) were estimated visually during excavation. This information can be found on the technical data sheets (appendix 2). Grain size analysis (LC 21-040) was performed for each of the samples. It showed that the till matrix is composed of sand and silt, as well as silty sand. The analytical results show that the proportion of fine particles (< 80 µm) ranges from 34% to 42%. The results of grain size analysis are presented with the technical data sheets in appendix 2.
- Permeability tests (ASTM D2434-68) were performed in a rigid-walled mould on till samples collected in pits PU-B01, PU-B03 and PU-B13. These tests were performed on the fraction passing 20 mm at SNC Lavalin's laboratory in Longueuil. The results obtained indicate permeability coefficients of between 2.1 x 10^{-4} and 6.1 x 10^{-4} cm/s. Detailed results are included with the technical data sheets in appendix 2.

Recommendations

- Based on the field study and the various analytical results available, the characteristics of site B appear to be favourable for the development of a TLF. The till is thick, of good quality and well-graded. The test pits did not reach the bedrock underlying the till and the groundwater level was more than 4.2 m deep everywhere except in pits PU-B08 and PU-B10 where it was encountered at a depth of 2.8 m and 3.2 m, respectively. Even if the area associated with these pits is excluded, the usable area remains above 40,000 m².

- Piezometers will have to be installed to monitor the groundwater fluctuations over the course of one year and determine the highest level in and around the site.
- The buffer zone for water network shown on map 2 (appendix 1) was determined by photo-interpretation from high-resolution (30 cm) aerial photographs taken in 2017. Despite the good quality of the aerial photographs, field investigations will have to be carried out during the ESIA to determine the limits of the surrounding wetlands and trace the beds of watercourses. This would therefore ensure that the various environmental standards in effect are respected.

APPENDIX 1

Map 2 : Site B characterization

- Test pits location

Wemindji New Landfill
Site Study

Site B Characterization

Sources:

Orthophoto, resolution 30 cm, 2017

Surveys and mapping: Poly-Géo
File: 18085_po_004_Map2_190705.mxd

0 20 40 60 m
UTM, Zone 17, NAD83 (CSRS)

Map 2

July 2019

WAPTUM

POLY-GÉO INC.

Potential landfill site

Test pit

PU-B09 (2.8m) — Test pit name (water table depth)

N

78°50'30" 78°50'20" 78°50'10" 78°50' 78°49'50" 78°49'40" 78°49'30"

53°2'20" 53°2'10" 53°2' 53°1'50"

Stream

PU-B09 (4.8m)
PU-B01 (4.2m)
PU-B11 (5.3m)
PU-B02 (4.4m)
PU-B10 (3.2m)
PU-B03 (4.7m)
PU-B06
PU-B08 (2.8m)
PU-B07
PU-B12
PU-B05
PU-B16
PU-B13
PU-B14
PU-B04
PU-B15

SITE B

Slashed trail used with the shovel for site exploration

150m from water network

Lake

APPENDIX 2

- Technical description of test pits
- Grain size analysis
- Permeability test

POLY-GÉO INC.

REPORT OF AN EXPLORATION TRENCH

TRENCH N° : PU-B01
Page : 1 de 1

Customer : Cree Nation of Wemindji
Project name : New landfill site study
N° of project : 18085
Localisation : Site - B

Geographic coordinates **X :** 645486 m **Y :** 5878324 m
UTM NAD83 Zone : 17 **Z (±) :** 15 m (GPSmap60CSX)

LEGEND

AG : Grain Size Analysis (LC 21-040)
MD gros : Coarse Micro-Deval (LC 21-070)
MD fin : Fine Micro-Deval (LC 21-101)
LA : Los Angeles (LC 21-400)
VB : Methylene Blue (LC 21-255)
MO : Organic Material (LC 31-228)
Petr. : Petrography (CSA A23.2-15A)
Fri. : Fiability (LC 21-080)

Sample
Not remoulded
BS : Bulk sample
MA : Manual withdrawall
INF : Infiltration
Groundwater

DEPTH. (m)	LEVEL (m)	SYMBOL	STRATIGRAPHIC DESCRIPTION	COBBLES VOL%	BOULDERS VOL% (mm max. diam)	SAMPLES TYPE NO.	SAMPLES STATE	INF	LABORATORY TEST
	0,0		Organic matter and sand.						
0,5	0,1		Sand, traces of gravel. Presence of cobbles.	<10%					
1,0	1,0		Till : Silt and sand matrix, some gravel (<15%). Presence of cobbles and boulders. Compact and Moist (under 3m of depth).						
1,5									
2,0									
2,5									
3,0				10-15%	<10% (800)				
3,5						BS-A			AG Permeability coefficient = 0.00061 cm/s
4,0									
4,5									
5,0									
	5,2		End of the trench						

REMARKS :
BS-A = 2 samples
1) 1 X 25 - 30 Kg (for grain size analysis)
2) 1 X 2 - 3 Kg (for water content analysis)

EQUIPMENT USED : Komatsu PC200LC
WALL STABILITY : Stable (above 3m)

DATE : 2019-05-06
DESCRIBED BY : Daniel Brosseau
APPROVED BY : Daniel Brosseau

Log_Tranchee_v3_EN.sty Date d'impression : 2019-07-03

SNC·LAVALIN

2740, chemin Sullivan
Val-d'Or, (Québec), J9P 0B9
Téléphone : (819) 824-6894
Télécopieur : (819) 824-3762

SOLS ET GRANULATS
SOMMAIRE DES ESSAIS

Soumis à : Mme Geneviève Gagnon, Geog., M.Sc., CAPM
Waptum (formerly TMS inc.)
1610-2075 Robert Bourassa
Montréal, Québec, H3A 2L1

Dossier N° : 665169
Date : 2019-05-21

Vos références

Entrepreneur : -
Projet N° : 18-001103 - Lot # 530
Projet : Waptum - Essais en laboratoire 2019

Localisation : Val-d'Or

RENSEIGNEMENTS GÉNÉRAUX

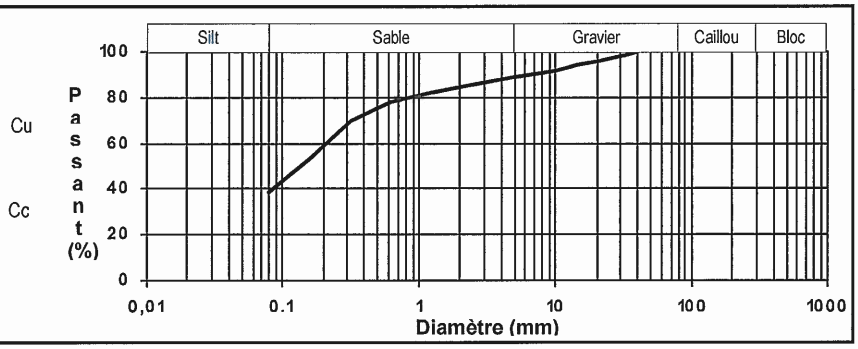
No échantillon	: 18-SG-09827	**Prélevé par**	: Client
Type de matériau	: Sable et silt avec un peu de gravier	**Source**	: Site B, Wemindji
Calibre du matériau	: Non spécifié	**Date de l'essai**	: 2019-05-17
Usage proposé	: Site d'enfouissement		
Lieu de prélèvement	: Wemindji, éch. PU-B01, prof. 3,5m		
Date de prélèvement	: 2019-05-06	**Date de réception**	: 2019-05-13

GRANULOMÉTRIE
(LC 21-040)

Tamis	% passant	Exigences min.	Exigences max.
112 mm	100		
80 mm	100		
56 mm	100		
40 mm	100		
31,5 mm	98		
20 mm	96		
14 mm	94		
10 mm	92		
5 mm	89		
2,5 mm	86		
1,25 mm	82		
630 µm	78		
315 µm	70		
160 µm	54		
80 µm	38,6		

MODULE DE FINESSE : 1,53

Cu
Cc



ESSAIS DIVERS	Résultats	Exigences min.	Exigences max.

PROCTOR MODIFIÉ (NQ 2501-255) **Méthode :**
Masse volumique sèche maximale : kg/m³
Teneur en eau optimale optimale : %

REMARQUE : * Un astérisque accompagne tout résultat individuel non conforme lorsque les exigences sont spécifiées.
Échantillon prélevé et transmis au laboratoire par le client.

Vérifié par : Armelle Kamdem
Armelle Kamdem , , tech.

Chargé de projet : Ibodian
Ibrahima Bodian ing. Jr

SNC·LAVALIN

ESSAI DE PERMÉABILITÉ EN MOULE RIGIDE

ASTM D2434-68 (2006)

DOSSIER : **665169**
CLIENT : **Waptum (formerly TMS inc.)**
PROJET : **Essais en laboratoire 2019**
LOCAL. : **Val-d'Or**

SONDAGE: **PU**
ÉCHANT. : **B01**
PROF.: **3.5 mètres**
18-SG-09827
FICHIER : 665169-B01.KMR

CARACTÉRISTIQUES VOLUMÉTRIQUES			
	État	Initial	Final
Diamètre du moule	mm	144.4	
Longueur du spécimen	mm	161.5	161.5
Section d'écoulement	cm^2	163.8	
Volume du spécimen	cm^3	2645	2645
Masse humide	g	5412	5714
Masse sèche	g	4994	
Teneur en eau, w	%	8.38	14.41

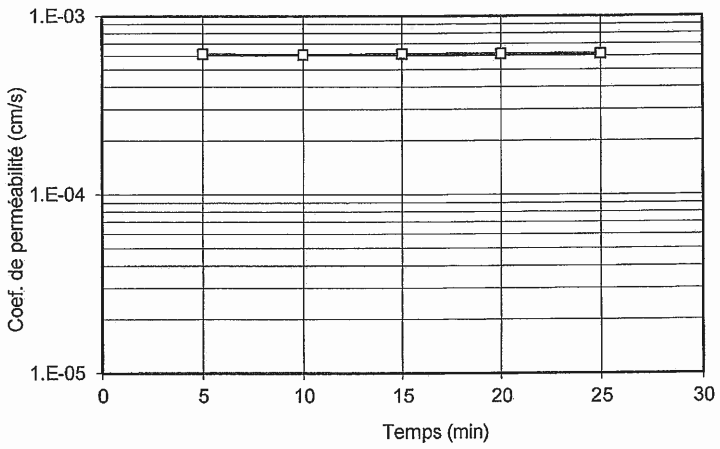
PARAMÈTRES PHYSIQUES					PROPRIÉTÉS PHYSIQUES	
	État	Initial	Consol.	Final		
Teneur en eau , w	%	8.38	8.38	14.41	D_{Rs}	2.70*
Masse vol. sèche, ρ_d	kg/m^3	1888	1888	1888	$\rho_{d\,max}$	
Deg. de saturation, S_r	%	53	53	91	w_{opt}	
Porosité, n	1/1	0.299	0.299	0.299		
Indice des vides, e	1/1	0.426	0.426	0.426		

CONDITIONS D'ESSAI			
	Étape	Consol.	Perm.
Pression axiale	kPa	0	0
Gradient moyen	1/1		3.26

TENEUR EN EAU			
État	Initial	Final	Initial
Type	Auxil.	Totale	Totale
Tare no	C-26	C-30	
Masse humide	1016.4	6301.5	5412.2
Masse sèche	987.6	5581.8	4994.0
Masse tare	591.9	587.8	
w %	**7.29**	**14.41**	**8.38**

ÉQUIPEMENT ET MÉTHODE	
Moule :	GEO-094
Unité :	4
ΔL Piéz. :	100 mm
Séquence :	CSK
Temp.eau :	20 °C

DONNÉES EXPÉRIMENTALES				
Δt	Vol. eau	Gradient	Vitesse	k
min	cm^3	1/1	cm/s	cm/s
0	0	3.26		
5	98	3.26	2.0E-03	6.1E-04
10	195	3.26	2.0E-03	6.1E-04
15	293	3.26	2.0E-03	6.1E-04
20	391	3.26	2.0E-03	6.1E-04
25	489	3.26	2.0E-03	6.1E-04



Type de matériau : Sable et silt, un peu de gravier.
Type de spécimen : Compacté

Remarques :
L'essai a été réalisé avec une eau commerciale de qualité potable.
Spécimen compacté à la teneur en eau de réception.

* : Valeur théorique ou estimée

RÉSULTATS D'ESSAI		
Masse volum. sèche initiale :	1888	kg/m^3
Teneur en eau initiale :	8.4	%
Degré de saturation initial :	53	%
Coefficient de perméabilité :	6.1E-04	cm/s
Gradient hydraulique moyen :	3.26	1/1

Effectué par : Mireille Landry, tech.
Vérifié par : Sonia Beaulieu, tech.
Sonia Beaulieu.
Date : 2019-05-21

POLY-GÉO INC.

REPORT OF AN EXPLORATION TRENCH

TRENCH N° : PU-B02
Page : 1 de 1

Customer : Cree Nation of Wemindji
Project name : New landfill site study
N° of project : 18085
Localisation : Site - B

Geographic coordinates **X :** 645434 m **Y :** 5878272 m
UTM NAD83 Zone : 17 **Z (±) :** 11 m (GPSmap60CSX)

LEGEND

AG : Grain Size Analysis (LC 21-040)
MD gros : Coarse Micro-Deval (LC 21-070)
MD fin : Fine Micro-Deval (LC 21-101)
LA : Los Angeles (LC 21-400)
VB : Methylene Blue (LC 21-255)
MO : Organic Material (LC 31-228)
Petr. : Petrography (CSA A23.2-15A)
Fri. : Fiability (LC 21-080)

Sample
Not remoulded
BS : Bulk sample
MA : Manual withdrawall
INF : Infiltration
Groundwater

DEPTH. (m)	LEVEL (m)	SYMBOL	STRATIGRAPHIC DESCRIPTION	COBBLES VOL%	BOULDERS VOL% (mm max. diam)	SAMPLES TYPE NO.	SAMPLES STATE	INF	LABORATORY TEST
0,0	0,0		Organic matter.						
	0,2		Gravelly sand.						
1,0	1,0		Till : Silt and sand matrix. Presence of gravel (~10%), cobbles and boulders. Compact and Moist (between 4 and 5 meters of depth).	~10%	~10% (500)				
5,0	5,0		End of the trench.						

REMARKS :
No sample taken. Material is moist under 4m depth.
Medium difficulty excavation due to the compactness of the material.
Grain size material similar to the PU-B01 trench.

EQUIPMENT USED : Komatsu PC200LC
WALL STABILITY : Stable

DATE : 2019-05-06
DESCRIBED BY : Daniel Brosseau
APPROVED BY : Daniel Brosseau

Log_Tranchee_v3_EN.sty Date d'impression : 2019-07-03

POLY-GÉO INC.

REPORT OF AN EXPLORATION TRENCH

TRENCH N° : PU-B03
Page : 1 de 1

Customer : Cree Nation of Wemindji
Project name : New landfill site study
N° of project : 18085
Localisation : Site - B

Geographic coordinates **X :** 645359 m **Y :** 5878266 m
UTM NAD83 Zone : 17 **Z (±) :** 15 m (GPSmap60CSX)

LEGEND

AG : Grain Size Analysis (LC 21-040)
MD gros : Coarse Micro-Deval (LC 21-070)
MD fin : Fine Micro-Deval (LC 21-101)
LA : Los Angeles (LC 21-400)
VB : Methylene Blue (LC 21-255)
MO : Organic Material (LC 31-228)
Petr. : Petrography (CSA A23.2-15A)
Fri. : Fiability (LC 21-080)

Sample
Not remoulded
BS : Bulk sample
MA : Manual withdrawall
INF : Infiltration
Groundwater

DEPTH. (m)	LEVEL (m)	SYMBOL	STRATIGRAPHIC DESCRIPTION	COBBLES VOL%	BOULDERS VOL% (mm max. diam)	SAMPLES TYPE NO.	SAMPLES STATE	INF	LABORATORY TEST
	0,0								
	0,1		Organic matter and sand.						
0,5			Sand, some gravel.						
	0,7		Till : Compact silt and sand matrix, some gravel (<15%). Presence of cobbles and boulders.						
1,0									
1,5									
2,0									
2,5				<10%	<10% (500)				
3,0									
3,5						BS-A			AG Permeability coefficient = 0.00021 cm/s
4,0									
4,5									
	4,8		End of the trench.						
5,0									

REMARKS :
BS-A = 2 samples
1) 1 X 25 - 30 Kg (for grain size analysis)
2) 1 X 2 - 3 Kg (for water content analysis)

EQUIPMENT USED : Komatsu PC200LC
WALL STABILITY : Stable

DATE : 2019-05-06
DESCRIBED BY : Daniel Brosseau
APPROVED BY : Daniel Brosseau

Log_Tranchee_v3_EN.sty Date d'impression : 2019-07-03

SNC·LAVALIN

2740, chemin Sullivan
Val-d'Or, (Québec), J9P 0B9
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Télécopieur : (819) 824-3762

SOLS ET GRANULATS
SOMMAIRE DES ESSAIS

Soumis à : Mme Geneviève Gagnon, Geog., M.Sc., CAPM
Waptum (formerly TMS inc.)
1610-2075 Robert Bourassa
Montréal, Québec, H3A 2L1

Dossier N° : 665169
Date : 2019-05-21

Vos références

Entrepreneur : -
Projet N° : 18-001103 - Lot # 530
Projet : Waptum - Essais en laboratoire 2019

Localisation : Val-d'Or

RENSEIGNEMENTS GÉNÉRAUX

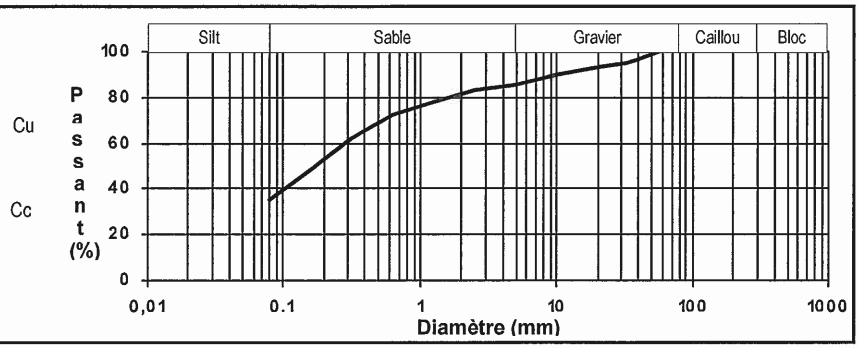
No échantillon : 18-SG-08500
Type de matériau : Sable et silt avec un peu de gravier
Calibre du matériau : Non spécifié
Usage proposé : Site d'enfouissement
Lieu de prélèvement : Wemindji, éch. PU-B03, prof. 3,5m
Date de prélèvement : 2019-05-06

Prélevé par : Client
Source : Site B, Wemindji
Date de l'essai : 2019-05-17
Date de réception : 2019-05-13

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	95		
20 mm	93		
14 mm	92		
10 mm	90		
5 mm	86		
2,5 mm	83		
1,25 mm	78		
630 µm	72		
315 µm	62		
160 µm	49		
80 µm	35,3		

MODULE DE FINESSE : 1,9



ESSAIS DIVERS	Résultats	Exigences min.	Exigences max.

PROCTOR MODIFIÉ (NQ 2501-255) **Méthode :**
Masse volumique sèche maximale : kg/m³
Teneur en eau optimale optimale : %

REMARQUE : * Un astérisque accompagne tout résultat individuel non conforme lorsque les exigences sont spécifiées.
Échantillon prélevé et transmis au laboratoire par le client.

Vérifié par : Armelle Kamdem
Armelle Kamdem , , tech.

Chargé de projet : Ibodian
Ibrahima Bodian ing. Jr

SNC·LAVALIN

ESSAI DE PERMÉABILITÉ EN MOULE RIGIDE

ASTM D2434-68 (2006)

DOSSIER : **665169**
CLIENT : **Waptum (formerly TMS inc.)**
PROJET : **Essais en laboratoire 2019**
LOCAL. : **Val-d'Or**

SONDAGE: **PU**
ÉCHANT. : **B03**
PROF.: **3.5 mètres**
18-SG-08500
FICHIER : 665169-B03.KMR

CARACTÉRISTIQUES VOLUMÉTRIQUES			
	État	Initial	Final
Diamètre du moule	mm	144.4	
Longueur du spécimen	mm	161.5	161.5
Section d'écoulement	cm^2	163.8	
Volume du spécimen	cm^3	2645	2645
Masse humide	g	5885	6017
Masse sèche	g	5387	
Teneur en eau, w	%	9.24	11.69

PARAMÈTRES PHYSIQUES					
	État	Initial	Consol.	Final	
Teneur en eau , w	%	9.24	9.24	11.69	
Masse vol. sèche, ρ_d	kg/m^3	2037	2037	2037	
Deg. de saturation, S_r	%	78	78	98	
Porosité, n	1/1	0.243	0.243	0.243	
Indice des vides, e	1/1	0.322	0.322	0.322	

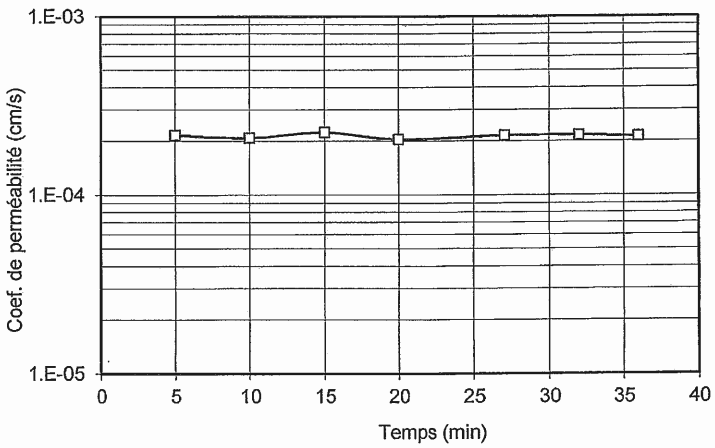
PROPRIÉTÉS PHYSIQUES	
D_{Rs}	2.70*
$\rho_{d\,max}$	
w_{opt}	

CONDITIONS D'ESSAI			
	Étape	Consol.	Perm.
Pression axiale	kPa	0	0
Gradient moyen	1/1		5.28

TENEUR EN EAU			
État	Initial	Final	Initial
Type	Auxil.	Totale	Totale
Tare no	C-9	C-24	
Masse humide	1693.3	6602.9	5885.2
Masse sèche	1621.8	5973.4	5387.2
Masse tare	594.0	586.2	
w %	**6.96**	**11.69**	**9.24**

ÉQUIPEMENT ET MÉTHODE	
Moule :	GEO-094
Unité :	4
ΔL Piéz. :	100 mm
Séquence :	CSK
Temp.eau :	20 °C

DONNÉES EXPÉRIMENTALES				
Δt	Vol. eau	Gradient	Vitesse	k
min	cm^3	1/1	cm/s	cm/s
0	0	5.28		
5	56	5.28	1.1E-03	2.2E-04
10	110	5.28	1.1E-03	2.1E-04
15	168	5.28	1.2E-03	2.2E-04
20	221	5.28	1.1E-03	2.0E-04
27	299	5.28	1.1E-03	2.1E-04
32	355	5.28	1.1E-03	2.2E-04
36	399	5.28	1.1E-03	2.1E-04



Type de matériau : Sable et silt, un peu de gravier.
Type de spécimen : Compacté

Remarques :
L'essai a été réalisé avec une eau commerciale de qualité potable.
Spécimen compacté à la teneur en eau de réception.

* : Valeur théorique ou estimée

RÉSULTATS D'ESSAI		
Masse volum. sèche initiale :	2037	kg/m^3
Teneur en eau initiale :	9.2	%
Degré de saturation initial :	78	%
Coefficient de perméabilité :	2.1E-04	cm/s
Gradient hydraulique moyen :	5.28	1/1

Effectué par : Mireille Landry, tech.
Vérifié par : Sonia Beaulieu, tech.
Date : 2019-05-21

POLY-GÉO INC.

REPORT OF AN EXPLORATION TRENCH

TRENCH N° : PU-B04
Page : 1 de 1

Customer : Cree Nation of Wemindji
Project name : New landfill site study
N° of project : 18085
Localisation : Site - B

Geographic coordinates **X :** 645303 m **Y :** 5878091 m
UTM NAD83 Zone : 17 **Z (±) :** 12 m (GPSmap60CSX)

LEGEND

AG : Grain Size Analysis (LC 21-040)
MD gros : Coarse Micro-Deval (LC 21-070)
MD fin : Fine Micro-Deval (LC 21-101)
LA : Los Angeles (LC 21-400)
VB : Methylene Blue (LC 21-255)
MO : Organic Material (LC 31-228)
Petr. : Petrography (CSA A23.2-15A)
Fri. : Fiability (LC 21-080)

Sample
Not remoulded
BS : Bulk sample
MA : Manual withdrawall
INF : Infiltration
Groundwater

DEPTH. (m)	LEVEL (m)	SYMBOL	STRATIGRAPHIC DESCRIPTION	COBBLES VOL%	BOULDERS VOL% (mm max. diam)	SAMPLES TYPE NO.	SAMPLES STATE	INF	LABORATORY TEST
	0,0		Organic matter and sand						
0,5	0,1		Sand to gravelly sand.						
	0,8		Sandy gravel.						
1,0	1,0		Till : Silty sand matrix. Some gravel (10-15%), presence of cobbles and boulders.						
1,5									
2,0									
2,5									
3,0				~10%	<10% (1200)				
3,5									
4,0									
4,5									
5,0	5,0		End of the trench.						

REMARKS :
No sample taken.
Medium difficulty excavation due to the density of cobbles and boulders.

EQUIPMENT USED : Komatsu PC200LC
WALL STABILITY : Stable

DATE : 2019-05-06
DESCRIBED BY : Daniel Brosseau
APPROVED BY : Daniel Brosseau

Log_Tranchee_v3_EN.sty Date d'impression : 2019-07-03

REPORT OF AN EXPLORATION TRENCH

POLY-GÉO INC.

TRENCH N° : PU-B05
Page : 1 de 2

Customer : Cree Nation of Wemindji
Project name : New landfill site study
N° of project : 18085
Localisation : Site - B

Geographic coordinates **X :** 645323 m **Y :** 5878153 m
UTM NAD83 Zone : 17 **Z (±) :** 10 m (GPSmap60CSX)

LEGEND

AG : Grain Size Analysis (LC 21-040)
MD gros : Coarse Micro-Deval (LC 21-070)
MD fin : Fine Micro-Deval (LC 21-101)
LA : Los Angeles (LC 21-400)
VB : Methylene Blue (LC 21-255)
MO : Organic Material (LC 31-228)
Petr. : Petrography (CSA A23.2-15A)
Fri. : Fiability (LC 21-080)

Sample
Not remoulded
BS : Bulk sample
MA : Manual withdrawall
INF : Infiltration
Groundwater

DEPTH. (m)	LEVEL (m)	SYMBOL	STRATIGRAPHIC DESCRIPTION	COBBLES VOL%	BOULDERS VOL% (mm max. diam)	SAMPLES TYPE NO.	SAMPLES STATE	INF	LABORATORY TEST
	0,0		Organic matter and sand.						
0,5	0,2		Sand, some gravel (10-15%). Presence of cobbles and boulders.	10-15%	<10% (1400)				
1,0	0,9		Till : Silty sand matrix. Traces of gravel (<10%), presence of cobbles and boulders.						
1,5									
2,0									
2,5									
3,0				<10%	<10%				
3,5									
4,0									
4,5									
5,0									

REMARKS :
No sample taken.
Medium difficulty excavation due to the compactness of the material.

EQUIPMENT USED : Komatsu PC200LC
WALL STABILITY : Stables

DATE : 2019-05-06
DESCRIBED BY : Daniel Brosseau
APPROVED BY : Daniel Brosseau

Log_Tranchee_v3_EN.sty Date d'impression : 2019-07-03

POLY-GÉO INC.

REPORT OF AN EXPLORATION TRENCH

TRENCH N° : **PU-B05**
Page : 2 de 2

DEPTH. (m)	LEVEL (m)	SYMBOL	STRATIGRAPHIC DESCRIPTION	COBBLES VOL%	BOULDERS VOL% (mm max. diam)	SAMPLES TYPE NO.	SAMPLES STATE	INF	LABORATORY TEST
6,0									
	6,1		End of the trench.						
6,5									
7,0									
7,5									
8,0									
8,5									
9,0									
9,5									
10,0									
10,5									
11,0									
11,5									
12,0									
12,5									
13,0									
13,5									
14,0									
14,5									
15,0									

POLY-GÉO INC.

REPORT OF AN EXPLORATION TRENCH

TRENCH N° : PU-B06
Page : 1 de 1

Customer : Cree Nation of Wemindji
Project name : New landfill site study
N° of project : 18085
Localisation : Site - B

Geographic coordinates **X :** 645309 m **Y :** 5878235 m
UTM NAD83 Zone : 17 **Z (±) :** 2 m (GPSmap60CSX)

LEGEND

AG : Grain Size Analysis (LC 21-040)
MD gros : Coarse Micro-Deval (LC 21-070)
MD fin : Fine Micro-Deval (LC 21-101)
LA : Los Angeles (LC 21-400)
VB : Methylene Blue (LC 21-255)
MO : Organic Material (LC 31-228)
Petr. : Petrography (CSA A23.2-15A)
Fri. : Fiability (LC 21-080)

Sample
Not remoulded
BS : Bulk sample
MA : Manual withdrawall
INF : Infiltration
Groundwater

DEPTH. (m)	LEVEL (m)	SYMBOL	STRATIGRAPHIC DESCRIPTION	COBBLES VOL%	BOULDERS VOL% (mm max. diam)	SAMPLES TYPE NO.	SAMPLES STATE	INF	LABORATORY TEST
0,0									
	0,1		Organic matter and sand.						
0,5			Sand, traces of gravel (<10%) and presence of cobbles.	<10%					
	0,7		Till : Silty sand matrix. Traces of gravel (<10%), presence of cobbles and boulders.						
1,0									
1,5									
2,0									
2,5									
3,0				<10%	<10% (500)				
3,5									
4,0									
4,5									
5,0									
	5,1		End of the trench.						

REMARKS :
No sample taken.

EQUIPMENT USED : Komatsu PC200LC
WALL STABILITY : Stable

DATE : 2019-05-06
DESCRIBED BY : Daniel Brosseau
APPROVED BY : Daniel Brosseau

Log_Tranchee_v3_EN.sty Date d'impression : 2019-07-03

POLY-GÉO INC.

REPORT OF AN EXPLORATION TRENCH

TRENCH N° : PU-B07
Page : 1 de 1

Customer : Cree Nation of Wemindji
Project name : New landfill site study
N° of project : 18085
Localisation : Site - B

Geographic coordinates **X :** 645372 m **Y :** 5878217 m
UTM NAD83 Zone : 17 **Z (±) :** 3 m (GPSmap60CSX)

LEGEND

AG : Grain Size Analysis (LC 21-040)
MD gros : Coarse Micro-Deval (LC 21-070)
MD fin : Fine Micro-Deval (LC 21-101)
LA : Los Angeles (LC 21-400)
VB : Methylene Blue (LC 21-255)
MO : Organic Material (LC 31-228)
Petr. : Petrography (CSA A23.2-15A)
Fri. : Fiability (LC 21-080)

Sample
Not remoulded
BS : Bulk sample
MA : Manual withdrawall
INF : Infiltration
Groundwater

DEPTH. (m)	LEVEL (m)	SYMBOL	STRATIGRAPHIC DESCRIPTION	COBBLES VOL%	BOULDERS VOL% (mm max. diam)	SAMPLES TYPE NO.	SAMPLES STATE	INF	LABORATORY TEST
0,0	0,0								
	0,1		Organic matter and sand.						
0,5			Sand and gravel to gravely sand, slightly oxidized.						
1,0									
1,5									
	1,6		Silty sand.						
2,0									
2,5	2,4		Till : Silt and sand matrix, traces of gravel (<10%). Presence of cobbles and boulders.	<10%	<10% (700)				
3,0									
3,5									
4,0									
4,5									
5,0	5,0		End of the trench.						

REMARKS :
No sample taken and no roc refusal during the excavation.
Medium difficulty excavation due to the compactness of the material at the bottom of the trench.
No infiltration detected.

EQUIPMENT USED : Komatsu PC200LC
WALL STABILITY : Stable

DATE : 2019-05-06
DESCRIBED BY : Daniel Brosseau
APPROVED BY : Daniel Brosseau

Log_Tranchee_v3_EN.sty Date d'impression : 2019-07-03

REPORT OF AN EXPLORATION TRENCH

POLY-GÉO INC.

TRENCH N° : PU-B08
Page : 1 de 1

Customer : Cree Nation of Wemindji
Project name : New landfill site study
N° of project : 18085
Localisation : Site - B

Geographic coordinates **X :** 645435 m **Y :** 5878225 m
UTM NAD83 Zone : 17 **Z (±) :** 5 m (GPSmap60CSX)

LEGEND

AG : Grain Size Analysis (LC 21-040)
MD gros : Coarse Micro-Deval (LC 21-070)
MD fin : Fine Micro-Deval (LC 21-101)
LA : Los Angeles (LC 21-400)
VB : Methylene Blue (LC 21-255)
MO : Organic Material (LC 31-228)
Petr. : Petrography (CSA A23.2-15A)
Fri. : Fiability (LC 21-080)

Sample
Not remoulded
BS : Bulk sample
MA : Manual withdrawall
INF : Infiltration
Groundwater

DEPTH. (m)	LEVEL (m)	SYMBOL	STRATIGRAPHIC DESCRIPTION	COBBLES VOL%	BOULDERS VOL% (mm max. diam)	SAMPLES TYPE NO.	SAMPLES STATE	INF	LABORATORY TEST
0,0									
	0,1		organic matter and sand.						
			Sand, traces of gravel.						
0,5									
1,0									
	1,1		Till : Silt and sand matrix. Traces of gravel (<10%), presence of cobbles and boulders.	<10%	<10% (500)	BS-A			AG
1,5									
2,0									
2,5									
3,0									
3,5									
4,0									
4,5									
5,0	4,8		End of the trench.						

REMARKS :
BS-A = 2 samples
1) 1 X 25 - 30 Kg (for grain size analysis)
2) 1 X 2 - 3 Kg (for water content analysis)

EQUIPMENT USED : Komatsu PC200LC
WALL STABILITY : Moderately stable (unstable bellow 3m)

DATE : 2019-05-06
DESCRIBED BY : Daniel Brosseau
APPROVED BY : Daniel Brosseau

Log_Tranchee_v3_EN.sty Date d'impression : 2019-07-03

SNC·LAVALIN

2740, chemin Sullivan
Val-d'Or, (Québec), J9P 0B9
Téléphone : (819) 824-6894
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SOLS ET GRANULATS
SOMMAIRE DES ESSAIS

Soumis à : Mme Geneviève Gagnon, Geog., M.Sc., CAPM
Waptum (formerly TMS inc.)
1610-2075 Robert Bourassa
Montréal, Québec, H3A 2L1

Dossier N° : 665169
Date : 2019-06-17

Vos références

Entrepreneur : -
Projet N° : 18-001103 - Lot # 530
Projet : Waptum - Essais en laboratoire 2019

Localisation : Val-d'Or

RENSEIGNEMENTS GÉNÉRAUX

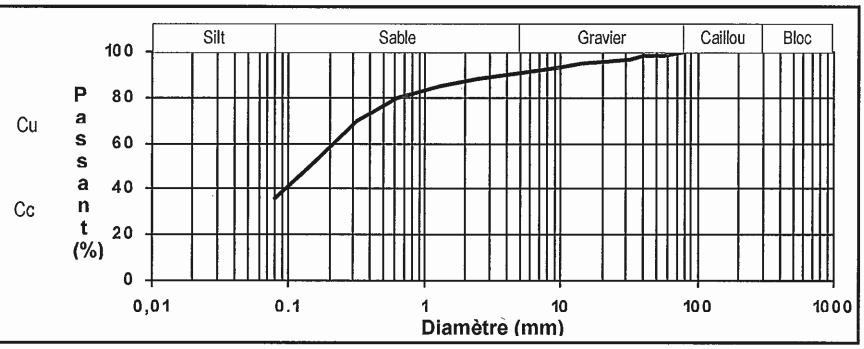
No échantillon : 18-SG-09822
Type de matériau : Sable et silt, traces de gravier
Calibre du matériau : Non spécifié
Usage proposé : Site d'enfouissement
Lieu de prélèvement : Wemindji, éch. PU-B08, prof. 3,5m
Date de prélèvement : 2019-05-06

Prélevé par : Client
Source : Site B, Wemindji
Date de l'essai : 2019-05-17
Date de réception : 2019-05-13

GRANULOMÉTRIE
(LC 21-040)

Tamis	% passant	Exigences min.	Exigences max.
112 mm	100		
80 mm	100		
56 mm	98		
40 mm	98		
31,5 mm	97		
20 mm	96		
14 mm	95		
10 mm	93		
5 mm	91		
2,5 mm	88		
1,25 mm	85		
630 µm	80		
315 µm	70		
160 µm	53		
80 µm	35,9		

MODULE DE FINESSE : 1,46



ESSAIS DIVERS	Résultats	Exigences min.	Exigences max.

PROCTOR MODIFIÉ (NQ 2501-255) **Méthode :**
Masse volumique sèche maximale : kg/m³
Teneur en eau optimale optimale : %

REMARQUE : * Un astérisque accompagne tout résultat individuel non conforme lorsque les exigences sont spécifiées.

Vérifié par : Armelle Kamdem
Armelle Kamdem , , tech.

Chargé de projet : Ibodiay
Ibrahima Bodian ing. Jr

POLY-GÉO INC.

REPORT OF AN EXPLORATION TRENCH

TRENCH N° : PU-B09
Page : 1 de 1

Customer : Cree Nation of Wemindji
Project name : New landfill site study
N° of project : 18085
Localisation : Site - B

Geographic coordinates **X :** 645429 m **Y :** 5878346 m
UTM NAD83 Zone : 17 **Z (±) :** 4 m (GPSmap60CSX)

LEGEND

AG : Grain Size Analysis (LC 21-040)
MD gros : Coarse Micro-Deval (LC 21-070)
MD fin : Fine Micro-Deval (LC 21-101)
LA : Los Angeles (LC 21-400)
VB : Methylene Blue (LC 21-255)
MO : Organic Material (LC 31-228)
Petr. : Petrography (CSA A23.2-15A)
Fri. : Fiability (LC 21-080)

Sample
Not remoulded
BS : Bulk sample
MA : Manual withdrawall
INF : Infiltration
Groundwater

DEPTH. (m)	LEVEL (m)	SYMBOL	STRATIGRAPHIC DESCRIPTION	COBBLES VOL%	BOULDERS VOL% (mm max. diam)	SAMPLES TYPE NO.	SAMPLES STATE	INF	LABORATORY TEST
	0,0		Organic matter.						
0,5	0,2		Till : Sandy gravel matrix slightly oxidized.						
1,0	0,7		Till : Compact silt and sand matrix, traces of gravel (< 10%). Presence of cobbles and boulders. Moist below 4,5m depth.	<10%	<10% (700)				
1,5									
2,0									
2,5									
3,0									
3,5									
4,0									
4,5									
5,0	5,0		End of the trench.						

REMARKS :
No sample taken.
Medium difficulty excavation due to the presence of boulders.

EQUIPMENT USED : Komatsu PC200LC
WALL STABILITY : Stable

DATE : 2019-05-07
DESCRIBED BY : Daniel Brosseau
APPROVED BY : Daniel Brosseau

Log_Tranchee_v3_EN.sty Date d'impression : 2019-07-03

POLY-GÉO INC.

REPORT OF AN EXPLORATION TRENCH

TRENCH N° : PU-B10
Page : 1 de 1

Customer : Cree Nation of Wemindji
Project name : New landfill site study
N° of project : 18085
Localisation : Site - B

Geographic coordinates **X :** 645480 m **Y :** 5878272 m
UTM NAD83 Zone : 17 **Z (±) :** 11 m (GPSmap60CSX)

LEGEND

AG : Grain Size Analysis (LC 21-040)
MD gros : Coarse Micro-Deval (LC 21-070)
MD fin : Fine Micro-Deval (LC 21-101)
LA : Los Angeles (LC 21-400)
VB : Methylene Blue (LC 21-255)
MO : Organic Material (LC 31-228)
Petr. : Petrography (CSA A23.2-15A)
Fri. : Fiability (LC 21-080)

Sample
Not remoulded
BS : Bulk sample
MA : Manual withdrawall
INF : Infiltration
Groundwater

DEPTH. (m)	LEVEL (m)	SYMBOL	STRATIGRAPHIC DESCRIPTION	COBBLES VOL%	BOULDERS VOL% (mm max. diam)	SAMPLES TYPE NO.	SAMPLES STATE	INF	LABORATORY TEST
0,0	0,0		Organic matter and sand.						
	0,1		Sand slightly oxidized, some gravel. Traces of cobbles.	<10%					
0,5									
	0,7		Till : Silt and sand, traces of gravel (< 10%). Presence of cobbles and boulders.						
1,0									
1,5									
2,0									
2,5				<10%	<10% (800)				
3,0									
3,5									
4,0									
4,5									
5,0	5,0		End of the trench.						

REMARKS :
No sample taken.

EQUIPMENT USED : Komatsu PC200LC
WALL STABILITY : Moderatly stable

DATE : 2019-05-07
DESCRIBED BY : Daniel Brosseau
APPROVED BY : Daniel Brosseau

Log_Tranchee_v3_EN.sty Date d'impression : 2019-07-03

POLY-GÉO INC.

REPORT OF AN EXPLORATION TRENCH

TRENCH N° : PU-B11
Page : 1 de 1

Customer : Cree Nation of Wemindji
Project name : New landfill site study
N° of project : 18085
Localisation : Site - B

Geographic coordinates **X :** 645392 m **Y :** 5878304 m
UTM NAD83 Zone : 17 **Z (±) :** 17 m (GPSmap60CSX)

LEGEND

AG : Grain Size Analysis (LC 21-040)
MD gros : Coarse Micro-Deval (LC 21-070)
MD fin : Fine Micro-Deval (LC 21-101)
LA : Los Angeles (LC 21-400)
VB : Methylene Blue (LC 21-255)
MO : Organic Material (LC 31-228)
Petr. : Petrography (CSA A23.2-15A)
Fri. : Fiability (LC 21-080)

Sample
Not remoulded
BS : Bulk sample
MA : Manual withdrawall
INF : Infiltration
Groundwater

DEPTH. (m)	LEVEL (m)	SYMBOL	STRATIGRAPHIC DESCRIPTION	COBBLES VOL%	BOULDERS VOL% (mm max. diam)	SAMPLES TYPE NO.	SAMPLES STATE	INF	LABORATORY TEST
	0,0								
	0,1		Organic matter and sand.						
0,5			Sand to gravelly sand.						
1,0									
	1,2		Till : Silty sand matrix, some gravel (<15%). Presence of cobbles and boulders. Moist below 3,5m depth.						
1,5									
2,0									
2,5									
3,0				<10%	<10% (800)				
3,5									
4,0						BS-A			AG
4,5									
5,0									
	5,3		End of the trench.						

REMARKS :
BS-A = 2 samples
1) 1 X 25 - 30 Kg (for grain size analysis)
2) 1 X 2 - 3 Kg (for water content analysis)

EQUIPMENT USED : Komatsu PC200LC
WALL STABILITY : Stable

DATE : 2019-05-07
DESCRIBED BY : Daniel Brosseau
APPROVED BY : Daniel Brosseau

Log_Tranchee_v3_EN.sty Date d'impression : 2019-07-03

SNC·LAVALIN

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SOLS ET GRANULATS
SOMMAIRE DES ESSAIS

Soumis à : Mme Geneviève Gagnon, Geog., M.Sc., CAPM
Waptum (formerly TMS inc.)
1610-2075 Robert Bourassa
Montréal, Québec, H3A 2L1

Entrepreneur : -

Projet : Waptum - Essais en laboratoire 2019

Localisation : Val-d'Or

Dossier N° : 665169
Date : 2019-06-17

Vos références

Projet N° : 18-001103 - Lot # 530

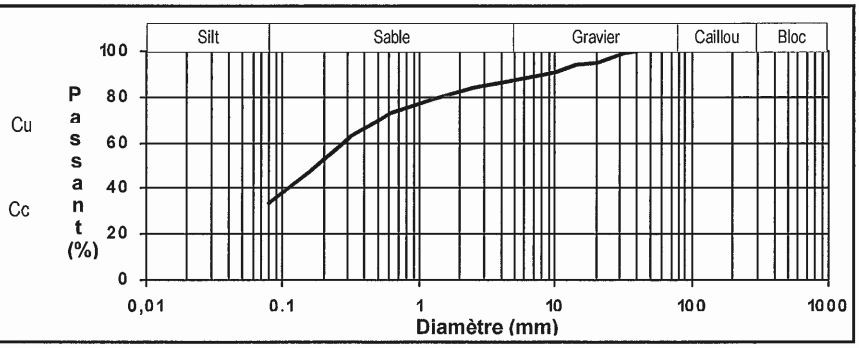
RENSEIGNEMENTS GÉNÉRAUX

No échantillon	: 18-SG-08498	**Prélevé par**	: Client
Type de matériau	: Sable et silt avec un peu de gravier	**Source**	: Site B, Wemindji
Calibre du matériau	: Non spécifié	**Date de l'essai**	: 2019-05-17
Usage proposé	: Site d'enfouissement		
Lieu de prélèvement	: Wemindji, éch. PU-B11, prof. 3,9m		
Date de prélèvement	: 2019-05-07	**Date de réception**	: 2019-05-13

GRANULOMÉTRIE
(LC 21-040)

Tamis	% passant	Exigences min.	Exigences max.
112 mm	100		
80 mm	100		
56 mm	100		
40 mm	100		
31,5 mm	99		
20 mm	95		
14 mm	94		
10 mm	91		
5 mm	87		
2,5 mm	84		
1,25 mm	79		
630 µm	73		
315 µm	63		
160 µm	48		
80 µm	34,0		

MODULE DE FINESSE : 1,8



ESSAIS DIVERS	Résultats	Exigences min.	Exigences max.

PROCTOR MODIFIÉ (NQ 2501-255) **Méthode :**
Masse volumique sèche maximale : kg/m³
Teneur en eau optimale optimale : %

REMARQUE : * Un astérisque accompagne tout résultat individuel non conforme lorsque les exigences sont spécifiées.

Vérifié par : Armelle Kamdem
Armelle Kamdem , , tech.

Chargé de projet : Ibodian
Ibrahima Bodian ing. Jr

POLY-GÉO INC.

REPORT OF AN EXPLORATION TRENCH

TRENCH N° : PU-B12
Page : 1 de 1

Customer : Cree Nation of Wemindji
Project name : New landfill site study
N° of project : 18085
Localisation : Site - B

Geographic coordinates **X :** 645258 m **Y :** 5878183 m
UTM NAD83 Zone : 17 **Z (±) :** 16 m (GPSmap60CSX)

LEGEND

AG : Grain Size Analysis (LC 21-040)
MD gros : Coarse Micro-Deval (LC 21-070)
MD fin : Fine Micro-Deval (LC 21-101)
LA : Los Angeles (LC 21-400)
VB : Methylene Blue (LC 21-255)
MO : Organic Material (LC 31-228)
Petr. : Petrography (CSA A23.2-15A)
Fri. : Fiability (LC 21-080)

Sample
Not remoulded
BS : Bulk sample
MA : Manual withdrawall
INF : Infiltration
Groundwater

DEPTH. (m)	LEVEL (m)	SYMBOL	STRATIGRAPHIC DESCRIPTION	COBBLES VOL%	BOULDERS VOL% (mm max. diam)	SAMPLES TYPE NO.	SAMPLES STATE	INF	LABORATORY TEST
	0,0		Organic matter.						
0,5	0,2		Sand, some gravel. Presence of cobbles.	<10%					
1,0	0,7		Sand and gravel slightly oxidized.		<5% (2000)				
1,5	1,1		Till : Compact silty sand matrix, traces of gravel (~ 10%). Presence of cobbles and boulders.						
2,0									
2,5									
3,0				~10%	<10% (800)				
3,5									
4,0									
4,5									
5,0									
	5,1		End of the trench.						

REMARKS :
No sample taken.
Medium difficulty excavation due to the present of boulders.

EQUIPMENT USED : Komatsu PC200LC
WALL STABILITY : ± Stable

DATE : 2019-05-07
DESCRIBED BY : Daniel Brosseau
APPROVED BY : Daniel Brosseau

Log_Tranchee_v3_EN.sty Date d'impression : 2019-07-03

POLY-GÉO INC.

REPORT OF AN EXPLORATION TRENCH

TRENCH N° : **PU-B13**
Page : 1 de 1

Customer : Cree Nation of Wemindji
Project name : New landfill site study
N° of project : 18085
Localisation : Site - B

Geographic coordinates **X :** 645266 m **Y :** 5878125 m
UTM NAD83 Zone : 17 **Z (±) :** 14 m (GPSmap60CSX)

LEGEND

AG : Grain Size Analysis (LC 21-040)
MD gros : Coarse Micro-Deval (LC 21-070)
MD fin : Fine Micro-Deval (LC 21-101)
LA : Los Angeles (LC 21-400)
VB : Methylene Blue (LC 21-255)
MO : Organic Material (LC 31-228)
Petr. : Petrography (CSA A23.2-15A)
Fri. : Fiability (LC 21-080)

Sample
Not remoulded
BS : Bulk sample
MA : Manual withdrawall
INF : Infiltration
Groundwater

DEPTH. (m)	LEVEL (m)	SYMBOL	STRATIGRAPHIC DESCRIPTION	COBBLES VOL%	BOULDERS VOL% (mm max. diam)	SAMPLES TYPE NO.	SAMPLES STATE	INF	LABORATORY TEST
0,0	0,0		Organic matter and sand.						
	0,2		Sand, some gravel.						
1,5	1,4		Till : Silt and sand matrix, traces of gravel (~15%). Presence of cobbles and boulders.	<10%	<10%	BS-A			AG Permeability coefficient = 0.0004 cm/s
5,0	4,9		End of the trench.						

REMARKS :
Medium difficulty excavation due to the compactness of the material (i.e. Till).
BS-A = 2 samples
1) 1 X 25 - 30 Kg (for grain size analysis) - 2) 1 X 2 - 3 Kg (for water content analysis)

EQUIPMENT USED : Komatsu PC200LC
WALL STABILITY : Stable

DATE : 2019-05-07
DESCRIBED BY : Daniel Brosseau
APPROVED BY : Daniel Brosseau

Log_Tranchee_v3_EN.sty Date d'impression : 2019-07-03

SNC·LAVALIN

2740, chemin Sullivan
Val-d'Or, (Québec), J9P 0B9
Téléphone : (819) 824-6894
Télécopieur : (819) 824-3762

SOLS ET GRANULATS
SOMMAIRE DES ESSAIS

Soumis à : Mme Geneviève Gagnon, Geog., M.Sc., CAPM
Waptum (formerly TMS inc.)
1610-2075 Robert Bourassa
Montréal, Québec, H3A 2L1

Dossier N° : 665169
Date : 2019-05-21

Vos références

Entrepreneur : -
Projet N° : 18-001103 - Lot # 530
Projet : Waptum - Essais en laboratoire 2019

Localisation : Val-d'Or

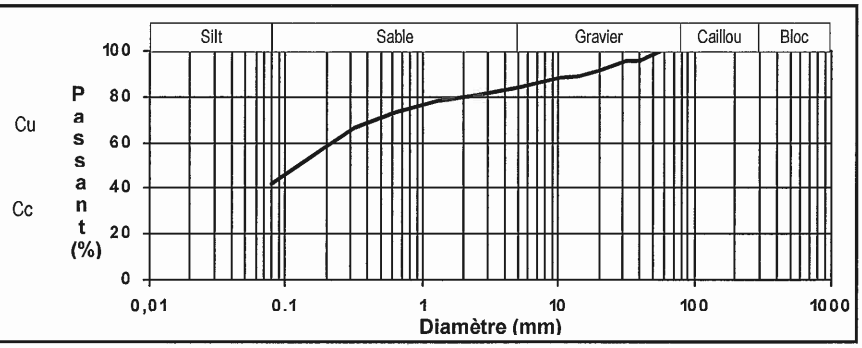
RENSEIGNEMENTS GÉNÉRAUX

No échantillon	: 18-SG-08499	**Prélevé par**	: Client
Type de matériau	: silt et sable avec un peu de gravier	**Source**	: Site B, Wemindji
Calibre du matériau	: Non spécifié	**Date de l'essai**	: 2019-05-17
Usage proposé	: Site d'enfouissement		
Lieu de prélèvement	: Wemindji, éch. PU-B13, prof. 3,3m		
Date de prélèvement	: 2019-05-07	**Date de réception**	: 2019-05-13

GRANULOMÉTRIE
(LC 21-040)

Tamis	% passant	Exigences min.	Exigences max.
112 mm	100		
80 mm	100		
56 mm	100		
40 mm	96		
31,5 mm	96		
20 mm	92		
14 mm	89		
10 mm	88		
5 mm	84		
2,5 mm	81		
1,25 mm	78		
630 µm	73		
315 µm	66		
160 µm	55		
80 µm	42,4		

MODULE DE FINESSE : 1,87



ESSAIS DIVERS	Résultats	Exigences min.	Exigences max.

PROCTOR MODIFIÉ (NQ 2501-255) **Méthode :**
Masse volumique sèche maximale : kg/m³
Teneur en eau optimale optimale : %

REMARQUE : * Un astérisque accompagne tout résultat individuel non conforme lorsque les exigences sont spécifiées.
Échantillon prélevé et transmis au laboratoire par le client.

Vérifié par : Armelle Kamdem
Armelle Kamdem , , tech.

Chargé de projet : Ibadiay
Ibrahima Bodian Ing. Jr

SNC·LAVALIN

ESSAI DE PERMÉABILITÉ EN MOULE RIGIDE

ASTM D2434-68 (2006)

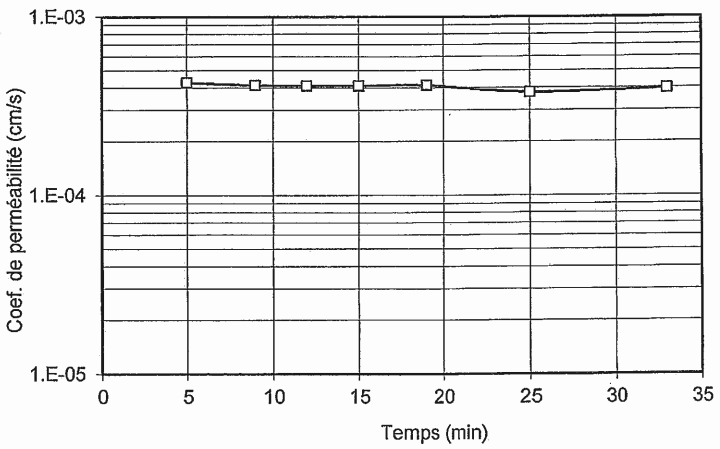
DOSSIER : **665169**
CLIENT : **Waptum (formerly TMS inc.)**
PROJET : **Essais en laboratoire 2019**
LOCAL. : **Val-d'Or**

SONDAGE: **PU**
ÉCHANT.: **B13**
PROF.: **3.3 mètres**
18-SG-08499
FICHIER : 665169-B13.KMR

CARACTÉRISTIQUES VOLUMÉTRIQUES				PARAMÈTRES PHYSIQUES					PROPRIÉTÉS PHYSIQUES	
	État	Initial	Final		État	Initial	Consol.	Final		
Diamètre du moule	mm	144.4		Teneur en eau , w	%	10.24	10.24	14.88	D_{Rs}	2.70*
Longueur du spécimen	mm	161.5	161.5	Masse vol. sèche, ρ_d	kg/m^3	1901	1901	1901	$\rho_{d\,max}$	
Section d'écoulement	cm^2	163.8		Deg. de saturation, S_r	%	66	66	97	w_{opt}	
Volume du spécimen	cm^3	2645	2645	Porosité, n	1/1	0.294	0.294	0.294		
Masse humide	g	5542	5775	Indice des vides, e	1/1	0.416	0.416	0.416		
Masse sèche	g	5027								
Teneur en eau, w	%	10.24	14.88							

CONDITIONS D'ESSAI					TENEUR EN EAU				ÉQUIPEMENT ET MÉTHODE	
	Étape	Consol.	Perm.		État	Initial	Final	Initial		
Pression axiale	kPa	0	0		Type	Auxil.	Totale	Totale	Moule :	GEO-094
					Tare no	C-8	C-3		Unité :	4
Gradient moyen	1/1		3.14		Masse humide	1803.3	6364.5	5542.0	ΔL Piéz. :	100 mm
					Masse sèche	1732.8	5616.4	5027.0		
					Masse tare	593.6	589.4		Séquence :	CSK
					w %	**6.20**	**14.88**	**10.24**	Temp.eau :	20 °C

DONNÉES EXPÉRIMENTALES				
Δt	Vol. eau	Gradient	Vitesse	k
min	cm^3	1/1	cm/s	cm/s
0	0	3.14		
5	66	3.14	1.3E-03	4.3E-04
9	117	3.14	1.3E-03	4.1E-04
12	155	3.14	1.3E-03	4.1E-04
15	193	3.14	1.3E-03	4.1E-04
19	244	3.14	1.3E-03	4.1E-04
25	314	3.14	1.2E-03	3.8E-04
33	412	3.14	1.2E-03	4.0E-04



Type de matériau : Silt et sable, un peu de gravier.
Type de spécimen : Compacté

Remarques :
L'essai a été réalisé avec une eau commerciale de qualité potable.
Spécimen compacté à la teneur en eau de réception.

RÉSULTATS D'ESSAI		
Masse volum. sèche initiale :	1901	kg/m^3
Teneur en eau initiale :	10.2	%
Degré de saturation initial :	66	%
Coefficient de perméabilité :	4.0E-04	cm/s
Gradient hydraulique moyen :	3.14	1/1

Effectué par : Mireille Landry, tech.
Vérifié par : Sonia Beaulieu, tech.
Date : 2019-05-21

* : Valeur théorique ou estimée

REPORT OF AN EXPLORATION TRENCH

POLY-GÉO INC.

TRENCH N° : PU-B14
Page : 1 de 1

Customer : Cree Nation of Wemindji
Project name : New landfill site study
N° of project : 18085
Localisation : Site - B

Geographic coordinates **X :** 645202 m **Y :** 5878109 m
UTM NAD83 Zone : 17 **Z (±) :** 11 m (GPSmap60CSX)

LEGEND

AG : Grain Size Analysis (LC 21-040)
MD gros : Coarse Micro-Deval (LC 21-070)
MD fin : Fine Micro-Deval (LC 21-101)
LA : Los Angeles (LC 21-400)
VB : Methylene Blue (LC 21-255)
MO : Organic Material (LC 31-228)
Petr. : Petrography (CSA A23.2-15A)
Fri. : Fiability (LC 21-080)

Sample
Not remoulded
BS : Bulk sample
MA : Manual withdrawall
INF : Infiltration
Groundwater

DEPTH. (m)	LEVEL (m)	SYMBOL	STRATIGRAPHIC DESCRIPTION	COBBLES VOL%	BOULDERS VOL% (mm max. diam)	SAMPLES TYPE NO.	SAMPLES STATE	INF	LABORATORY TEST
0,0	0,0		Organic matter and sand.						
	0,1		Sand, some gravel. Presence of cobbles.	<10%					
1,0									
	1,3		Till : Compact silt and sand matrix, traces of gravel (<10%). Presence of cobbles and boulders.	<10%	<10% (1000)				
5,0	4,9		End of the trench.						

REMARKS :
No sample taken.

EQUIPMENT USED : Komatsu PC200LC
WALL STABILITY : stable

DATE : 2019-05-07
DESCRIBED BY : Daniel Brosseau
APPROVED BY : Daniel Brosseau

Log_Tranchee_v3_EN.sty Date d'impression : 2019-07-03

POLY-GÉO INC.

REPORT OF AN EXPLORATION TRENCH

TRENCH N° : PU-B15
Page : 1 de 1

Customer : Cree Nation of Wemindji
Project name : New landfill site study
N° of project : 18085
Localisation : Site - B

Geographic coordinates **X :** 645234 m **Y :** 5878046 m
UTM NAD83 Zone : 17 **Z (±) :** 9 m (GPSmap60CSX)

LEGEND

AG : Grain Size Analysis (LC 21-040)
MD gros : Coarse Micro-Deval (LC 21-070)
MD fin : Fine Micro-Deval (LC 21-101)
LA : Los Angeles (LC 21-400)
VB : Methylene Blue (LC 21-255)
MO : Organic Material (LC 31-228)
Petr. : Petrography (CSA A23.2-15A)
Fri. : Fiability (LC 21-080)

Sample
Not remoulded
BS : Bulk sample
MA : Manual withdrawall
INF : Infiltration
Groundwater

DEPTH. (m)	LEVEL (m)	SYMBOL	STRATIGRAPHIC DESCRIPTION	COBBLES VOL%	BOULDERS VOL% (mm max. diam)	SAMPLES TYPE NO.	SAMPLES STATE	INF	LABORATORY TEST
0,0									
	0,1		Organic matter and sand.						
0,5			Fine to medium sand. Traces of gravel.						
1,0	0,9		Till : Silt and sand matrix, traces of gravel. Presence of cobbles and boulders.						
1,5									
2,0									
2,5									
3,0				<10%	<10% (1000)				
3,5									
4,0									
4,5									
5,0	4,9		End of the trench.						

REMARKS :
No sample taken.
Medium difficulty excavation due to the presence of boulders.

EQUIPMENT USED : Komatsu PC200LC
WALL STABILITY : Stable

DATE : 2019-05-07
DESCRIBED BY : Daniel Brosseau
APPROVED BY : Daniel Brosseau

Log_Tranchee_v3_EN.sty Date d'impression : 2019-07-03

REPORT OF AN EXPLORATION TRENCH

POLY-GÉO INC.

TRENCH N° : PU-B16
Page : 1 de 1

Customer : Cree Nation of Wemindji
Project name : New landfill site study
N° of project : 18085
Localisation : Site - B

Geographic coordinates **X :** 645386 m **Y :** 5878156 m
UTM NAD83 Zone : 17 **Z (±) :** 10 m (GPSmap60CSX)

LEGEND

AG : Grain Size Analysis (LC 21-040)
MD gros : Coarse Micro-Deval (LC 21-070)
MD fin : Fine Micro-Deval (LC 21-101)
LA : Los Angeles (LC 21-400)
VB : Methylene Blue (LC 21-255)
MO : Organic Material (LC 31-228)
Petr. : Petrography (CSA A23.2-15A)
Fri. : Fiability (LC 21-080)

Sample
Not remoulded
BS : Bulk sample
MA : Manual withdrawall
INF : Infiltration
Groundwater

DEPTH. (m)	LEVEL (m)	SYMBOL	STRATIGRAPHIC DESCRIPTION	COBBLES VOL%	BOULDERS VOL% (mm max. diam)	SAMPLES TYPE NO.	SAMPLES STATE	INF	LABORATORY TEST
	0,0		Organic matter.						
0,5	0,2		Sand, some gravel. Presence of cobbles and boulders.	<10%	<10% (900)				
1,0	0,9		Till : Silt and sand matrix, traces of gravel (~ 10%). Presence of cobbles and boulders. Moist below 3m of depth.						
1,5									
2,0									
2,5									
3,0				~10%	~10% (700)				
3,5									
4,0									
4,5									
5,0	4,9		End of the trench.						

REMARKS :
Medium difficulty excavation due to the density of cobbles and boulders.
No sample taken.

EQUIPMENT USED : Komatsu PC200LC
WALL STABILITY : Stable

DATE : 2019-05-07
DESCRIBED BY : Daniel Brosseau
APPROVED BY : Daniel Brosseau

Log_Tranchee_v3_EN.sty Date d'impression : 2019-07-03

APPENDIX 3

- Photographic album

Photo 1 : Crossing of a wet area near the north-eastern limit of site B.

Photo 2 : Typical view of the sparse vegetation on the surface of Site B.

Photo 3 : PU-B01

Photo 4 : PU-B01

Photo 5 : PU-B02

Photo 6 : PU-B-02

Photo 7 : PU-B03

Photo 8 : PU-B03

Photo 9 : PU-B04

Photo 10 : PU-B04

Photo 11 : PU-B05

Photo 12 : PU-B05

Photo 13 : PU-B06

Photo 14 : PU-B06

Photo 15 : PU-B07

Photo 16 : PU-B07

Photo 17 : PU-B08

Photo 18 : PU-B08

Photo 19 : PU-B09

Photo 20 : PU-B09

Photo 21 : PU-B10

Photo 22 : PU-B10

Photo 23 : PU-B11

Photo 24 : PU-B11

Photo 25 : PU-B12

Photo 26 : PU-B12

Photo 27 : PU-B13

Photo 28 : PU-B13

Photo 29 : PU-B14

Photo 30 : PU-B14

Photo 31 : PU-B15

Photo 32 : PU-B15

Photo 33 : PU-B16

Photo 34 : PU-B16

6.5 Appendix D - Final Criteria Evaluation Matrix

Waptum Project Name : New Landfill Site Study
Waptum Project Number : 18-001103
2019-07-19

NEW LANDFILL SITE SELECTION TABLE

Criteria	Excellent (3pts)	Good (2pts)	Marginal (1pt)	Importance	Site A Evaluaton	Mark A	Site B Evaluaton	Mark B	Site C Evaluaton	Mark C	Site D Evaluaton	Mark D
Distance from the community (km)	3	2-3 and 4-5	<2 to >5	3	1	3	3	9	2	6	2	6
Urbain planning constraints	30 years +	15 to 30 years	0 to 15 years	3	1	3	3	9	3	9	3	9
Distance between the incinerator and the site (km)	< 5	5-8	>8	3	3	9	3	9	2	6	2	6
Campsite at proximity (km)	> 3	1-3	< 1	2	1	3	2	6	2	6	2	6
Surface drainage at proximity of the site	Naturally drained	Dry (presence of ditch)	Waterlogged	1	3	3	3	3	3	3	3	3
Presence of rock nearby	No rock at proximity	Rock outside the bounderies of the site	Rock inside the bounderies	2	3	9	3	9	2	6	2	6
Length of new access road (km)	0	0-6	> 6	2	3	9	2	6	2	6	2	6
Length of new access road to deforest (km)	0	0-6	> 6	1	3	9	3	9	2	6	2	6
Major construction required for the access (ei. Bridge)	0	0-$ 5,000,000	>$ 5,000,000	2	3	9	3	9	2	6	2	6
Number of natural river to cross	< 1	2-6	> 6	3	3	9	3	9	3	9	3	9
Surface area (m^2)	> 46,000	23,000-46,000	< 23,000	3	3	9	2	6	2	6	1	3
Surface topography	Flat (av. 2%)	Undul (av 5%)	Highly irregular (>5%)	2	3	9	2	6	1	3	1	3
Soil permeability	Low	Medium	High	3	NA		3		NA		NA	
Groundwater depth (m)	> 5	3.6-5	< 3.6	3	NA		2		NA		NA	
Distance to watercourse (m)	> 500	300 - 500	150 - 300	1	2	6	1	3	1	3	1	3
Density of vegetation	Low	Medium	High	1	2	6	2	6	2	6	2	6
Hunting potential	Low	Medium	High	1	2	6	2	6	2	6	2	6
Social Acceptability	High	Medium	Low	2	1	3	3	9	3	9	3	9
Visibility from the access road / Easthetic	0-15%	15-50 %	> 80%	2	2	6	3	9	3	9	3	9
Distance from an airfield (m)	> 8000	1000-8000	< 1000	2	2	6	2	6	2	6	2	6
TOTAL POINTS						**117**		**129**		**111**		**108**