



**LA GRANDE ALLIANCE FEASIBILITY  
STUDY – PHASE I**

**POTENTIAL BORROW SOURCES  
AND QUARRY SITES ASSESSMENT –  
NEMASKA ACCESS ROAD**

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## **1.0 Introduction**

### **1.1 General**

La Grande Alliance refers to the *Memorandum of Understanding (MOU) on the Cree-Québec Sustainable Infrastructure Program in Eeyou Istchee Baie-James*, signed between the Cree Nation Government (CNG) and the Government of Québec on February 17, 2020. The purpose of the MOU is to provide a framework for Cree local and regional entities to work closely with relevant Québec government ministries to connect, develop and protect the territory of the Eeyou Istchee Baie-James's region of northern Québec in an inclusive and participatory manner. The main objective of La Grande Alliance is to build a promising program for the strategic, predictable, and sustainable development of the territory over a 30-year time horizon.

Infrastructure development is a major component of *La Grande Alliance*. The program aims at improving and building major transportation infrastructure on the territory, including the implementation of a railway alongside the Billy-Diamond Highway to Whapmagoostui, where the construction of a deep-water port is being considered. The current project is divided into three phases. Phase I being carried out by the Vision Eeyou Istchee Consortium, focusing on the feasibility design of the following infrastructures:

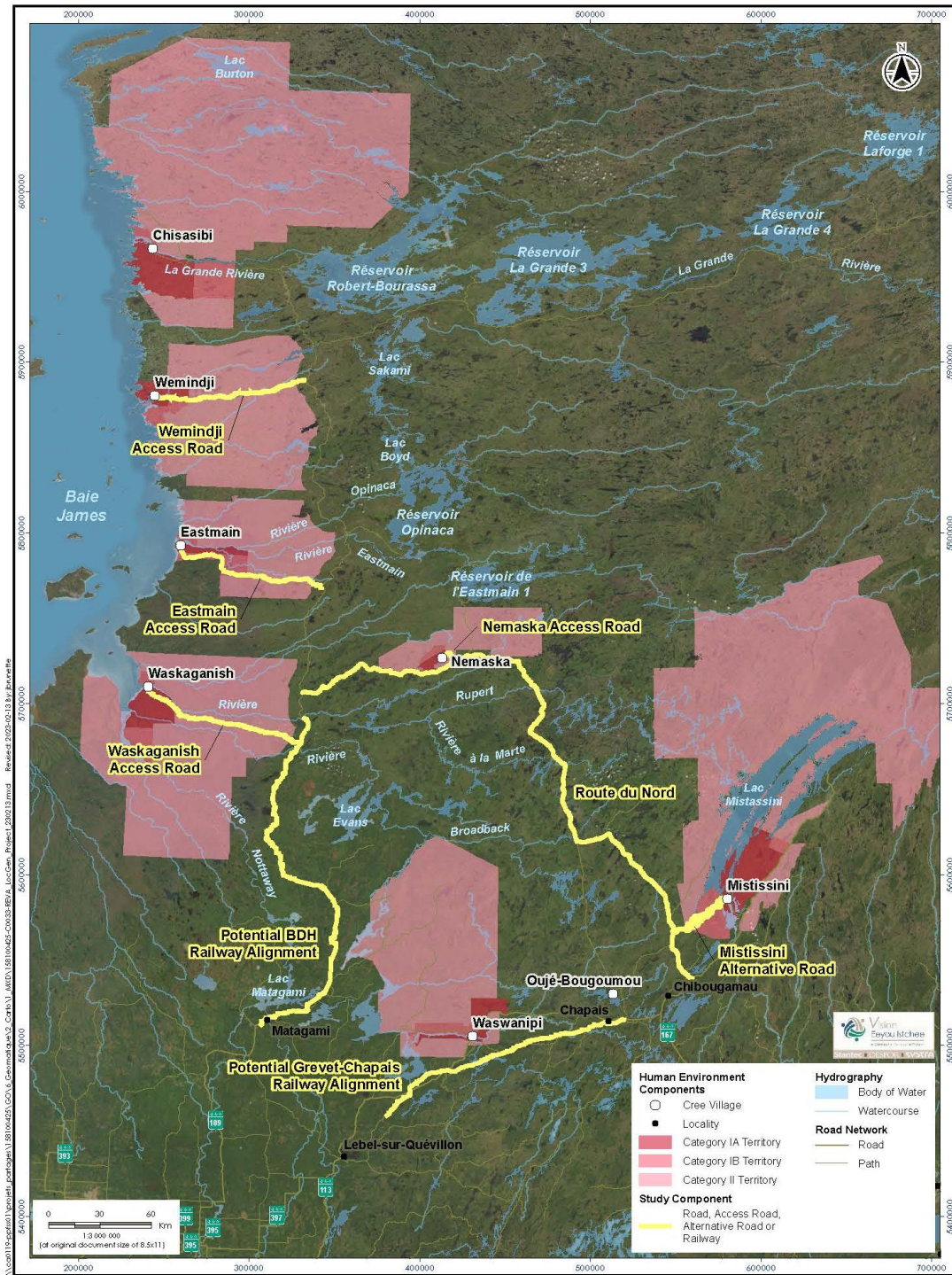
- Upgrade of the existing access roads between the Billy-Diamond Highway (BDH) and the Cree communities of Waskaganish, Eastmain and Wemindji;
- Upgrade of the existing access road between the Route du Nord and the community of Nemaska;
- New railway along the Billy-Diamond Highway (BDH) between the town of Matagami and KP 257 of the same highway (Rupert River Bridge);
- Recommissioning of the railway line from Grevet (Lebel-sur-Quévillon) to Chapais (approximately 225 km);
- Construction of transfer areas along the Billy-Diamond Highway and Grevet-Chapais line corridors, specifically the area at KP 257;
- Upgrade of the Route du Nord, and;
- Construction of a secondary access road to the Cree Nation of Mistissini.

The location of the infrastructures listed above is shown on Figure 1.

Limitations associated with this report and its contents are provided in the Statement of General Conditions included in Appendix A.



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**Figure 1 La Grande Alliance – Phase I Feasibility Study Area Overview**



## **1.2 Scope of Work**

One of the objectives of the Vision Eeyou Istchee's feasibility study was to evaluate the availability of borrow materials (i.e. granular borrow sources and bedrock quarries) to supply the project's needs for the construction and/or upgrade of the different infrastructures.

Subsequently, Cree Development Corporation (CDC) mandated Stantec to conduct a geotechnical investigation which includes the exploration of granular potential borrows sources and quarry sites previously identified within the feasibility study. This report presents the results of the desktop borrow sources and quarry sites assessment and the results of the geotechnical investigations of the targeted site along the Nemaska Access Road.

The main tasks performed regarding the identification and exploration of potential borrow sources and quarry sites consisted of the:

- Selection and acquisition of aerial photos covering the study area;
- Compilation and review of data related to the geology and the surficial deposits;
- Photo interpretation and delineation of sectors showing potential for material extraction (granular material and bedrock);
- Proposal of a field investigation program and identification of field targets for the conduction of boreholes;
- Acquisition of the necessary environmental permits and authorization to carry out the geotechnical investigation;
- Execution of the geotechnical field program which includes the:
  - Coordination with subcontractors and tallymen;
  - Forest clearing; and
  - Realization of boreholes.
- Laboratory testing to characterize the materials (bedrock) to determine the suitability for the project needs;
- Preparation of a summary report presenting the main characteristics of the potential borrow sources and quarry sites, including an estimate of the potentially exploitable volumes.





### **1.3 Material Requirements**

Preliminary estimates of borrow materials required for the pavement of the Nemaska Access Road are presented in Table 1. Note that these estimates consist of compacted volumes and exclude quantities generated from the excavation of road cuts.

**Table 1 Summary of the Material Requirements for the Nemaska Access Road**

<b>Type of Material</b>	<b>Volume (compacted) (m<sup>3</sup>)</b>
MG 112	32 500
MG 20	16 522
Pavement (ESG-10 and ESG-14)	6 125

According to the BNQ-2560-114 standard (BNQ, 2014) used by the ministère des Transports et de la Mobilité durable for aggregates used in civil engineering works, several requirements must be met in order for aggregates to be used as a granular material for granular base and subbase of the road.

Regarding the intrinsic characteristics, the aggregate must be at most category 5 meaning that the Micro-Deval test result must not exceed 35%, the Los Angeles test result must not exceed 50%, and the sum of the two results must not exceed 80%. As for the manufacturing characteristics, the aggregate can meet any of the categories from a to e (i.e. with a percentage of fragmentation of at least 50%).



## **2.0 Study Area and Background Review**

The study area extends from the junction between the Route du Nord and the Nemaska Access Road (KP 299) to the community of Nemaska (total of 10.35 km). The study area consists of a buffer of 5 km on both sides of the Nemaska Access Road, although the actual distances were usually much lower due to environmental or accessibility constraints. However, the study area had to be extended along the Route du Nord to find a suitable site for a pit, the same 5 km buffer was then applied along that road. The most important environmental constraints encountered were major watercourses, waterbodies, and wetlands.

Regional bedrock geology mapping (SIGÉOM, 2023) shows that the study area is underlain by Archean bedrock belonging to the Superior Province. The bedrock encountered along the Nemaska Access Road consist of biotite granite.

During the Late Wisconsinan Glaciation (24 000 to 8 000 years before present (BP), the James Bay region was covered by the Laurentide Ice Sheet. During this glaciation, large amounts of materials were transported and subsequently deposited as till (morainal deposits) across the region. Following the ice melt, the marine transgression of the Tyrrell Sea peaked around 7 900 BP (Hardy 1977). Glaciomarine silt and clay accumulated in the low-lying areas and coarser deposits accumulated along the former Tyrrell Sea shorelines.

Locally, the area is mostly covered by till deposits, glaciofluvial sediments discharged with the meltwaters from the retreating glacial margin, and rock ridges. Some fine glaciomarine sediments are found overlying till in lower areas, especially those which are connected to Champion Lake. Organic accumulations are also frequently found in flat and poorly drained areas.



## **3.0 Methodology**

### **3.1 Photo Interpretation and Identification of Potential Granular Borrow Sources and Quarry Sites**

Photo interpretation allows the geomorphologists to assess the study area in three dimensions in order to identify landforms that are likely to contain granular materials. Spatial delineation of potential borrow sources is based on the geomorphologist knowledge of Quaternary deposits and on their ability to identify landforms that could potentially provide suitable granular borrow materials. Within the study area, landforms expected to be favorable for borrow material extraction include glaciofluvial deposits such as esker and outwash deposits, and littoral deposits from the postglacial Tyrrell Sea.

In addition to granular deposits, a potential quarry site was selected by identifying a favorable bedrock hill - about 8-10 meters above the surrounding terrain – and by delineating the area that could provide a significant volume.

The photo interpretation exercise was completed using a mirror stereoscope for the visualization of black and white 1: 20 000 scale aerial photos. The aerial photos used for the achievement of this mandate were acquired from Natural Resources Canada (NARCAN, 2023) - National Air Photo Library (NAPL) and are listed in Table 2.

The potential sites were selected based on their distance from the Nemaska Access Road or the Route du Nord to limit the costs associated with the construction and/or maintenance of access roads. Special attention was given to avoid apparent environmental constraints such as the proximity of the potential sites to watercourses or waterbodies, and wetlands.

The potential borrow source and quarry site were identified and drawn directly onto the aerial photographs. These were subsequently scanned and georeferenced, and the delineated landforms were digitized using ArcMap© software. The sites are identified by the prefixes GD (Granular Deposit) or Q (Quarry) followed by the kilometre point (KP) of their location (i.e., GD-312 or Q-304).



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**Table 2 Aerial Photos Used for the Identification of Potential Borrow Sources and Quarry Sites**

<b>Year</b>	<b>Roll number</b>	<b>No. of aerial photo</b>	<b>Scale</b>	<b>Photo type</b>
1983	A26319	4 to 7; 30 to 34; 58 to 61	1: 20 000	Black & white

### **3.2 Environmental Permitting**

Before proceeding with the geotechnical investigations, Vision Eeyou Istchee obtained the necessary authorizations and permits for the execution of the work:

- Land use (obtained from the ministère des Ressources naturelles et des Forêts du Québec);
- Tree cutting (obtained from the ministère des Forêts, de la Faune et des Parcs du Québec); and
- Declaration of compliance (submitted to the ministère de l'Environnement, de la Lutte contre les changements climatiques du Québec).

All field activities (land occupancy, land clearing, exploration trenches and drilling) were carried out in compliance with the current laws and regulations.

### **3.3 Geotechnical Field Investigation**

One (1) potential borrow source and one (1) potential quarry site were identified during the desktop assessment considering the required volumes. At the current stage of the feasibility study, the geotechnical investigation was limited to the exploration of the potential site Q-304.

The fieldwork for the potential quarry site assessment was carried out on August 4, 2022 and consisted in drilling two (2) boreholes (Q-304-BH22-01, Q-304-BH22-02) at the potential quarry site Q-304. The boreholes were drilled using a track-mounted CME-55 drill rig to depths of 9.17 m and 8.71 m, respectively. The subsurface stratigraphy encountered was recorded by Stantec field personnel. When encountered, overburden samples were recovered at regular intervals using a B or N sized split-spoon sampler. Rock coring was carried out in all boreholes using a HQ-size core barrel (with an inner diameter of 47.6 mm) to confirm the type and characteristics of the bedrock. Bedrock samples collected during the fieldwork investigation were sent to Stantec's laboratory for detailed classification and additional testing.

### **3.4 Laboratory Testing**

All rock samples were brought back to Stantec laboratory and were subjected to a detailed visual examination and additional classification by a geologist. Laboratory testing conducted on rock cores consisted of four (4) Micro-Deval tests (LC 21-070), and four (4) Los Angeles tests (LC 21-400).



### **3.5 Volume Calculation**

The volume estimates were calculated by multiplying the potential borrow source or quarry site's area by the estimated average thickness of suitable materials or exploitable bedrock. Photo interpretation and Canadian Digital Surface Models derived from radar data (NRCan, 2000) were used to determine the potential exploitable thickness of granular material or bedrock. However, a conservative approach was used while estimating the potential volumes to avoid overestimating the material availability.

### **3.6 Site Potential Classification**

The site potential classification consists of a qualitative assessment of the site based on the accessibility, material quality (grain-size distribution, Los Angeles, and Micro-Deval results), potential volumes available, and the effort required to develop the site.

The classification uses four different categories which are defined as:

**High** – Clean, well-graded sand with variable proportions of gravel, or bedrock suitable to use as high quality aggregates with minimum processing. Presence of significant volumes and easy to access with minimum effort required for site development.

**Good** – Good quality material generally consisting of well-graded sand with variable proportions of gravel and limited quantities of silt, or good quality bedrock which could provide good quality aggregates with minimal processing effort. Presence of significant volumes and relatively easy to access with limited effort required for site development.

**Fair** - Fair quality material consisting generally of poorly graded sand and variable proportions of gravel with or without substantial silt content or fair quality bedrock. Available material volumes are less significant and/or are relatively difficult to access (absence, or existing access requiring significant rehabilitation effort). Materials may require treatment to meet the standards (granulometric specification).

**Poor (not suitable)** - Poor quality material generally consisting of silty, poorly graded, fine-grained sand with minor gravel, poor-quality bedrock or presence of major extraction constraints (shallow water table, thick overburden, etc.).

The site potential classification is provided only for the site for which a geotechnical field investigation was conducted as part of this mandate (in this case one quarry site – Q-304) since no site-specific data are available for the other sites.



## 4.0 Results

Using aerial photo interpretation one (1) potential granular borrow source and one (1) quarry site were identified as being more likely to contain suitable materials along the Nemaska Access Road and the Route du Nord. The potential borrow source consists of a juxtaglacial and proglacial subaquatic landform, while the potential quarry site consists of a small bedrock hill 8-10 m high. A specific attention was given to avoid as much as possible the sites where environmental constraints (proximity to watercourses, waterbodies, or wetlands) were present. The main characteristics of the identified borrow source and quarry site are listed in Table 3, while their specific description is presented below.

Site and borehole locations are shown on the figures presented in Appendix B. The borehole reports are presented in Appendix C. Laboratory test results are shown in Appendix D while a photographic album of the bedrock cores is provided in Appendix E.

**Table 3 Potential Granular Borrow Sources and Quarry Sites Identified Along the Nemaska Access Road and the Route du Nord**

Site ID	Status	Centroid Coordinates (NAD 83 CSRS MTM 9)		No. SMS (lease expiration date) <sup>1</sup>	Claim <sup>1</sup>	Material Type	Area (ha)
		Easting (m)	Northing (m)				
GD-312	Existing	318 120	5 720 830	32N09-26 (2023/03/31)	No	Sand	24.9
Q-304	New	321 985	5 730 590	N/A	No	Bedrock (Granite)	7.4

<sup>1</sup> Source : Gestim Plus, 2023

### 4.1 Potential Granular Borrow Sources

The following section presents the potential borrow sources identified near the Nemaska Access Road. The Figure B1 (Appendix B) shows an overview map of the potential borrow source and quarry site locations near the Nemaska Access Road while Figure B2 (Appendix B) shows a site-specific map of the delineated sites.

#### 4.1.1 Potential Borrow Source GD-312

**Landform Type:** Flat juxtaglacial and proglacial subaquatic landforms

**Material:** Sand

**Estimated Average Material Thickness:** 2 m

**Estimated Volume:** 150 000 m<sup>3</sup>



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## Site Description:

The potential borrow source GD-312 is located approximately 800 m north of the Route du Nord at KP 312, about 13 km west of the junction with the Nemaska Access Road. The delineated site has a length of 945 m, a width ranging from 170 to 290 m, and an area of 24.9 ha. The surface of the deposit is flat and forested. An existing borrow pit was already exploited at this location but the extraction lease will expire at the end of March 2023. The materials seem to be relatively thin, and the water table is expected to be reached at a shallow depth. Nevertheless, given the size of the site, the potential volume that could be extracted remains significant. Different wetlands and waterbodies are present around the potential site therefore a 30 m wide buffer would have to be respected along the surrounding wetlands and waterbodies. This site was also proposed for the Route du Nord potential borrow sources, but since the needs for granular deposits are quite low for the Nemaska Access Road, the materials extracted from this site could be shared between the two infrastructures.

## Site Access:

The site is accessible using the access road from the existing borrow pit.

## 4.2 Potential Quarry sites

The following section presents the potential quarry site identified along the Nemaska Access Road. The Figure B1 (Appendix B) shows an overview map of the potential borrow source locations along the Nemaska Access Road and the Route du Nord while Figure B3 (Appendix B) shows site-specific map of site Q-304.

### 4.2.1 Potential Quarry Site Q-304

**Landform type:** Bedrock ridge

**Material:** Bedrock (pink granite)

**Estimated Average Material Thickness:** 8 – 10 m

**Estimated volume:** 200 000 m<sup>3</sup> (230 000 m<sup>3</sup> including a swell ratio of 1.15 once compacted)

#### Site description:

The potential quarry site Q-304 is located 1.4 km north of the Nemaska Access Road. The site consists of a northeast/ southwest oriented bedrock ridge of approximately 440 m long and 170 m wide (7.4 ha). The ridge presents a partial vegetation cover and extensive areas of exposed bedrock. The delineated site was never exploited before. Wetlands seem to be present around the site representing environmental constraints that may require additional attention. Additionally, a small river flows approximately 55 m northeast of the site but its presence does not limit the potential exploitable volume.

#### Site access:

There is currently no access to the site apart from the trail that was cleared for the drilling activities as part of this geotechnical investigation. A new access road of about 1.5 km would need to be built to be able to access the site.



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**Field investigation program and laboratory testing:**

Two boreholes (Q-304-BH22-01, Q-304-BH22-02) were drilled on site on August 4, 2022, reaching maximum depths of 9.17 m and 8.71 m, respectively. Following the description of the bedrock cores by a geologist, representative samples of rock were selected to perform two (2) Micro-Deval tests (LC 21-070) and Los Angeles tests (LC 21-400) for each borehole.

**Subsurface conditions:**

The observed stratigraphy within the borehole Q-304-BH22-01 consisted of pink granite from the surface down to a depth of 9.17 m. As for the borehole Q-304-BH22-02, a thin organic layer (0.00 - 0.30 m) was encountered before reaching the bedrock also composed of pink granite down to a depth of 8.71 m.

The laboratory test results for the selected samples showed that the Micro-Deval results varied from 6 to 9 %, while the Los Angeles results ranged from 30 to 43 % indicating that the bedrock should be suitable to produce different types of aggregates.

The stratigraphy observed within the two boreholes is summarized in Table 4 while the laboratory test results are provided in Table 5.

**Site potential:**

Good – The bedrock appears to be suitable for the production of crushed stone, but the exploitation of the site will require the construction of a 1.5 km long access road. The presence of wetlands could slightly complicate the exploitation of the site.

**Table 4 Summary of Observed Stratigraphy for the Potential Quarry Site Q-304**

Borehole ID	Total depth (m)	Stratigraphy (depth-m)	
		Topsoil (m)	Granite (m)
Q-304-BH22-01	9.17	-	0.00-9.17
Q-304-BH22-02	8.71	0.00 – 0.30	0.30 – 8.71

**Table 5 Laboratory Results for Potential Quarry Site Q-304**

Borehole ID	Sample	Depth (m)	Geotechnical laboratory test results	
			Micro-Deval (%) (LC 21-070)	Los Angeles (%) (LC 21-400)
Q-304-BH22-01	DC-01 to DC-03	0.00 – 4.67	7	35
Q-304-BH22-01	DC-04 to DC-06	4.67 – 9.14	6	30
Q-304-BH22-02	DC-01 to DC-03	0.30 – 5.18	8	35
Q-304-BH22-02	DC-04 to DC06	5.18 – 8.71	9	43





## **5.0 Discussion and Conclusion**

The assessment undertaken to identify a potential borrow source and a potential quarry site was conducted to comply with the material needs for the upgrade of the Nemaska Access Road between km 299 of the Route du Nord and the community of Nemaska.

Using aerial photo interpretation, one (1) potential borrow source and one (1) potential quarry sites were identified. The potential quarry site (Q-304) was selected for further geotechnical investigations. Two (2) boreholes were advanced within the potential site Q-304 to describe the bedrock and to perform additional tests in the laboratory (Micro-Deval, and Los Angeles tests). Based on the information collected as part of the desktop assessment and subsequent geotechnical investigation, the quality and quantity of the potentially suitable material were characterized. Table 6 summarizes the potential exploitable volumes identified along the Nemaska Access Road.

**Table 6 Summary of the Potentially Exploitable Volumes Identified Along the Nemaska Access Road**

<b>Site ID</b>	<b>Material Type</b>	<b>Estimated average material thickness (m)</b>	<b>Potential volume with respect to environmental constraints (m<sup>3</sup>)</b>	<b>Potential bedrock volume considering a swell ratio of 1.15 (once compacted)</b>
GD-312	Sand	2	150 000	N/A
Q-304	Bedrock	8-10	200 000	230 000

The site GD-312 appears to be a favorable potential borrow source since it seems to contain a significant amount of material and has an existing access. As for the potential quarry site Q-304, it consists of an unexploited site (new quarry). The laboratory results showed that the bedrock encountered in both boreholes on site Q-304 would be suitable to provide the materials needed for the upgrade and paving of the Nemaska Access Road.

Based on the actual material requirements, the volumes contained within the delineated potential borrow source and quarry site would be sufficient to meet the needs for the granular subbase, granular base and paving of the Nemaska access road. However, an update of the available material volumes will have to be conducted before construction works begins as some potential sources may have been used for other purposes in the meantime. Based on this update, a geotechnical investigation campaign should be conducted to confirm the quality and quantity (volumes) of available materials. Also, an assessment of the access road conditions should be carried out at the appropriate time to evaluate the extent of the rehabilitation work needed.

Finally, it must be noted that the location and the exploitation of borrow pits and quarries are subject to the Regulation respecting sand pits and quarries (Chapter Q-2, r 7.1) of the Environment Quality Act (Gouvernement du Québec, 2022). The final selection and delineation of the sites should be done according to the applicable regulations in effect at the time of their exploitation.



## 6.0 References

Bureau de normalisation du Québec, 2014. Norme BNQ-2560-114/2014, Travaux de génie civil – Granulats. 69 pages

Gestim Plus, 2023. Gestim Gestion des titres miniers. Interactive map.

[https://gestim.mines.gouv.qc.ca/MRN\\_GestimP\\_Presentation/ODM02201\\_menu\\_base.aspx](https://gestim.mines.gouv.qc.ca/MRN_GestimP_Presentation/ODM02201_menu_base.aspx)

Gouvernement du Québec, Environment Quality Act, Regulation respecting sand pits and quarries (updated August 1, 2022). <https://www.legisquebec.gouv.qc.ca/en/document/cr/Q-2,%20r.%207.1>

Hardy, L., 1977. Deglaciation, and Lacustrine and Marine Episodes on the Québec Portion of the James Bay Lowlands. Géographie Physique et Quaternaire, 31(3-4), 261-273. <https://doi.org/10.7202/1000277ar>

Natural Resources Canada (NRCan), 2000. Canadian Digital Surface Model.

<https://open.canada.ca/data/en/dataset/768570f8-5761-498a-bd6a-315eb6cc023d>

Système d'information géominière du Québec (SIGÉOM), 2023. Interactive map.

[https://sigeom.mines.gouv.qc.ca/signet/classes/l1108\\_afchCarteIntr](https://sigeom.mines.gouv.qc.ca/signet/classes/l1108_afchCarteIntr)



# **APPENDICES**

## **Appendix A Statement of General Conditions**



## STATEMENT OF GENERAL CONDITIONS

USE OF THIS REPORT: This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Stantec Experts-conseils and the Client. Any use which a third party makes of this report is the responsibility of such third party.

BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Stantec Experts-conseils present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Stantec Experts-conseils is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

STANDARD OF CARE: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

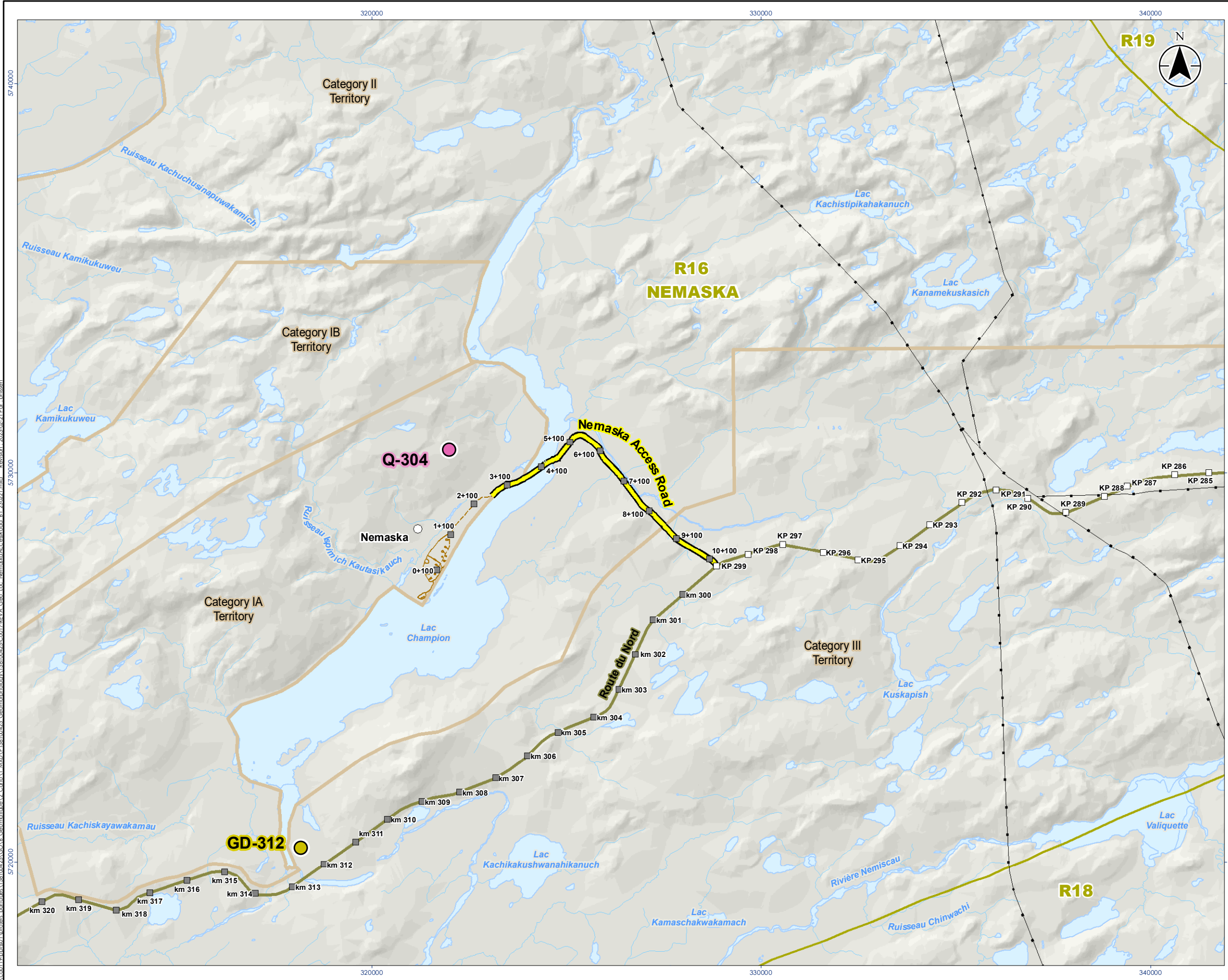
INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Stantec Experts-conseils at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Stantec Experts-conseils must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Stantec Experts-conseils will not be responsible to any party for damages incurred as a result of failing to notify Stantec Experts-conseils that differing site or sub-surface conditions are present upon becoming aware of such conditions.

PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Stantec Experts-conseils, sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Stantec Experts-conseils cannot be responsible for site work carried out without being present.

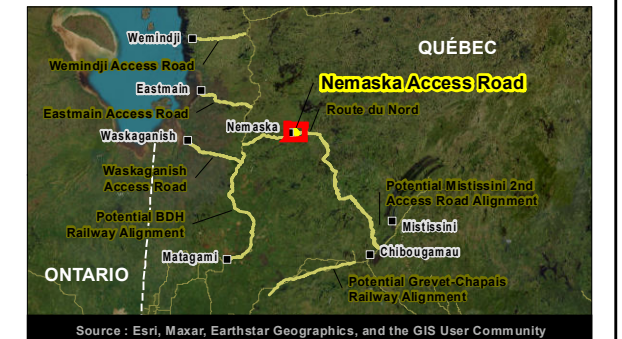
## Appendix B Figures





Map No. **B1**  
 Title **Potential Borrow Sources and Quarry Sites Nemaska Access Road**  
 Client/Project Cree Development Corporation  
 La Grande Alliance – Feasibility Study  
 Phase 1  
 Project Location 158100425-C0017 REVA  
 Eeyou Itchee, Québec Prepared by Julie Brunette on 2023-02-21  
 Verified by E. Ferland on 2023-02-21  
 Independent Review by F. Vinet on 2023-02-21

- Human Environment Component**
- Cree Village
  - Power Line
  - Category I, II or III Territory
- Study Component**
- Nemaska Access Road
  - Route du Nord
- Potential Material Source**
- Potential Quarry Site (Q)
  - Potential Borrow Source (GD)
- Trapline Limit and Community Name**
- Nemaska
- Hydrography**
- Body of Water
  - Intermittent Watercourse
  - Permanent Watercourse
- Road Network**
- Kilometric Point (MTQ, 2021)
  - Kilometric Point (Create by Stantec)
- Road Classification**
- Local
  - Access Path



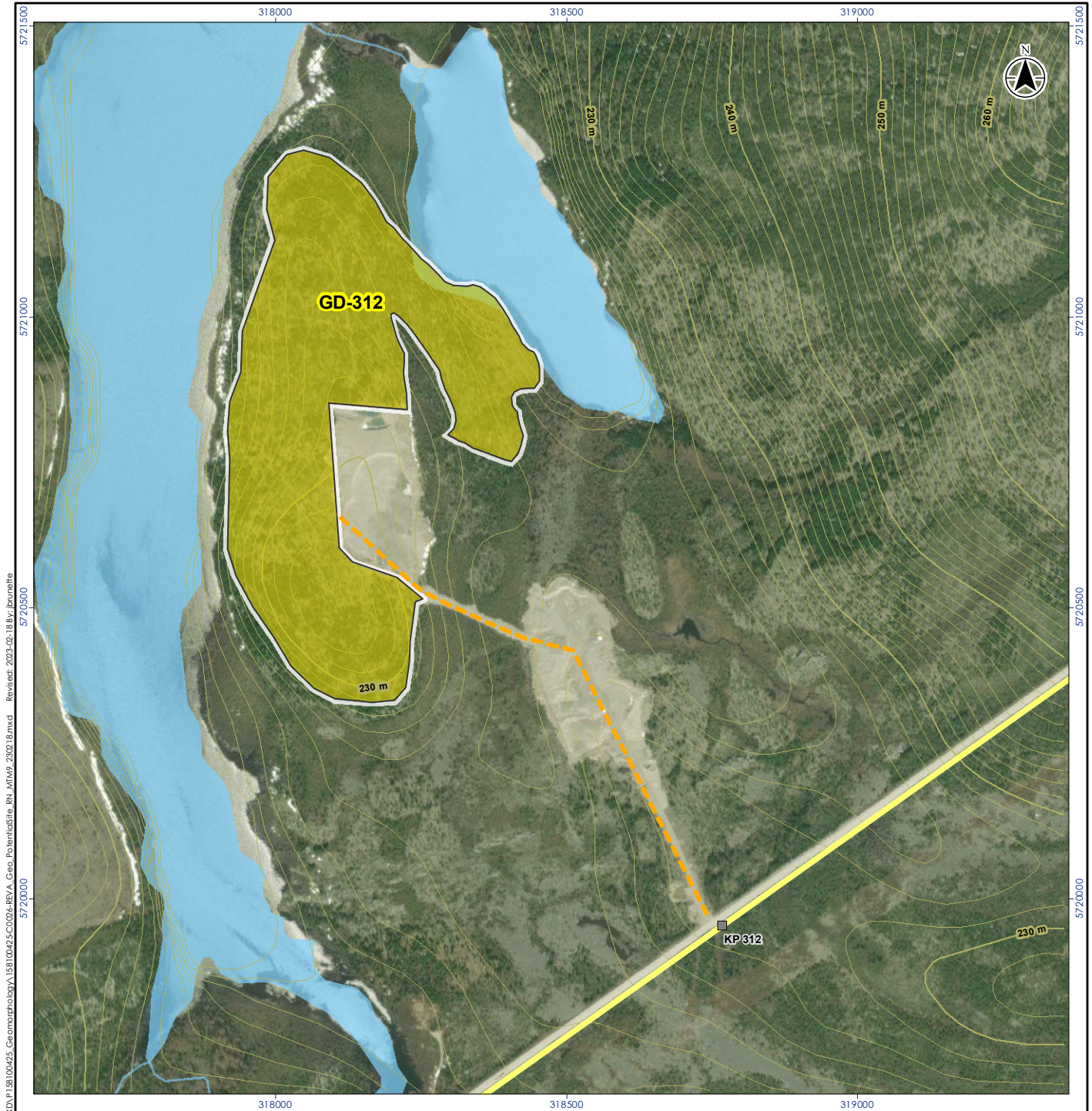
- Notes**
1. Coordinate System: NAD 1983 CSRS MTM 9
  2. Geotechnical Investigation: Stantec, 2023
  3. Road Network: Adresses Québec, 2021
  4. Hydrography: GRHQ, 2017
  5. Orthoimagery: ESRI-World Imagery, 2017

**Stantec**

0 1 2 km  
 1:100 000  
 (At original document size of 11x17)

Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Vision Eeyou Itchee has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Vision Eeyou Itchee assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.





\cadd\119\proj\pds\158100425\GD-312\_Geomorphology\158100425-C008-REVA\_Geo\_PotentialSite\_RN\_MTMP\_2302\_18.mxd  
 Reviewer: 2023-02-18 By: J. Brunette



- Notes**
1. Coordinate System: NAD 1983 UTM Zone 18N
  2. Geotechnical Investigation and Projected Component: Stantec, 2023
  3. Road Network: Adresses Québec, 2021
  4. Hydrography: GRHQ, 2017
  5. Topography: Forêt Ouverte, 2023
  6. Orthomogery: ESR-World Imagery, 2012 to 2021

- Proposed Access Road**
- Route du Nord
  - Proposed Access Road
- Geotechnical Investigation**
- Potential Borrow Source (GD)
- Road Network**
- Kilometric Point (Created by Stantec)

- Hydrography**
- Body of Water
  - Watercourse
- Topography**
- Contour line (1 m)
  - Primary
  - Secondary

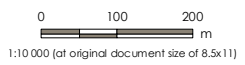


Project Location: 158100425-C008 REVA  
 Prepared by J. Brunette on 2023-02-18  
 Technical Review by E. Ferland on 2023-02-18  
 Independent Review by F. Vinet on 2023-02-18

Client/Project  
 Cree Development Corporation  
 La Grande Alliance – Feasibility Study  
 Phase 1

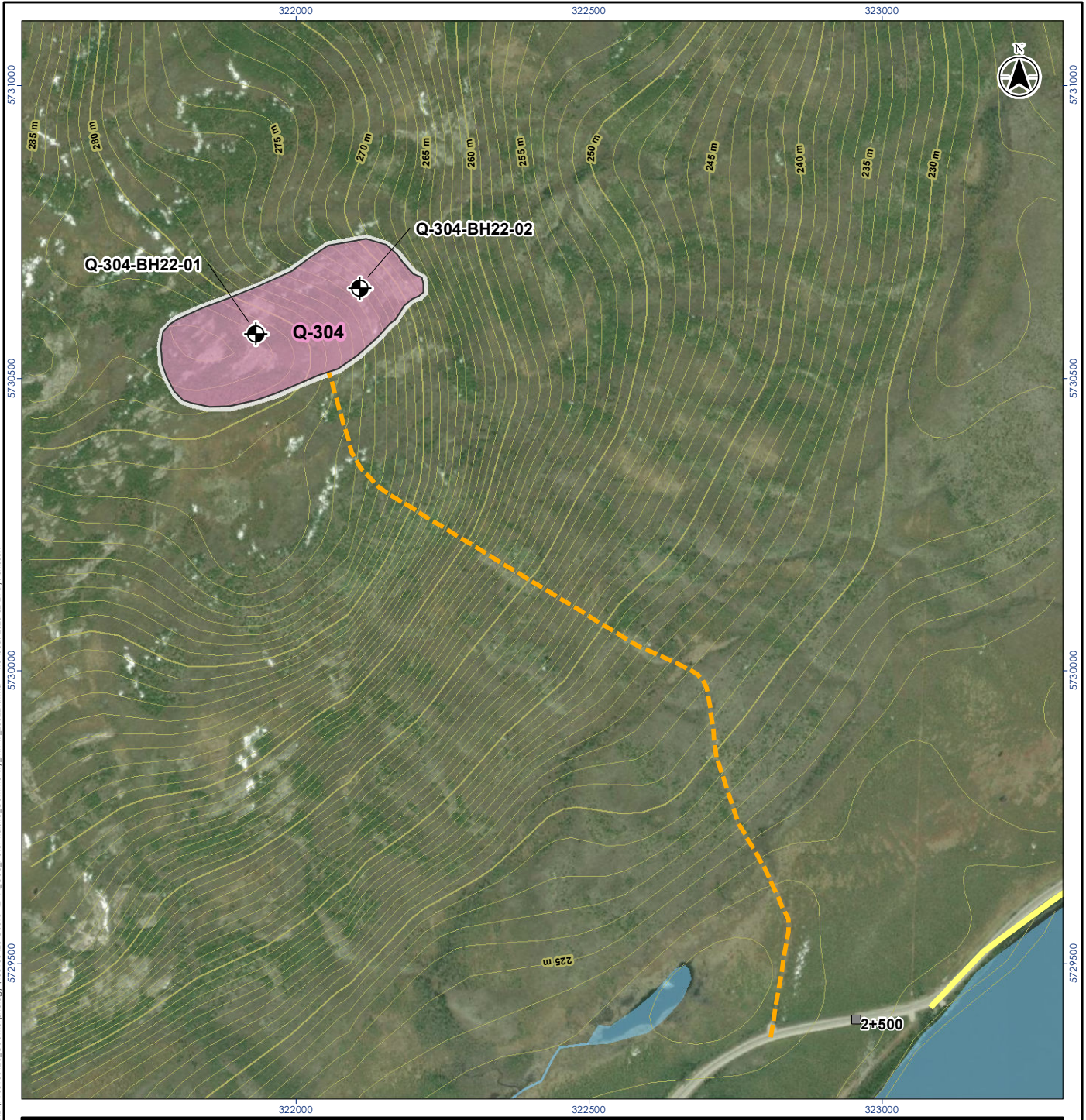
Map No.  
**B2**

Title  
**Potential Borrow Source GD-312**



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- Study Component**
- Nemaska Access Road
- Projected Component**
- Proposed Access Road
- Potential Material Source**
- Potential Quarry Site (Q)
- Geotechnical Investigation**
- Borehole

- Road Network**
- Kilometric Point (Created by Stantec)
- Hydrography**
- Body of Water
  - Watercourse



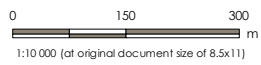
Project Location: 158100425-C0013 REV A  
 Prepared by J. Brunette on 2023-02-21  
 Technical Review by E. Ferland on 2023-02-21  
 Independent Review by F. Vinet on 2023-02-21

Client/Project: Cree Development Corporation  
 La Grande Alliance – Feasibility Study  
 Phase 1

Map No. **B3**

Title: **Potential Quarry Site Q-304**

- Notes**
- Coordinate System: NAD 1983 CSRS MTM 9
  - Geotechnical Investigation: Stantec, 2023
  - Road Network: Adresses Québec, 2021
  - Hydrography: GRHQ, 2017
  - Topography: Forêt Ouverte, 2023
  - Orthoimagery: ESRI-World Imagery, 2017



\\c0119-ppl\ssd\projets\_papier\158100425-C0013-REV A\_Geo\_Potential\Ble\_Community\_MTM\_230221.mxd - Revised: 2023-02-21 By: bris/en

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## Appendix C Borehole Reports











STRATIGRAPHY				SAMPLES					WATER LEVEL / WATER INFLOW		TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	
25				+		DC-05		HQ	100	100			
8				+		DC-06		HQ	100	93			
		8,71	END OF BOREHOLE										
30													
10													
35													
11													
40													
12													
45													
14													
50													
15													
55													
17													
60													

GA : grain size analysis  
 H : hydrometer test  
 C : consolidation  
 W : water content  
 W<sub>L</sub> : liquid limit  
 W<sub>p</sub> : plastic limit  
 Dr : specific gravity  
 k : permeability  
 f<sub>c</sub> : compressive str.  
 OM : organic matter  
 CA : chemical analyses  
 SAV : soil aggressivity value

X : N (standard pen.)  
 ∇ : Nc (dyn. pen.)  
 ■ : Cu intact  
 □ : Cu remoulded  
 ◆ : Su intact  
 ◇ : Su remoulded

W<sub>p</sub>   W   W<sub>L</sub>

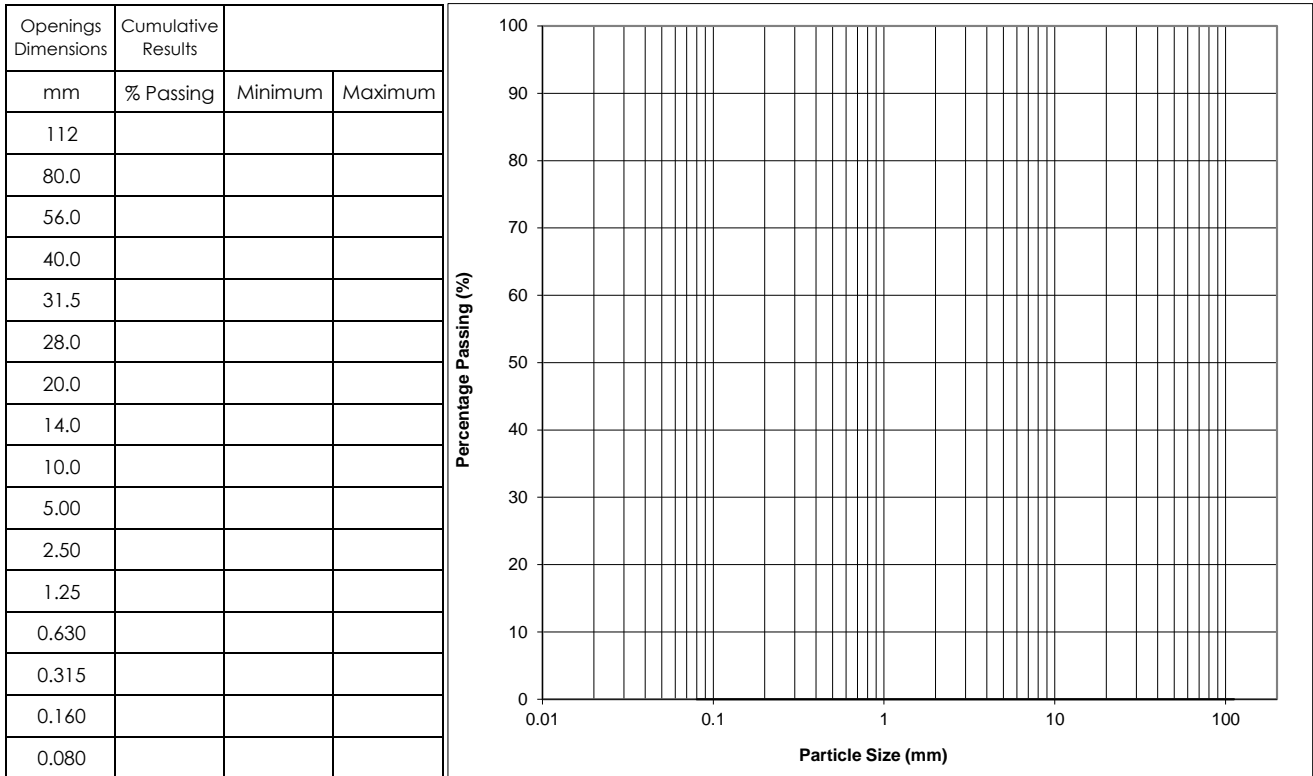
20 40 60 80 100 120

## **Appendix D Laboratory Test Results**



Client : Cree Development Corporation	Type of material : Crushed rock cores
Project : La Grande Alliance - Feasibility Study - Phase I Nemaska Access Road	Sampled by : Khaled haiek
Project No : 158100425.500.710.2	Sampling Date : April 08, 2022
Sample No : Q-304-BH22-01 DC-01 to DC-03	
Depth : 0,00 - 4,67m	

**Sieve Analysis (LC 21-040 / BNQ 2501-025 )**



Soils Classification		Modified Proctor (BNQ 2501-255)	
% Gravel		Testing Method used	
% Sand		Maximum Dry Unit Weight (kg/m <sup>3</sup> )	
% Fine Particles		Optimum Moisture Content (%)	

Other Tests							
Test / Standard	Results	Requirements		Test / Standard	Results	Requirements	
		Min	Max			Min	Max
Los Angeles (grading B) (LC 21-400) (%)	35						
Micro Deval (grading F) (LC 21-070) (%)	7						

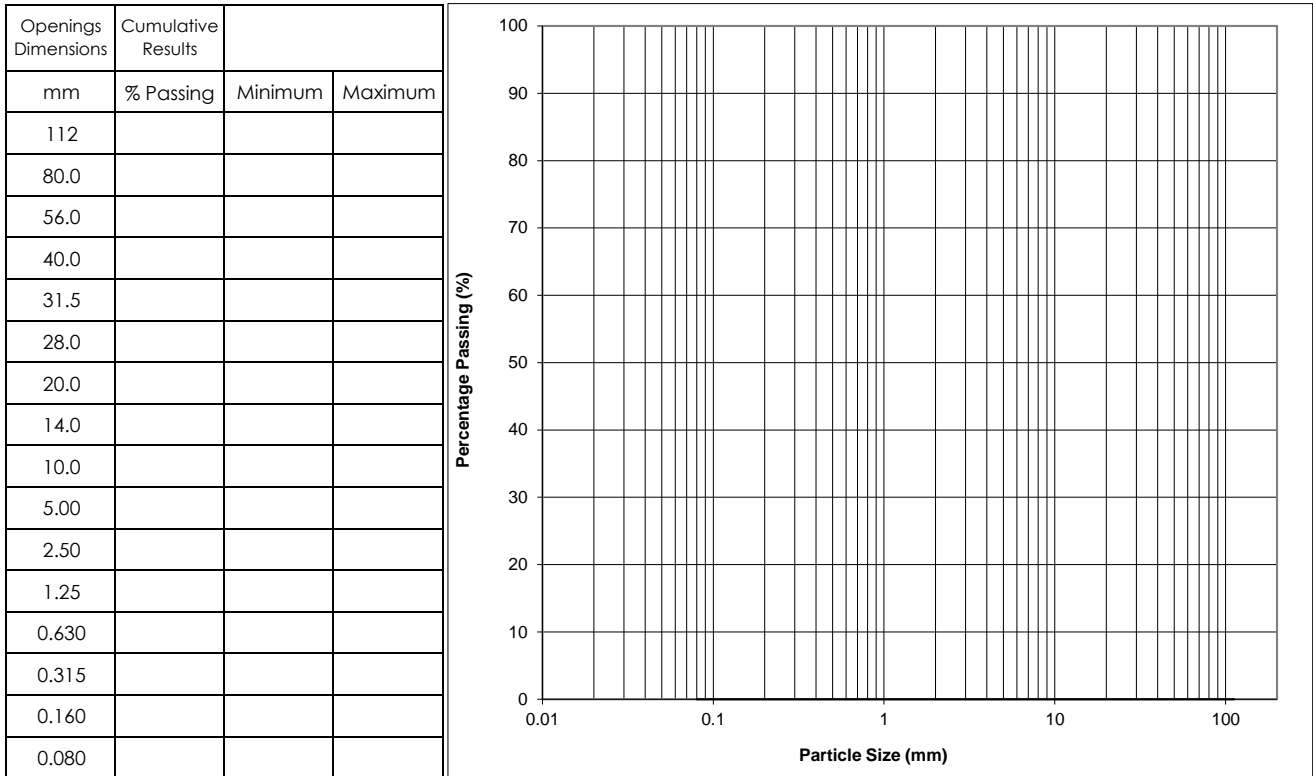
Remarks : \_\_\_\_\_

Prepared By: Benoit Cyr, Geo. *BJ* .Geo #786 Date: January 27, 2023



Client : Cree Development Corporation	Type of material : Crushed rock cores
Project : La Grande Alliance - Feasibility Study - Phase I Nemaska Access Road	Sampled by : Khaled haiek
Project No : 158100425.500.710.2	Sampling Date : April 08, 2022
Sample No : Q-304-BH22-01 DC-04 to DC-06	
Depth : 4,67 - 9,14m	

**Sieve Analysis (LC 21-040 / BNQ 2501-025 )**



Soils Classification		Modified Proctor (BNQ 2501-255)	
% Gravel		Testing Method used	
% Sand		Maximum Dry Unit Weight (kg/m <sup>3</sup> )	
% Fine Particles		Optimum Moisture Content (%)	

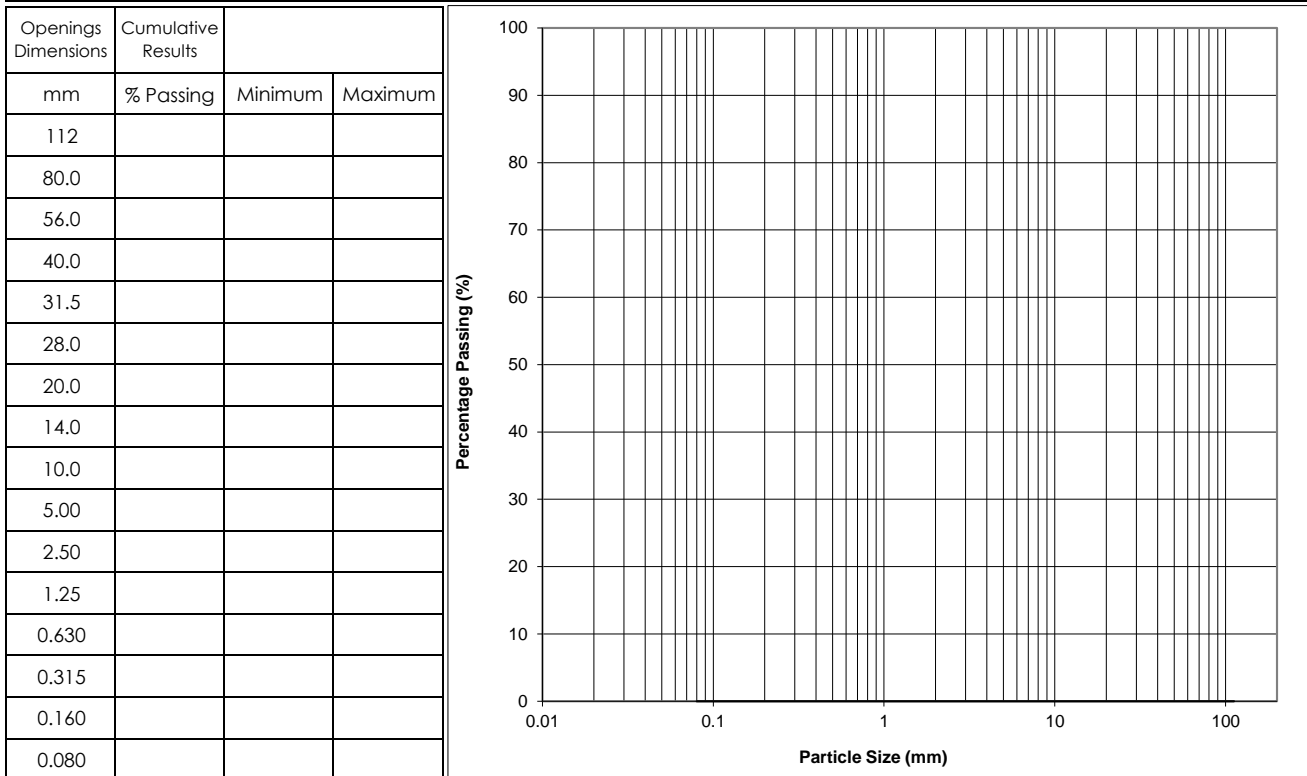
Other Tests							
Test / Standard	Results	Requirements		Test / Standard	Results	Requirements	
		Min	Max			Min	Max
Los Angeles (grading B) (LC 21-400) (%)	30						
Micro Deval (grading F) (LC 21-070) (%)	6						

Remarks : \_\_\_\_\_

Prepared By: Benoit Cyr, Geo. *Bj* .Geo #736 Date: January 27, 2023

Client : Cree Development Corporation	Type of material : Crushed rock cores
Project : La Grande Alliance - Feasibility Study - Phase I Nemaska Access Road	Sampled by : Khaled haiek
Project No : 158100425.500.710.2	Sampling Date : April 08, 2022
Sample No : Q-304-BH22-02 DC-01 to DC-03	
Depth : 0,30 - 5,18m	

**Sieve Analysis (LC 21-040 / BNQ 2501-025 )**



**Soils Classification**

**Modified Proctor (BNQ 2501-255)**

% Gravel		Testing Method used	
% Sand		Maximum Dry Unit Weight (kg/m <sup>3</sup> )	
% Fine Particles		Optimum Moisture Content (%)	

**Other Tests**

Test / Standard	Results	Requirements		Test / Standard	Results	Requirements	
		Min	Max			Min	Max
Los Angeles (grading B) (LC 21-400) (%)	35						
Micro Deval (grading F) (LC 21-070) (%)	8						

Remarks :

\_\_\_\_\_

\_\_\_\_\_

Prepared By:

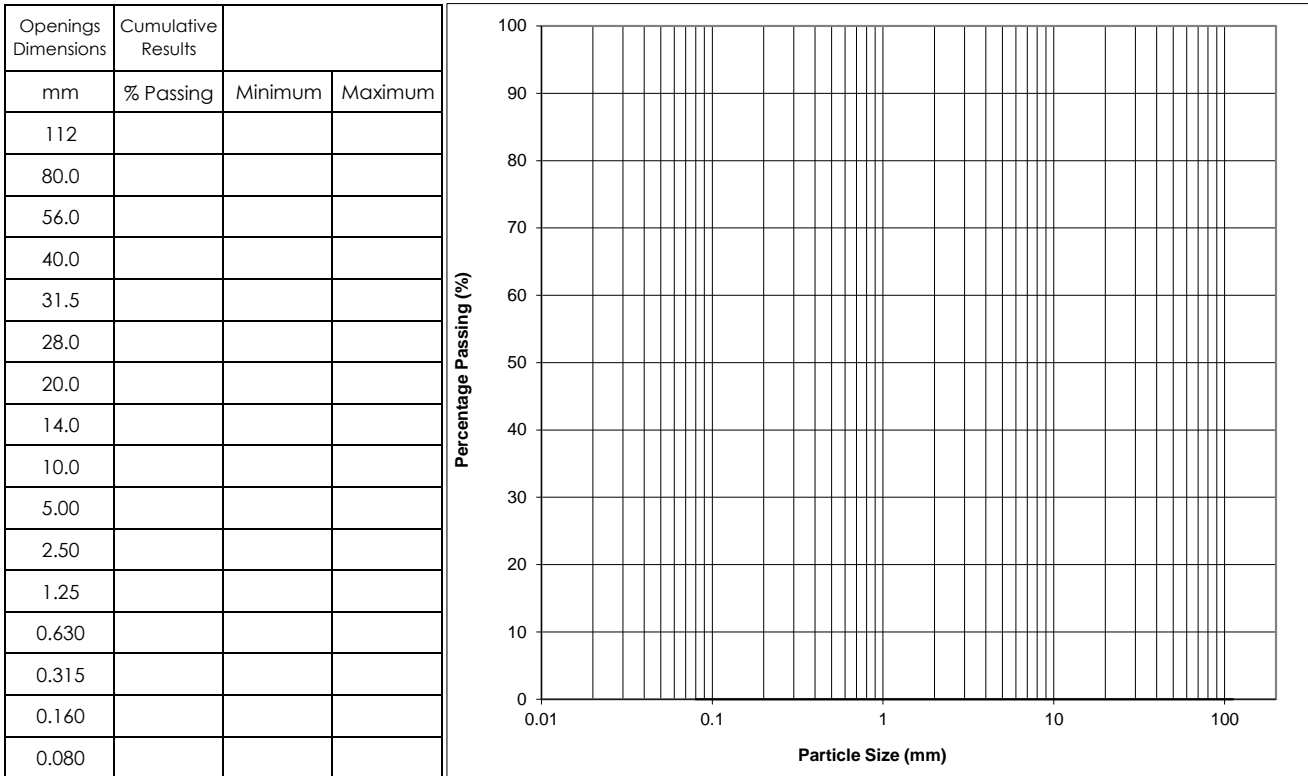
Benoit Cyr, Geo. *BJ* .Geo  
#786

Date: January 27, 2023

\_\_\_\_\_

Client : Cree Development Corporation	Type of material : Crushed rock cores
Project : La Grande Alliance - Feasibility Study - Phase I Nemaska Access Road	Sampled by : Khaled haiek
Project No : 158100425.500.710.2	Sampling Date : April 08, 2022
Sample No : Q-304-BH22-02 DC-04 to DC-06	
Depth : 5,18 - 8,71m	

**Sieve Analysis (LC 21-040 / BNQ 2501-025 )**



**Soils Classification**

**Modified Proctor (BNQ 2501-255)**

% Gravel		Testing Method used	
% Sand		Maximum Dry Unit Weight (kg/m <sup>3</sup> )	
% Fine Particles		Optimum Moisture Content (%)	

**Other Tests**

Test / Standard	Results	Requirements		Test / Standard	Results	Requirements	
		Min	Max			Min	Max
Los Angeles (grading B) (LC 21-400) (%)	43						
Micro Deval (grading F) (LC 21-070) (%)	9						

Remarks :

\_\_\_\_\_

Prepared By:

Benoit Cyr, Geo. *BJ* .Geo  
#786

Date: January 27, 2023

\_\_\_\_\_

## Appendix E Photographic Album





Photo 1: Q-304-BH22-01 (Wet)



Photo 2: Q-304-BH22-01 (Dry)



Photo 3: Q-304-BH22-02 (Wet)



Photo 4: Q-304-BH22-02 (Dry)