

Appendix 14A

Terrain, Soils, and Permafrost Baseline Report

Grays Bay Road and Port Project Terrain, Soils, and Permafrost Baseline Report

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West Kitikmeot Resources Corp

Prepared by:

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March 2026

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Sign-off

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Table of Contents

1	Introduction	1
1.1	Inuit Knowledge, Traditional Knowledge, and Community Knowledge	2
2	Spatial Boundaries.....	3
2.1	Project Development Area	3
2.2	Local Assessment Area	3
2.3	Regional Assessment Area.....	4
3	Methodology.....	6
3.1	Compilation and Review of Background Data	6
3.1.1	Project-Specific Reports and Datasets.....	6
3.1.2	Other Data Sources.....	6
3.2	Terrain Mapping	7
3.3	Soil Mapping	9
3.4	Field Studies	10
4	Summary Baseline Conditions	12
4.1	Physiography and Bedrock Geology.....	12
4.2	Permafrost.....	13
4.2.1	Climate.....	13
4.2.2	Active layer	15
4.2.3	Permafrost distribution.....	16
4.2.4	Taliks	17
4.2.5	Ground ice	18
4.2.6	Ground thermal regime.....	20
4.2.7	Permafrost, Surface Water and Groundwater interactions	22
4.3	Surficial Materials.....	22
4.3.1	Materials and Landforms Description.....	22
4.3.2	Surficial Material Distribution	27
4.4	Geomorphological Processes	29
4.4.1	Geomorphological Processes Description	29
4.4.2	Geomorphological Processes Distribution	36
4.5	Soils.....	38
4.5.1	Soil Description.....	38
4.5.2	Soil Distribution.....	39
5	References.....	45

List of Tables

Table 3.1	Terrain Mapping Classification.....	8
Table 4.1	1991-2020 Temperature and Precipitation Climate Normals for Lupin	14
Table 4.2	Distribution of Surficial Materials Within the RAA	27
Table 4.3	Distribution of Dominant Surficial Materials Within the LAA	28
Table 4.4	Distribution of Dominant Surficial Materials along the Route Alignment	28
Table 4.5	Distribution of Dominant Surficial Materials within the Aerodrome, Jericho Station and Port Landside Infrastructure portion of the PDA	29
Table 4.6	Distribution of Dominant Geomorphological Processes within the LAA	36
Table 4.7	Distribution of Dominant Geomorphological Processes along the Road PDA	37
Table 4.8	Distribution of Dominant Geomorphological Processes within the Aerodrome PDA, Jericho Station PDA and Port PDA (Landside Infrastructure).....	37
Table 4.9	Summary description of Soil Great Group	38
Table 4.10	Soils present in the LAA.....	39
Table 4.11	Soil Mapping Unit Descriptions	40
Table 4.12	Distribution of Soil Mapping Units in the LAA	43

List of Figures

Figure 2.1	Terrain, Soils, and Permafrost Assessment Area	5
Figure 3.1	Example of terrain map label	7
Figure 4.1	Elevation profile along the route (in metres above sea level).....	13
Figure 4.2	1991-2020 Temperature and Precipitation Climate Normals for Lupin.	15
Figure 4.3	Regional Permafrost Distribution (modified from O'Neill et al. 2020a).	16
Figure 4.4	Conceptual scheme of talik distribution within discontinuous and continuous permafrost (from Van Huissteden 2020).	17
Figure 4.5	Talik assessment, High Lake, Lake L718 and Kennarctic River (modified from BGC 2006).	18
Figure 4.6	Permafrost ground ice estimation from ground ice map of Canada (based on O'Neill et al. 2019).	19
Figure 4.7	Theoretical ground thermal regime of a cold permafrost (from Lewkowicz et al. 2024).	20
Figure 4.8	Ground thermal regime of permafrost under marine clay deposits, from October 2004 to April 2006 at High Lake (from BGC 2006).....	21
Figure 4.9	Example of a till veneer over bedrock as observed by BGC (2013).....	23
Figure 4.10	Eskers (red arrows). Left: road crossing an esker (KM 115). Right: aerial picture showing an esker (BGC 2013).	24
Figure 4.11	Satellite image showing marine deposits in the vicinity of the proposed aerodrome site (in white).	25
Figure 4.12	Example of blocky colluvial deposit along the Koglokoakyok (Kennarctic River) near KM 176.	26
Figure 4.13	Example of gullies that have formed in glaciofluvial material east of the road alignment near KM 115.	30

**Grays Bay Road and Port Project
Terrain, Soils, and Permafrost Baseline Report**

Table of Contents
March 2026

Figure 4.14	Example of exposed marine material expected to be affected by wind erosion and gullying near the aerodrome site (lower left portion of the figure).	31
Figure 4.15	Examples of slopes exhibiting seepage across the road alignment near KM 212. The blue arrows show the drainage direction.	32
Figure 4.16	Gullies and landslides (indicated by the black arrows) in marine soils near the southern end of the aerodrome area (in white).....	33
Figure 4.17	Possible thermokarst features (indicated by the black arrows) including depressions and ponds in marine soils next to the aerodrome site.....	34
Figure 4.18	Ice wedge polygons. Left: conceptual scheme of an ice wedge polygons network (from Liljedahl et al. 2016). Right: Ice wedge polygons in the LAA in the Hood River area near KM 108.....	35
Figure 4.19	Example of gelifraction and bedrock shattering in the LAA (photo from BGC 2013).	35

List of Appendices

Appendix A	Regional Geology Map
Appendix B	Geotechnical Boreholes and Ground Temperature Monitoring Sites
Appendix C	Photographs of stream conditions across the PDA (from BGC 2013)
Appendix D	Surficial Material in the RAA
Appendix E	Surficial Material and Soils in the LAA

Abbreviations

asl.....	above sea level
BGC.....	BGS Engineering Inc.
GIS.....	Geographic Information System
GSC.....	Geological Survey of Canada
IAG.....	Inuit Advisory Group
IS.....	Impact Statement
KM.....	kilometre marker
LAA.....	Local Assessment Area
LiDAR.....	Light Detection and Ranging
MAGT.....	Mean annual ground temperature
MMG.....	Minerals and Metals Group
NIRB.....	Nunavut Impact Review Board
PDA.....	Project Development Area
Project, the.....	Grays Bay Road and Port Project
RAA.....	Regional Assessment Area
SMU.....	Soil Map Unit
WKR.....	West Kitikmeot Resources Corp.

Symbols and Units of Measure

%.....	percent
°C.....	degrees Celsius
cm.....	centimetre
ha.....	hectare
km.....	kilometre
m.....	metre

Glossary

Term	Definition
Fluvial	Well sorted sediments that have been transported and deposited by streams and rivers.
Geomorphological Processes	Natural mechanisms of weathering, erosion and deposition that results in the modification of the surficial materials and landforms at the earth's surface
Glaciofluvial	Fluvial sediments that were deposited in contact with glacial ice.
Glaciolacustrine	Lacustrine sediments that were deposited in contact with glacial ice.
Organic Soil	Soil order classified under the Canadian Soils Classification System (Soil Classification Working Group 1998) that is comprised of material of botanical origin varying in different degrees of decomposition within the pedon.
Overburden	Depositional material that is found below topsoil or organic soil and above mine rock that can sometimes be used in reclamation.
Parent Materials	Sediments from which soils form that are classified based on their mode of formation.
Peat	Organic (i.e., humic, mesic, or fibric material) horizons of Organic soils.
Permafrost	Ground (soil or rock and included ice or organic material) that remains at or below 0°C for at least two consecutive years
Project Development Area	Encompasses the anticipated area of physical disturbance associated with the construction and operations and maintenance of the Grays Bay Road and Port Project (the Project).
Soil	The surface organic layer, which includes live plant material, leaf litter, moss and decomposed organic matter, and the upper mineral soil layers. The upper mineral soil layers, typically the first 10 to 15 cm of a profile, comprise the rooting medium that provides nutrients and moisture-holding capacity for vegetation.

**Grays Bay Road and Port Project
Terrain, Soils, and Permafrost Baseline Report**

Glossary
March 2026

Term	Definition
Soil Erosion	The detachment, movement and later deposition of soil particles caused by water or wind. Accelerated erosion can be caused by human activity and can have adverse effects.
Soil Profile	Vertical section of soil from the ground surface to where the soil meets the underlying bedrock or unaltered surficial material.
Soil Quality	The measure of the capacity of a soil to function within a natural or managed ecosystem to sustain plant or animal productivity, maintain or enhance water and air quality and support human health and habitation.
Soil Reclamation Suitability	The physical, chemical, and biological properties and characteristics of soil affect its use as a plant growth medium.
Soil Texture	Defined by classes that are based on the size and distribution of primary particles (clay, silt, sand).
Surficial Material	Surficial materials are non-lithified, unconsolidated sediments. They are produced by weathering, sediment deposition, biological accumulation, human and volcanic activity.
Terrain	The Physical features and characteristics of the land, which include a mosaic of surficial materials, surface expressions (or landforms), as well as geomorphological processes (i.e., natural mechanisms of weathering, erosion and deposition) that result in the modification of the surficial materials and landforms at the earth's surface.
Topsoil	Leaf litter or organic layer and A and/or AB horizon of mineral soils.
Till	Sediments consisting of well-compacted heterogeneous material that has been transported on or in the vicinity of a glacier.

1 Introduction

West Kitikmeot Resources Corp. (WKR) is an Inuit-owned, Inuit-led company focused on the advancement of the Grays Bay Road and Port Project (the “Project”) in the Kitikmeot Region of Nunavut. WKR’s largest shareholder is a wholly owned subsidiary of the Kitikmeot Inuit Association. The Project is proposed as a multi-user, multi-use transportation infrastructure to be located on a combination of Inuit Owned Land and Crown land in the Kitikmeot Region of western Nunavut. Subject to approval, the Grays Bay Road and Port Project (the Project) would result in the establishment of the first deep water port in the Canadian Central Arctic at Grays Bay, as well as a 230 kilometre (km) all-season access road between Grays Bay and Jericho Station near Contwoyto Lake. The Project will connect to the already-approved Tibbitt to Contwoyto Winter Road (TCWR). The multi-user, multi-use Project would allow for the establishment of shared infrastructure with many potential users including the federal and territorial governments, communities, community members, resource companies, and defence agencies.

This Grays Bay Road and Port Project Terrain, Soils, and Permafrost Baseline Report (Baseline report) summarizes baseline conditions for terrain, soils, and permafrost within the Project spatial boundaries (as defined in Section 2), and was prepared to support the preparation of an Impact Statement (IS).

The content of this Baseline report was developed in accordance with the *Guidelines for the Preparation of an Impact Statement for West Kitikmeot Resources Corp’s Grays Bay Road and Port Proposal* (Nunavut Impact Review Board [NIRB] 2026), more specifically, with regards to specific guidance associated with the terrestrial environment Valued Component, which includes physiography and bedrock geology, permafrost, surficial materials and landforms, geomorphological processes and soils.

For the purposes of this Baseline report, soils are defined as the surface organic layer, which includes live plant material, leaf litter, moss and decomposed organic matter, and the upper mineral soil layers. The upper mineral soil layers, typically the first 10 to 15 centimetres (cm) of a profile, comprise the rooting medium that provides nutrients and moisture-holding capacity for vegetation. The terrain refers to physical features and characteristics of the land, which includes a mosaic of surficial materials, surface expressions (or landforms), as well as geomorphological processes (i.e., natural mechanisms of weathering, erosion and deposition that result in the modification of the surficial materials and landforms at the earth’s surface). The permafrost (i.e., earth material whose temperature remains below 0°C continuously for two years or longer) is a key characteristic of northern landscapes.

Key topics included in the baseline description of terrain, soils, and permafrost for the Project include the following:

- Physiography and Bedrock Geology (Section 4.1)
- Permafrost (Section 4.2)
- Surficial Materials (Section 4.3)
- Geomorphological Processes (Section 4.4)
- Soils (Section 4.5)

1.1 Inuit Knowledge, Traditional Knowledge, and Community Knowledge

A considerable amount of Inuit Knowledge has been documented for the Project, which has substantially informed WKR's understanding of baseline environmental and socio-economic conditions in the Project Development Area (PDA). For the purposes of the IS, focus is placed on Inuit of the Kitikmeot Region, or Kitikmiut. The Project is located wholly within the Kitikmeot Region; as such, the region and its people are where key Project interactions and effects are most likely to occur.

Verified Inuit Knowledge and perspectives considered and integrated in the IS were shared through two primary Project-specific sources.

1. **Naonaiyaotit Traditional Knowledge Project (NTKP):** The Kitikmeot Inuit Association maintains a repository of Inuit Knowledge for the Kitikmeot Region within a Geographic Information System (GIS)-based database called the NTKP. The NTKP contains the collective body of documented and verified Inuit Knowledge of the Kitikmeot Region, including but not limited to knowledge of birds, fish, terrestrial and marine mammals, water quality, travel routes, gathering places, and heritage. The Kitikmeot Inuit Association compiled a Project-specific report called *Kitikmiut Knowledge of the Proposed Koglokoakyok (Grays Bay) Port and Road Project* (Banci and Spicker 2024), which provides the majority of the Inuit Knowledge shared and integrated in the IS.
2. **Inuit Advisory Group (IAG):** Initiated in 2018 by the previous Project proponent, WKR re-initiated the IAG in 2025. Through a series of IAG workshops, WKR and Inuit land users, Elders, and Knowledge Holders have met to discuss and document feedback and advice about the Project, including but not limited to dialogue about wildlife, fisheries, land use, archaeology, water, air quality, and access management. Through the IAG, multiple perspectives have been shared, allowing for the integration of knowledge systems (both Inuit Knowledge and western science), resulting in a more informed and sustainable Project. At the time of filing, four IAG workshops had occurred (GBEEC 2018a, 2018b; IAG 2025a, 2025b), with additional workshops planned for the future.

Pertinent baseline information from these sources of Inuit Knowledge is not presented further here; rather, this information is provided in the above-noted reports themselves, the 'Baseline Conditions' sections of each assessment section, and integrated in the Terrain, Soils, and Permafrost section (see Volume 6, Section 14 of the IS) where appropriate. The same process was applied when integrating baseline information associated with applicable Traditional Knowledge and Community Knowledge shared in publicly available literature and through the Project-specific engagement program.

2 Spatial Boundaries

The Project is entirely located within the Kitikmeot Region of Nunavut as shown in Figure 2.1. Project components will be located on a combination of Crown land and Inuit Owned Lands and in federal waters.

The soils, terrain and permafrost spatial boundaries were selected based on past project experience, guidance from regulators, input from Kitikmeot Inuit (hereafter referred to as Kitikmiut), other Indigenous groups, and other potentially affected communities, public interest, and professional judgment. These boundaries represent the areas where data was compiled to characterize baseline conditions in support of the project-specific effects assessment and the cumulative effect assessment.

2.1 Project Development Area

The Project Development Area (PDA) encompasses the physical footprint of all project components, including both permanent and temporary disturbances (e.g., extent of project infrastructure, planned clearing, and laydown areas). The PDA includes six sub-areas based on the types of components to be developed: the Port (which is further divided into marine and landside infrastructure), Road, Aerodrome, Jericho Station, and Winter Road PDAs. The boundaries of the PDAs were created by applying buffers around where the Project components will be sited and varies by each of the sub-areas depending on necessary flexibility for final siting of certain project components based on conditions on the ground. For the Road PDA and Winter Road PDA, a 75 m buffer was applied to the roads centreline, for the Port PDA and the Aerodrome PDA, the areas were subdivided based on the conceptual project component locations and then buffered approximately 1,000 m for the landside Port PDA, approximately 300 m for the marine Port PDA, and 500 m for the Aerodrome PDA. The Jericho Station PDA was buffered based on the existing development from the old Jericho Mine site that will be used for the Project and the need for additional space to accommodate the Project components that will be developed as part of the Project for this location. The Winter Road PDA will only exist annually between the beginning of February and end of March, will be built on land where the existing Jericho Station road ends, at the southeastern portion of Jericho Station, to the shoreline of Contwoyto Lake where it will connect to the TCWR. For the purposes of the impact assessment, the PDA is the same as the Site Study Area identified in the IS Guidelines. The soils, terrain, and permafrost assessment areas, including the PDA, are shown in Figure 2.1

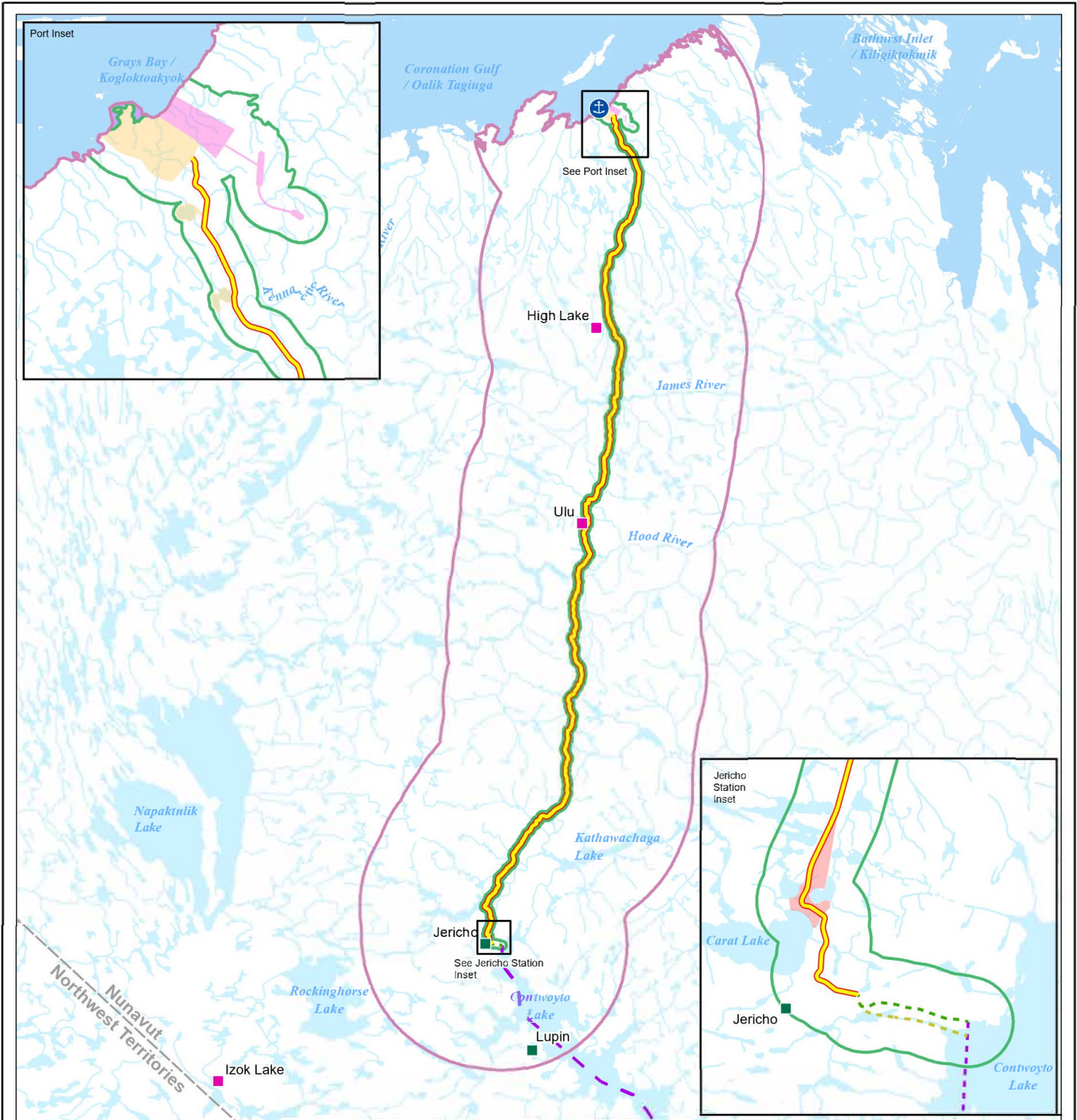
2.2 Local Assessment Area

The Local Assessment Area (LAA) for soils, terrain and permafrost was defined as a 1 kilometre (km) buffer centered on the PDA. It is within which project environmental effects, both direct and indirect, can be predicted or measured with a reasonable degree of accuracy and confidence. The LAA includes the PDA and adjacent areas where environmental effects may reasonably be expected to occur.

The size of the LAA is consistent with other interconnected disciplines such as vegetation and wildlife.

2.3 Regional Assessment Area

The Regional Assessment Area (RAA) for soils, terrain and permafrost was defined as a 30-km buffer centered on the PDA based on regional context needed for vegetation and wildlife assessment (i.e., to align with vegetation connectivity, and with wildlife and wildlife habitat assessment boundaries). It includes the area within which cumulative effects on soils, terrain and permafrost may occur, depending on the location of other past, present or reasonably foreseeable future projects or activities.



- Grays Bay Port
 - Grays Bay Road
 - Grays Bay Winter Road
 - Grays Bay Winter Road Optional Alignment
 - Local Assessment Area (LAA)
 - Regional Assessment Area (RAA)
 - Advanced Mineral Exploration Site
 - Closed Mine Site
 - Territorial Boundary
 - Tibbitt to Contwoyto Winter Road
 - Watercourse
 - Ocean
 - Waterbody
- Project Development Area (PDA)**
- Aerodrome
 - Jericho Station
 - Port (Landside Infrastructure)
 - Port (Marine-based Infrastructure)



Project Location: Kitikmeot Region, Nunavut
 Client/Project: West Kitikmeot Resources Corp
 Grays Bay Road and Port

Figure No. 2.1
 Title: Terrain, Soils, and Permafrost Assessment Area

Terrain, Soils, and Permafrost Assessment Area

Notes
 1. Coordinate System: WGS 1984 UTM Zone 12N
 2. Data Sources: Governments of Nunavut and Canada, Stantec

3 Methodology

The approach developed to gather information and present baseline conditions for the PDA, LAA and RAA consisted of the following tasks:

- The review of background data relevant to soils, terrain and permafrost (including data gathered from previous field investigation programs)
- Soil and terrain mapping

Details regarding the methodology associated to both these tasks are presented below.

3.1 Compilation and Review of Background Data

A desktop assessment of existing background data was conducted to establish baseline conditions for terrain, soils, and permafrost. Several different data sources were consulted, including existing project-specific reports, digital mapping datasets, data from previous field investigation programs and scientific peer-reviewed literature. A complete list of references consulted to prepare this report is presented in Section 5.

3.1.1 Project-Specific Reports and Datasets

Among the first documents reviewed as part of the background review were historic reports and datasets produced as part of baseline studies previously conducted for earlier iterations of the Project as directed or for the Kitikmeot Inuit Association, Government of Nunavut, Minerals and Metals Group (MMG) Limited and other previous proponents.

3.1.2 Other Data Sources

Key data sources consulted as part of the assessment included the following:

- Google Earth and ArcGIS satellite imagery
- Light Detection and Ranging (LiDAR)
- Topographic base data and other digital datasets available from the Government of Data Catalogue
- Publications and geospatial datasets from the Geological Survey of Canada (GSC), including:
 - Permafrost-related landforms and geotechnical data compilation, Yellowknife to Grays Bay corridor region, Slave geological province (Morse et al. 2023)
 - Bedrock geology mapping by Stublely and Irwin (2019)
 - Surficial geology mapping by the GSC (2014, 2016a, 2016b, 2017; Kerr 2018, 2022), that includes a distinct category for eskers
- Publicly available reports and scientific literature (see in-text references).

3.2 Terrain Mapping

The main purpose of the soils and terrain mapping was to augment the understanding of site-specific conditions within the PDA and LAA. This mapping was required as existing open-source mapping data often lack precision to adequately document site conditions at a project development scale.

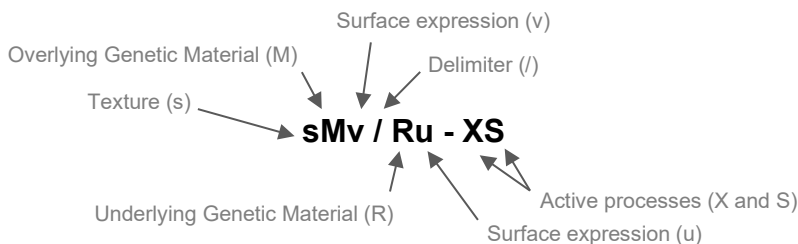
Mapping terrain conditions within the LAA was initiated as part of previous studies associated with earlier iterations of the Project. In 2004 and 2005, the project footprint included a corridor running nearly due north from Ulu to Grays Bay, with additional project footprints related to the port facilities at Grays Bay and at High Lake. In 2007 and 2008 additional mapping took place linking Ulu to Izok Lake via a road route going nearly due south to the Lupin mine site via the Jericho Mine site and then west to Izok Lake. This mapping was completed by Gartner Lee Limited. In 2012, Paragon completed some additional mapping and ground truthing of the initial terrain mapping as part of their ecosystem mapping. Summary observations from that mapping are included in a draft report by Paragon (2012).

In 2024 and 2025, Nunami Stantec compiled existing datasets and completed some additional mapping for a few areas not covered as part of previous project iterations. The mapping was conducted using the ArcGIS platform, using available aerial photography, ortho-imagery and LiDAR-derived data available for the Project.

As part of the mapping, relatively homogeneous terrain units (or polygons) were delineated based on surficial materials (e.g., till, glaciolacustrine), surface expression (e.g., hummocky, fan), or stratigraphic composition (i.e., identifying the expected subsurface material) and geomorphological processes (e.g., gully). In general, the delineation was conducted at scales ranging from 1:5,000 to 1:10,000. As a rule, surficial materials occupying less than 20 % of the total area of a polygon were not indicated in the terrain unit label.

Because of the detailed nature of the mapping, some terrain map units (polygons) were classified using a composite label accounting for two main material types. The description of the terrain map labels is presented in Figure 3.1 below.

Figure 3.1 Example of terrain map label



For consistency, the terrain map classification and legend are the same as initially developed in earlier iterations of the Project (see Table 3.1). A simplified version of the legend is included on the 1:20,000 terrain figures, which are presented in Appendix E.

Table 3.1 Terrain Mapping Classification

Genetic Materials		
Code	Definition	Description
A	Anthropogenic (disturbed)	Material or deposit altered by human activity.
C	Colluvium	Usually boulder- and cobble-rich, with silty to sandy matrix. Bedrock is usually present within a few metres of the surface.
F	Fluvial	Dominantly sand and silt, with coarser beds and stringers. Flooding and high-water table common.
G	Glaciofluvial	Usually mixed sand and gravel, with occasional boulders. Include eskers.
L	Glaciolacustrine	Usually silt and fine sand, with some clay.
M	Marine	Dominated by clay and silt, with fine to coarse sand common. Sandy to gravelly sand layers are common.
O	Organic	Partly to fully decomposed plant matter >0.4 m thick.
R	Bedrock	Exposed or very shallow bedrock.
T	Till (glacial)	Usually composed of well-graded (poorly sorted) sand, silt, and cobbles. Boulder-rich. Till and colluvium could not always be differentiated.
U	Undifferentiated	Boulder-rich with unknown composition at depth. Probably shallow bedrock, but boulder-rich surface prohibited further observation.
<i>A stratigraphic relationship between two genetic materials is indicated with a forward slash, where the material (capital letter) left of the slash overlies the material (capital letter) right of the slash.</i>		
Surface Expressions		
Code	Definition	Description
b	Blanket	Between about 1 and 2 m thick.
c	Channel-shaped, channelled	May act as a water collector and/or water movement path.
d	Depression	May act as a water collecting basin.
e	Delta	Fan-shaped with higher centre and lower edges and front (inferred to have formed in subaqueous).
f	Fan	Fan-shaped with higher centre and lower edges and front (inferred to have formed subaerially).
h	Hummocky	Lumpy, irregular topography.
j	Strong Slopes	Uniform Strong Slopes (15-45 %)
k	Kettled, pitted (non-genetic)	Bowl-shaped or irregular concavities in otherwise relatively level ground.
l	Long, gentle slope	Continuous slope of mainly uniform grade.
m	Rolling	Wave-like to irregular rising-and-falling topography.
p	Plain	Broad, mainly level terrain.
r	Ridge	Linear, elevational crest(s).
s	Steep slope	Composite or simple slopes at or greater than repose angle of boulders (>45 %)
t	Terraced	A scarp face and the horizontal or gently inclined surface (tread) above it
u	Undulating	Gently rising-and-failing topography.

**Grays Bay Road and Port Project
Terrain, Soils, and Permafrost Baseline Report**

Section 3: Methodology
March 2026

Surface Expressions (cont'd)		
Code	Definition	Description
v	Veneer	Less than about 1 m thick.
w	Discontinuous	Thickness ranging between 0 and 2 m.
x	Complex	Multiple landform types of particular origin.
<i>Up to two surface expressions can be used. These surface expressions may be superimposed or occur separately within a given map unit.</i>		
Geomorphological Processes		
Code	Definition	Description
A	Rapid mass movement	Downslope gravitational wastage of material that occurs within seconds to minutes (e.g., debris slide/flow, rockfall).
D	Deflation	Removal of fine sediments (mainly sand and silt) from the surface of a landform by wind erosion.
K	Thermokarst	Formation of cavities, sinkholes and/or gullies through permafrost melt.
S	Solifluction, seepage	Slow, frost-related soil creep and/or subsurface drainage on slope.
V	Gullied	Incision of V-shaped ravines through fluvial and hillslope processes.
W	High water table, poorly drained	Water table is close to surface (<1 m), or the site is otherwise wet due to poor surface drainage.
X	Permafrost-affected (general)	Influenced by permafrost processes, including cryoturbation, frost boils and/or melt.
Xb	Beaded stream	Ice wedges and/or ice bodies present below the surface. Poor drainage and stream nearby. Potentiality seasonal flooding.
Xw	Ice wedge-polygonal ground	Ice wedge-polygonal ground originating through poor drainage and formation of near-surface ice bodies.
<i>Up to two processes can be used. When no letter shows in the map label, geomorphological processes are assumed to be inactive or have not had an important effect on landform morphology.</i>		

3.3 Soil Mapping

For the purpose of this Baseline report, soil types and landscape features are represented by soil map units (SMUs). SMUs are individual polygons encompassing areas of similar dominant surficial material, dominant slope gradients, drainage and soil and topographic assemblages found within the delineation.

For the LAA, SMUs were derived from the polygons that were initially produced as part of the terrain mapping exercise. These polygons (or parent materials) are representative of local soil development patterns as they represent the underlying geological material (generally bedrock or a superficial or drift deposit) in which soil horizons have formed. The size and characteristics of the resulting SMU polygons adhere to standards established by the Canadian System of Soil Classification (Mapping System Working Group 1981).

The SMU polygons were classified as follows:

- By attributing terrain mapping polygons based on inferred relationships between soil types and surficial material, vegetation types, slope gradients, slope morphology, drainage patterns and soil landscape types,
- Soil data collected from field surveys was used to assign dominant and co-dominant soil types, soil texture, coarse fragment content and drainage for each SMU polygon. Polygons without inspection points had data extrapolated from adjacent polygons containing inspection points.

3.4 Field Studies

Field studies specific to documenting soils and terrain conditions occurred in 2004, 2005, 2008 and 2012.

The primary objectives of these studies were to observe, describe, and interpret soils (pedological) and terrain (geomorphological) features, structures, and processes. Special interest was given to augment the information base for underrepresented soil and landform types, and to collect soil and landform information including the presence of permafrost. The field investigation also provided key opportunities to validate observations and findings made as part of the desktop mapping.

Soils were described and classified according to the Soil Classification Working Group (1998). Soil inspections were done by digging small pits followed by hand-augering either to permafrost, stony contacts or a control depth of 1 m. Organic soils were examined by extracting samples with a soil auger, or a soil probe with extensions to permafrost, or to a refusal depth.

Soil samples for laboratory analyses were collected at selected sites to confirm soil classification and to provide data for land use interpretations. Relevant soils, landform and permafrost information, such as organic matter depth were also recorded.

The following field investigations program was conducted for the Project.

Gartner Lee Limited and Paragon - 2008

Ground inspections in 2004, 2005 and 2008 consisted of slope measurement in percentages, aspect, landscape position, elevation, drainage class as per Agriculture Canada's soil classification system (Soil Classification Working Group 1998), textural composition using both soil textural classification and the Unified Soil Classification system, depth to permafrost and/or bedrock, and surface stoniness. Information on the water table or subsurface water movement was noted when relevant. Surface expression, landform associations (Soil Classification Working Group 1998), and active or potential geomorphological processes were also noted.

Paragon - 2012

The latest round of fieldwork was conducted by Paragon in the Izok Corridor Project area during the summer of 2012. Eighty-five sites were inspected including four reclaimed sites at Lupin mine and four disturbed sites along the winter road.

Soil pits were dug approximately 1 m deep or shallower to the depth of permafrost or rock within or next to each vegetation survey plot. At each soil inspection site, observations were made regarding texture, genetic material, surface expression and active process. Slopes, aspect, stoniness, land use, erosion, drainage, nutrient and moisture regimes and depth to permafrost, bedrock or water were also described. Soil profile descriptions included horizon depth, colour, mottles, texture, structure, rooting, and coarse fragments. These soils and landscapes were described in accordance with soil survey guidelines (Coen 1987; Soil Classification Working Group 1998).

Soils and Terrain Field Database

Data collected during the above-listed historical field programs, including available photographs and laboratory results were compiled into an Access Database. The database includes site-specific information on a total of 552 individual field plots, some including soil laboratory results.

Data contained within this database was used to validate the soils and terrain mapping conducted for the LAA.

4 Summary Baseline Conditions

The following sections summarize the findings of the baseline program for terrain, soils, and permafrost based on available background data and reports, soil and terrain mapping as well as historical field investigations conducted for the Project.

4.1 Physiography and Bedrock Geology

The LAA extends from Jericho Station, northwest of Contwoyto Lake, to the Grays Bay Port in the Coronation Gulf. From south to north, the Project crosses four watersheds, which are associated with the following main rivers: the Burnside River, the Hood River, the James River and the Kennarctic River. Hydrological information on each of those watersheds is available from the Grays Bay Road and Port Project Hydrology Baseline Report (see Volume 7, Appendix 19A of the IS).

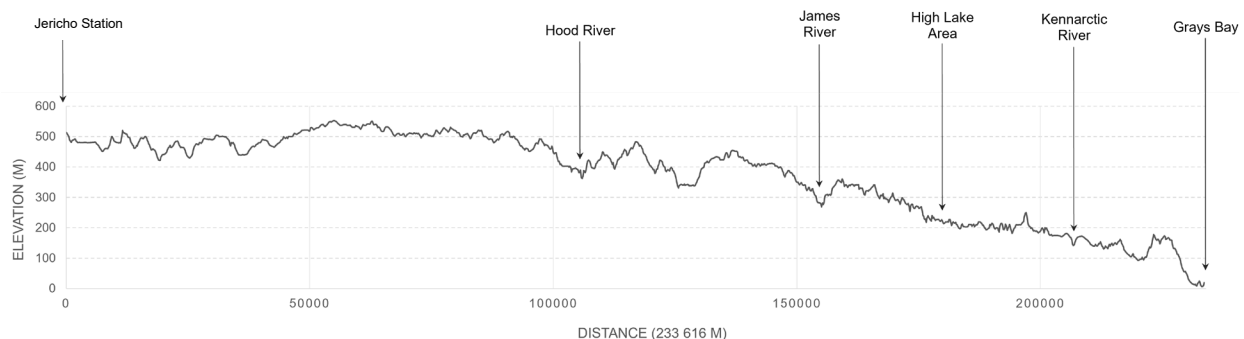
Both the LAA and RAA are located on the Canadian Shield, Kazan region, Bear-Slave Upland subdivision. The physiographic region is characterized by homogenous large areas of bare and massive rocks, forming broad treeless uplands, plateaus, and lowlands (Government of Canada (GOC) 2019). The bare rock landscape was shaped by glaciers, forming undulating bedrock dominated by glacial deposits. The deglaciation of the area started at about 12,500 years before present (Kerr 1996). The isostatic depression caused by ice load resulted in the sedimentation of marine deposits along the Coronation Gulf shoreline, within marine soils now present at elevation reaching up to about 200 metres (m) above sea level (asl) (Wolfe et al. 2017).

The topography of the region is described as undulating to moderately rugged. The PDA, LAA and RAA cross undulating bedrock, canyons, steep cliffs, valley bottoms and numerous lakes. Overall, the topography is fairly subdued, with most bedrock-controlled hills generally showing under 100 m of total elevation gain/loss.

An elevation profile developed from open-sourced digital elevation data¹ along the proposed road alignment shows an elevation of approximately 514 m asl at the beginning of the route near Jericho Station then reaching an elevation of approximately 40 m at the endpoint of the route (kilometre marker [KM] 233), next to the Port PDA (see Figure 4.1). The maximum elevation of 552 m asl is found near KM 50 of the road, between Jericho Station and Hood River. The total length of the road is 233.2 km. Figure 4.1 provides a general overview of the elevation variations along the road PDA.

¹ <https://www.pgc.umn.edu/data/arcticdem/>

Figure 4.1 Elevation profile along the route (in metres above sea level)



The bedrock within the road alignment and within the LAA comprises a complex series of Archean sedimentary and volcanic rocks, as well as Proterozoic igneous rocks. From south to north, the LAA crosses six main rock categories, which consist of the following: argillite-meta-sedimentary, granitoid, volcanic, turbidic wacke to mudstone, mafic (gabbro, anorthosite, diorite) and sills/dykes composed of diabase and gabbro (Lorax 2013, Stublely and Irwin 2019).

A figure presenting the regional bedrock geology (Stublely and Irwin 2019) along the RAA is presented in Appendix A.

The bedrock is mainly exposed and is covered by thin to thick mantle of surficial material, primarily till and marine sediments towards the north. The surficial materials can be discontinuous, 2 m thick (veneer) to 20 m thick (mantle), as described in Section 4.3.

4.2 Permafrost

4.2.1 Climate

The Koppen-Geiger climate classification indicates that the RAA is located in the polar tundra climate zone (Kottek et al. 2006). Environment and Climate Change Canada (ECCC) operates meteorological stations with long-term records in Lupin and Kugluktuk. Lupin is approximately 30 km south-southeast of Jericho Mine while Kugluktuk is located on the Nunavut coast approximately 180 km west of the proposed Grays Bay Port. BGS Engineering Inc. (BGC 2013) compared air temperatures from the short and sporadic records from Izok Lake, High Lake, and Grays Bay with the ECCC stations and determined the Lupin record is closest in average daily air temperatures and provides a good approximation of historical air temperature for the RAA.

For the most recent climate normals period, 1991-2020, mean annual air temperature in Lupin was -10.3°C . Mean monthly air temperatures are below 0°C for eight months (October-May), with the coldest mean monthly air temperatures of -28.9°C and -28.3°C recorded in January and February, respectively. During the summer, the warmest mean monthly air temperature of 12.0°C was recorded in July. In the 1982-2025 station record, extreme temperature ranges for Lupin from -49.0°C to 31.0°C . During the 1991-2020 period, the average number of freezing degree days and thawing degree days in Lupin was 4741.1 and 973.2, respectively.

**Grays Bay Road and Port Project
Terrain, Soils, and Permafrost Baseline Report**

Section 4: Summary Baseline Conditions
March 2026

Mean total annual precipitation (rain and snow) in Lupin was 303.5 mm (water equivalent) during the 1991-2020 period, with 160.5 mm of rainfall and 143.3 cm of snowfall. Rainfall accounts for the majority (approximately 88 to 97 %) of the precipitation recorded during the summer months (June-August) with snowfall accounting for the majority or all the precipitation recorded October to April (approximately 97 to 100 %); May and September precipitation is a mix of rainfall and snowfall. The largest mean monthly total rainfall of 35.4 mm was recorded in August while the largest mean monthly total snowfall of 29.0 cm was recorded in October. In the 1982-2025 station record, extreme daily precipitation records for Lupin are 41.8 mm of rainfall and 31.8 cm of snowfall.

1991-2020 temperature and precipitation climate normals values for Lupin are presented in Table 4.1 and Figure 4.2.

Table 4.1 1991-2020 Temperature and Precipitation Climate Normals for Lupin

1991-2020 Climate Normals for Lupin	Daily Mean Air Temperature (°C)	Daily Maximum Air Temperature (°C)	Daily Minimum Air Temperature (°C)	Total Precipitation (mm)	Total Rainfall (mm)	Total Snowfall (cm)
Annual						
Annual	-10.3	-6.5	-14.0	303.5	160.5	143.3
Seasonal						
Winter	-27.6	-24.1	-30.9	29.7	0.0	30.1
Spring	-15.0	-10.8	-19.0	48.1	5.4	42.7
Summer	9.5	14.1	4.9	134.3	128.6	5.9
Fall	-8.1	-5.1	-11.0	91.4	26.6	64.7
Monthly						
January	-28.9	-25.3	-32.4	8.0	0.0	8.0
February	-28.3	-24.7	-31.3	7.5	0.0	7.9
March	-24.2	-20.3	-28.0	14.0	0.0	14.0
April	-15.7	-11.3	-20.4	15.4	0.6	14.9
May	-5.0	-0.9	-8.6	18.7	4.8	13.8
June	7.1	11.9	2.4	28.7	25.1	3.7
July	12.0	17.1	7.0	38.4	38.1	0.3
August	9.3	13.3	5.4	67.2	65.4	1.9
September	2.6	5.5	-0.3	43.7	25.7	17.9
October	-7.7	-5.2	-10.1	29.9	0.9	29.0
November	-19.1	-15.7	-22.5	17.8	0.0	17.8
December	-25.7	-22.3	-29.1	14.2	0.0	14.2

Notes:

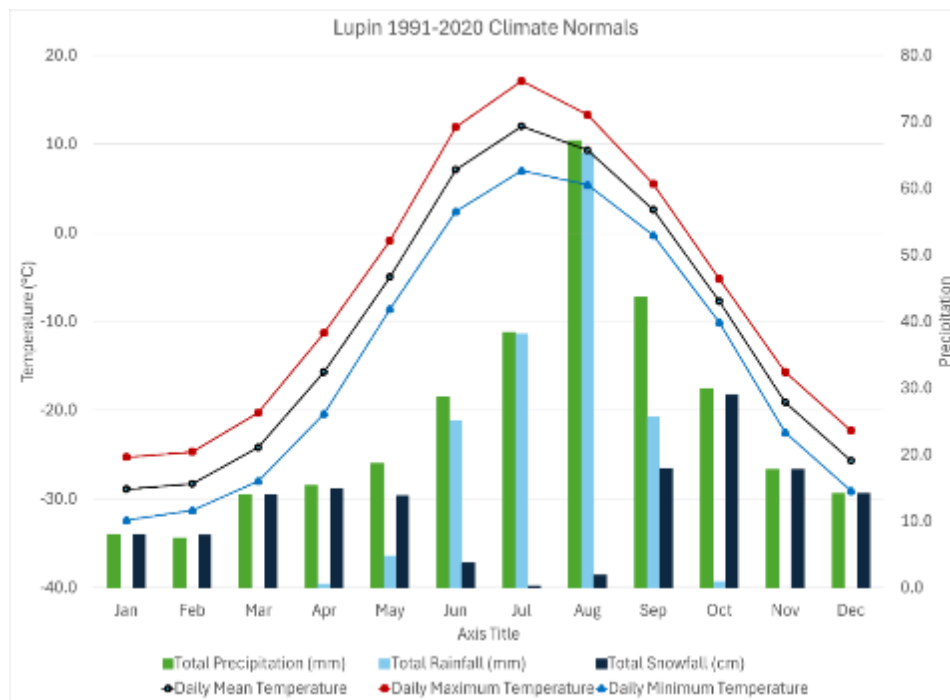
Winter = December, January, February

Spring = March, April, May

Summer = June, July, August

Fall = September, October, November

Figure 4.2 1991-2020 Temperature and Precipitation Climate Normals for Lupin.



4.2.2 Active layer

Active layer is the upper ground layer that will vary above and below 0°C during the year (thaw and freeze) according to seasonal variation (Permafrost Subcommittee 1988). Active layer thickness will vary according to the ground surface characteristics (topography, soil texture, organic soils, vegetation, snow cover and onset, water bodies).

Data relative to the active layer within the LAA is available from soils and terrain surveys conducted by AECOM (2011), Paragon (2012), Rescan (2013), and geotechnical investigations by BGC (2013). Thermistor data from 2008 (AECOM 2011) indicated an active layer thickness ranging from close to 0 to 8 m around Izok Lake, 70 km southeast of the LAA. Active layer observations were also made from soil pit observations conducted in eighty-five sites in July and August 2012 (Paragon 2012). Measurements range from shallow active layer in ice-rich marine deposits (15 to 70 cm), to greater than the full depth of the soil pits (1 m) in glaciofluvial, till, and colluvium deposits.

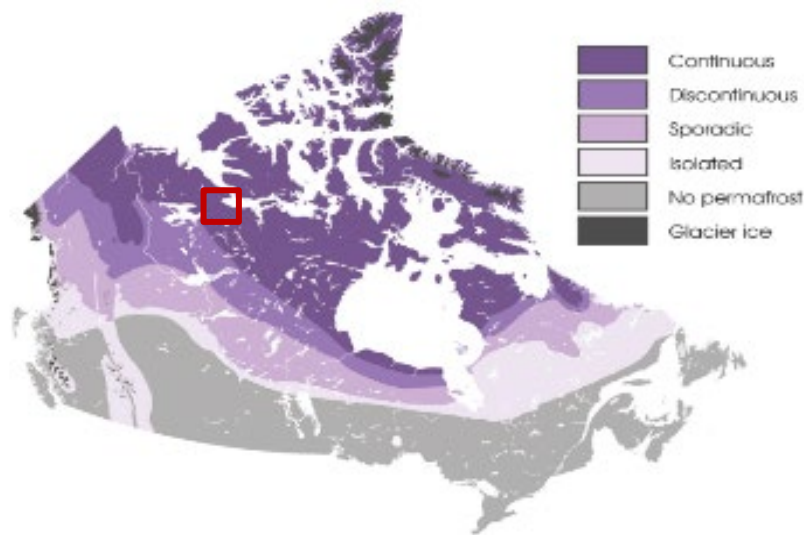
At the Goose Property Area, about 230 km South-East of the southern limit of the PDA, the active layer depth was between 1.25 and 1.65 m; at the George Property, about 170 km East of the southern limit of the PDA the active layer depth was between 1.5 and 2.4 m (Rescan 2013).

BGC (2013) compiled active layer thicknesses from drilling conducted at the mine sites of Jericho, Ulu and High Lake, plus Grays Bay Port between 1993 and 2006. The active layer measurements were observed to vary according to location and surficial material types. At the south of the LAA, the reported active layer was shallow in organic soil (0.5 m) and deeper in bedrock (up to 4 m). Along the central and northern portions of the LAA, it ranges from 1.2 to 6 m, the deeper measurements were found in bedrock at High Lake. In the northern area of the Port PDA, the active layer was 1.5 m thick in marine sediments.

4.2.3 Permafrost distribution

Permafrost refers to ground material that remains at or below 0°C for a minimum of two consecutive years (Permafrost Subcommittee 1988). The RAA is located by continuous permafrost, which underlays 90 to 100 % of the area (Heginbottom et al. 1995; O'Neill et al. 2020a).

Figure 4.3 Regional Permafrost Distribution (modified from O'Neill et al. 2020a).



In the RAA, permafrost is expected to be thicker than 300 m (BGC 2013). The estimated base of permafrost in the Izok Lake area is from 251 to 300 m deep and about 440 m deep in the High Lake area (AECOM 2011, BGC 2006).

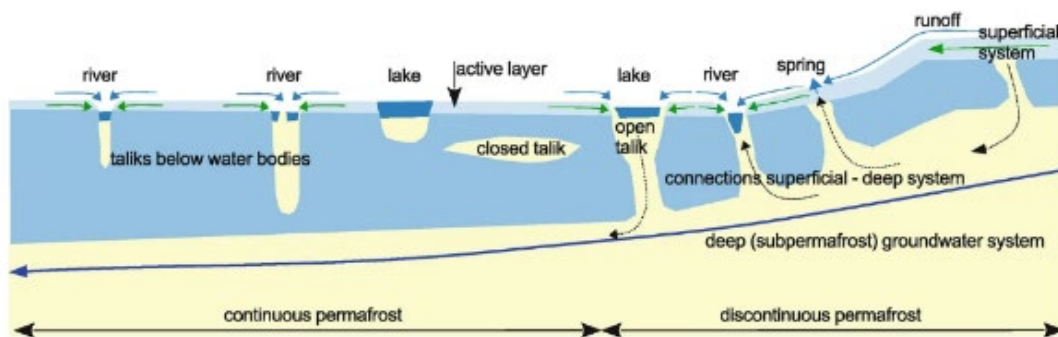
Climate is the predominant element controlling the broad distribution of permafrost. Other contributing factors influencing its distribution and properties (e.g., depth, ice content) include the topography, soils characteristics, vegetation and snow cover, surface water, geothermal gradient as well as the overall geological history of a given location. Those properties will then influence the thaw sensitivity of permafrost.

4.2.4 Taliks

Taliks are bodies or layers of unfrozen ground in permafrost areas. They form around lakes and tributary streams that do not freeze completely in the winter; the temperature of the water will influence the ground temperature regime, resulting in taliks that vary in size and shape. When the talik is confined to a specific area, it is a closed talik. When different taliks are connected to each other, they form an open talik and create a hydraulic connection between water bodies in permafrost area (Figure 4.4).

In continuous permafrost, taliks represent 0 to 10 % of unfrozen ground, and are expected to be confined under larger water bodies.

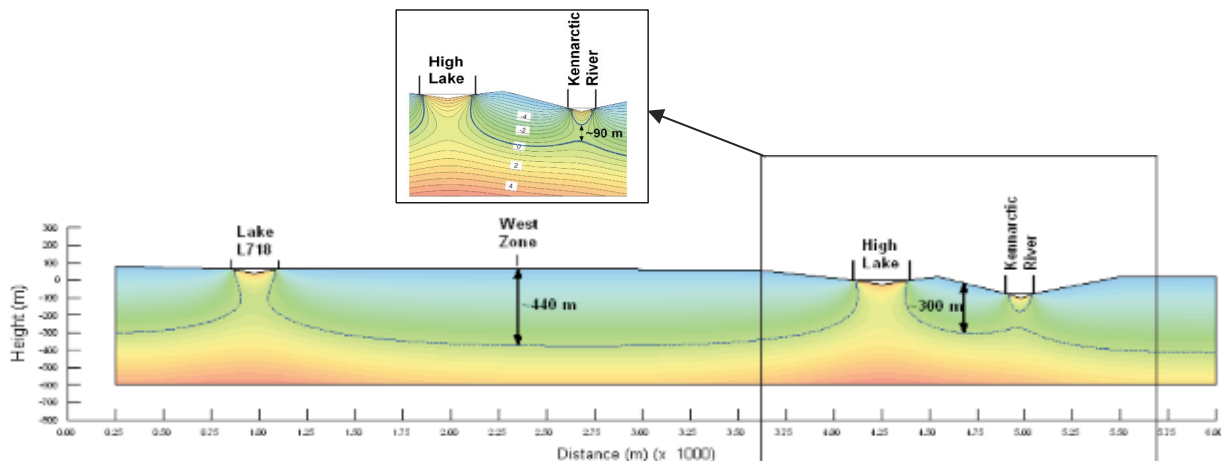
Figure 4.4 Conceptual scheme of talik distribution within discontinuous and continuous permafrost (from Van Huissteden 2020).



Along the LAA, taliks are expected to be found under large lakes and rivers. For instance, open taliks were observed below large lakes at the southern end of the LAA, around Izok Lake (AECOM 2011). Under the Izok Lake, an open talik extends from the bottom of the lake to about 265 m below, at the base of permafrost, and saturates fresh and weathered bedrock (AECOM 2011). It connects the lake to the deep groundwater systems vertically, and it is horizontally confined by permafrost.

BGC (2006) assessed that open taliks can develop under round lakes that are larger than 470 m in diameter and elongated lakes that are larger than 240 m in width. In the High Lake area, BGC (2006) investigations showed the existence of a talik at Granite Lake, which reaches 15 m deep. Their model simulations in the High Lake area showed that High Lake's talik extended to L718 Lake's talik, indicating a hydraulic connection between the two lakes, and potential permafrost degradation (Figure 4.5). The model showed that the Kennarctic River had a closed talik (BGC 2006).

Figure 4.5 Talik assessment, High Lake, Lake L718 and Kennarctic River (modified from BGC 2006).



4.2.5 Ground ice

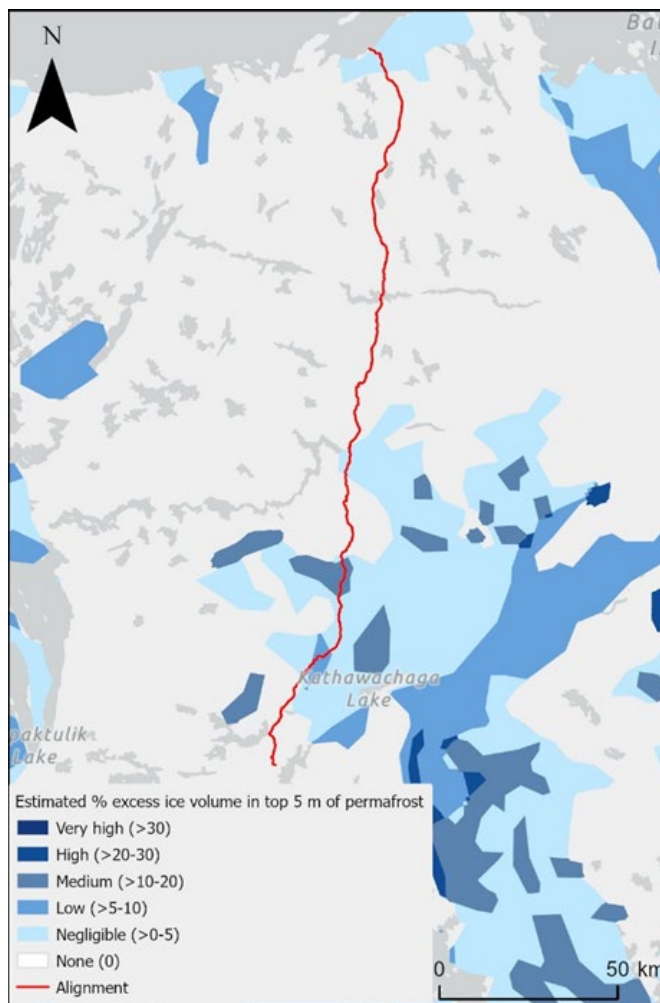
Ground ice is present in permafrost soils in various forms, such as porous ice that fills the pores of the soils, ice lenses (from under a mm thick to a few decimetres thick) or massive ice that can reach a few metres of thickness.

According to permafrost mapping and regional ground ice estimations (O'Neill et al. 2020b), the permafrost ground ice content is expected to be low within the LAA, ranging from absent to less than 5 % (Figure 4.6). The only exceptions are two short segments south and north of the RAA, where low (5 to 10 % of excess ice) to medium ground ice content (10 to 20 % of excess ice) may be present.

Segregated ice consists of discrete ice lenses or layers that form by migration of unfrozen pore water towards a freezing front (Taber 1929; O'Neill et al. 2019). Examples include ice structures that bound the enclosing sediments (intrusive ice), reticulate ice lenses, layers, and veins, ice crystals and icy coatings on soil particles. When the ice content (ice volume / ground volume) exceeds the unfrozen soil porosity (ground pore volume / ground volume), it is called excess ice (Van Everdingen 2005). In the active layer, segregated ice pushes soil particles and stones to the surface, and on slopes results in the slow downslope movement of soil materials. The process is driven by daily freeze–thaw cycles and is expected to be encountered within the LAA/RAA. The ice contents of the different surficial materials are expected to vary from high in peat and organic-rich soils, fine-grained glaciolacustrine or clay-till, to low in alluvial and glaciofluvial sand and gravels.

Massive ice may occur as large bodies of preserved glacial ice (relic ice), as thick ice beds developed in situ by segregation occurring between fine-grained materials (silts and clays) and coarser sands, and as ice wedges (see Section 4.4.1.5).

Figure 4.6 Permafrost ground ice estimation from ground ice map of Canada (based on O'Neill et al. 2019).



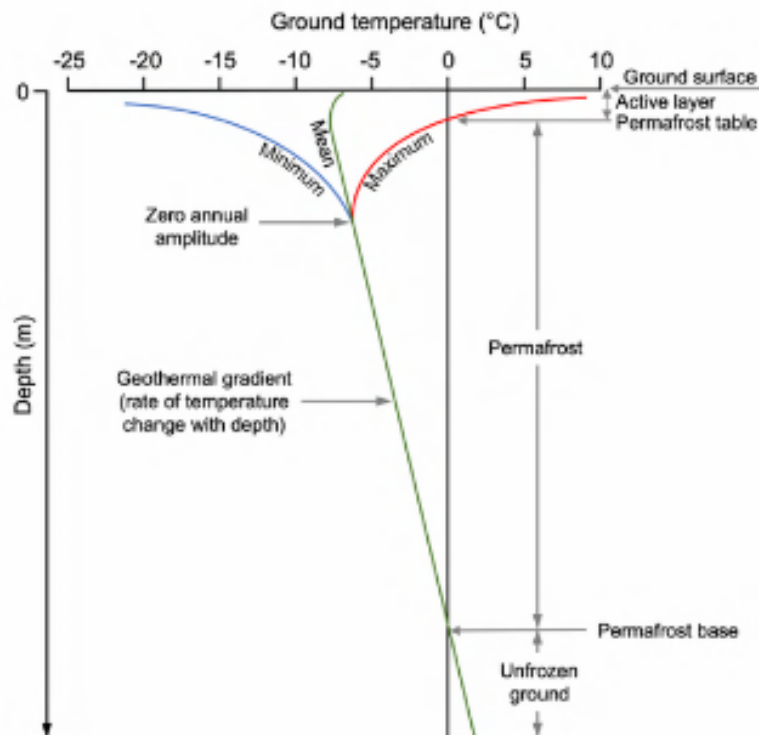
Different studies and sporadic field data show that the regional ice contents are underestimated, especially in glacial deposits (O'Neill et al. 2022). A preliminary regional model of ground ice abundance within the RAA shows higher ice contents in areas previously considered as ice-free (O'Neill et al. 2022). Wolfe et al. (2017) indicated that ground ice could be more present than expected in glaciomarine and glaciofluvial deposits, such as buried massive ice, or segregated ice and ice-wedge polygons. Onsite measurements at Jericho showed the existence of massive ice (Wolfe 1998). More buried massive ice could be found in glacier ice contact outwash sediments such as glaciolacustrine and marine deltas, or hummocky till (Dredge et al. 1999; Wolfe 1998; Wolfe et al. 2017). Plus, BGC (2013) reports field observations of ground ice in Grays Bay area. Along the Coronation Gulf, below 200 m asl, marine sediments are likely to have developed segregated ice, with up to 70 % excess ice (Wolfe et al. 2017).

While the overall area is estimated to have low excess ice content (O'Neill et al. 2019), especially within areas of till veneers and till blankets (Dredge et al. 1999), the available satellite imagery suggests that ice wedges are present at several locations.

4.2.6 Ground thermal regime

Ground thermal regime is the general temperature variation of permafrost according to depth and time of the year (Figure 4.7). It indicates the active layer and permafrost table depth, which is when the maximum ground temperature (red line) crosses the 0 °C line (Lewkowicz et al. 2024). The zero annual amplitude is the depth at which seasonal variations of temperature stop. Permafrost base is then where the temperature of the ground goes above zero because of the geothermal gradient. The ground thermal regime indicates the general thermal state and thickness of permafrost, if it is cold (< -2 °C) or warm (> -2 °C), thick or shallow. The ground thermal regime information results from registered ground temperature in boreholes that were instrumented with thermistor cables (a few metres to hundreds of meters deep).

Figure 4.7 Theoretical ground thermal regime of a cold permafrost (from Lewkowicz et al. 2024).



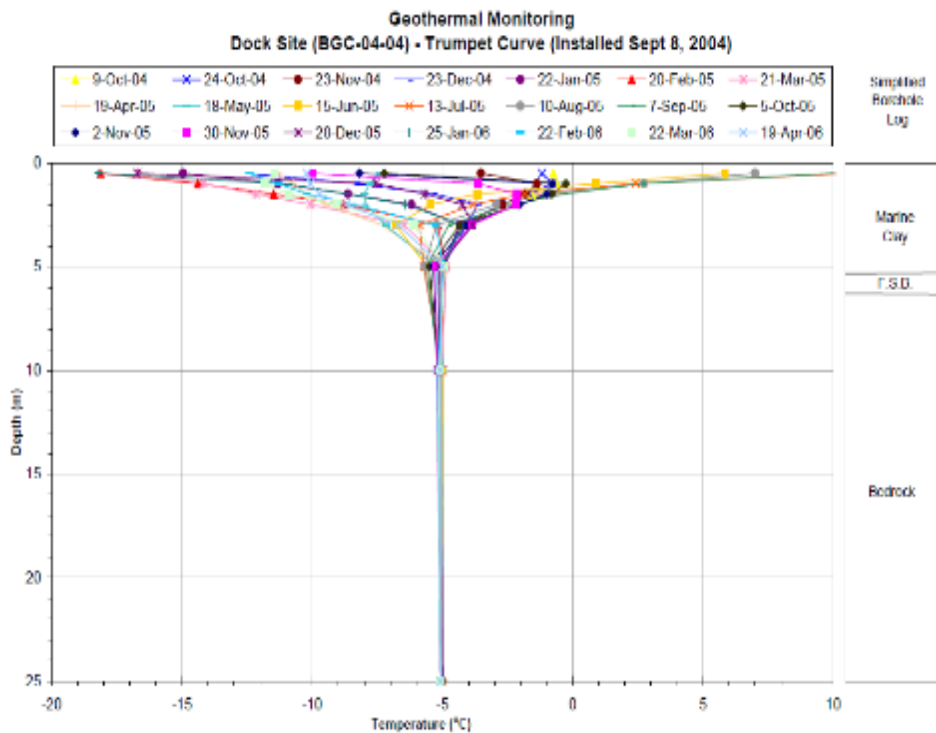
**Grays Bay Road and Port Project
Terrain, Soils, and Permafrost Baseline Report**

Section 4: Summary Baseline Conditions
March 2026

Information on the ground thermal regime of the RAA is available from BGC (2006) and SRK (2003). A total of 27 ground temperature monitoring sites falling within the RAA are presented in Appendix B. These sites were computed by Morse et al. (2023).

Compiled annual air temperature ranged from -10 to -11.8 °C in the RAA (BGC 2013). Permafrost mean annual ground temperature (MAGT) along the LAA/RAA was comprised between -1.4 (Jericho) and -7 °C (Ulu) and was -5 °C at Grays Bay Port. At Jericho Mine, the MAGT was between -1.4 and -7 °C (SRK 2003). The geothermal gradient was estimated to be 1.6 °C/100 m in the High Lake region, where permafrost MAGT was between -2.3 and -6 °C (BGC 2006). An example of ground thermal regime in the High Lake area is shown in Figure 4.8. Permafrost table is at about 1.5 m in marine sediments, and permafrost temperature is cold (-5 °C).

Figure 4.8 Ground thermal regime of permafrost under marine clay deposits, from October 2004 to April 2006 at High Lake (from BGC 2006)



4.2.7 Permafrost, Surface Water and Groundwater interactions

At the watershed scale, surface, and subsurface runoff transports water from snowmelt and rainfall from hillslopes to numerous lakes and stream systems. In the RAA, drainage conditions are characterized by an overall rapid runoff peak during spring snowmelt, which is allowed by the generally thin nature of surficial materials in the region.

The main water discharges are through canyons and river valleys that have developed along the main tributaries of the Kennarctic River. Within the LAA, the road alignment crosses 17 large permanent streams in areas of various widths of floodplains. In undulating terrain, surface drainage is often condensed into channels, some of the larger ones associated with post-glacial erosion. On moderately steep to steep hill slopes and escarpments, surface runoff is directed into gullies often showing signs of mass movement. Along low angle hill slopes, areas affected by increased seepage and surface runoff often host distinct vegetation communities that facilitate their identification on air photos and satellite imagery.

Local groundwater quantity and flow patterns are influenced by the presence of continuous permafrost, such as fine-grained frozen ground. Drainage patterns are seasonally controlled by the thermal state of the active layer and depth to permafrost, as well as the presence of ephemeral drainage channels. During the warm season, perched groundwater can flow through the active layer because of melting ice and then discharge to surface intermittent streams or lakes. Surface runoff and seepage occur through and above the active layer. In the Izok Lake area, groundwater levels are about half a meter below the ground surface (AECOM 2011).

Streams and water bodies are underlain by taliks, some connected, and some contained within permafrost (AECOM 2011; BGC 2006). In the continuous permafrost of the PDA, LAA and RAA, deeper groundwater flows and connections are expected to occur within those taliks.

4.3 Surficial Materials

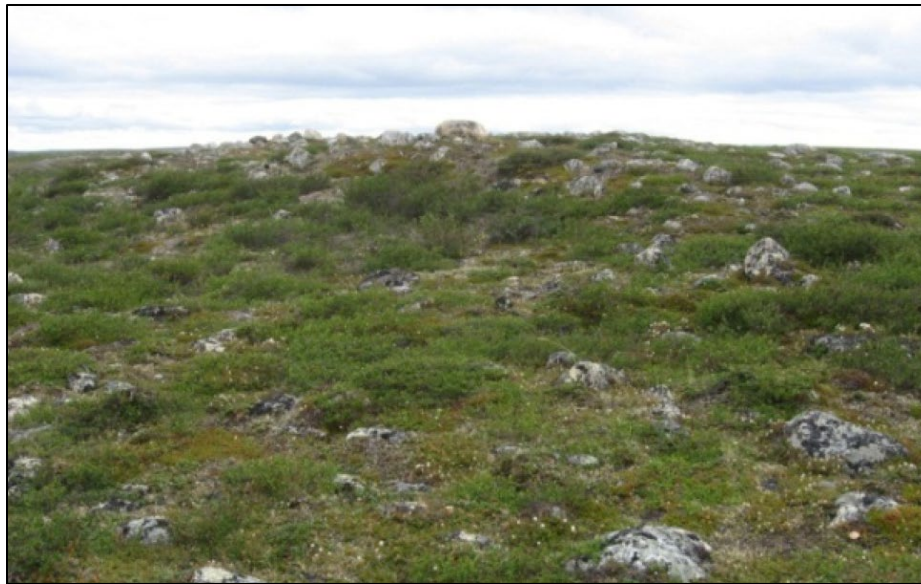
4.3.1 Materials and Landforms Description

Published surficial geology mapping covering the region identifies glaciofluvial materials, till, glaciolacustrine materials, marine materials, colluvium, fluvial materials, bedrock, and organic materials within the RAA (Dredge et al.1999; GSC 2014, 2016a, 2016b, 2017; Kerr 2018, 2022). The following describes the different Quaternary materials and landforms present within the Project boundary limits, with special attention to landscape features observed within the PDA and LAA. The materials are presented from most ancient to most recent (although not accounting for potential glacial-readvance over older deposits).

Till is composed of sediments deposited at, or close to, ice margins in conjunction with the advance and retreat of glacial ice. The term moraine or moraine deposits are sometimes used to encompass a vast range of features and deposits that are subdivided on the basis of landforms. Material forming till deposits is generally heterogeneous, often dense to compact, with a matrix mixture consisting of silt to coarse sand, with variable proportion of gravels and boulders. Large concentrations of boulders are common at the ground surface. Till is often the dominant material found on valley floors. While its thickness ranges

along the PDA, LAA and RAA, most till deposits are found as veneers (i.e. < 1 m) (Figure 4.9) and blankets less than 3 to 4 m in thickness. While till is present as a dominant surficial material throughout the regions, till deposits are also expected to occur at depths, overlaid or covered by more recent materials.

Figure 4.9 Example of a till veneer over bedrock as observed by BGC (2013)



Glaciofluvial deposits consist of materials that exhibit clear evidence of having been deposited by glacial meltwater streams either directly in front of, or in contact with, glacier ice. Typically range from unsorted and non-bedded gravel made up of a wide range of particle sizes, such as that resulting from very rapid aggradation at an ice front, to moderately to well-sorted, stratified gravel. Soils forming on glaciofluvial deposits are typically well to moderately well drained and are rapidly permeable.

Within the PDA and LAA, glaciofluvial deposits are found as plains, terrasses, hummocky deposits and eskers. The thickness varies considerably, from a thin veneer to more than 30 m when associated with large eskers. Eskers are long, winding ridges composed primarily of sand and gravel and formed by glacial meltwater flowing through channels within and beneath glaciers (Figure 4.10). Within the RSA, it is expected that some eskers may contain massive ice bodies (Wolfe et al. 2017). In the Tahikyoak (Contwoyto Lake) area, eskers are mainly composed of sand (~ 65 %), gravel (~ 32 %), with traces of fines (~ 3 %) (Traynor 2001). Hints of massive ground ice degradation (kettle lakes) were observed in an esker along the Hannigayok (James River), as well as solifluction which is creeping of frozen ground and indicates relatively high ground ice content (BGC 2013; Morse et al. 2023).

Figure 4.10 Eskers (red arrows). Left: road crossing an esker (KM 115). Right: aerial picture showing an esker (BGC 2013).



It is important to note that eskers are important features, for both Inuit (past and present) and wildlife use (Banci and Spicker 2024; BGC 2013; Traynor 2001). They were used by Inuit as landmarks, camp sites and corridors to move across the tundra:

Inuit used the area below the eskers for campsites so that they could use the high points of the eskers for lookouts. (Banci and Spicker 2024)

Many species make their dens in eskers, such as grizzlies, wolves, foxes and squirrels. Caribou also travels on eskers during the summer.

Most of these eskers have permafrost under them so they are a lot cooler than straight moss or soil. The ground is a lot cooler at the bottom of these eskers and the water is a lot colder too. At the bottom of these eskers are ponds formed from the esker springs. (Banci and Spicker 2024)

The road alignment intersects or would be built close to a few eskers, for example at KM 14, KM 103, KM 115, KM 147 and KM 157.5. The total surface area of the road and infrastructure that overlaps eskers is 33.3 ha, which represents 0.2 % of the total surface area of eskers within the RAA (i.e., 19 696.6 ha).

Glaciolacustrine sediments (sometimes referred to as lacustrine “L”) were deposited in contact with glacial ice, in the margins of glacial lakes. They are usually massive to well-laminated fines with silt, fine sand and clay, which can include gravels and materials released by floating ice. Glaciolacustrine materials are expected to range from 1 m to 20 m thick and are mainly present in the James River Valley.

Marine sediments were deposited in a marine environment when the sea reached a higher level after deglaciation and then retreated. They can overlay till deposits. Marine sediments combine diverse sedimentation environments such as deep to shallow water deposits and littoral (e.g., beaches) deposits. They are composed of fine sediments (clay and silt), fine to coarse sand, and gravels. The sediments can be massive, to laminated layers, 1 to 20 m thick (littoral, veneer and blanket). Marine sediments are encountered up to 200 m asl in the northernmost portion of the PDA, LAA and RAA, especially in the vicinity of the aerodrome site (Figure 4.11). The marine deposits are expected to be ice rich, often including ice-wedge polygons and in some areas, presenting signs of thermokarst.

Figure 4.11 Satellite image showing marine deposits in the vicinity of the proposed aerodrome site (in white).



Colluvium consists of materials that have reached their present positions because of direct, gravity-induced movement. The material is usually massive to moderately well stratified, non-sorted to poorly sorted sediments with a range of particle sizes from clay to boulders and blocks. The character of particular colluvial deposits varies based on the nature of the material from which it was derived and the depositional process.

In the PDA, LAA and RAA, most colluvium deposits are found at the base of steep slopes where they have accumulated following weathering (frost cracking) and gravity-induced movement (mainly rockfall). These deposits are generally very coarse, consisting primarily of boulders and cobbles with a silty to sandy matrix. Consequently, they are found to be rapidly to moderately well drained and occasionally poorly drained. In the LAA, they mainly originate from volcanic lithology (andesite and breccia), igneous rocks (diabase with gabbro sills and dykes) (Stubley and Irwin 2019). These deposits can range in depth from veneers less than a meter thick to landslide deposits tens of meters thick.

Colluvium deposits derived from till and marine deposits are also present, generally resulting from such small landslides, or from slow mass movement like creep and solifluction.

Figure 4.12 Example of blocky colluvial deposit along the Kogloктоаkyok (Kennarctic River) near KM 176.



Fluvial (alluvial) materials consist of material transported and deposited by streams and rivers. They are composed of sand, silt, clay and coarser sediments (pebbles to boulders); consequently, fluvial materials are mostly imperfectly drained and moderately to rapidly permeable. Within the PDA, LAA and RAA, fluvial deposits are forming floodplains, fans and terraces. Fluvial sediments are found along small intermittent streams and poorly defined flow paths, to large permanent river systems. Fluvial soils often experience periodic flooding and sediment deposition; therefore, have either weak or no soil development.

Terrain conditions at major stream crossings were previously presented by BGC (2013). The data was summarized according to riverbed material and stream capacity, including:

- Large permanent streams (6.5 to 57 m wide) characterized by bedrock outcrops and/or boulders, with cobbles, gravels, and fines.
- Large permanent streams (12 to 78 m wide) and small permanent (1 to 1.5 m wide) incised in till material with boulders, cobbles, and gravels and/or fines.
- Large permanent streams (74 m wide), small permanent and intermittent streams (1 to 4.5 m wide) incised in fine to coarse-grained glaciofluvial composed of gravels and fines with cobbles and sometimes boulders.
- Large permanent streams (14.5 to 19 m wide) incised in ice-rich saline and non-saline sediments, mainly fines with boulders and cobbles.

Photographs showing various terrain conditions along streams found across the PDA are presented in Appendix C. Refer to BGC (2013) for additional information on streams, their specific location and characteristics.

Organic deposits consist of materials resulting from the accumulation of vegetative matter that contain at least 30 % of organic matter by weight. Organic deposits are generally poor to very poorly drained, predominantly found in topographic depressions, but also present on flat to very gentle sloping terrain. While they can reach up to approximately 2 m in thickness at a few locations within the RAA, most organic deposits found within the PDA and LAA are expected to be less than one metre thick.

Anthropogenic disturbances to soils, terrain and permafrost occur in the PDA, LAA and RAA. They are commonly associated to mine sites (e.g., Jericho Mine area) as well as existing structures such as camp sites, access trails and areas where gravel extraction has occurred.

4.3.2 Surficial Material Distribution

The following section describes the spatial distribution of surficial materials by dominance in the RAA, LAA, and PDA (see Table 4.2, Table 4.3, Table 4.4 and Table 4.5). Distribution of surficial materials and soils in the RAA is presented in Appendix D and Appendix E, respectively.

The RAA surficial materials were documented based on existing regional scale (1:125 000) mapping published by the GSC (2014, 2016a, 2016b, 2017; Kerr 2018, 2022), while the LAA and PDA material statistics were based on LAA terrain mapping (1:10 000 scale) initiated by Palmer and completed by Nunami Stantec.

Table 4.2 Distribution of Surficial Materials Within the RAA

Dominant Surficial Geology	Area of RAA (ha)	Percent of RAA (%)
Till (T)	686,892.0	46.1
Bedrock (R)	669,750.6	45.0
Marine (M)	52,101.7	3.5
Glaciofluvial (GF)	41,933.4	2.8
Glaciolacustrine (GL)	22,215.2	1.5
Organic (O)	9,236.8	0.6
Alluvial (A)	4,946.8	0.3
Glaciomarine (GM)	1,745.6	0.1
Eolian (E)	739.2	< 0.1
Glacial Ice or Snowpacks (Isn)	286.3	< 0.1
Total	1,489,847.4	100.0

**Grays Bay Road and Port Project
Terrain, Soils, and Permafrost Baseline Report**

Section 4: Summary Baseline Conditions
March 2026

Table 4.3 Distribution of Dominant Surficial Materials Within the LAA

Dominant Surficial Geology	Area of LAA (ha)	Percent of LAA (%)
Till (T)	24,698.3	49.5
Marine (M)	8,093.6	16.2
Bedrock (R)	6,118.6	12.3
Water (W)	4,738.8	9.5
Glaciofluvial (G)	3,895.7	7.8
Glaciolacustrine (L)	1,188.8	2.4
Fluvial (F)	417.2	0.8
Undifferentiated (U)	371.9	0.7
Colluvium (C)	208.5	0.4
Anthropogenic (A)	132.1	0.3
Total	49,863.5	100.0

Table 4.4 Distribution of Dominant Surficial Materials along the Route Alignment

Dominant Surficial Geology	Length of Alignment (km)	Percent of Alignment (%)
Till (T)	136.7	58.6
Marine (M)	32.9	14.1
Glaciofluvial (G)	26.4	11.3
Bedrock (R)	24.8	10.6
Glaciolacustrine (L)	7.3	3.1
Anthropogenic (A)	3.2	1.4
Undifferentiated (U)	1.0	0.4
Water (W)	0.4	0.2
Colluvium (C)	0.4	0.2
Fluvial (F)	0.1	< 0.1
Total	233.2	100.0

Table 4.5 Distribution of Dominant Surficial Materials within the Aerodrome, Jericho Station and Port Landside Infrastructure portion of the PDA

Type	Dominant Surficial Geology	Area of PDA (ha)	Percent of overall PDA (%)
Aerodrome Infrastructure Boundary	Marine (M)	454.8	30.5
	Bedrock (R)	41.8	2.8
	Colluvium (C)	2.7	0.2
	Water	0.9	0.1
Jericho Station Infrastructure Boundary	Glaciofluvial (G)	48.4	3.2
	Anthropogenic (A)	44.9	3.0
	Water (W)	3.6	0.2
	Till (T)	1.5	0.1
Port Landside Infrastructure Boundary	Marine (M)	600.5	40.2
	Bedrock (R)	201.5	13.5
	Water (W)	91.9	6.2
Total		1,492.6	100.0

4.4 Geomorphological Processes

Geomorphological processes (or geoprocesses) are natural mechanisms of weathering, deposition and erosion that result in the modification of the surficial materials and landforms at the earth's surface.

This section summarizes the different geoprocesses identified within the Project's spatial boundaries.

4.4.1 Geomorphological Processes Description

4.4.1.1 *Water Erosion and gullying*

Gully erosion refers to the incision of surficial materials and bedrock through fluvial and hillslope processes such as running water, mass movement and resulting in the formation of parallel, sub-parallel and dendritic, long, V- and U-shaped channels (Howes and Kenk 1997). Gullying is more common in loose or exposed materials, such as marine and glaciofluvial deposits. Several gullying areas were identified on the terrain mapping. For example, at KM 112.8, the roadway passes 50 m away from coarse gullies (Figure 4.13).

Figure 4.13 Example of gullies that have formed in glaciofluvial material east of the road alignment near KM 115.



4.4.1.2 *Wind erosion*

Wind erosion primarily occurs through deflation (i.e., the removal of loose, fine-grained particles) and abrasion (the wearing down of surfaces by windblown particles). Within the PDA, LSA and RSA wind erosion is limited to fine-grained deposits bare of vegetation and organic topsoil, primarily within the marine deposits found along the northernmost portion of the route (i.e., below from 200 m asl; see example in Figure 4.14).

Figure 4.14 Example of exposed marine material expected to be affected by wind erosion and gullying near the aerodrome site (lower left portion of the figure).

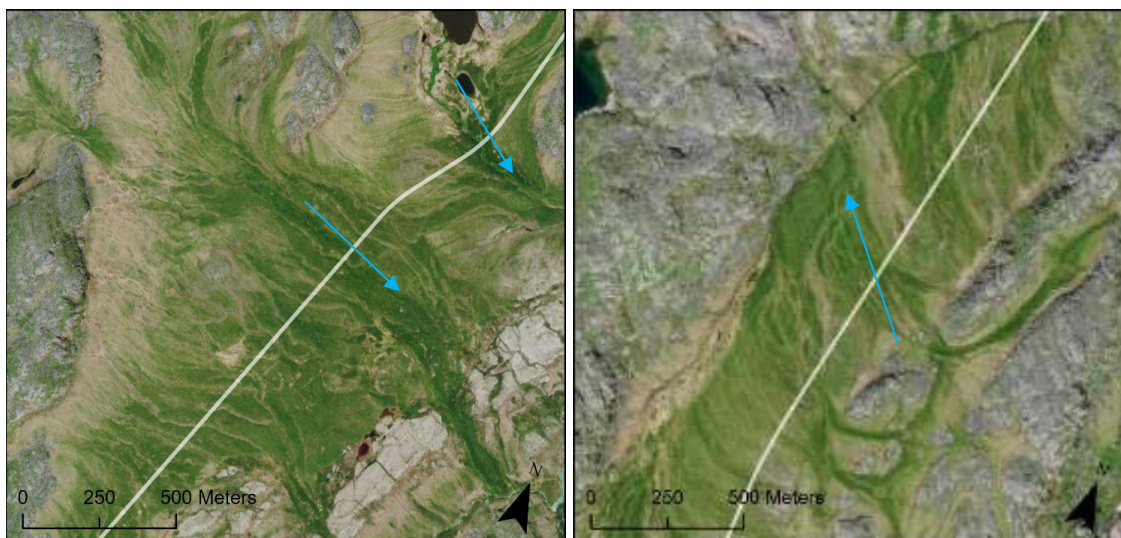


4.4.1.3 Seepage and Solifluction

Surface seepage involves the movement of abundant surface water discharge, where evidence of substantial seasonal drainage is provided by physical and vegetative indicators (Howes and Kenk 1997). The process is often associated with low soil infiltration rates and high-water storage capacity and is influenced by permafrost. As part of the LAA terrain mapping the occurrence of seepage was combined under the Solifluction (S) nomination, which consists of “slow, frost-related soil creep and/or subsurface drainage on slope”.

Within the PDA, slopes exhibiting seepage are drained into beaded or channeled streams (Figure 4.15).

Figure 4.15 Examples of slopes exhibiting seepage across the road alignment near KM 212. The blue arrows show the drainage direction.



4.4.1.4 **Landslides**

While landslides can occur as a variety of forms and types, they are relatively rare within the Project boundaries (see Geomorphological Processes Distribution Section 4.4.2). Landslides identified within the PDA, LAA and RAA consist mainly of the following:

Rockfall or fragmental rockfall is the detachment of individual rock fragments from a steep rock slope, and their gravitational downhill transport by falling, bouncing, and rolling. Evidence for ongoing or periodic rockfall includes the presence of colluvial accumulation, or individual fragments of rock below a steep rock slope. The LAA and RAA are characterized by widespread bedrock with discontinuous till veneer, which includes steep slopes (some near vertical) along rounded bedrock ridges. Occasional isolated rock fall events are expected to occur in these areas, especially where blocky colluvial deposits are located.

Active layer detachment occurs with deepening of the permafrost table. When the thawing front encounters ice rich sediments, the ice melts which results in a localized landslide on slopes. Marine sediments along the Coronation Gulf Coast are ice-rich, and active layer detachment often occurs in those deposits (Morse et al. 2023; Wolfe et al. 2017). Only a few surficial landslides were encountered, generally in the northern portion of the LAA, primarily along the upper slope of incised marine deposits (Figure 4.16).

Figure 4.16 Gullies and landslides (indicated by the black arrows) in marine soils near the southern end of the aerodrome area (in white).



4.4.1.5 Periglacial processes

Periglacial processes are physical processes, primarily driven by freezing and thawing, that occur in areas where ground freezes and thaws seasonally, particularly in regions with permafrost, shaping landscapes and creating unique landforms. Common periglacial processes active within the PDA, LAA and RAA include frost wedging, frost heave and solifluction. The processes can result in the formation of a range of landforms including, but not limited to, thermokarst, ice wedged and other types of pattern ground (e.g., block field or felsenmeer, sorted stripes, frost boils, etc.).

Thermokarst are topographic depressions of various sizes and shapes, that result from thawing of ground ice found in permafrost. Thermokarst lakes occur in fine sediments such as marine deposits or organic soils, where segregated ice generally forms. Thermokarst are triggered by a change of near-surface thermal regime, which can be caused by various factors, such as climate change, vegetation change, or construction of a road. The thawing process can transform a frozen peatland to a collapsed wetland, expand lakes, or cause local floods.

In the RAA, thermokarst were visually indicated by localized ponds that occur in ice wedge polygon fields (Figure 4.17), or in organic soils (Morse et al. 2023). These features generally initiate as small water-saturated depressions that progressively expand as circular features, often coalescing with each other by lateral expansion.

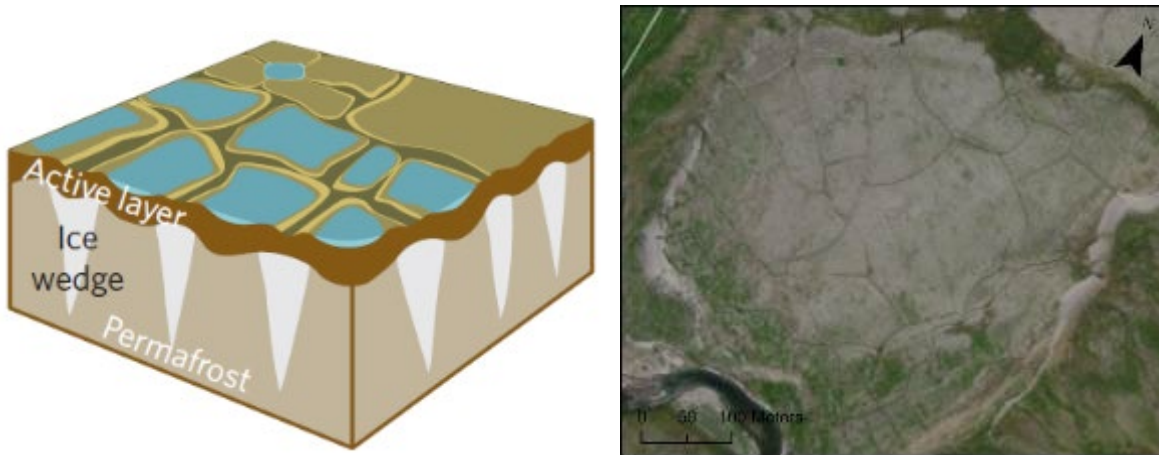
Figure 4.17 Possible thermokarst features (indicated by the black arrows) including depressions and ponds in marine soils next to the aerodrome site.



Ice wedges are downward-tapering bodies of nearly pure ice that accumulate in near-surface permafrost (Lachenbruch 1962; O'Neill et al. 2019). They form with ground cracking under thermal contraction and stress due to cold temperatures (MacKay 2000; Permafrost Subcommittee 1988). Ground cracks fill with meltwater during summer which will freeze during the cold season. The ice will then crack and fill with water in the next thaw season, which will freeze allowing the ice wedge to grow. Year after year, the ice will form a large wedge. This repeated process results in the growth of an ice wedge over time, often leading to a commonly recognizable pattern of ice wedge polygons in lowland terrain (see Figure 4.18).

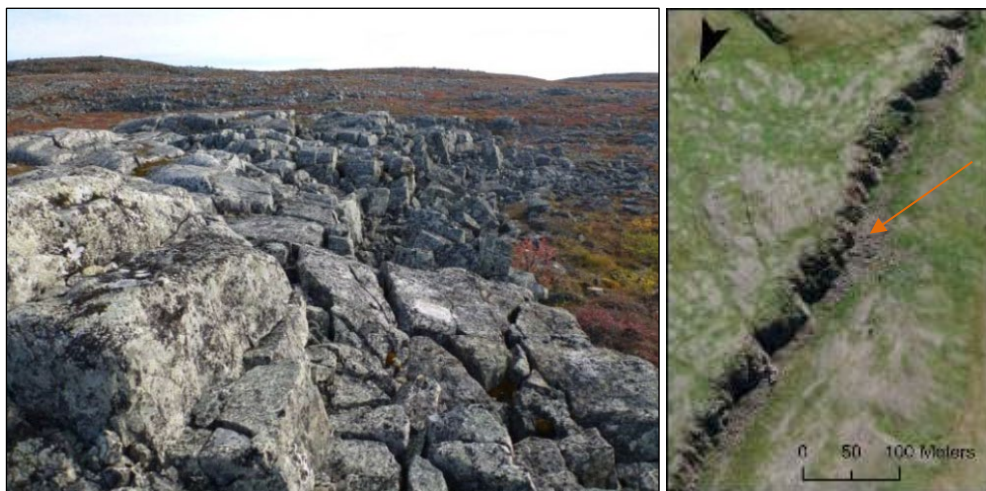
The terrain along the LAA and RAA contains several areas characterized by the presence of ice wedges, such as the Jericho Station PDA, the Hood River area (KM 104 to 110) and the Aerodrome PDA. Work by Morse et al. (2021, 2023) suggests that they are predominant in marine, glaciofluvial and organic sediments.

Figure 4.18 Ice wedge polygons. Left: conceptual scheme of an ice wedge polygons network (from Liljedahl et al. 2016). Right: Ice wedge polygons in the LAA in the Hood River area near KM 108



Frost shattering (gelifraction) is widespread in periglacial areas and was observed by BGC 2013 in the area. Freeze and thaw cycles lead to weakening of rock structure and result in frost shattering and weathered bedrock (Figure 4.19).

Figure 4.19 Example of gelifraction and bedrock shattering in the LAA (photo from BGC 2013).



Solifluction features are indicative of gravitational downslope movement of saturated unfrozen materials across a frozen or otherwise impermeable substrate. The LAA mapping showed that seepage commonly takes place along glacial outwash plains, or along gently sloping till surface below from steeper escarpments.

4.4.1.6 Icing

Icing (aufeis) is a common hydrogeological and hydrological process that occurs in cold regions, generally between late autumn and early spring, when planar and/or convex bodies of freshwater ice form by freezing of groundwater spring or of floodwater. Icing is commonly found in river valleys and at foothills depending on fault system, fractures in bedrock and drainage network characteristics (Crites et al. 2020; Morse and Wolfe 2015; Yoshikawa et al. 2007).

Naturally developing icing is common in fluvial deposits and in bedrock areas and can also be found in till veneers and marine blankets (Morse et al. 2023). No spatial data is currently available to inform on the potential occurrence of icing within the PDA and LAA.

4.4.2 Geomorphological Processes Distribution

This section summarizes the main geomorphological processes met in the LAA, that are of interest in project development design. They are described by dominance in the LAA, road alignment and PDA (see Table 4.6, Table 4.7 and Table 4.8). This section refers to the LAA surficial material maps, which include geomorphological processes (Appendix E).

Table 4.6 Distribution of Dominant Geomorphological Processes within the LAA

Dominant Geomorphological Process	Area of LAA (ha)	Percent of LAA (%)
Seepage, Solifluction (S)	9,481.9	19.0
Permafrost Processes (X)	2,595.6	5.2
Ice-wedge Polygons (Xw)	1,920.1	3.9
Gullied (V)	674.6	1.4
Thermokarst (K)	547.9	1.1
Mass Movement (A)	33.3	0.1
Sub-Total	15,253.4	30.6
Null ¹	34,610.5	69.4
Total	49,863.9	100.0

Note:

¹ Corresponds to map polygons where no visible Geomorphological Processes were identified

**Grays Bay Road and Port Project
Terrain, Soils, and Permafrost Baseline Report**

Section 4: Summary Baseline Conditions
March 2026

Table 4.7 Distribution of Dominant Geomorphological Processes along the Road PDA

Dominant Geomorphological Process	Length of Alignment (km)	Percent of Alignment (%)
Seepage, Solifluction (S)	54.4	23.3
Ice-wedge Polygons (Xw)	10.8	4.6
Permafrost Processes (X)	4.4	1.9
Thermokarst (K)	1.1	0.5
Gullied (V)	0.2	0.1
Sub-Total	70.9	30.4
Null ¹	162.3	69.6
Total	233.2	100.0

Note:

¹ Corresponds to map polygons where no visible Geomorphological Processes were identified

Table 4.8 Distribution of Dominant Geomorphological Processes within the Aerodrome PDA, Jericho Station PDA and Port PDA (Landside Infrastructure)

Type	Dominant Geomorphological Process	Area of PDA (ha)	Percent of PDA (%)
Aerodrome PDA	Permafrost Processes (X)	303.5	20.3
	Gullied (V)	262.8	17.6
	Seepage, Solifluction (S)	65.0	4.4
	Thermokarst (K)	24.5	1.6
	Ice-wedge Polygons (Xw)	22.3	1.5
Jericho Station PDA	Ice-wedge Polygons (Xw)	48.6	3.3
	Seepage, Solifluction (S)	1.0	0.1
	Permafrost Processes (X)	0.5	0.0
Port PDA (Landside Infrastructure)	Seepage, Solifluction (S)	372.4	24.9
	Permafrost Processes (X)	169.5	11.4
	Gullied (V)	0.7	0.0
Sub-Total		1,270.7	85.1
Null ¹		221.9	14.9
Total		1,492.6	100.0

Note:

¹ Corresponds to map polygons where no visible Geomorphological Processes were identified

4.5 Soils

4.5.1 Soil Description

Soils in Canada are classified according to the Canadian System of Soil Classification (Soil Classification Working Group 1998), which includes 10 major groups called soil orders. The nature of the soils and the effects of the dominant soil-forming processes determine these soil orders. Each order is then subdivided into great groups which present differentiating criteria of the order. The classification at the great group level is based on properties that reflect differences in the strengths of dominant processes. Each great group is further subdivided into a soil subgroup that has the differentiating criteria of the order and the great group.

Soil mapping and field investigations have identified two soil orders in the LAA: Cryosols and Regosols. The primary influence on soil development across all project's spatial boundaries is climate. Because of the presence of continuous permafrost throughout the region, Cryosols are the dominant soil order in the LAA. Regosolic soils are weakly developed and characterized by a lack of pedogenic processes. Factors that contribute to the lack of pedogenic processes include the age of the material, recent deposition, colluvium on slopes subject to mass wasting, and a dry, cold climatic condition.

The Cryosolic order is divided into three great groups, of which two are present in the LAA; Turbic Cryosols and Static Cryosols. Turbic Cryosols are mineral soils that have permafrost within 2 m of the surface and evidence of cryoturbation, which is indicated by the presence of disrupted, mixed, or broken horizons and/or displaced material. Static Cryosols are also mineral soils but have permafrost within 1 m of the surface and lack evidence of cryoturbation. These soil great groups are further divided into soil subgroups based on the presence or absence of diagnostic soil horizons. Only one Regosolic soil subgroup was identified; Orthic Regosol.

A summary description of Soil Great Group is presented in Table 4.9.

Table 4.9 Summary description of Soil Great Group

Soil Order	Description of Soil Order	Description of Soil Great Groups
Cryosol	Permafrost-affected soils can be associated with wetlands, tundra or taiga forest conditions. They are formed in either mineral or organic materials that have permafrost either within 1 m of the surface or within 2 m if the active layer of the soil profile has been strongly cryoturbated. Cryosolic soils have a mean annual temperature of < zero degree Celsius.	Turbic Cryosols are mineral soils strongly affected by cryoturbation or frost churning that generates various forms of patterned ground. Static Cryosols lack the frost churning process.
Regosol	Regosols are soils that have not been weathered and are associated with active landforms such as floodplains, colluvial slopes, beaches, thaw slumps and debris flows. These soils do not exhibit weathering or horizon formation typical of other soils.	Orthic Regosols occur in areas where soil development is impeded such as steep slopes.

The soil subgroups observed in the LAA are presented in Table 4.10.

Table 4.10 Soils present in the LAA

Soil Order	Soil Great Group	Soil Subgroup	Symbol ¹
Cryosolic	Turbic Cryosol	Orthic Dystric Turbic Cryosol	OD.TC
		Orthic Eutric Turbic Cryosol	OE.TC
		Brunisolic Dystric Turbic Cryosol	BRD.TC
		Brunisolic Eutric Turbic Cryosol	BRE.TC
		Gleysolic Turbic Cryosol	GL.TC
		Histic Dystric Turbic Cryosol	HD.TC
		Histic Eutric Turbic Cryosol	HE.TC
		Histic Regosolic Turbic Cryosol	HR.TC
		Regosolic Turbic Cryosol	R.TC
	Static Cryosol	Brunisolic Dystric Static Cryosol	BRD.SC
		Gleysolic Static Cryosol	GL.SC
		Regosolic Static Cryosol	R.SC
	Regosolic	Regosol	Orthic Regosol

Note:

¹ Symbols are two to seven uppercase letters representing the subgroup as described in the Canadian System of Soil Classification (Soil Classification Working Group 1998).

4.5.2 Soil Distribution

Twenty-three (23) soil map units were developed based on inferred relationships between soil types and surficial material, vegetation types, slope gradient, slope morphology, drainage patterns, and soil landscape types. The characteristics and descriptions of each SMU present are provided in Table 4.11. The distribution of the soil mapping units within the LAA is provided in Table 4.12. The soil mapping is presented alongside with the terrain mapping in Appendix E.

**Grays Bay Road and Port Project
Terrain, Soils, and Permafrost Baseline Report**

Section 4: Summary Baseline Conditions
March 2026

Table 4.11 Soil Mapping Unit Descriptions

SMU	Dominant Soil Type ¹	Co-Dominant Soil Type ¹	Soil Texture	Coarse Fragment (%)	Drainage	Soil Moisture Regime	Parent Material ²	Geomorphological Processes ²
1	BRD.SC	O.R; OD.TC; OE.SC; OE.TC	Coarse Sand, Loamy Sand, Silt	10	Well to Moderately Well	Xeric to Mesic	Gf; Gu; Gt; Gh; Gh/Ru; Ghu/Ru; Ghw/Ru; Grw/Ru; Gw/Rm	-
2	BRD.SC	OE.TC	Fine Sandy Loam	2	Well to Imperfect	Subxeric to Subhygric	Gf; Gu; Gt; Gh; Gh/Ru; Ghu/Ru	D
3	BRE.TC	BRE.SC; GL.TC; OE.TC; O.R; R	Sandy Loam to Sand	15	Well to Poor	Xeric to Subhygric	Gf; Gu; Gr; Geh; Gt; Gtc; Gm; Gw; Ge; Gpx; Gpc; Grw	X; SK; XwK; XwS; XwA; Xw; WXw; Xb; SW
4	BRD.TC	R; OD.TC; R.TC; BRD.SC; BRE.SC; OE.TC; R.SC	Sandy Loam to Sand, Loamy Coarse Sand	15	Moderately Well to Well	Subxeric to Mesic	Tv/Ru; Tw/Rh; Tv/Rm	-
5	BRD.TC	OD.TC; R.TC; HD.TC; GL.TC	-	-	Moderately Well to Poor	Hygric to Subhygric	Tv/Ru; Tw/Rh; Tv/Rm	W
6	GL.TC	HE.TC; OD.TC	-	-	Poor to Moderately Well	Subhygric to Mesic	Lb; Lb/Ru; Lb/Rm; Ld; Lw	-
7	GL.TC	OE.TC	Sandy Loam to Sand, Silt	0	Poor to Moderately Well	Subhygric to Mesic	Lb	S
8	HD.TC; HR.TC GL.TC	BRD.TC; OE.TC; BRE.SC; BRE.TC; OD.TC; R.TC	Sandy Loam to Sand	5	Poor to Moderately Well	Mesic to Subhygric	Tb; Tb/Ru; Tb/Rm; Tbw/Rm; Tc; Th; Tl; Tv; Tvl; Tvw/Rh; Tvw/Rm; Tw/Rm	WXb
9	GL.SC; GL.TC	OE.TC; BRE.TC; OD.TC; R.TC	Loam to Sandy Loam	0	Poor to Moderately Well	Subhygric to Mesic	Uc	-

**Grays Bay Road and Port Project
Terrain, Soils, and Permafrost Baseline Report**

Section 4: Summary Baseline Conditions
March 2026

SMU	Dominant Soil Type ¹	Co-Dominant Soil Type ¹	Soil Texture	Coarse Fragment (%)	Drainage	Soil Moisture Regime	Parent Material ²	Geomorphological Processes ²
10	GL.TC	OD.TC; OE.TC; BRE.TC; OD.SC; R.TC	Silty Loam, Silty Clay Loam, Sandy Loam, Loamy Sand	0	Poor to Moderately Well	Subhygric to Mesic	Tb/Tl; Tb/Ru; Tl/Ru; Tlb/Rm	S
11	Rock	BRE.TC; OD.TC	Loamy Sand to Sandy Loam	20	Rapid to Well	Xeric to Submesic	Ru; Rh; Rj; Rrh; Rm	-
12	O.R	-	-	-	Imperfect to Very Poor	Subhydric to Subhygric	Fc; Ft; Fw; Fw/T; Fp/Gt	Wxw
13	Rock	O.R; BRE.TC; GL.SC; GL.TC; OD.TC; OE.TC	Silty loam, Sandy Loam, Loamy Coarse Sand	0	Rapid to Poor	Mostly Xeric with minor inclusions of Hygric	Rs; Cw/Rs	-
14	HD.TC; HR.TC	BRE.TC; GL.TC; OD.TC; OE.TC; R.TC	Silt, Silty Loam, Sandy Loam, Loamy Sand, Very Fine Sand	0	Moderately Well to Poor	Hygric to Subhydric	Td	W
15	BRD.TC	OE.TC; R.TC	Sandy Loam	5	Moderately Well to Imperfect	Mesic to Subhygric	Tw/Ru; Tl/Ru	SW
16	BRE.TC	OD.TC BRE.SC OE.TC	Sandy Loam to Sand	10	Well to Poor	Submesic to Subhygric	Gxw; Gw; Gv	WXw; D
17	BRE.SC	O.R; R.TC	Silty Loam, Loam, Sand	10	Well or Poor	Subhydric or Subxeric	Fp; Fb; Ff	-
18	GL.TC	OD.TC; R	-	-	Moderately Well to Poor	Hygric to Subhygric	Mb; Ml	-
19	R.SC	-	-	-	Rapid to Moderately Well	Mesic to Xeric	Cw; Cv	-

**Grays Bay Road and Port Project
Terrain, Soils, and Permafrost Baseline Report**

Section 4: Summary Baseline Conditions
March 2026

SMU	Dominant Soil Type ¹	Co-Dominant Soil Type ¹	Soil Texture	Coarse Fragment (%)	Drainage	Soil Moisture Regime	Parent Material ²	Geomorphological Processes ²
20	R.SC	OD.TC; R.TC; HD.TC; GL.TC; R	-	-	Rapid to Imperfect	Subhygric to Mesic	Mvl; Mv; Md; Mw; Mbl/R; Mb/R; MI; Mbc/R; Mw/Ru; Mv/Ru	Sk; SX; W; Xb; S
21	GL.TC	-	-	-	Imperfect to Poor	Hygric /Subhygric	Mc	W
22	GL.TC	HE.TC; OD.TC; R.TC	Silty Loam, Silt, Very Fine Sandy Loam, Loamy Fine Sand	0	Imperfect to Very Poor	Subhygric to Hygric	Lw/Ru; LI/Ru	-
23	R.SC	OD.TC; R.TC; HD.TC; GL.TC	-	-	Rapid to Poor	Subhygric to Xeric	M; Ms; Mw; Mb; MI; Mpl; Mb/R; C/Mb	V

Notes:

¹Coded labels represent the subgroup as described in Table 4.10 and the Canadian System of Soil Classification (Soil Classification Working Group 1998).

² Coded labels represent terrain and geomorphological processes found in Table 3.1.

**Grays Bay Road and Port Project
Terrain, Soils, and Permafrost Baseline Report**

Section 4: Summary Baseline Conditions
March 2026

Table 4.12 Distribution of Soil Mapping Units in the LAA

Soil Mapping Unit (SMU)	Area (ha)	Percentage (%)
1	939	1.9
2	527	1.1
3	1,514	3.0
4	11,222	22.5
5	68	0.1
6	87	0.2
7	468	0.9
8	12,112	24.3
9	471	0.9
10	2,310	4.6
11	4,476	9.0
12	72	0.1
13	356	0.7
14	2,718	5.5
15	771	1.5
16	993	2.0
17	364	0.7
18	910	1.8
19	675	1.4
20	2,983	6.0
21	179	0.4
22	601	1.2
23	235	0.5
Disturbed	135	0.3
Water	4,680	9.4
Total	49,864	100.0

**Grays Bay Road and Port Project
Terrain, Soils, and Permafrost Baseline Report**

Section 4: Summary Baseline Conditions
March 2026

The majority of the LAA was identified as SMU 8 (24.3 %) and SMU 4 (22.5 %). SMU 8 is dominated by Histic Dystric Turbic Cryosols and Histic Regosolic Turbic Cryosols. Both soil subgroups have permafrost within 2 m of the surface, evidence of cryoturbation, and thick (> 15 cm) organic horizons in the upper 1 m. Histic Dystric Turbic Cryosols have developed a modified B horizon greater than 5 cm in thickness while Histic Regosolic Turbic Cryosols lack this modified B horizon. The soils in SMU 8 are moderately well drained to poorly drained with areas having a high-water table. The soil moisture regime is mesic to subhydic. SMU 4 is dominated by Brunisolic Dystric Turbic Cryosols which have permafrost within 2 m of the surface, evidence of cryoturbation, a low degree of base saturation indicated by a pH less than 5.5, and a modified B horizon greater than 10 cm thick. These soils are moderately well drained to well drained with soil moisture regimes ranging from mesic to subxeric.

There is a higher risk of wind erosion in SMU 2 and 16 where deflation is a notable geomorphological process. These areas have potential for soil loss due to wind erosion where the turbulent action of wind modifying the soil surface by the lifting out of fine-grained particles. SMU 2 and 16 occupy a total area of 1,520 ha or 3 % of the LAA.

Higher risk of water erosion occurs in glaciolacustrine, lacustrine, and marine deposits with long unilateral slopes greater than 5 %. These deposits of finer material have a greater potential for hillslope erosion. Areas of concern can be found in SMU 6, 18, 21, 22, 23 depending on the slope.

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**Grays Bay Road and Port Project
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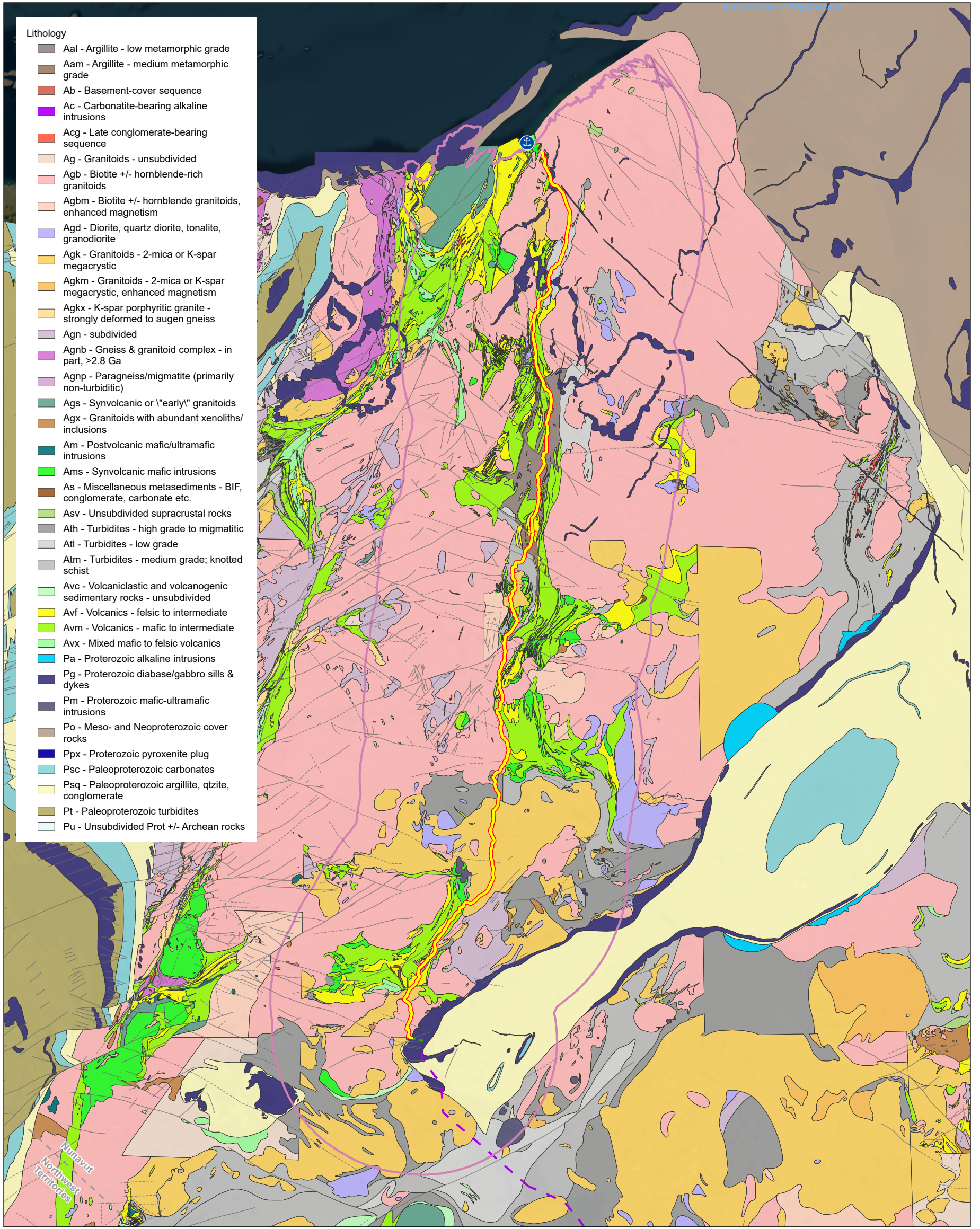
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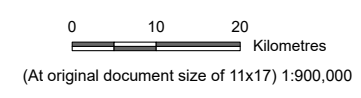
Appendix A Regional Geology Map

Lithology

- Aal - Argillite - low metamorphic grade
- Aam - Argillite - medium metamorphic grade
- Ab - Basement-cover sequence
- Ac - Carbonatite-bearing alkaline intrusions
- Acg - Late conglomerate-bearing sequence
- Ag - Granitoids - unsubdivided
- Agb - Biotite +/- hornblende-rich granitoids
- Agbm - Biotite +/- hornblende granitoids, enhanced magnetism
- Agd - Diorite, quartz diorite, tonalite, granodiorite
- Agk - Granitoids - 2-mica or K-spar megacrystic
- Agkm - Granitoids - 2-mica or K-spar megacrystic, enhanced magnetism
- Agkx - K-spar porphyritic granite - strongly deformed to augen gneiss
- Agn - subdivided
- Agnb - Gneiss & granitoid complex - in part, >2.8 Ga
- Agnp - Paragneiss/migmatite (primarily non-turbiditic)
- Ags - Synvolcanic or "early" granitoids
- Agx - Granitoids with abundant xenoliths/inclusions
- Am - Postvolcanic mafic/ultramafic intrusions
- Ams - Synvolcanic mafic intrusions
- As - Miscellaneous metasediments - BIF, conglomerate, carbonate etc.
- Asv - Unsubdivided supracrustal rocks
- Ath - Turbidites - high grade to migmatitic
- Atl - Turbidites - low grade
- Atm - Turbidites - medium grade; knotted schist
- Avc - Volcaniclastic and volcanogenic sedimentary rocks - unsubdivided
- Avf - Volcanics - felsic to intermediate
- Avm - Volcanics - mafic to intermediate
- Avx - Mixed mafic to felsic volcanics
- Pa - Proterozoic alkaline intrusions
- Pg - Proterozoic diabase/gabbro sills & dykes
- Pm - Proterozoic mafic-ultramafic intrusions
- Po - Meso- and Neoproterozoic cover rocks
- Ppx - Proterozoic pyroxenite plug
- Psc - Paleoproterozoic carbonates
- Psq - Paleoproterozoic argillite, quartzite, conglomerate
- Pt - Paleoproterozoic turbidites
- Pu - Unsubdivided Prot +/- Archean rocks



- Ⓜ Grays Bay Port
- 🟡 Grays Bay Road
- 🟢 Grays Bay Winter Road
- 🟠 Grays Bay Winter Road Optional Alignment
- 🟣 Regional Assessment Area (RAA)
- Fault**
- Defined
- - - Assumed
- - - Territorial Boundary
- Tibbitt to Contwoyto Winter Road Route



Project Location: West Kitikmeot Region, Nunavut
 Prepared by DS on 2026-02-09
 TR by XM on 2026-02-09

Client/Project: 123514886_062

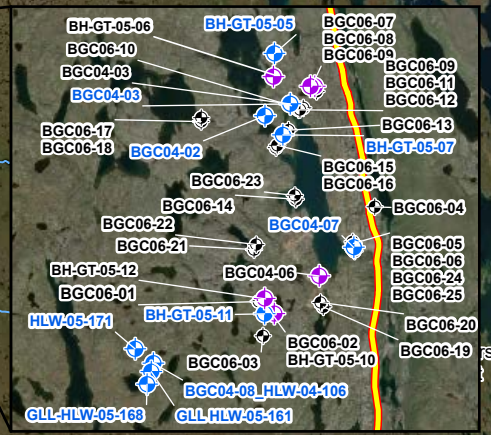
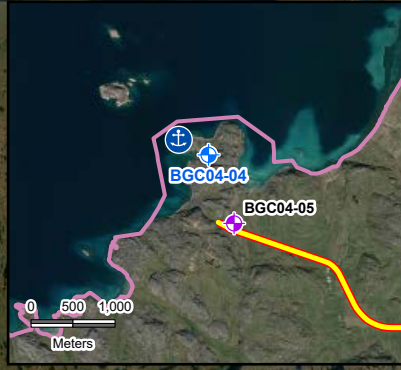
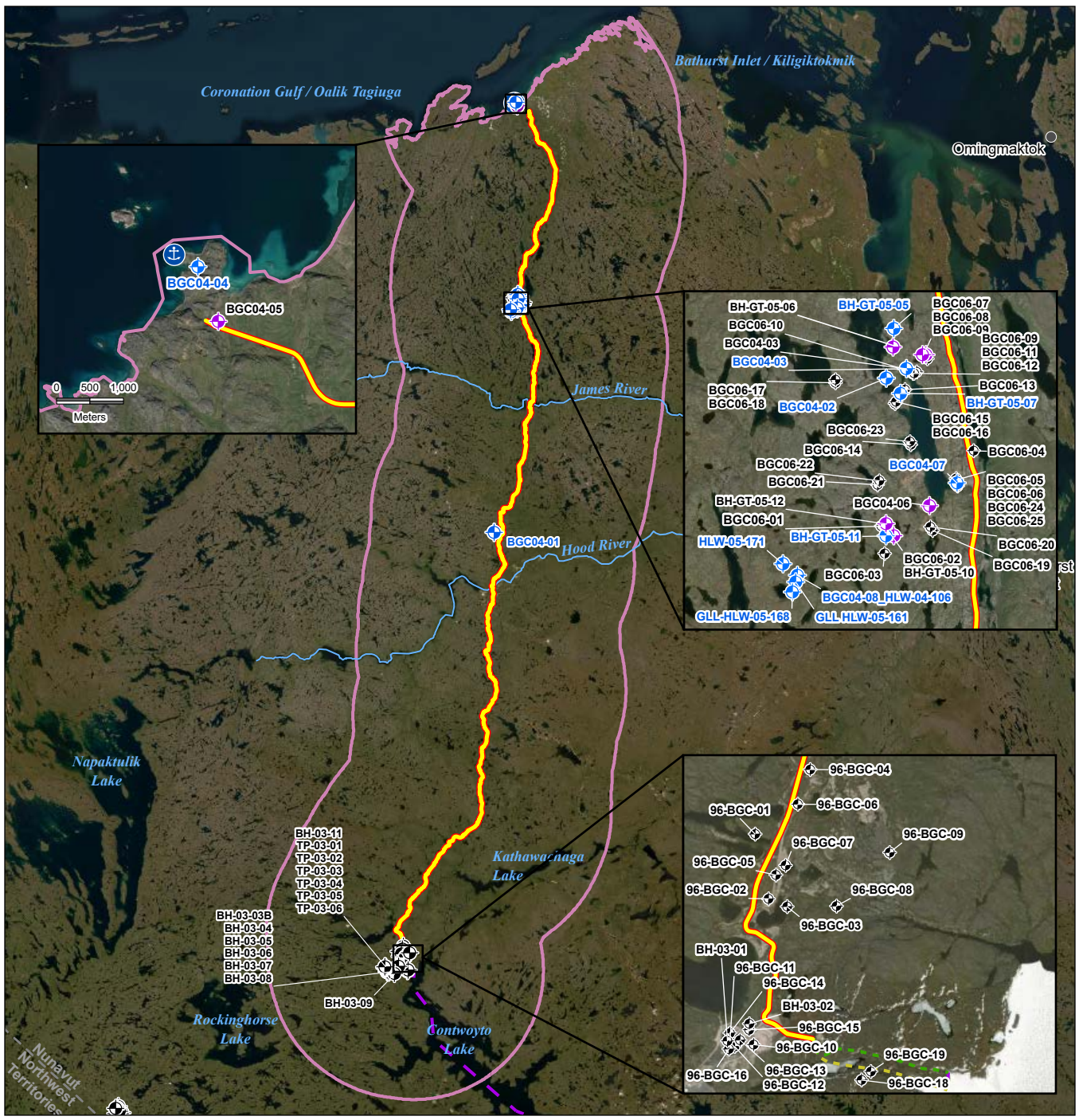
West Kitikmeot Resources Corp
 Grays Bay Road and Port

Figure No.
Appendix A

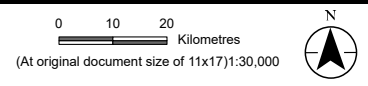
Title
Regional Bedrock Geology

Notes
 1. Coordinate System: WGS 1984 UTM Zone 12N
 2. Data Sources: Governments of Nunavut, Northwest Territories and Canada, Stantec.
 3. Service Layer Credits: World Imagery: Earthstar Geographics

Appendix B Geotechnical Boreholes and Ground Temperature Monitoring Sites



- Geotechnical Borehole**
- BGC 2006
 - Borehole Report, Morse et al., 2023
- Ground Temperature Monitoring Site**
- BGC 2006
 - Grays Bay Port
 - Grays Bay Road
 - Grays Bay Winter Road
 - Grays Bay Winter Road Optional Alignment
 - Regional Assessment Area (RAA)
 - Territorial Boundary
 - Tibbitt to Contwoyto Winter Road



Project Location: West Kitikmeot Region, Nunavut. Prepared by AYIU on 2026-02-23, TR by OPIRAUX on 2026-02-23.

Client/Project: West Kitikmeot Resources Corp, Grays Bay Road and Port. 123514868_0065

Figure No. **Appendix B**
 Title **Ground Temperature Monitoring Sites and Boreholes**

Notes
 1. Coordinate System: WGS 1984 UTM Zone 12N
 2. Data Sources: Government of Canada, Morse et al., 2023, Stantec, BGC.
 3. Imagery: Earthstar Geographics

Appendix C Photographs of stream conditions across the PDA (from BGC 2013)

**Grays Bay Road and Port Project
Terrain, Soils, and Permafrost Baseline Report**

Appendix C: Photographs of stream conditions across the PDA (from BGC 2013)
March 2026



Bedrock, boulders (with cobbles and gravels)



Ice-rich, non-saline deposits



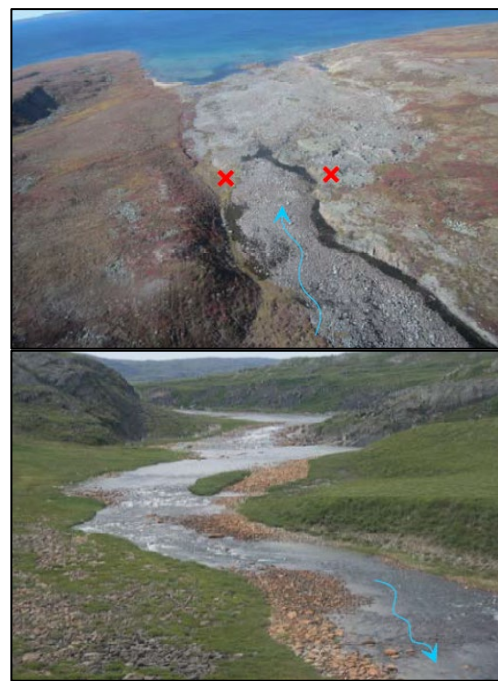
Fine grained glaciomarine deposits



Boulder till



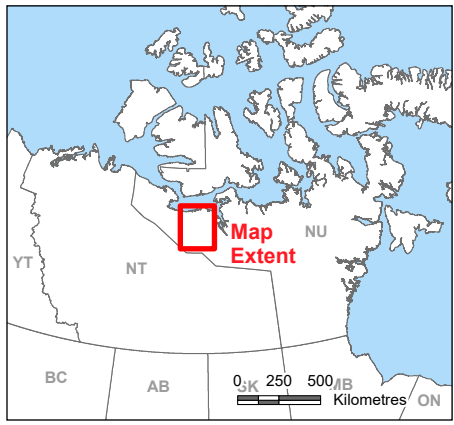
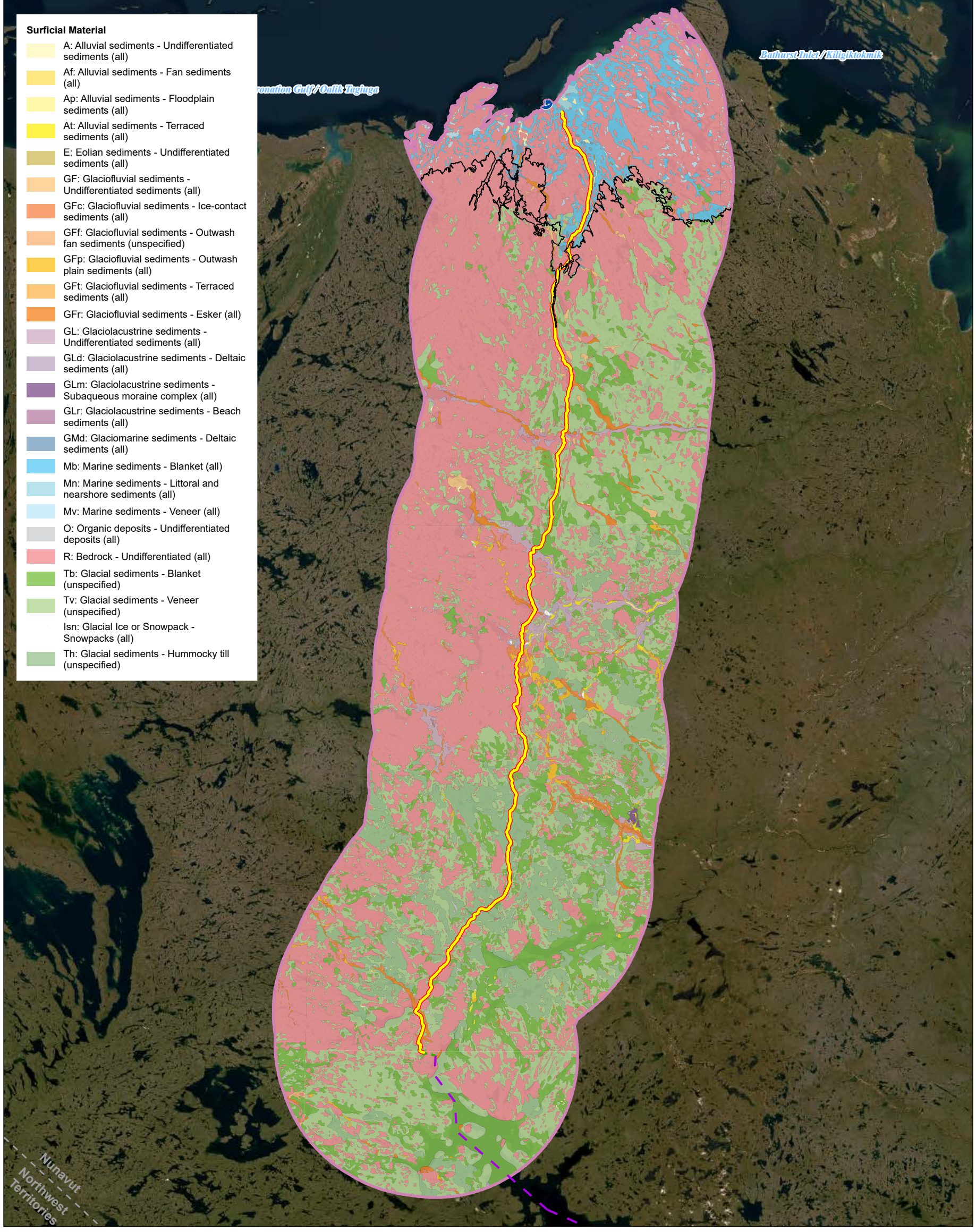
Till blanket



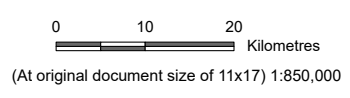
Bedrock and till, fluvial

Appendix D Surficial Material in the RAA

- Surficial Material**
- A: Alluvial sediments - Undifferentiated sediments (all)
 - Af: Alluvial sediments - Fan sediments (all)
 - Ap: Alluvial sediments - Floodplain sediments (all)
 - At: Alluvial sediments - Terraced sediments (all)
 - E: Eolian sediments - Undifferentiated sediments (all)
 - GF: Glaciofluvial sediments - Undifferentiated sediments (all)
 - GFc: Glaciofluvial sediments - Ice-contact sediments (all)
 - GFF: Glaciofluvial sediments - Outwash fan sediments (unspecified)
 - GFp: Glaciofluvial sediments - Outwash plain sediments (all)
 - GFT: Glaciofluvial sediments - Terraced sediments (all)
 - GFr: Glaciofluvial sediments - Esker (all)
 - GL: Glaciolacustrine sediments - Undifferentiated sediments (all)
 - GLd: Glaciolacustrine sediments - Deltaic sediments (all)
 - GLm: Glaciolacustrine sediments - Subaqueous moraine complex (all)
 - GLr: Glaciolacustrine sediments - Beach sediments (all)
 - GMd: Glaciomarine sediments - Deltaic sediments (all)
 - Mb: Marine sediments - Blanket (all)
 - Mn: Marine sediments - Littoral and nearshore sediments (all)
 - Mv: Marine sediments - Veneer (all)
 - O: Organic deposits - Undifferentiated deposits (all)
 - R: Bedrock - Undifferentiated (all)
 - Tb: Glacial sediments - Blanket (unspecified)
 - Tv: Glacial sediments - Veneer (unspecified)
 - Isn: Glacial Ice or Snowpack - Snowpacks (all)
 - Th: Glacial sediments - Hummocky till (unspecified)



- Grays Bay Port
- Grays Bay Road
- Grays Bay Winter Road
- Marine Limit (~200 masl)
- Regional Assessment Area (RAA)
- Territorial Boundary
- Tibbitt to Contwoyto Winter Road



Project Location: West Kitikmeot Region, Nunavut
 Prepared by AYIU on 2025-03-18
 TR by xxx on 2025-03-18

Client/Project: 123514886_063

West Kitikmeot Resources Corp
 Grays Bay Road and Port

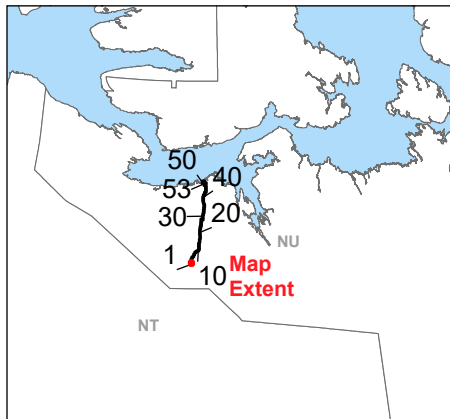
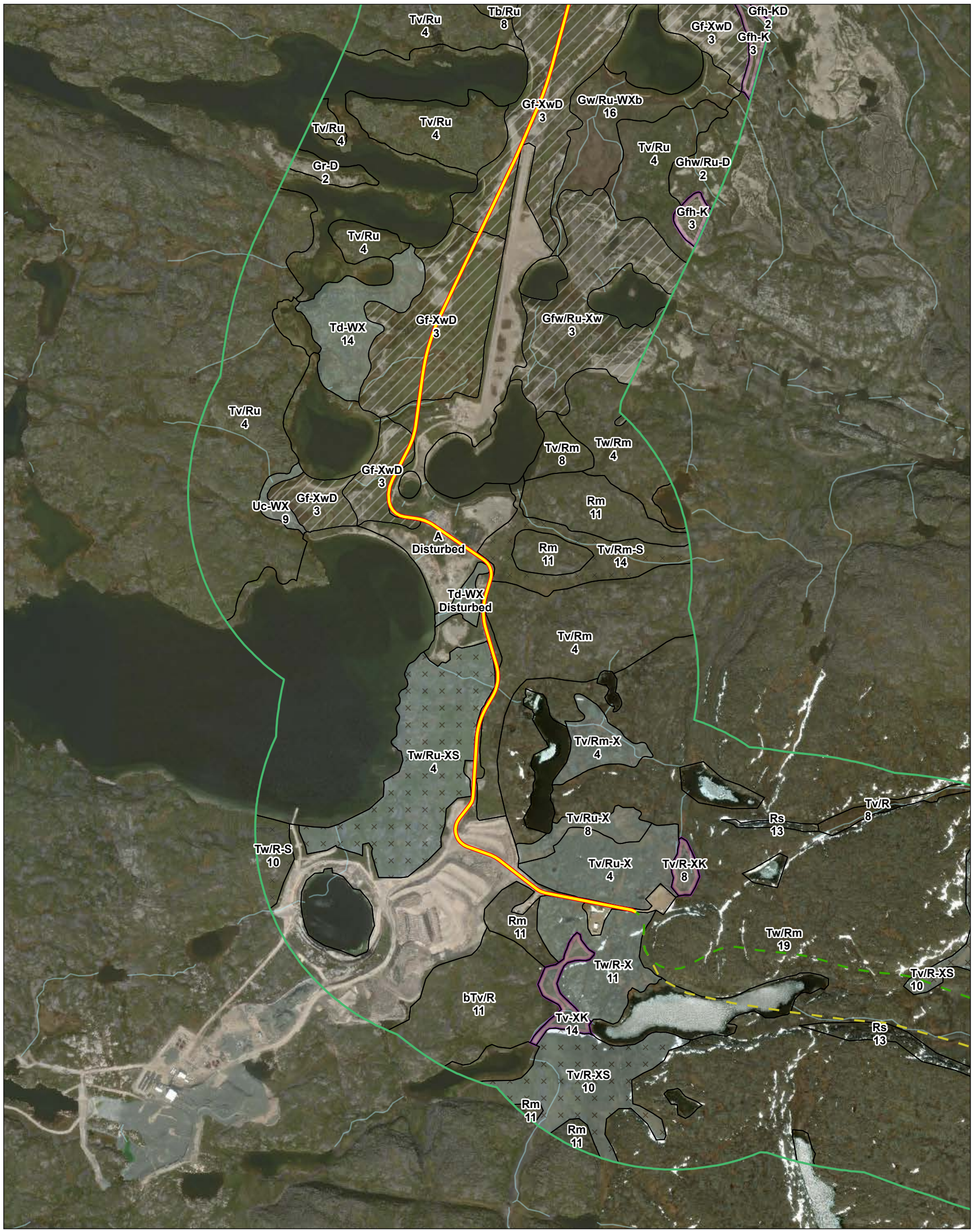
Figure No.
Appendix D
 Title
RAA Surficial Geology

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Notes
 1. Coordinate System: WGS 1984 UTM Zone 12N
 2. Data Sources: Governments of Nunavut, Northwest Territories and Canada, Stantec, GSC (2017) and Kerr (2018).
 3. Service Layer Credits: World Imagery: Earthstar Geographics

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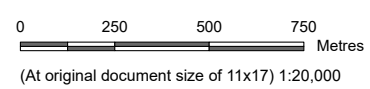
Appendix E Surficial Material and Soils in the LAA



Notes
 1. Coordinate System: WGS 1984 UTM Zone 12N
 2. Data Sources: Governments of Nunavut, Northwest Territories and Canada, Stantec, Morse et al. 2023.
 3. Service Layer Credits: World Imagery: Vantor

- Grays Bay Road
 - Grays Bay Winter Road
 - Grays Bay Winter Road Optional Alignment
 - Local Assessment Area (LAA)
 - Watercourse
- Terrain**
- Gullies
 - Ice Wedge Polygon
 - Permafrost Process
 - Seepage
 - Thermokarst

Genetic Materials		Surface Expressions	
A	Anthropogenic (disturbed)	b	Blanket
C	Colluvium	c	Channel-shaped, channelled
F	Fluvial	d	Depression
G	Glaciofluvial	e	Delta
L	Glaciolacustrine	f	Fan
M	Marine	h	Hummocky
O	Organic	j	Strong Slopes
R	Bedrock	k	Kettled, pitted (non-genetic)
T	Till (glacial)	l	Long, gentle slope
U	Undifferentiated	m	Rolling
Geomorphological Processes		r	Ridge
A	Rapid mass movement	s	Steep slope
D	Deflation	t	Terraced
K	Thermokarst	u	Undulating
S	Soilfuction, seepage	v	Veneer
V	Gullied	w	Discontinuous
W	High water table, poorly drained	x	Complex
X	Permafrost-affected (general)		
Xb	Beaded stream		
Xw	Ice wedge-polygonal ground		



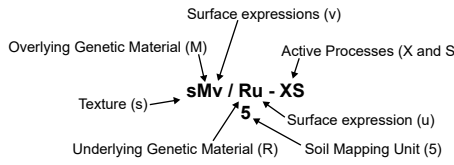
Project Location: West Kitikmeot Region, Nunavut
 Prepared by AYIU on 2026-02-23
 TR by OPIRAUX on 2026-02-23

Client/Project: 123514886_063

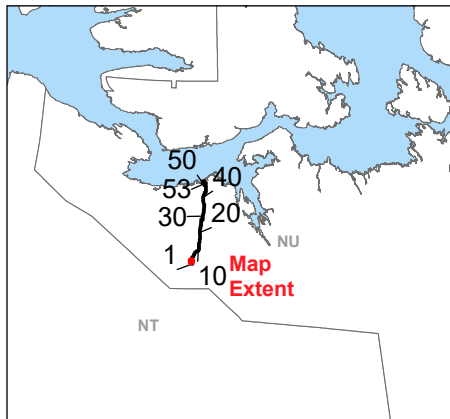
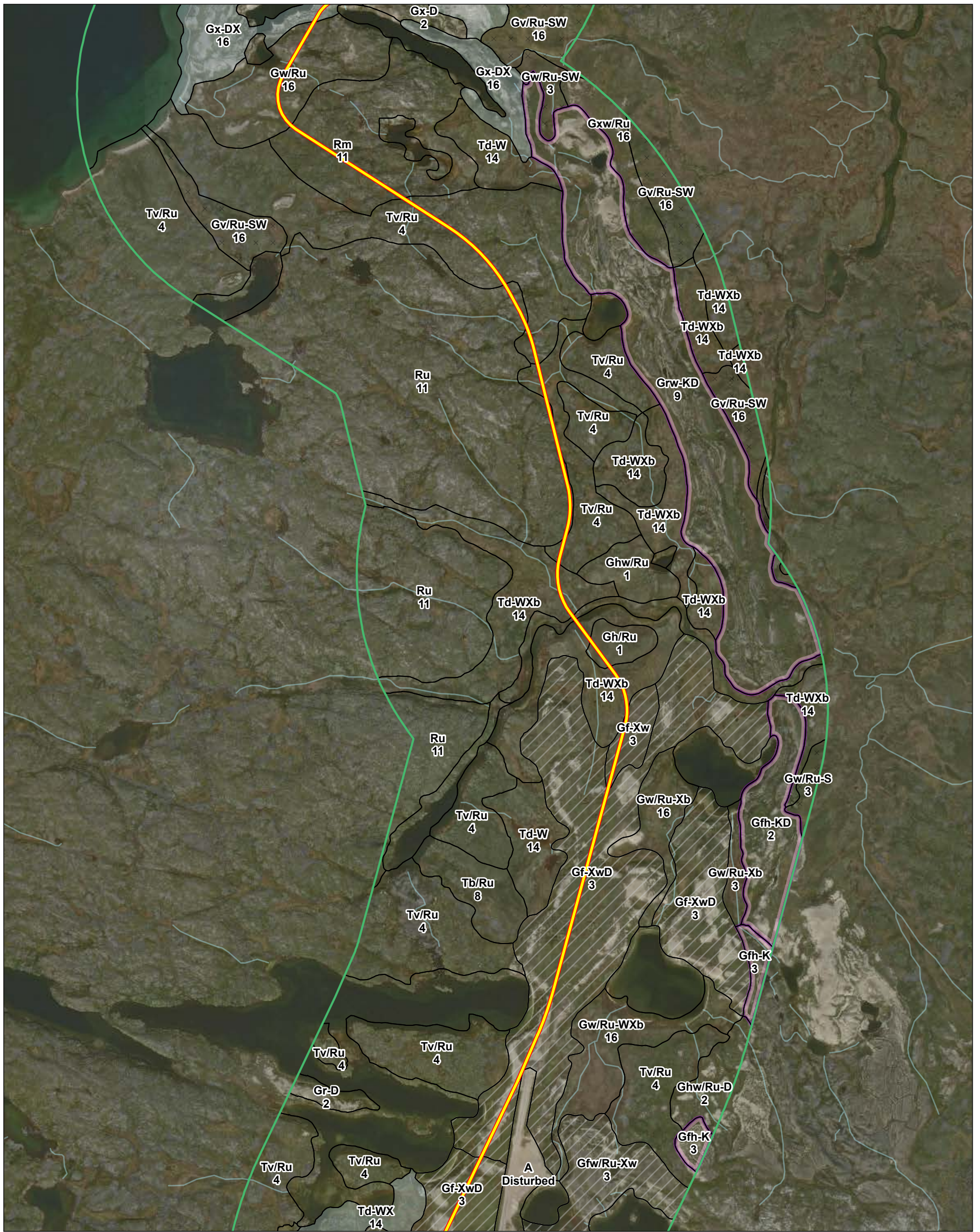
West Kitikmeot Resources Corp
 Grays Bay Road and Port

Figure No. **Appendix E** Page 2 of 53

LAA Terrain and Soil Mapping

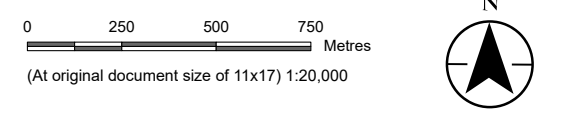


Delimiting (l): Indicates a stratigraphic relationship between the overlying material (capital letter) left of the slash and the underlying material (capital letter) right of the slash.



- Grays Bay Road
- Local Assessment Area (LAA)
- Watercourse
- Terrain**
- v v v v Gullies
- Ice Wedge Polygon
- Permafrost Process
- Seepage
- Thermokarst

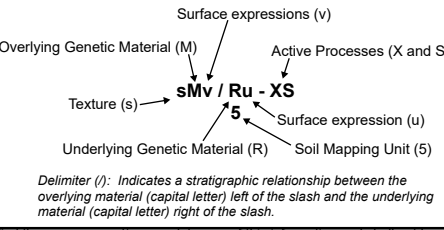
Genetic Materials		Surface Expressions	
A	Anthropogenic (disturbed)	b	Blanket
C	Colluvium	c	Channel-shaped, channelled
F	Fluvial	d	Depression
G	Glaciofluvial	e	Delta
L	Glaciolacustrine	f	Fan
M	Marine	h	Hummocky
O	Organic	j	Strong Slopes
R	Bedrock	k	Kettled, pitted (non-genetic)
T	Till (glacial)	l	Long, gentle slope
U	Undifferentiated	m	Rolling
Geomorphological Processes		r	Ridge
A	Rapid mass movement	s	Steep slope
D	Deflation	t	Terraced
K	Thermokarst	u	Undulating
S	Soilfuction, seepage	v	Veneer
V	Gullied	w	Discontinuous
W	High water table, poorly drained	x	Complex
X	Permafrost-affected (general)		
Xb	Beaded stream		
Xw	Ice wedge-polygonal ground		



Project Location West Kitikmeot Region, Nunavut
Client/Project West Kitikmeot Resources Corp
 Grays Bay Road and Port

Figure No. Appendix E
Title LAA Terrain and Soil Mapping

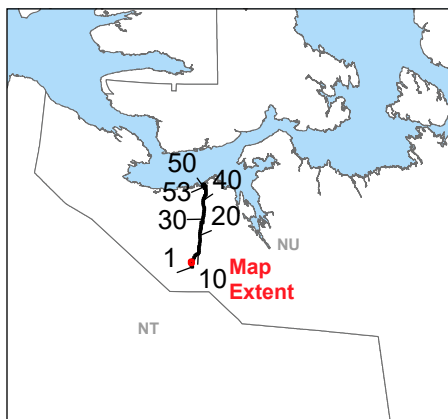
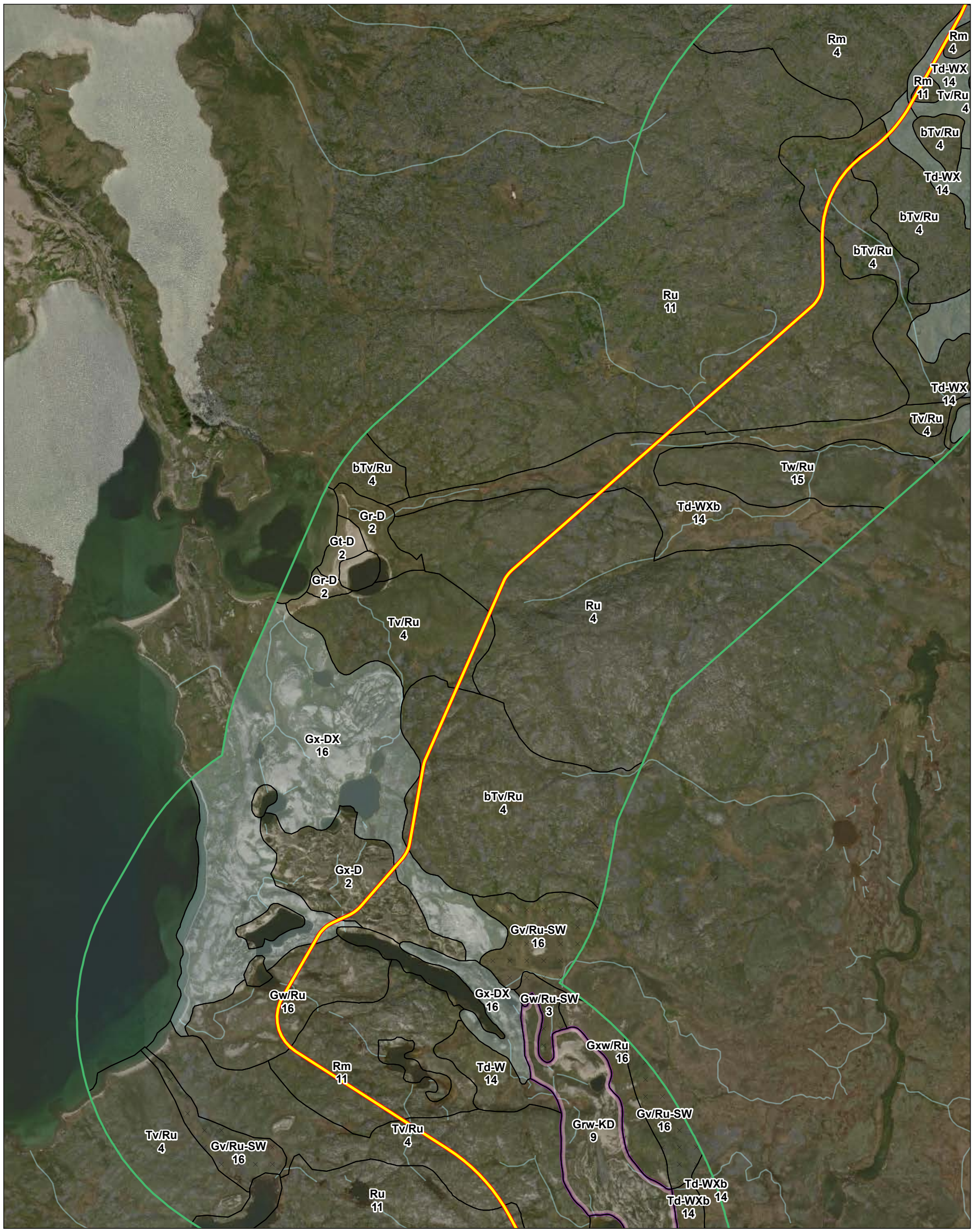
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Notes
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 2. Data Sources: Governments of Nunavut, Northwest Territories and Canada, Stantec, Morse et al. 2023.
 3. Service Layer Credits: World Imagery: Vantor

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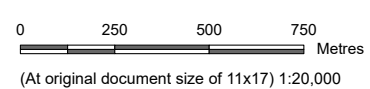
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- Grays Bay Road
- Local Assessment Area (LAA)
- Watercourse
- Terrain**
- v v v v v Gullies
- ▨ Ice Wedge Polygon
- ▨ Permafrost Process
- X X Seepage
- ▭ Thermokarst

Genetic Materials		Surface Expressions	
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F	Fluvial	d	Depression
G	Glaciofluvial	e	Delta
L	Glaciolacustrine	f	Fan
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O	Organic	j	Strong Slopes
R	Bedrock	k	Kettled, pitted (non-genetic)
T	Till (glacial)	l	Long, gentle slope
U	Undifferentiated	m	Rolling
Geomorphological Processes		r	Ridge
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Xb	Beaded stream		
Xw	Ice wedge-polygonal ground		



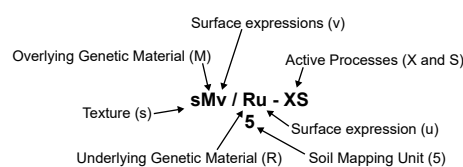
Project Location: West Kitikmeot Region, Nunavut
 Prepared by AYIU on 2026-02-23
 TR by OPIRAUX on 2026-02-23

Client/Project: 123514886_063

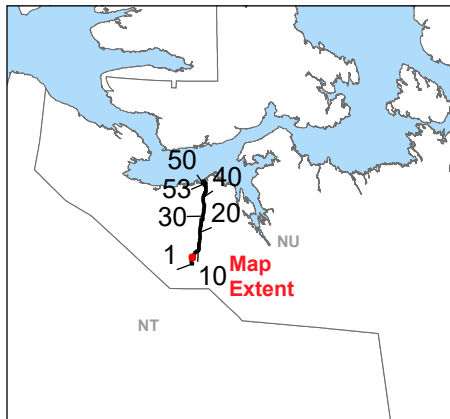
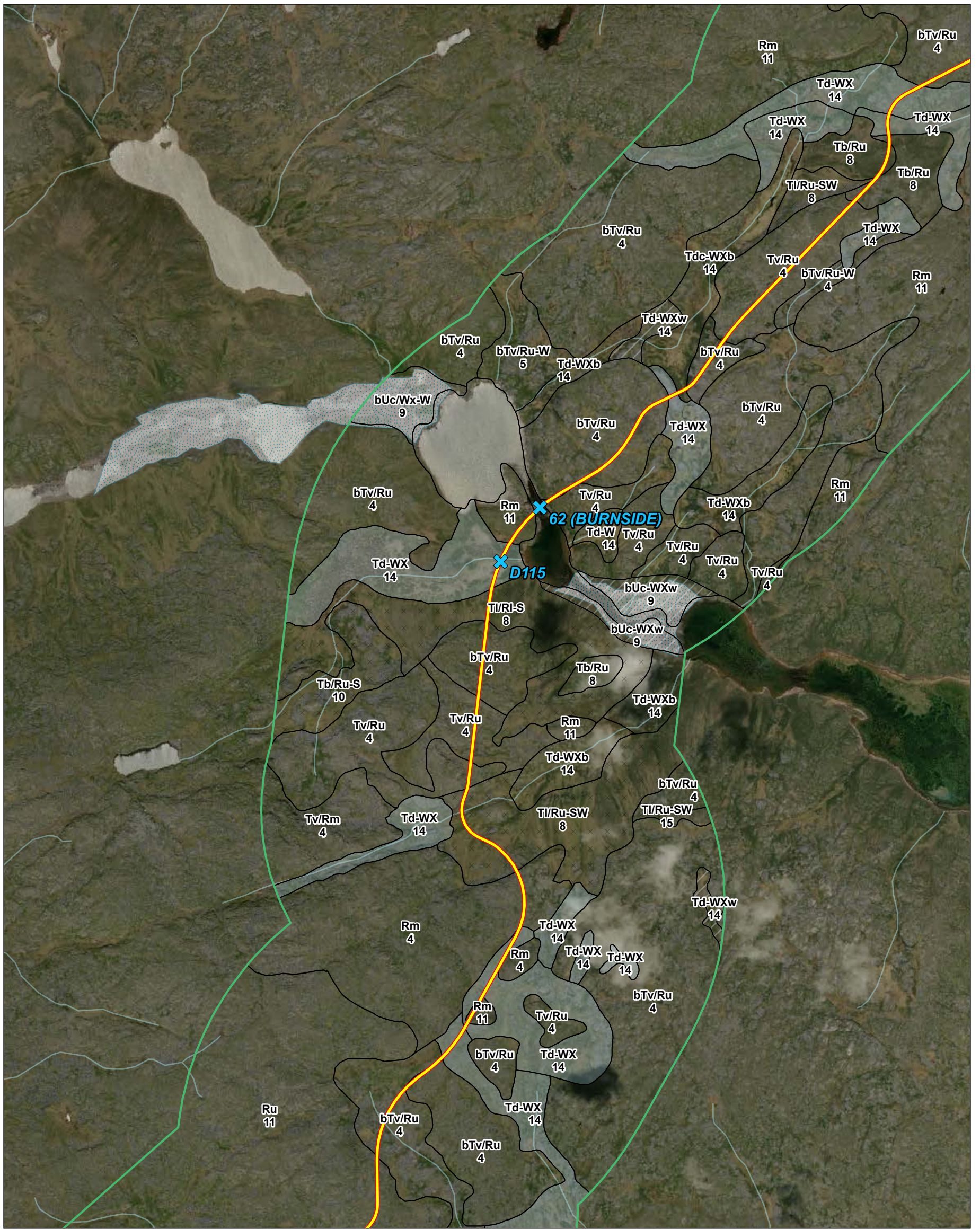
West Kitikmeot Resources Corp
 Grays Bay Road and Port

Figure No. **Appendix E** Page 4 of 53

Title **LAA Terrain and Soil Mapping**



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- Grays Bay Road
- Local Assessment Area (LAA)
- Watercourse
- Icing
- Terrain**
- Gullies
- Ice Wedge Polygon
- Permafrost Process
- Seepage
- Thermokarst

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A	Anthropogenic (disturbed)	b	Blanket
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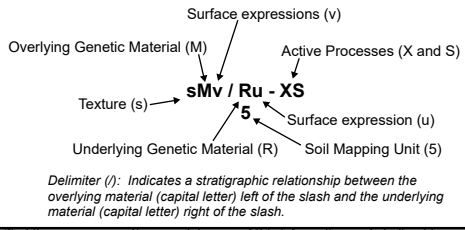
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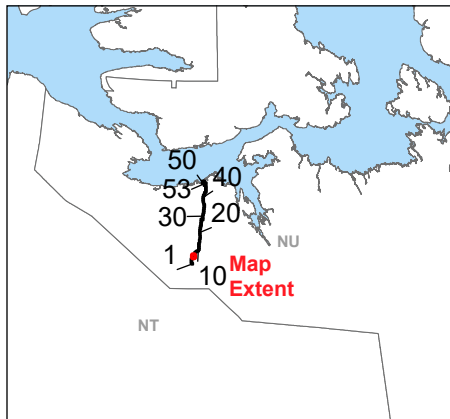
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 Prepared by AYIU on 2026-02-23
 TR by OPIRAUX on 2026-02-23

Client/Project 123514886_063
 West Kitikmeot Resources Corp
 Grays Bay Road and Port

Figure No. **Appendix E** Page 5 of 53
 Title **LAA Terrain and Soil Mapping**



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Notes
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- Grays Bay Road
- Local Assessment Area (LAA)
- Watercourse
- Icing
- Terrain**
- v v v v Gullies
- Ice Wedge Polygon
- Permafrost Process
- Seepage
- Thermokarst

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Xw	Ice wedge-polygonal ground		

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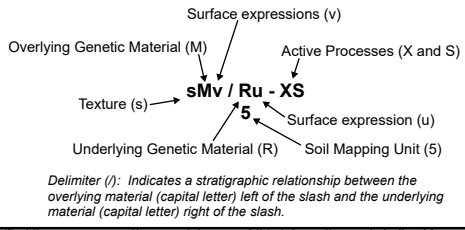
Project Location
West Kitikmeot Region, Nunavut

Client/Project
West Kitikmeot Resources Corp
Grays Bay Road and Port

Prepared by AYIU on 2026-02-23
TR by OPIRAUX on 2026-02-23

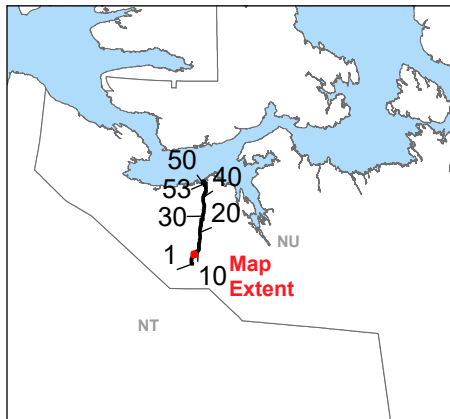
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Figure No. **Appendix E** Page 6 of 53
 Title **LAA Terrain and Soil Mapping**



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- Grays Bay Road
- Local Assessment Area (LAA)
- Watercourse
- Terrain**
- v v v v Gullies
- ▨ Ice Wedge Polygon
- Permafrost Process
- x x Seepage
- Thermokarst

Genetic Materials		Surface Expressions	
A	Anthropogenic (disturbed)	b	Blanket
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D	Deflation	t	Terraced
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W	High water table, poorly drained	x	Complex
X	Permafrost-affected (general)		
Xb	Beaded stream		
Xw	Ice wedge-polygonal ground		

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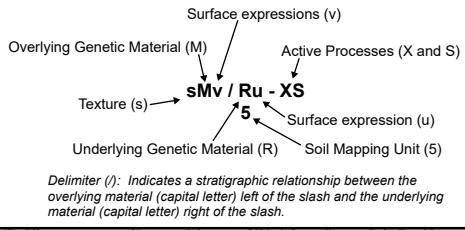
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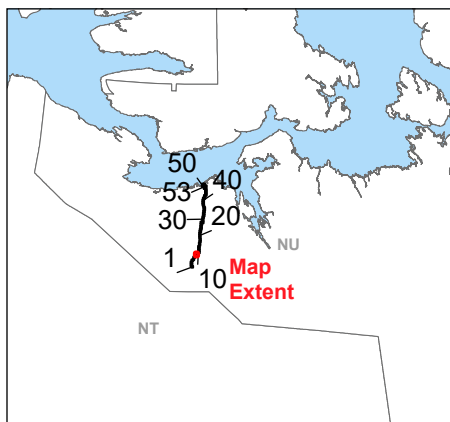
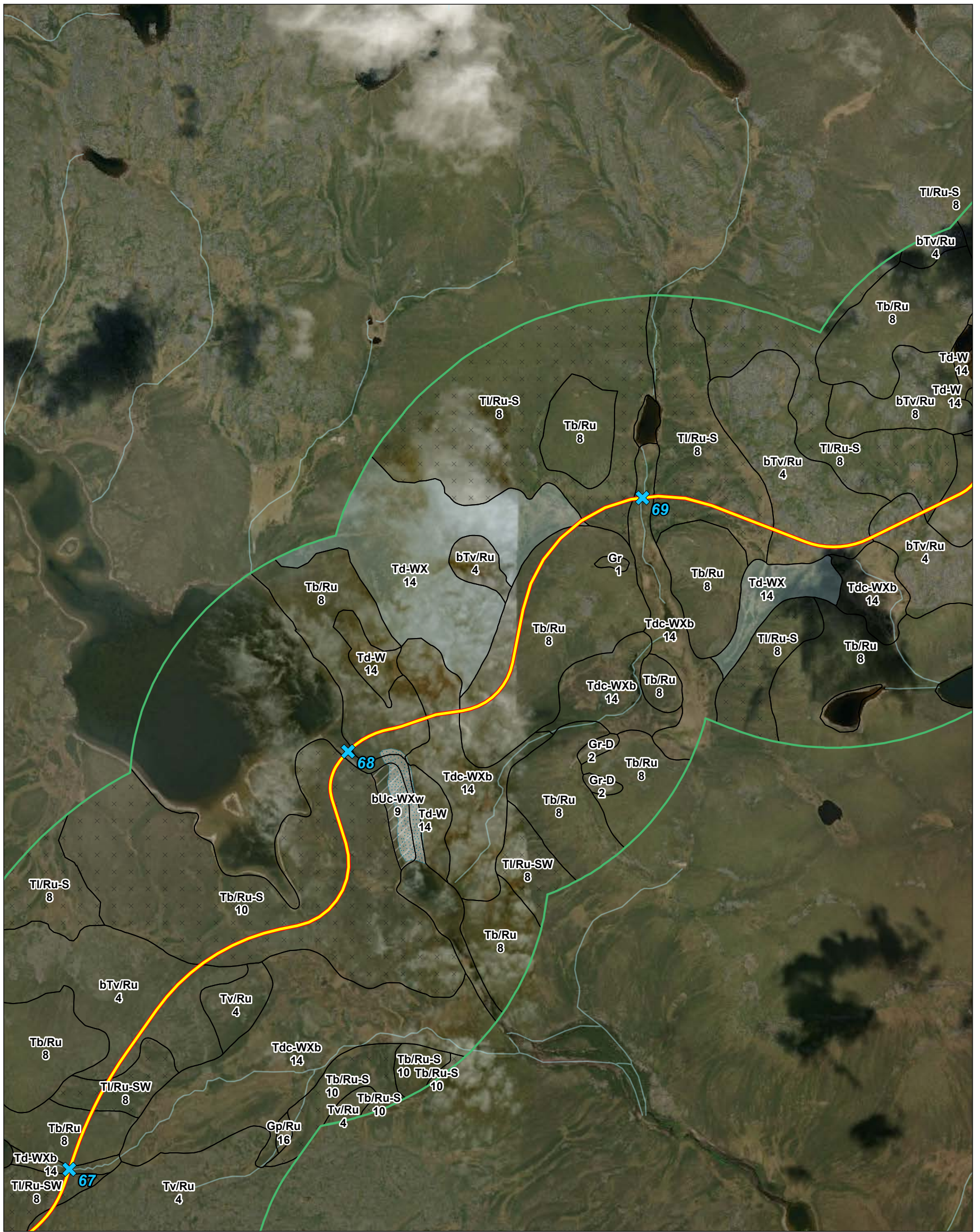
Project Location West Kitikmeot Region, Nunavut
Client/Project West Kitikmeot Resources Corp
 Grays Bay Road and Port

Prepared by AYIU on 2026-02-23
 TR by OPIRAUX on 2026-02-23
 123514886_063

Figure No. **Appendix E** Page 7 of 53
 Title **LAA Terrain and Soil Mapping**



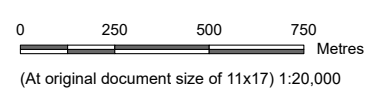
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 3. Service Layer Credits: World Imagery: Vantor

- Grays Bay Road
- Local Assessment Area (LAA)
- Watercourse
- Icing
- Terrain**
- v v v v Gullies
- Ice Wedge Polygon
- Permafrost Process
- Seepage
- Thermokarst

Genetic Materials		Surface Expressions	
A	Anthropogenic (disturbed)	b	Blanket
C	Colluvium	c	Channel-shaped, channelled
F	Fluvial	d	Depression
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O	Organic	j	Strong Slopes
R	Bedrock	k	Kettled, pitted (non-genetic)
T	Till (glacial)	l	Long, gentle slope
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Geomorphological Processes		r	Ridge
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K	Thermokarst	u	Undulating
S	Soilfuction, seepage	v	Veneer
V	Gullied	w	Discontinuous
W	High water table, poorly drained	x	Complex
X	Permafrost-affected (general)		
Xb	Beaded stream		
Xw	Ice wedge-polygonal ground		



Project Location
 West Kitikmeot Region, Nunavut

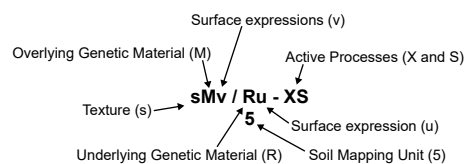
Client/Project
 West Kitikmeot Resources Corp
 Grays Bay Road and Port

Prepared by AYIU on 2026-02-23
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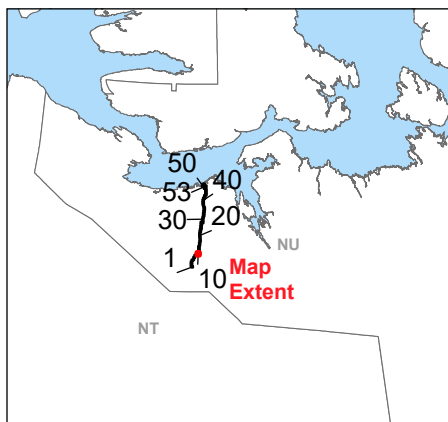
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Figure No. **Appendix E** Page 9 of 53

Title
LAA Terrain and Soil Mapping



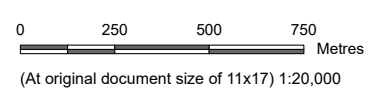
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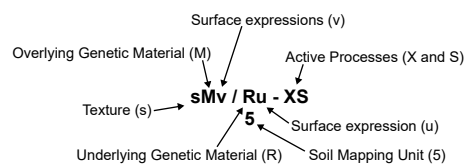


Project Location: West Kitikmeot Region, Nunavut
 Prepared by AYIU on 2026-02-23
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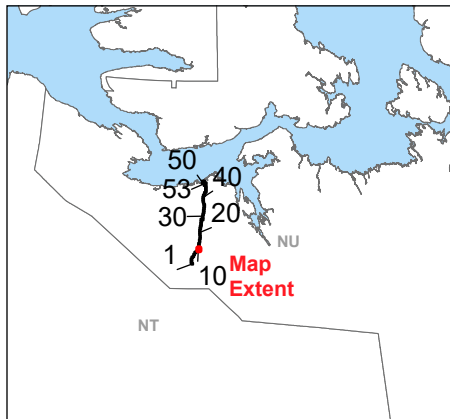
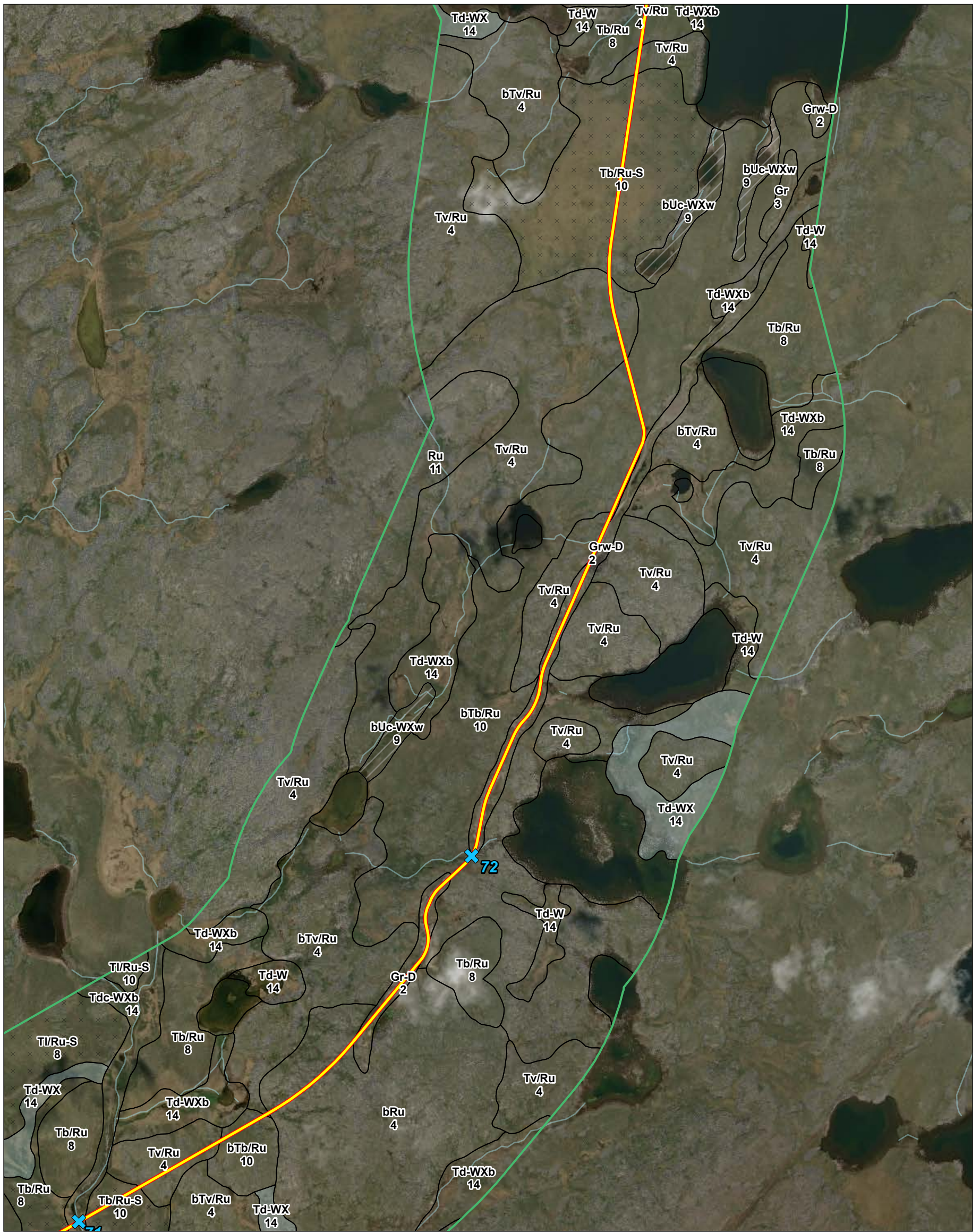
Client/Project: West Kitikmeot Resources Corp
 Grays Bay Road and Port
 123514886_063

Figure No. **Appendix E** Page 10 of 53

LAA Terrain and Soil Mapping



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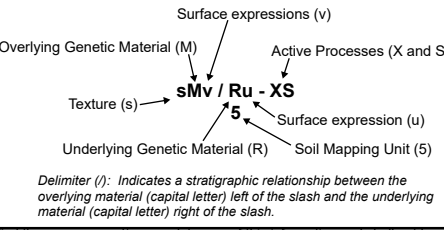
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Project Location
 West Kitikmeot Region, Nunavut

Client/Project
 West Kitikmeot Resources Corp
 Grays Bay Road and Port

Prepared by AYIU on 2026-02-23
 TR by OPIRAUX on 2026-02-23

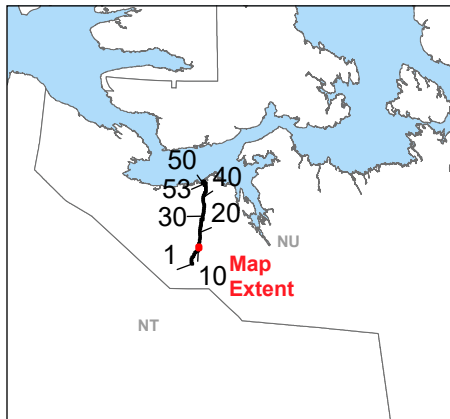
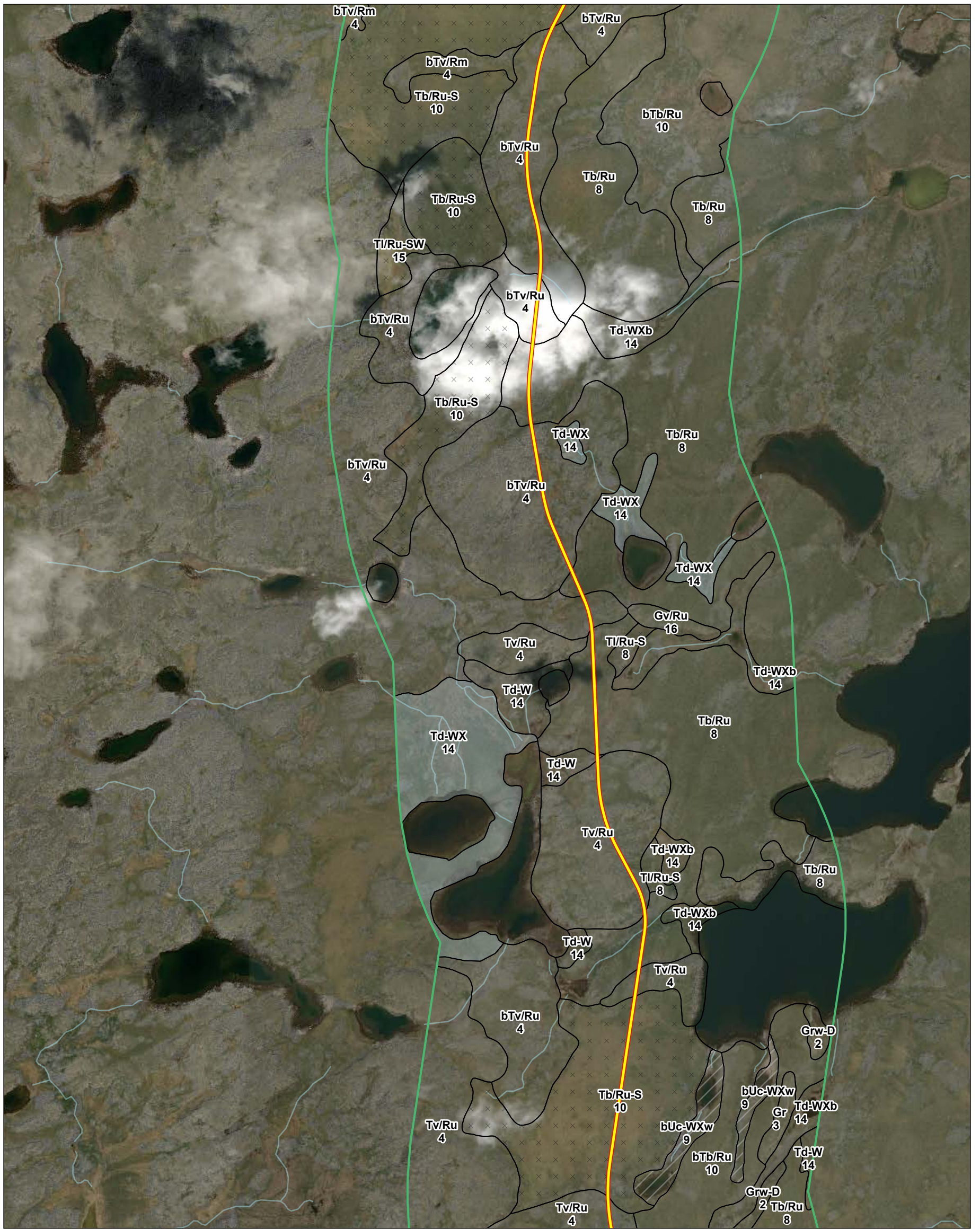
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- v v v v Gullies
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 - Thermokarst

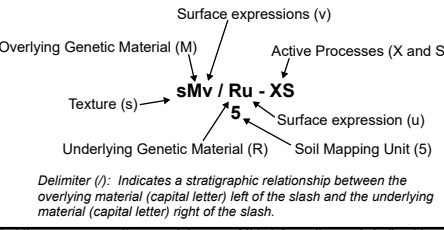
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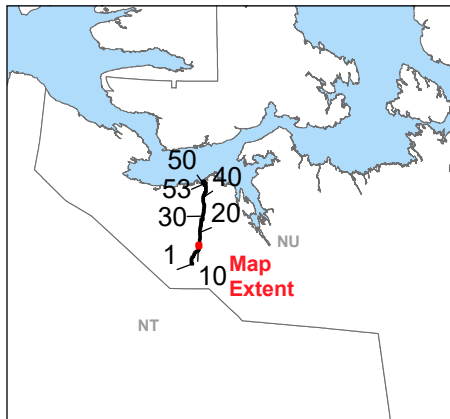
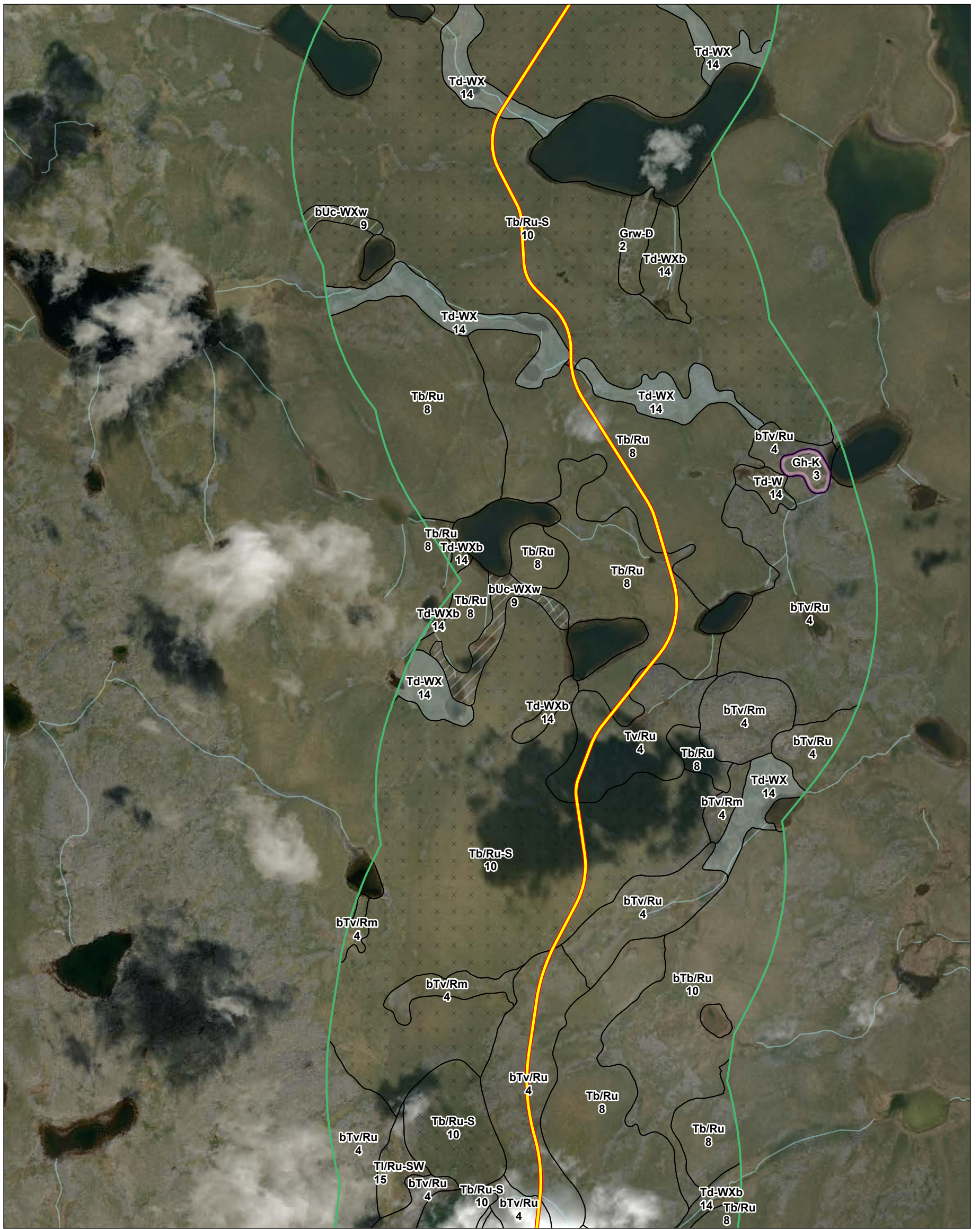
Project Location: West Kitikmeot Region, Nunavut
Client/Project: West Kitikmeot Resources Corp Grays Bay Road and Port
Prepared by AYIU on 2026-02-23
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123514886_063



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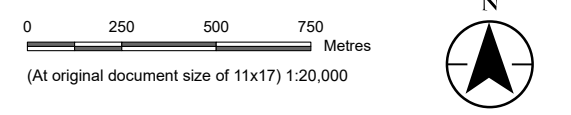
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- Watercourse
- Terrain**
- v v v v v Gullies
- Ice Wedge Polygon
- Permafrost Process
- Seepage
- Thermokarst

Genetic Materials		Surface Expressions	
A	Anthropogenic (disturbed)	b	Blanket
C	Colluvium	c	Channel-shaped, channelled
F	Fluvial	d	Depression
G	Glaciofluvial	e	Delta
L	Glaciolacustrine	f	Fan
M	Marine	h	Hummocky
O	Organic	j	Strong Slopes
R	Bedrock	k	Kettled, pitted (non-genetic)
T	Till (glacial)	l	Long, gentle slope
U	Undifferentiated	m	Rolling
Geomorphological Processes		r	Ridge
A	Rapid mass movement	s	Steep slope
D	Deflation	t	Terraced
K	Thermokarst	u	Undulating
S	Soilfuction, seepage	v	Veneer
V	Gullied	w	Discontinuous
W	High water table, poorly drained	x	Complex
X	Permafrost-affected (general)		
Xb	Beaded stream		
Xw	Ice wedge-polygonal ground		



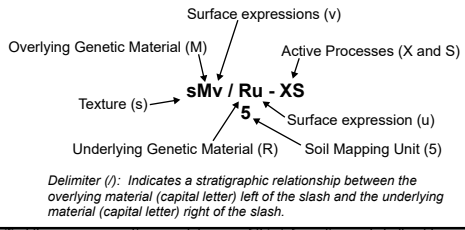
Project Location
 West Kitikmeot Region, Nunavut

Client/Project
 West Kitikmeot Resources Corp
 Grays Bay Road and Port

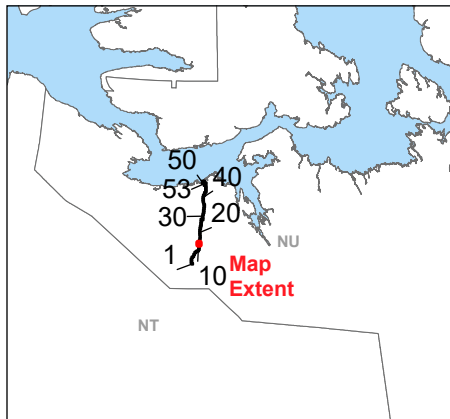
Prepared by AYIU on 2026-02-23
 TR by OPIRAUX on 2026-02-23

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Figure No. **Appendix E** Page 13 of 53
LAA Terrain and Soil Mapping



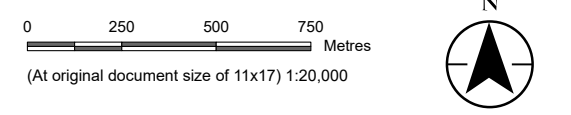
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 Reviset: 2026-02-23 By: dcapy



Notes
 1. Coordinate System: WGS 1984 UTM Zone 12N
 2. Data Sources: Governments of Nunavut, Northwest Territories and Canada, Stantec, Morse et al. 2023.
 3. Service Layer Credits: World Imagery: Vantor

- Grays Bay Road
- Local Assessment Area (LAA)
- Watercourse
- Terrain**
- v v v v Gullies
- Ice Wedge Polygon
- Permafrost Process
- Seepage
- Thermokarst

Genetic Materials		Surface Expressions	
A	Anthropogenic (disturbed)	b	Blanket
C	Colluvium	c	Channel-shaped, channelled
F	Fluvial	d	Depression
G	Glaciofluvial	e	Delta
L	Glaciolacustrine	f	Fan
M	Marine	h	Hummocky
O	Organic	j	Strong Slopes
R	Bedrock	k	Kettled, pitted (non-genetic)
T	Till (glacial)	l	Long, gentle slope
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V	Gullied	w	Discontinuous
W	High water table, poorly drained	x	Complex
X	Permafrost-affected (general)		
Xb	Beaded stream		
Xw	Ice wedge-polygonal ground		

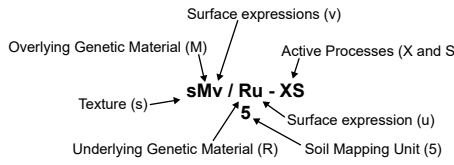


Project Location
 West Kitikmeot Region, Nunavut
 Prepared by AYIU on 2026-02-23
 TR by OPIRAUX on 2026-02-23

Client/Project
 123514886_063

West Kitikmeot Resources Corp
 Grays Bay Road and Port

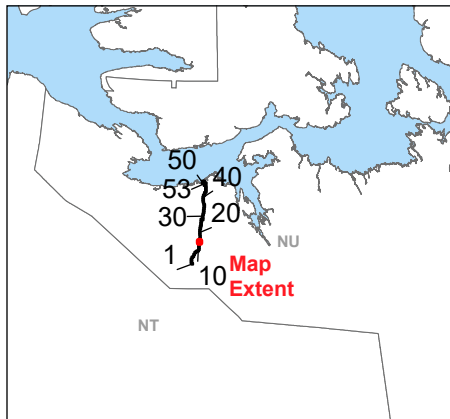
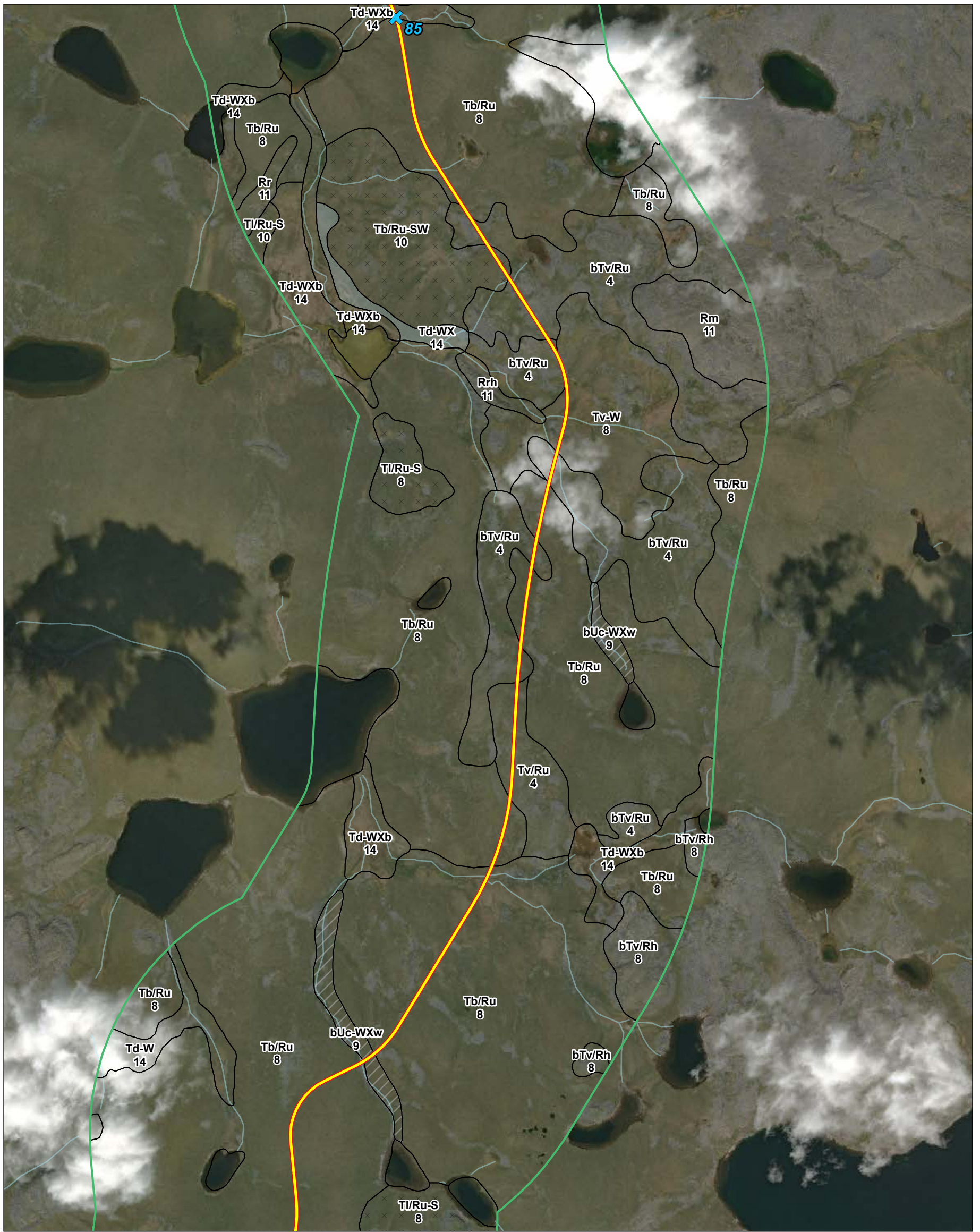
Figure No.
Appendix E
Title
LAA Terrain and Soil Mapping



Delimiter (/): Indicates a stratigraphic relationship between the overlying material (capital letter) left of the slash and the underlying material (capital letter) right of the slash.

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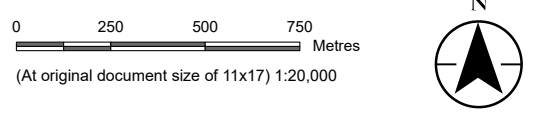
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 3. Service Layer Credits: World Imagery: Vantor

- Grays Bay Road
- Local Assessment Area (LAA)
- Watercourse
- Terrain**
- v v v v v Gullies
- Ice Wedge Polygon
- Permafrost Process
- Seepage
- Thermokarst

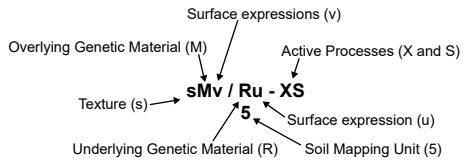
Genetic Materials		Surface Expressions	
A	Anthropogenic (disturbed)	b	Blanket
C	Colluvium	c	Channel-shaped, channelled
F	Fluvial	d	Depression
G	Glaciofluvial	e	Delta
L	Glaciolacustrine	f	Fan
M	Marine	h	Hummocky
O	Organic	j	Strong Slopes
R	Bedrock	k	Kettled, pitted (non-genetic)
T	Till (glacial)	l	Long, gentle slope
U	Undifferentiated	m	Rolling
Geomorphological Processes		r	Ridge
A	Rapid mass movement	s	Steep slope
D	Deflation	t	Terraced
K	Thermokarst	u	Undulating
S	Solifluction, seepage	v	Veneer
V	Gullied	w	Discontinuous
W	High water table, poorly drained	x	Complex
X	Permafrost-affected (general)		
Xb	Beaded stream		
Xw	Ice wedge-polygonal ground		



Project Location: West Kitikmeot Region, Nunavut
 Prepared by AYIU on 2026-02-23
 TR by OPIRAUX on 2026-02-23

Client/Project: West Kitikmeot Resources Corp
 Grays Bay Road and Port
 123514886_063

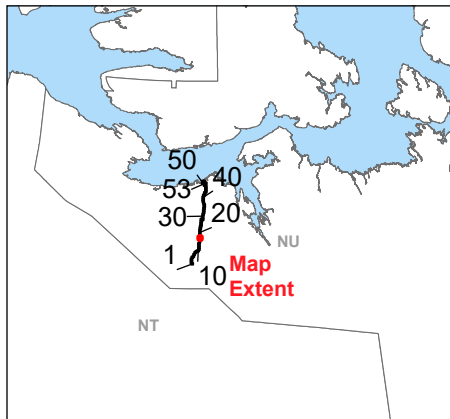
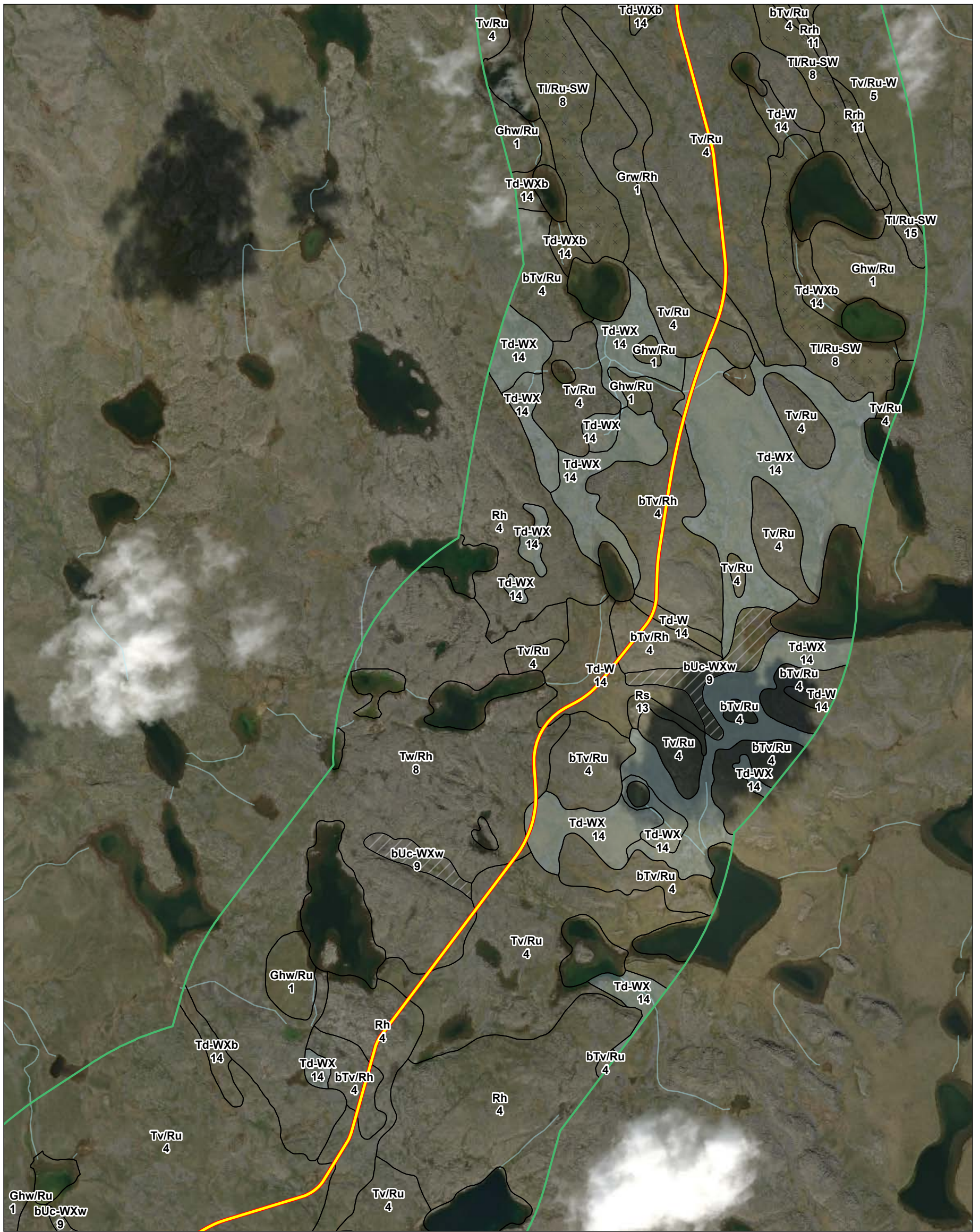
Figure No. **Appendix E** Page 15 of 53



Delimitator (/): Indicates a stratigraphic relationship between the overlying material (capital letter) left of the slash and the underlying material (capital letter) right of the slash.

LAA Terrain and Soil Mapping

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Notes
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 3. Service Layer Credits: World Imagery: Vantor

- Grays Bay Road
 - Local Assessment Area (LAA)
 - Watercourse
- Terrain**
- v v v v v Gullies
 - Ice Wedge Polygon
 - Permafrost Process
 - Seepage
 - Thermokarst

Genetic Materials		Surface Expressions	
A	Anthropogenic (disturbed)	b	Blanket
C	Colluvium	c	Channel-shaped, channelled
F	Fluvial	d	Depression
G	Glaciofluvial	e	Delta
L	Glaciolacustrine	f	Fan
M	Marine	h	Hummocky
O	Organic	j	Strong Slopes
R	Bedrock	k	Kettled, pitted (non-genetic)
T	Till (glacial)	l	Long, gentle slope
U	Undifferentiated	m	Rolling
Geomorphological Processes		r	Ridge
A	Rapid mass movement	s	Steep slope
D	Deflation	t	Terraced
K	Thermokarst	u	Undulating
S	Soilfuction, seepage	v	Veneer
V	Gullied	w	Discontinuous
W	High water table, poorly drained	x	Complex
X	Permafrost-affected (general)		
Xb	Beaded stream		
Xw	Ice wedge-polygonal ground		

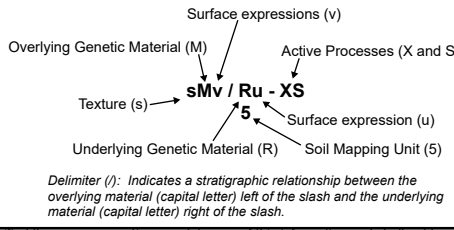
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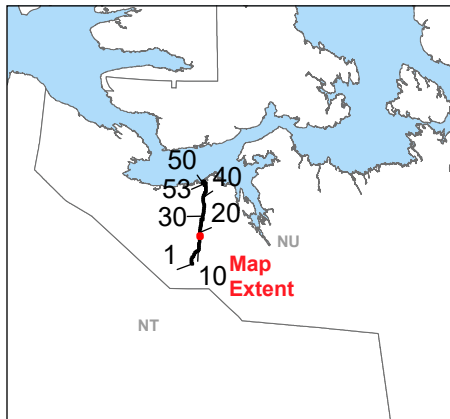
Project Location West Kitikmeot Region, Nunavut
Client/Project West Kitikmeot Resources Corp
 Grays Bay Road and Port

Prepared by AYIU on 2026-02-23
 TR by OPIRAUX on 2026-02-23
 123514886_063

Figure No. **Appendix E** Page 17 of 53
Title
LAA Terrain and Soil Mapping

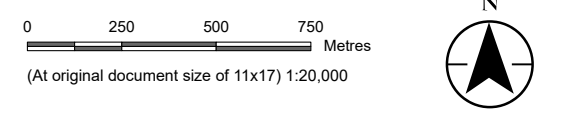


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 Reviset: 2026-02-23 By: dcapy



- Grays Bay Road
 - Local Assessment Area (LAA)
 - Watercourse
- Terrain**
- v v v v Gullies
 - / / / / Ice Wedge Polygon
 - Permafrost Process
 - X X Seepage
 - Thermokarst

Genetic Materials		Surface Expressions	
A	Anthropogenic (disturbed)	b	Blanket
C	Colluvium	c	Channel-shaped, channelled
F	Fluvial	d	Depression
G	Glaciofluvial	e	Delta
L	Glaciolacustrine	f	Fan
M	Marine	h	Hummocky
O	Organic	j	Strong Slopes
R	Bedrock	k	Kettled, pitted (non-genetic)
T	Till (glacial)	l	Long, gentle slope
U	Undifferentiated	m	Rolling
Geomorphological Processes		r	Ridge
A	Rapid mass movement	s	Steep slope
D	Deflation	t	Terraced
K	Thermokarst	u	Undulating
S	Soilfuction, seepage	v	Veneer
V	Gullied	w	Discontinuous
W	High water table, poorly drained	x	Complex
X	Permafrost-affected (general)		
Xb	Beaded stream		
Xw	Ice wedge-polygonal ground		

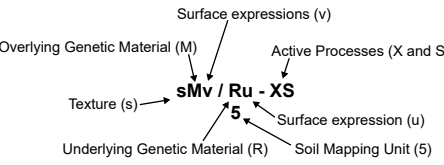


Project Location: West Kitikmeot Region, Nunavut
 Prepared by AYIU on 2026-02-23
 TR by OPIRAUX on 2026-02-23

Client/Project: 123514886_063

West Kitikmeot Resources Corp
 Grays Bay Road and Port

Figure No. **Appendix E** Page 18 of 53

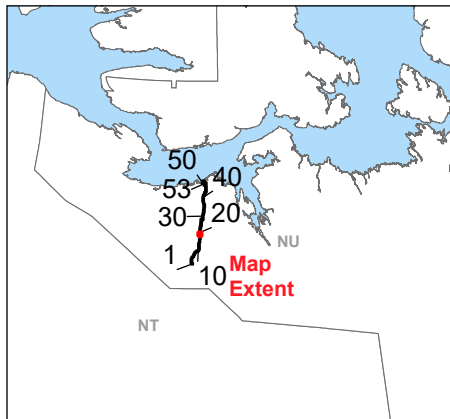


Delimitter (/): Indicates a stratigraphic relationship between the overlying material (capital letter) left of the slash and the underlying material (capital letter) right of the slash.

LAA Terrain and Soil Mapping

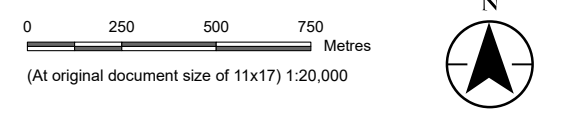
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Notes
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 2. Data Sources: Governments of Nunavut, Northwest Territories and Canada, Stantec, Morse et al. 2023.
 3. Service Layer Credits: World Imagery: Vantor



- Grays Bay Road
 - Local Assessment Area (LAA)
 - Watercourse
- Terrain**
- v v v v v Gullies
 - Ice Wedge Polygon
 - Permafrost Process
 - X Seepage
 - Thermokarst

Genetic Materials		Surface Expressions	
A	Anthropogenic (disturbed)	b	Blanket
C	Colluvium	c	Channel-shaped, channelled
F	Fluvial	d	Depression
G	Glaciofluvial	e	Delta
L	Glaciolacustrine	f	Fan
M	Marine	h	Hummocky
O	Organic	j	Strong Slopes
R	Bedrock	k	Kettled, pitted (non-genetic)
T	Till (glacial)	l	Long, gentle slope
U	Undifferentiated	m	Rolling
Geomorphological Processes		r	Ridge
A	Rapid mass movement	s	Steep slope
D	Deflation	t	Terraced
K	Thermokarst	u	Undulating
S	Soilfuction, seepage	v	Veneer
V	Gullied	w	Discontinuous
W	High water table, poorly drained	x	Complex
X	Permafrost-affected (general)		
Xb	Beaded stream		
Xw	Ice wedge-polygonal ground		

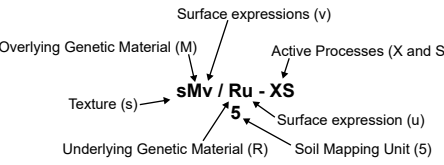


Project Location: West Kitikmeot Region, Nunavut
 Prepared by AYIU on 2026-02-23
 TR by OPIRAUX on 2026-02-23

Client/Project: 123514886_063

West Kitikmeot Resources Corp
 Grays Bay Road and Port

Figure No. **Appendix E** Page 19 of 53



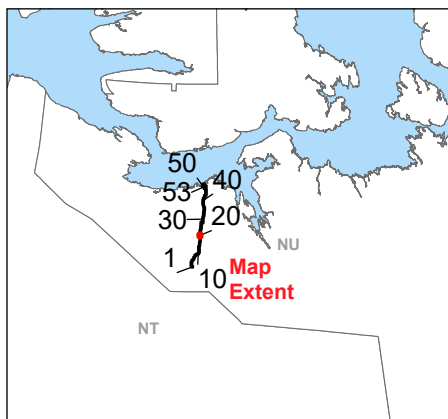
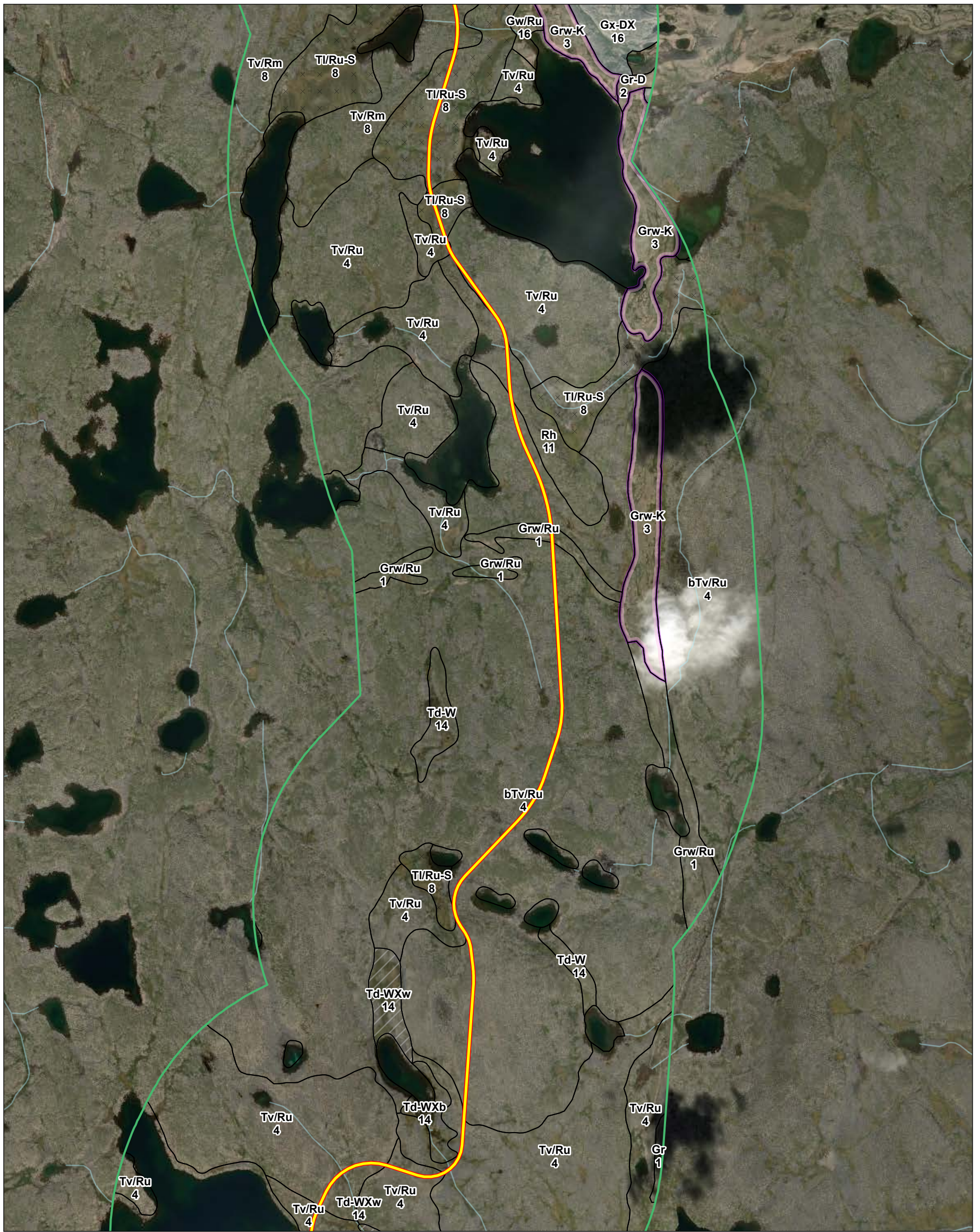
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LAA Terrain and Soil Mapping

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 Reviset: 2026-02-23 By: dcapy

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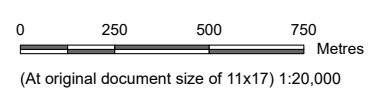
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 3. Service Layer Credits: World Imagery: Vantor

- Grays Bay Road
- Local Assessment Area (LAA)
- Watercourse
- Terrain**
- v v v v v Gullies
- Ice Wedge Polygon
- Permafrost Process
- Seepage
- Thermokarst

Genetic Materials		Surface Expressions	
A	Anthropogenic (disturbed)	b	Blanket
C	Colluvium	c	Channel-shaped, channelled
F	Fluvial	d	Depression
G	Glaciofluvial	e	Delta
L	Glaciolacustrine	f	Fan
M	Marine	h	Hummocky
O	Organic	j	Strong Slopes
R	Bedrock	k	Kettled, pitted (non-genetic)
T	Till (glacial)	l	Long, gentle slope
U	Undifferentiated	m	Rolling
Geomorphological Processes		r	Ridge
A	Rapid mass movement	s	Steep slope
D	Deflation	t	Terraced
K	Thermokarst	u	Undulating
S	Soilfuction, seepage	v	Veneer
V	Gullied	w	Discontinuous
W	High water table, poorly drained	x	Complex
X	Permafrost-affected (general)		
Xb	Beaded stream		
Xw	Ice wedge-polygonal ground		



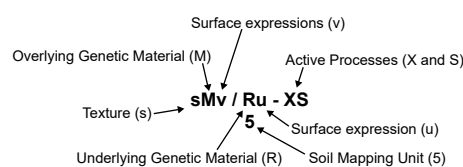
Project Location: West Kitikmeot Region, Nunavut
 Prepared by AYIU on 2026-02-23
 TR by OPIRAUX on 2026-02-23

Client/Project: 123514886_063

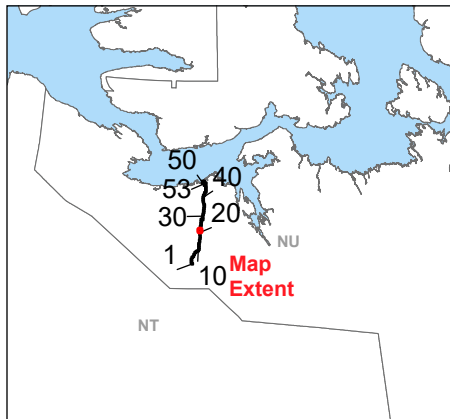
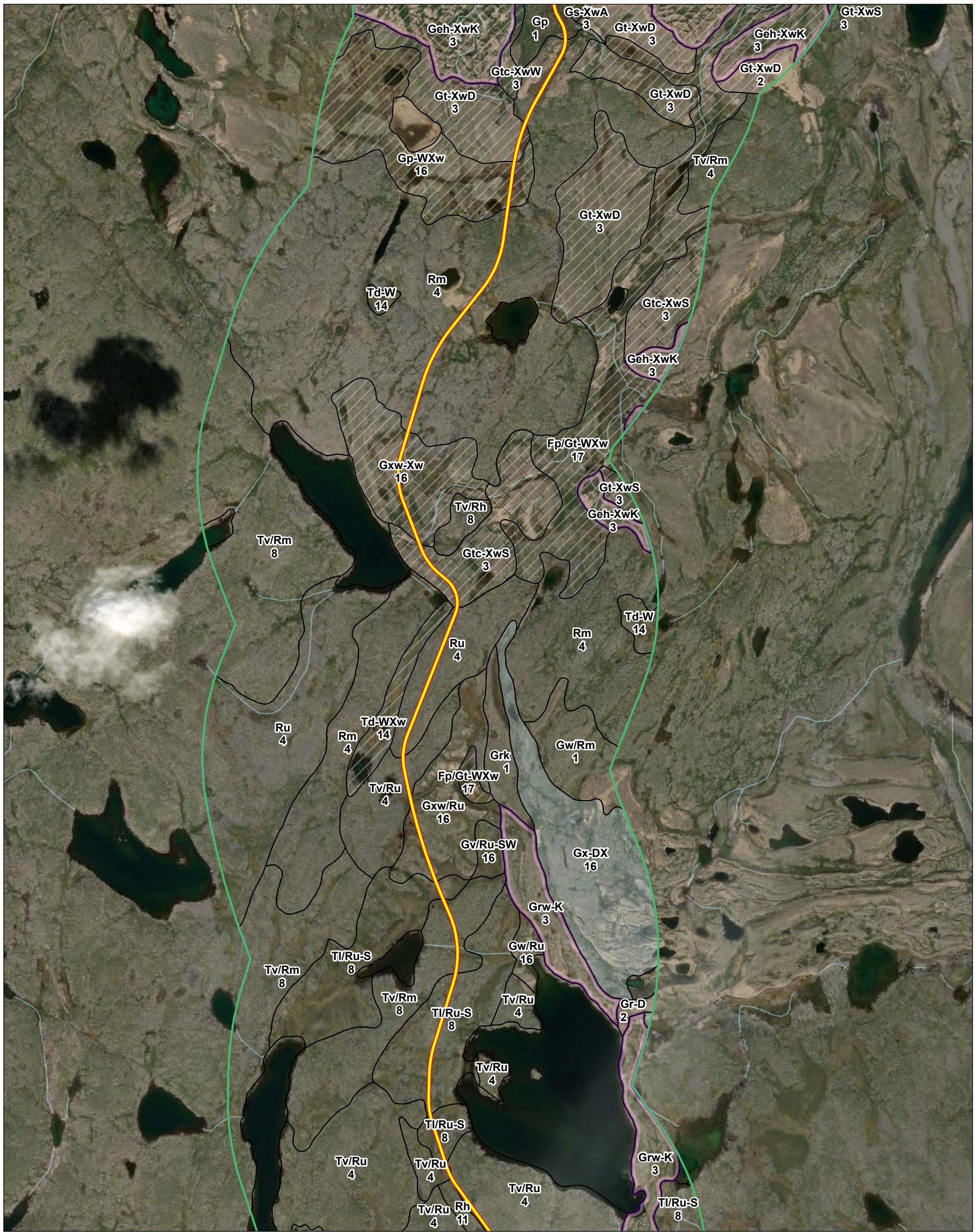
West Kitikmeot Resources Corp
 Grays Bay Road and Port

Figure No. **Appendix E** Page 20 of 53

LAA Terrain and Soil Mapping



Delimitter (/): Indicates a stratigraphic relationship between the overlying material (capital letter) left of the slash and the underlying material (capital letter) right of the slash.



Notes
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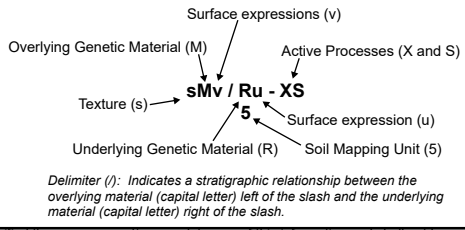
- Grays Bay Road
- Local Assessment Area (LAA)
- Watercourse
- Terrain**
- v v v v v Gullies
- Ice Wedge Polygon
- Permafrost Process
- Seepage
- Thermokarst

Genetic Materials		Surface Expressions	
A	Anthropogenic (disturbed)	b	Blanket
C	Colluvium	c	Channel-shaped, channelled
F	Fluvial	d	Depression
G	Glaciofluvial	e	Delta
L	Glaciolacustrine	f	Fan
M	Marine	h	Hummocky
O	Organic	j	Strong Slopes
R	Bedrock	k	Kettled, pitted (non-genetic)
T	Till (glacial)	l	Long, gentle slope
U	Undifferentiated	m	Rolling
Geomorphological Processes		r	Ridge
A	Rapid mass movement	s	Steep slope
D	Deflation	t	Terraced
K	Thermokarst	u	Undulating
S	Soilfuction, seepage	v	Veneer
V	Gullied	w	Discontinuous
W	High water table, poorly drained	x	Complex
X	Permafrost-affected (general)		
Xb	Beaded stream		
Xw	Ice wedge-polygonal ground		

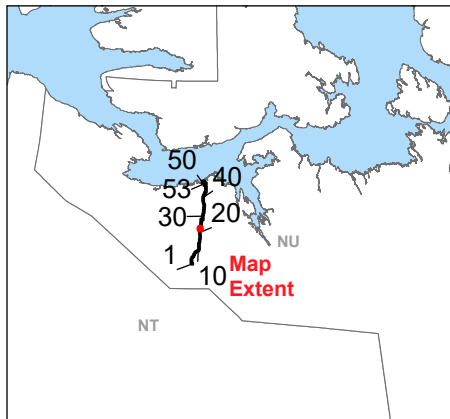
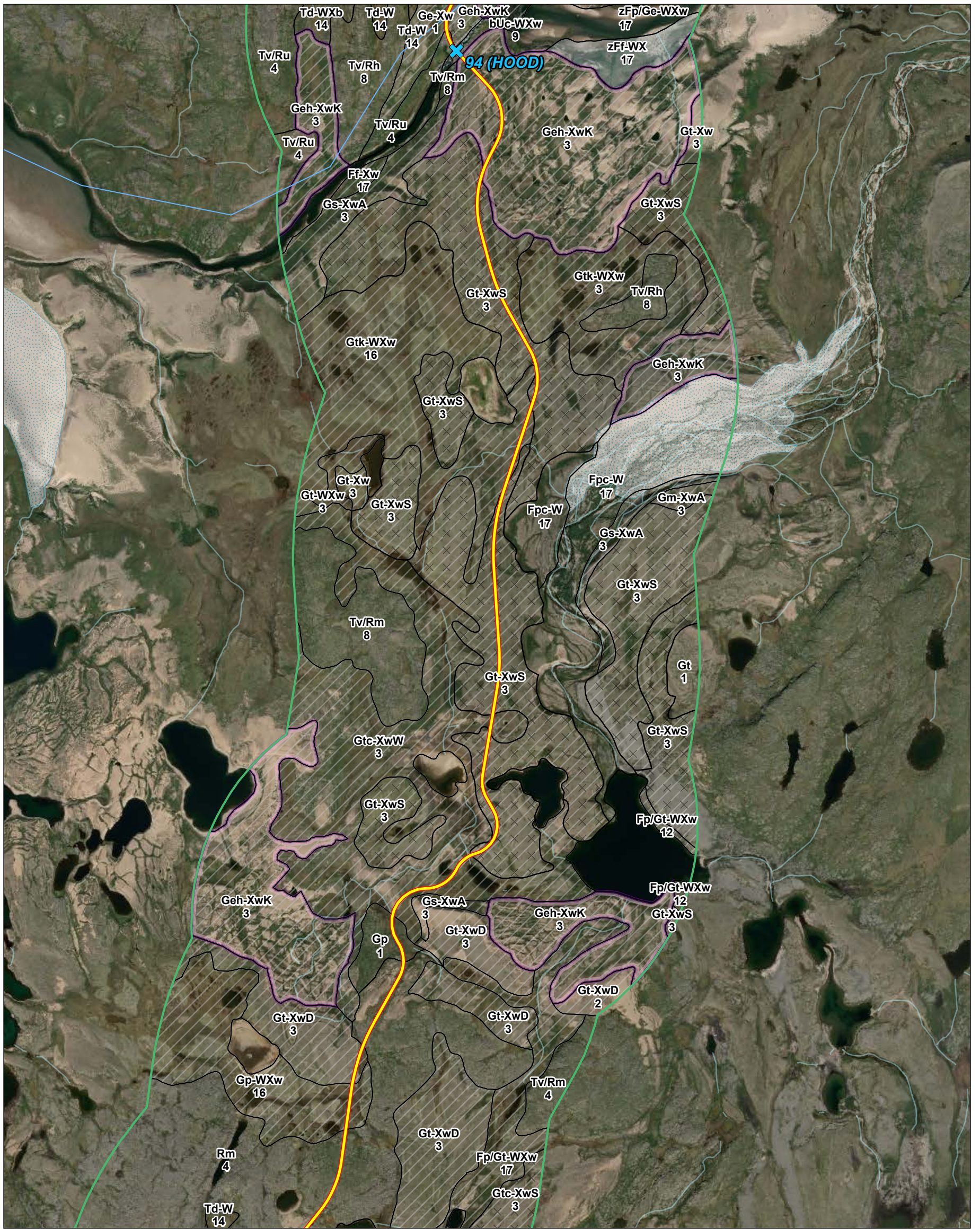
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Project Location West Kitikmeot Region, Nunavut
Client/Project West Kitikmeot Resources Corp Grays Bay Road and Port
 Prepared by AYIU on 2026-02-23
 TR by OPIRAUX on 2026-02-23
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Figure No. Appendix E Page 21 of 53
Title LAA Terrain and Soil Mapping



Delimitter (/): Indicates a stratigraphic relationship between the overlying material (capital letter) left of the slash and the underlying material (capital letter) right of the slash.



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 3. Service Layer Credits: World Imagery: Vantor

- Grays Bay Road
- Local Assessment Area (LAA)
- Watercourse
- Icing
- Terrain**
- v v v v Gullies
- Ice Wedge Polygon
- Permafrost Process
- Seepage
- Thermokarst

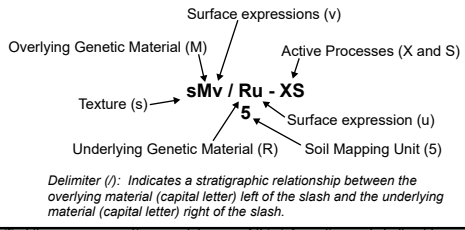
Genetic Materials		Surface Expressions	
A	Anthropogenic (disturbed)	b	Blanket
C	Colluvium	c	Channel-shaped, channelled
F	Fluvial	d	Depression
G	Glacioluvial	e	Delta
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O	Organic	j	Strong Slopes
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K	Thermokarst	u	Undulating
S	Soilfuction, seepage	v	Veneer
V	Gullied	w	Discontinuous
W	High water table, poorly drained	x	Complex
X	Permafrost-affected (general)		
Xb	Beaded stream		
Xw	Ice wedge-polygonal ground		

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Project Location West Kitikmeot Region, Nunavut
Client/Project West Kitikmeot Resources Corp Grays Bay Road and Port
 Prepared by AYIU on 2026-02-23
 TR by OPIRAUX on 2026-02-23
 123514886_063

Figure No. **Appendix E** Page 22 of 53



Delimitator (/): Indicates a stratigraphic relationship between the overlying material (capital letter) left of the slash and the underlying material (capital letter) right of the slash.

LAA Terrain and Soil Mapping

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