MN056-R106

GOVERNMENT OF YUKON
ENERGY, MINES AND RESOURCES
ASSESSMENT AND ABANDONED MINES BRANCH

# MT. NANSEN MINE RECLAMATION TERRAIN MAPPING AND MATERIALS SEARCH

W14101220

September 2009

EBA Engineering Consultants Ltd.
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## EXECUTIVE SUMMARY

Terrain mapping was completed by stereo air photograph interpretation with limited terrain ground truthing at thirty nine field stations in the Mt. Nansen area and along a corridor of the Nansen Road in the Dawson Mountain Range (Figure 3).

Most of the study area lies west of the limits of McConnell glaciation, so the surficial deposits are coarse and dry, and largely free of ground ice. The plateau surfaces in the ecoregion are too low to support alpine permafrost and most ice-rich ground is in valleys. Expect moist glaciolacustrine sediments to be ice-rich (Smith, Meikle, Roots, ed., 2004).

Most of the ecoregion was not glaciated but both early and late Wisconsin advances covered the southwestern part (Oswald and Senyk, 1977). A tongue of glaciated terrain in the broad valley of the underfit Rowlinson Creek hosts thick glacial deposits that extend to the west to within about 25 to 30 km of the Mt. Nansen mine site. Large glaciolacustrine deposits in this area were identified as the closest potential source of fine-textured material.

The area is underlain by metamorphic rock, with inclusions of sedimentary, volcanic and intrusive rocks. Middle and upper valley hillslopes in the study area are dominated by colluvium with some bedrock. Lower valley slopes are commonly covered by colluvium but often include colluvial fans and glaciofluvial terraces and escarpments. Earlier deglaciation deposited glaciofluvial sands and gravels as terraces and plains throughout the lower slopes and floors of streams in the study area (see FGt on Figure 3.1).

The boundary of the unglaciated eastern slopes of the Dawson Range with extensive recent glacial drift deposits is located about 25 km east of the mine site. Between this boundary and Carmacks occur extensive glacial deposits including glaciofluvial sands and gravels, glaciolacustrine (mainly silt) and morainal materials. The closest deposits of fine-textured glaciolacustrine (silt) materials are mapped within 2 km of the Mt. Nansen Road about 25 km east of the Mt. Nansen mine site (see LGa and LGp, Figure 3.3).

Field-checking in the study area was completed at a reconnaissance level. Additional field-checking is recommended to increase the reliability of the terrain interpretation and confirmation of soil textures.

Development of borrow sites for acquisition of fine-textured material is possible near the Rowlinson Creek crossing of the Mt. Nansen Road. Two potential borrow sites and probable access routes have been identified in this area (Figures 3.2 and 3.3). The follow-up phase of this project should include air photograph interpretation to locate a suitable alignment for access roads to potential borrow sites and a testpitting program to evaluate the quality and quantity of borrow material. Providing favourable results of the testpitting program and a decision to proceed with development of a source of fine-textured material, a Pit Development and Reclamation Plan should be prepared.

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## APPENDICES

## 1.0 INTRODUCTION

A review of previous reports, air photograph interpretation and terrain mapping was undertaken by EBA Engineering Consultants Limited (EBA) for the Mt. Nansen area. The studies were requested by Government of Yukon, Energy, Mines and Resources, Assessment and Abandoned Mines Branch (AAMB) to create an interpretive map of surficial geology in the Mt. Nansen area.

AAMB is in the process of assessment and management of mine waste at the Mt. Nansen mine site and may require borrow material with specific textures for mine reclamation.

The Mt. Nansen Mine is located in the Dawson Range, approximately 60 km west of Carmacks, Yukon and 180 km north of Whitehorse (Figure 1). This part of the south-central Yukon is included within the Little Salmon Carmacks First Nation traditional territory.

## 2.0 BACKGROUND

The Mt. Nansen area has a long history of mining including both underground and open pit development. The Mt. Nansen Mine was established for the production of gold and silver (Figure 1). The mine site is characterized by an abandoned mill, tailings and waste rock piles (front cover photograph).

The Mt. Nansen mine was last operated by BYG Resources in February 1999, when the company went into receivership after failing to meet the obligations of its water license.

## 3.0 METHODOLOGY

To initiate the terrain study (Phase I), previous relevant reports were reviewed. This included preliminary research of bedrock geology, glacial history and previous surficial geology mapping in the region; inventory, location and acquisition of air photos; air photograph interpretation of terrain; and identification of field targets for ground-truthing. The rationale to determine the boundaries of the study area was to identify and describe materials within a practical distance of the mine site and within a close proximity to existing roads.

Initial terrain mapping was completed by stereo air photograph interpretation of 1:20,000 scale black and white photographs (Appendix B). To increase the level of confidence of the interpretive mapping, limited terrain field checking was completed by EBA personnel by truck on July 7th and 8th, 2009. The poor condition of existing trails and general lack of vehicle access to some areas precluded field checking by truck and additional ground truthing was completed by helicopter on August 27, 2009. The preliminary terrain interpretation was revised based on the results of the field checking and a terrain map of the study area was produced (Figure 3). This report documents the results of the terrain

mapping and provides a synopsis of surficial geology based on air photograph interpretation, field checking and previous reports (Phase II).

The results of Phase I indicated a high probability of locating suitable borrow sources of fine-textured material potentially suitable for capping of contaminated soil or waste rock within 30 km of the mine site and a moderate to low probability of locating this material within 5 km of the mine site.

## 4.0 PHYSIOGRAPHY

The study area is located in the Dawson Mountain Range of the Yukon Plateau-Central Ecoregion of the Boreal Cordillera Ecozone. The sinuous eastern margin of the adjacent Klondike Plateau Ecoregion is located immediately west of Mt. Nansen. The study area (Figure 2) is characterized by smooth, rolling topography with moderate to deeply incised valleys. Most of the terrain lies between 1000 m and 1500 m elevation asl. Notable peaks in the study area are Mt. Nansen and Victoria Mountain at 1705 m and 1871 m as respectively.

Eastern parts of the study area (Figure 2) are drained by tributaries of Rowlinson Creek into the Nordenskiold River that meets the Yukon River at Carmacks. Most of the balance of the study area drains to the Nisling River, a tributary of the Donjek River within the White River watershed.

Open black and white spruce forest, with some aspen stands and birch, occur in valleys and on lower slopes, but much of the terrain is above treeline (1200 m).

The study area is located at the western portion of the Yukon Plateau-Central Ecoregion, which is in the rainshadow effect of the St. Elias– Coast Mountains and precipitation is relatively light, ranging from 250 to 300 mm, two-thirds of which falls during the summer. Snow cover generally exists from mid-October to mid-April in the valley floors and a month longer over the higher terrain. Mean annual temperatures are near –4°C, with monthly means ranging from -30°C in January to 15°C in July. The period with mean daily temperatures above 0°C is from late April to mid- October, although frost can occur at any time of the year.

The Yukon Plateau-Central Ecoregion spans the boundary between the widespread and sporadic discontinuous permafrost subzones. Most of the study area lies west of the limits of McConnell glaciation, so the surficial deposits are coarse and dry, and largely free of ground ice. However, fine-grained and moist sediments in valleys are prone to perennial freezing and occurrence of ground ice. The plateau surfaces in the ecoregion are too low to support alpine permafrost and most ice-rich ground is in valleys. Expect moist glaciolacustrine sediments to be ice-rich (Smith, Meikle, Roots, ed., 2004).

## 4.1 Bedrock Geology

The area is underlain by metamorphic rock, with inclusions of sedimentary, volcanic and intrusive rocks. Basic volcanic strata of the Cretaceous Carmacks Group occur near the eastern margin of the study area. Predominant units in the study area include Proterozoic and Paleozoic Age amphibolite, metamorphic mafic rocks, chlorite-biotite schist, amphibolite gneiss and altered and serpentinized ultramafic rocks. The Mt. Nansen Group includes andesite and dacite flows, breccia and tuff, rhyolite, porphyry plugs, dykes, sill and breccia. Intrusives mapped in the area are mid-Cretaceous Whitehorse Suite and may include hornblende diorite, biotite-hornblende quartz diorite, biotite-hornblende granodiorite, biotite-quartz monzonite and hornblende syenite (GSC, 1971).

The Dawson Range, on the western side of the ecoregion, contains over 150 mineral occurrences, primarily copper–gold with molybdenum porphyries with epithermal gold veins. Among those with calculated reserves are Minto, Cash, Mount Freegold–Antoniak, Laforma, and Williams Creek, the last with a large oxidized cap amenable to heap-leach and electrode precipitation of copper (Smith et.al., 2004).

## 4.2 Glacial History

The study area occurs at the western margin of the Yukon Plateau-Central Ecoregion and east of the limit of Cordilleran Pleistocene glaciation. Most of the ecoregion was not glaciated but both early and late Wisconsin advances covered the southwestern part (Oswald and Senyk, 1977). A tongue of glaciated terrain in the broad valley of the underfit Rowlinson Creek hosts thick glacial deposits that extend to the west to within about 25 to 30 km of the Mt. Nansen mine site. Large glaciolacustrine deposits in this area were identified as the closest potential source of fine-textured material.

Glacial till in the region is reported as medium-textured and mostly overlain with coarser textured glaciofluvial material at lower elevations. No glacial till was encountered within close proximity to the mine site during field checking of terrain.

# 5.0 SUMMARY OF RESULTS

Terrain mapping was completed for a selected study area in the vicinity of the Mt. Nansen Mine and along a corridor of the Nansen Road. Ground-truthing of interpreted terrain was completed at thirty nine field stations.

Middle and upper valley hillslopes in the study area are dominated by colluvium with some bedrock. Characteristic of the unglaciated landscape of the Dawson Range are small, sometimes castellated outcrops (tors) that often crown the ridgetops. Lower valley slopes are commonly covered by colluvium but often include colluvial fans and glaciofluvial terraces and escarpments.

An extensive record of earlier deglaciation deposited glaciofluvial sands and gravels as terraces and plains throughout the lower slopes and floors of streams in the study area.

There was initially assumed to be some potential for associated glaciolacustrine materials in the area; however, no deposits of these materials were mapped or discovered in close proximity to the Mt. Nansen mine site.

The boundary of the unglaciated eastern slopes of the Dawson Range with extensive recent glacial drift deposits is located about 25 km east of the mine site. Between this boundary and Carmacks occur extensive glacial deposits including glaciofluvial sands and gravels, glaciolacustrine (mainly silt) and morainal materials. The closest deposits of fine-textured glaciolacustrine (silt) materials are mapped within 2 km of the Mt. Nansen Road about 25 km east of the Mt. Nansen mine site (see LGa and LGp, Figure 3.3).

## 6.0 DISCUSSION AND RECOMMENDATIONS

The study area is characterized by bedrock and colluvium on valley slopes and ridges and discontinuous glaciofluvial and fluvial sand and gravel at the base of slopes and on valley floors. A common granular borrow material in the area consists of typically poorly graded glaciofluvial sand with some gravel deposited as terraces at most of the valley floors near the Mt. Nansen mine site (see FGt on Figure 3.1). This material presents a readily accessible and extensive source of borrow material where a coarse-textured soil is required.

Fine-textured soils (silts and clays) are notably absent in the study area within close proximity to the mine site. The closest accessible fine-textured materials were located about 25 km east of the mine site. Deposits of glaciolacustrine silt were confirmed by field checking within 2 km of the Mt. Nansen Road between about km 26 and km 32 (Figure 3.3). This area is at the western extent of glaciofluvial and glaciolacustrine terrain that shape the wide valley drained by the underfit Rowlinson Creek, a Quaternary watercourse within a wide valley of thick glacial deposits from the most recent period of deglaciation.

Field-checking in the study area was completed at a reconnaissance level. Additional field-checking is recommended to increase the reliability of the terrain interpretation and confirmation of soil textures.

Development of borrow sites for acquisition of fine-textured material is possible near the Rowlinson Creek crossing of the Mt. Nansen Road. Two potential borrow sites and probable access routes have been identified in this area (Figures 3.2 and 3.3). Development of these areas may be a cost-effective option if fine-textured materials are required during reclamation of materials at the Mt. Nansen mine site. The follow-up phase of this project should include air photograph interpretation to locate a suitable alignment for access roads to potential borrow sites and a testpitting program to evaluate the quality and quantity of borrow material. It is recommended that access trails be pioneered to advance excavator testpits in the areas targeted as having a high potential for fine-textured (silt) to determine the spatial extent, consistency, texture and depth of the material. Providing favourable results of the testpitting program and a decision to proceed with development of a source of fine-textured material, a Pit Development and Reclamation Plan should be prepared.

## 7.0 LIMITATIONS

Terrain interpretation was completed by review of air photographs with limited field checking. In order to complete this cost-effective, reconnaissance level terrain study, terrain polygon boundaries were not georectified and all boundaries are approximate. Terrain typing in polygons without field-checking stations should be field checked before the surficial geology interpretation is used for development planning. Additional field checking is recommended to increase the level of reliability.

## 8.0 CLOSURE

This report has been prepared for the exclusive use of Government of Yukon, Energy, Mines and Resources, Assessment and Abandoned Mines Branch (AAMB) for the specific application described in this report. It has been prepared in accordance with generally accepted geoscience practices. No other warranty is made, either expressed or implied. Geoscience judgement has been applied in developing the recommendations of this report. Further limitations are outlined in the General Conditions (Appendix A) that form a part of this report.

EBA Engineering Consultants Ltd.

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## 9.0 REFERENCES

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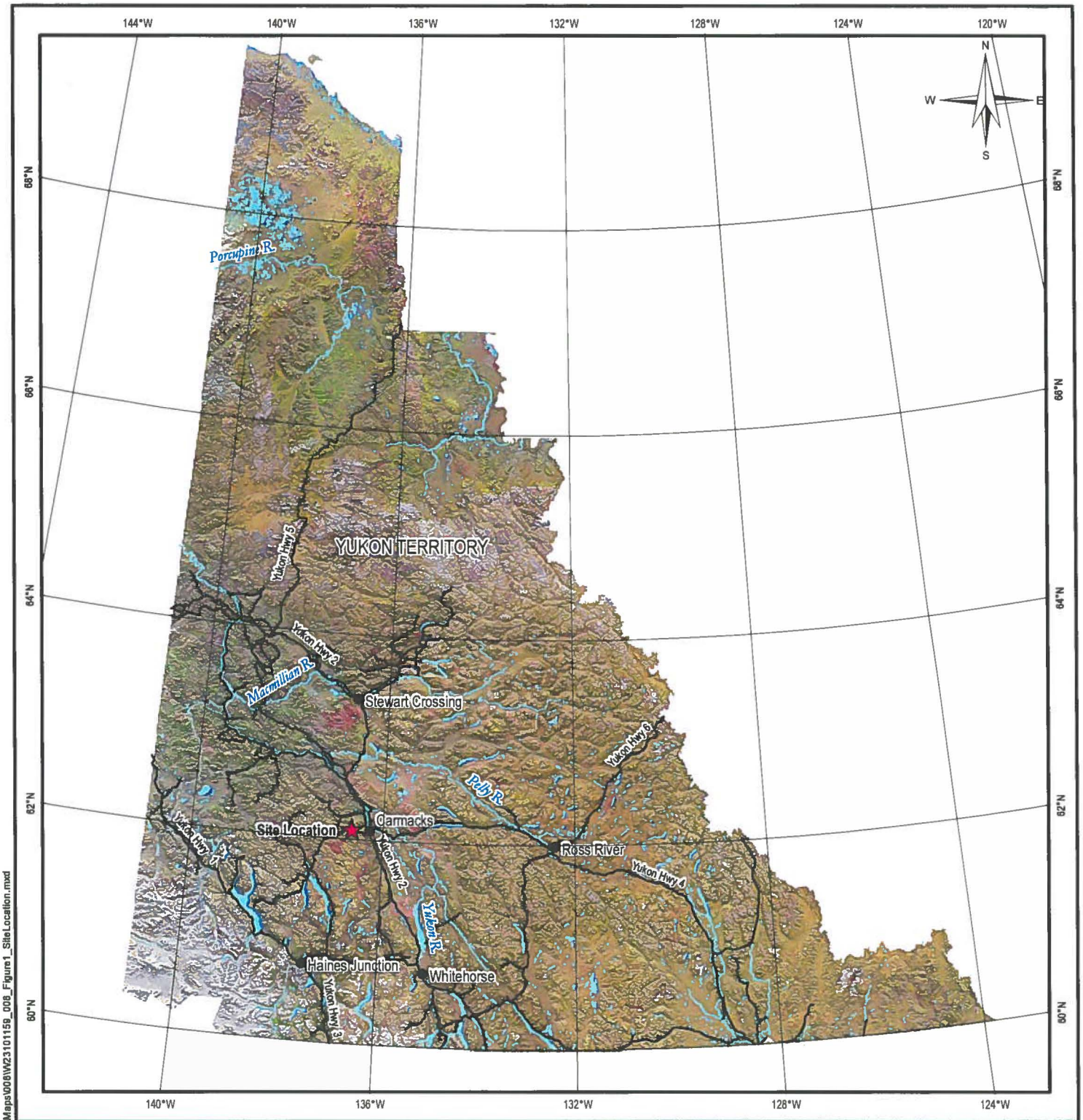
# FIGURES




## LEGEND

- Site Location
- Populated Place
- Major Road
- Watercourse

**NOTES**

Base data source: ESRI, Government of Yukon

ISSUED FOR REVIEW

# TERRAIN MAPPING AND MATERIALS SEARCH MT. NANSEN AREA, YUKON

## Site Location

| PROJECTION | DATUM |
|---|---|
| Yukon Albers | NAD83 |

Scale: 1:6,000,000

100 50 0 100

Kilometres

FILE NO.: W14101220_Figure01_SiteLocation.mxd

| PROJECT NO. | DWN | CKD | REV |
|---|---|---|---|
| W14101220 | MEZ | JD | 0 |

| OFFICE | DATE |
|---|---|
| EBA-VANC | July 29, 2009 |

Yukon Assessment and Abandoned Mone Branch, Energy Mines and Resources, Government of Yukon

EBA Engineering Consultants Ltd.

**Figure 1**

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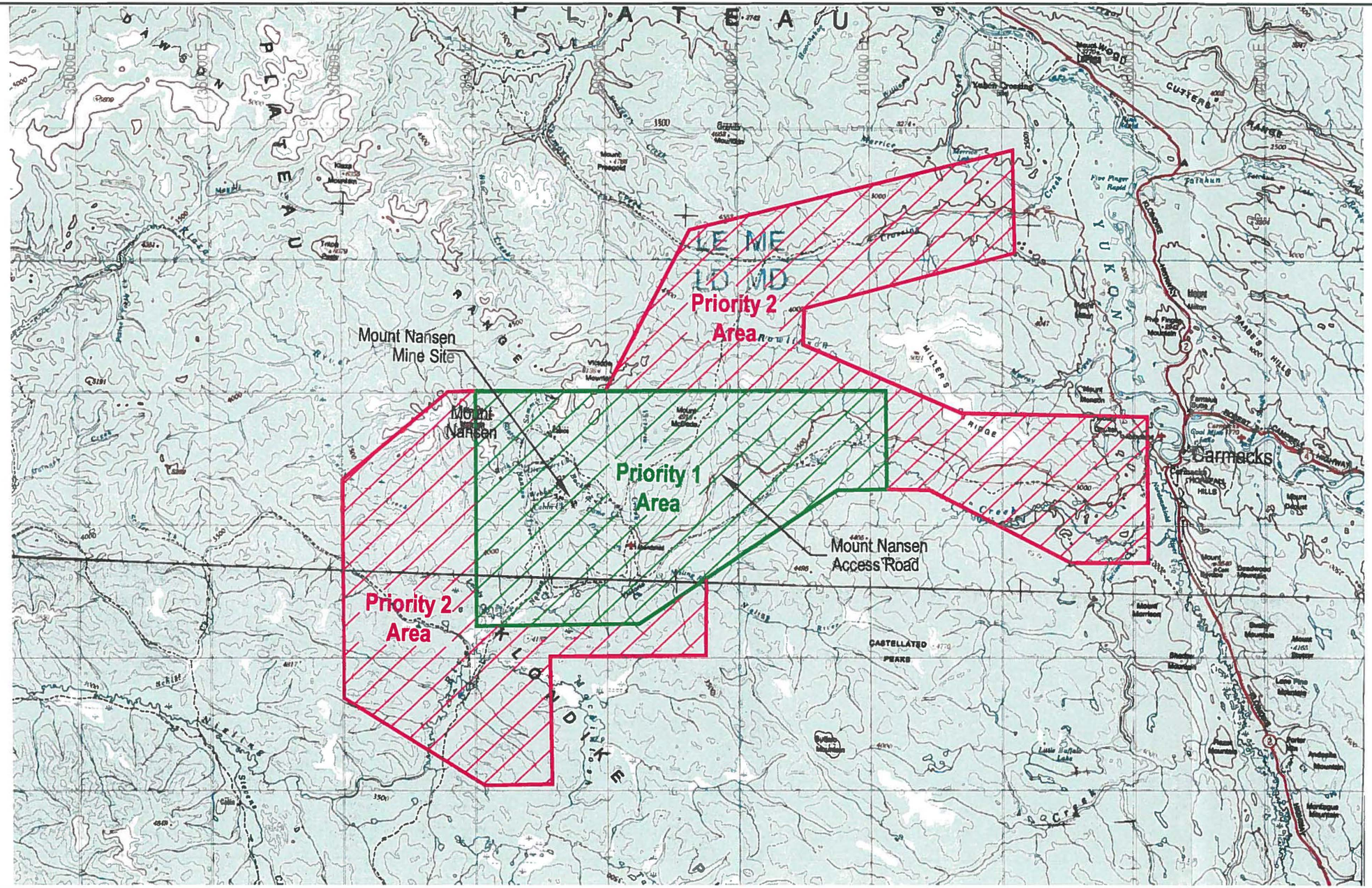


ISSUED FOR USE

LEGEND

- PRIORITY 1 AREA
- PRIORITY 2 AREA

NOTES

1. NTS MAP ZONE 7 115/I AND 115/H

0 10,000

Scale: 1: 300 000 (metres)

CLIENT

Yukon
Assessment & Abandoned Mine Branch
Energy, Mines & Resources
Government of Yukon

EBA Engineering Consultants Ltd.

Terrain Mapping & Materials Search
Mount Nansen Area, Yukon

STUDY AREA BOUNDARIES

| PROJECT NO. | DWN | CKD | REV |
|---|---|---|---|
| W14101220 | JSB | JTD | 0 |
| OFFICE: WHSE | DATE: September 30, 2009 | | |

Figure 2

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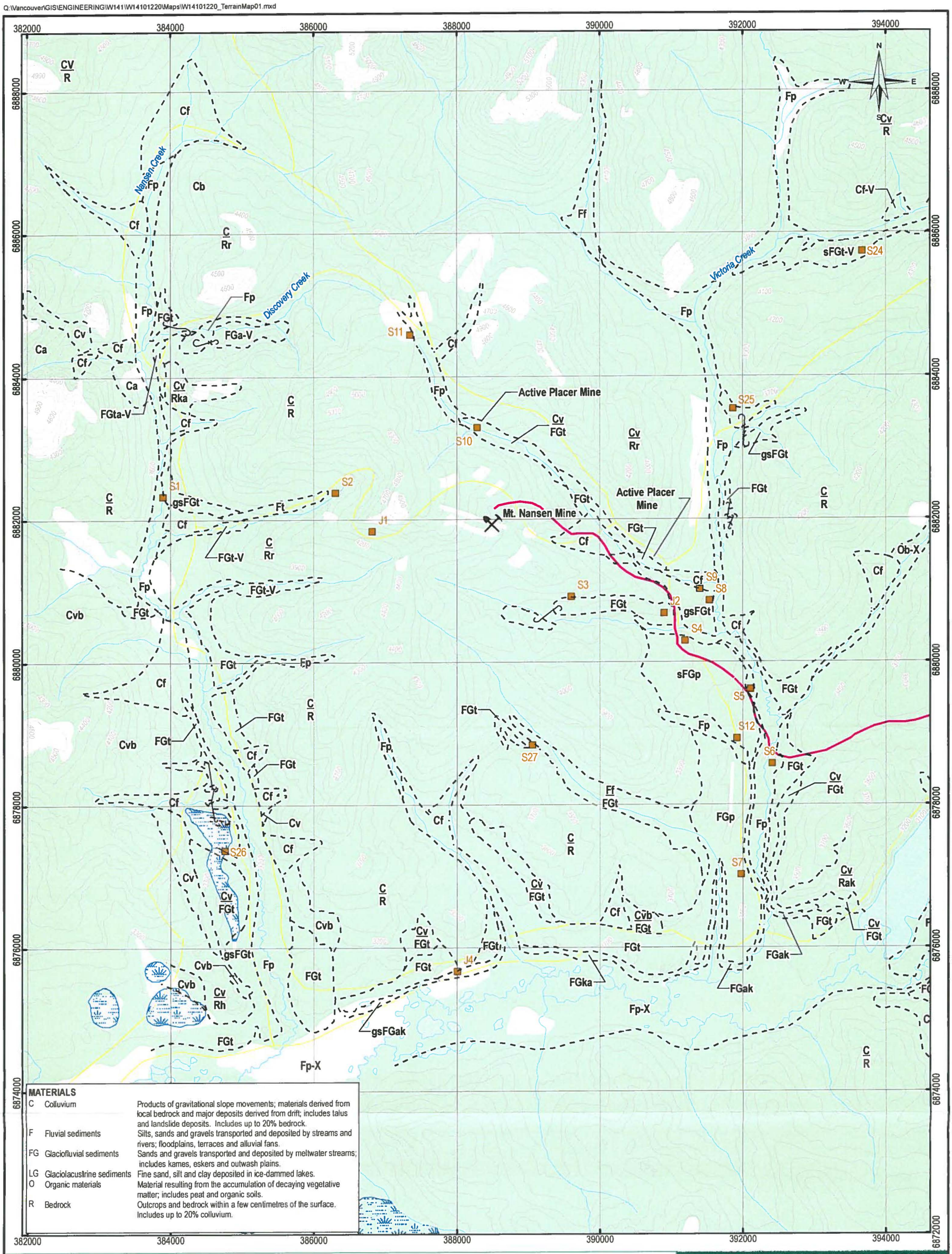


**MATERIALS**

| | | |
|---|---|---|
| C | Colluvium | Products of gravitational slope movements; materials derived from local bedrock and major deposits derived from drift; includes talus and landslide deposits. Includes up to 20% bedrock. |
| F | Fluvial sediments | Silts, sands and gravels transported and deposited by streams and rivers; floodplains, terraces and alluvial fans. |
| FG | Glaciofluvial sediments | Sands and gravels transported and deposited by meltwater streams; includes kames, eskers and outwash plains. |
| LG | Glaciolacustrine sediments | Fine sand, silt and clay deposited in ice-dammed lakes. |
| O | Organic materials | Material resulting from the accumulation of decaying vegetative matter; includes peat and organic soils. |
| R | Bedrock | Outcrops and bedrock within a few centimetres of the surface. Includes up to 20% colluvium. |

## LEGEND

- Mt. Nansen Mine
- Terrain Polygon Boundary (approximate)
- Field Station
- Trail
- Road
- Contour (100ft)
- Watercourse
- Waterbody
- Wetland
- Vegetation

### TERRAIN UNIT SYMBOLS

surficial material — initiation zone
texture — aCk - R"b — geomorphological process subclass
surface expression — geomorphological process

Cv / Rr indicates that "Cv" overlies "Rr"

### TEXTURE

| | | |
|---|---|---|
| z | silt | 2 - 62.5 µm |
| s | sand | 62.5 µm - 2 mm |
| g | gravel | mixture of pebbles (p), cobbles (k), boulders (b) and up to 20% sand |

### GEOMORPHOLOGICAL PROCESSES

| | | |
|---|---|---|
| V | Gullying | Slope affected by gully erosion. |
| X | Permafrost processes | Processes related to the presence of permafrost, permafrost aggradation and degradation. |

### SURFACE EXPRESSION

| | | |
|---|---|---|
| a | moderate slope(s) | predominantly planar slopes; 15-26° (28 - 49%) |
| b | blanket | material >1-2 m thick with topography derived from underlying bedrock (which may not be mapped) or surficial material |
| f | fan | a fan-shaped surface that is a sector of a cone; slopes 3-15° (5-27%) |
| h | hummocky | steep-sided hillocks and hollows; many slopes 15° (27%) and steeper |
| j | gentle slope(s) | predominantly planar slopes; 4-15° (6 - 27%) |
| k | moderately steep slope | predominantly planar slopes; 26-35° (50 - 70%) |
| p | plain | 0-3° (0-5%) |
| t | terrace(s) | stepped topography and benchlands |
| v | veneer | material <1-2 m thick with topography derived from underlying bedrock (may not be mapped) or surficial materials; may include outcrops of underlying material |

**NOTES**
Base data source: NTS 1:50,000

ISSUED FOR USE

# TERRAIN MAPPING AND MATERIALS SEARCH MT. NANSEN AREA, YUKON

## Terrain Map

| | | | |
|---|---|---|---|
| PROJECTION: UTM Zone 8 | | DATUM: NAD83 | Government of Yukon Energy, Mines and Resources, Yukon Assessment and Abandoned Mine Branch |
| Scale: 1:50,000 (800 400 0 800 Meters) | | | |
| FILE NO.: W14101220_TerrainMap01.mxd | | | EBA Engineering Consultants Ltd. |
| PROJECT NO.: W14101220 | DWN: MEZ | CKD: JD | REV: 0 |
| OFFICE: EBA-VANC | DATE: September 30, 2009 | | Figure 3.1 |

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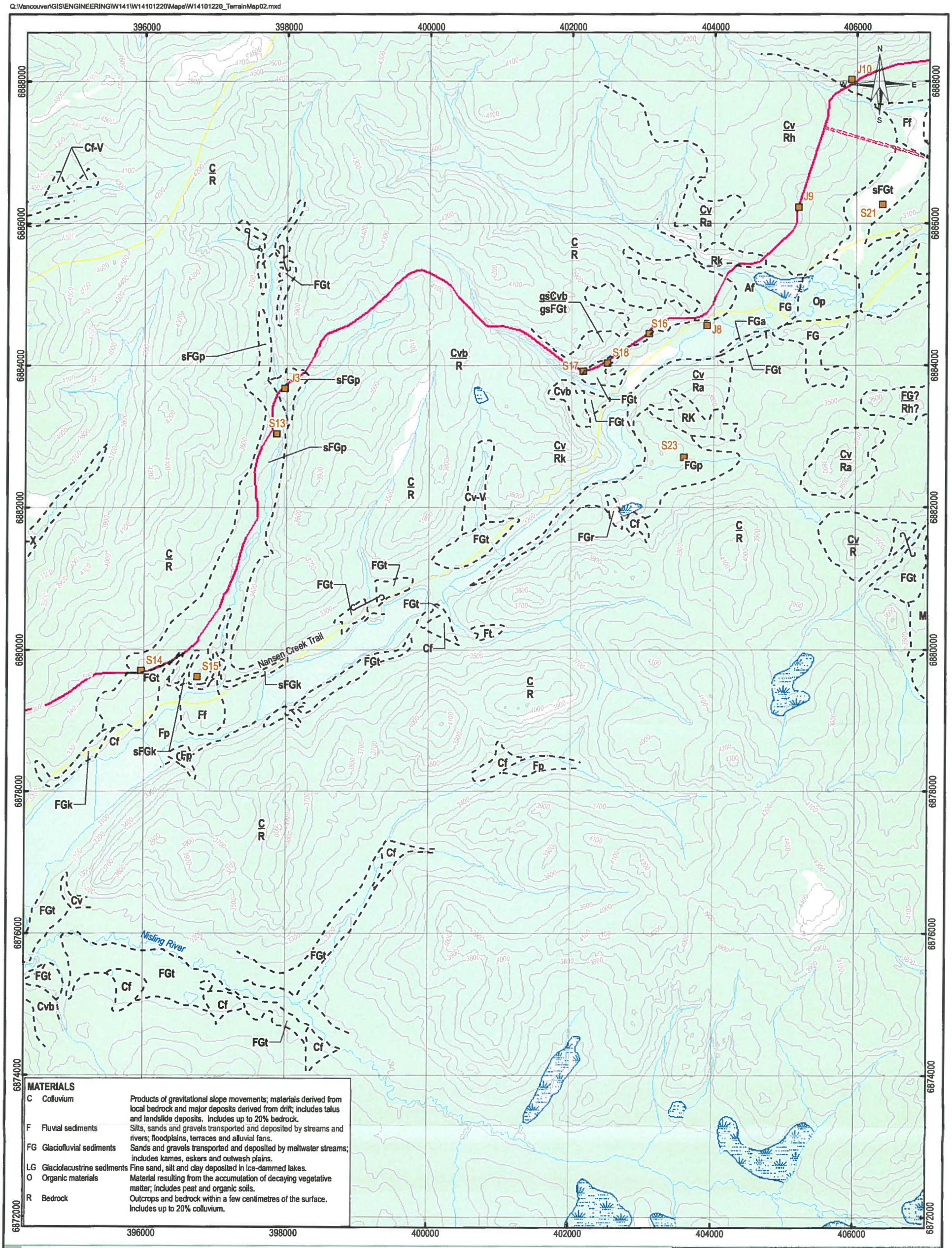


**MATERIALS**

| | | |
|---|---|---|
| C | Colluvium | Products of gravitational slope movements; materials derived from local bedrock and major deposits derived from drift; includes talus and landslide deposits. Includes up to 20% bedrock. |
| F | Fluvial sediments | Silts, sands and gravels transported and deposited by streams and rivers; floodplains, terraces and alluvial fans. |
| FG | Glaciofluvial sediments | Sands and gravels transported and deposited by meltwater streams; includes kames, eskers and outwash plains. |
| LG | Glaciolacustrine sediments | Fine sand, silt and clay deposited in ice-dammed lakes. |
| O | Organic materials | Material resulting from the accumulation of decaying vegetative matter; includes peat and organic soils. |
| R | Bedrock | Outcrops and bedrock within a few centimetres of the surface. Includes up to 20% colluvium. |

**LEGEND**

- Terrain polygon Boundary (approximate)
- Field Station
- Potential Access Route
- Trail
- Road
- Contour (100ft)
- Watercourse
- Waterbody
- Wetland
- Vegetation

**TERRAIN UNIT SYMBOLS**

surficial material — initiation zone
texture → aCk - R"b ← geomorphological process subclass
surface expression — geomorphological process

Cv Indicates that "Cv" overlies "Rr"
Rr

**TEXTURE**

| | | |
|---|---|---|
| z | silt | 2 - 62.5 µm |
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**GEOMORPHOLOGICAL PROCESSES**

| | | |
|---|---|---|
| V | Gullying | Slope affected by gully erosion. |
| X | Permafrost processes | Processes related to the presence of permafrost, permafrost aggradation and degradation. |

**SURFACE EXPRESSION**

| | | |
|---|---|---|
| a | moderate slope(s) | predominantly planar slopes; 15-26° (28 - 49%) |
| b | blanket | material >1-2 m thick with topography derived from underlying bedrock (which may not be mapped) or surficial material |
| f | fan | a fan-shaped surface that is a sector of a cone; slopes 3-15° (5-27%) |
| h | hummocky | steep-sided hillocks and hollows; many slopes 15° (27%) and steeper |
| j | gentle slope(s) | predominantly planar slopes; 4-15° (6 - 27%) |
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| t | terrace(s) | stepped topography and benchlands |
| v | veneer | material <1-2 m thick with topography derived from underlying bedrock (may not be mapped) or surficial materials; may include outcrops of underlying material |

**NOTES**

Base data source: NTS 1:50,000



# TERRAIN MAPPING AND MATERIALS SEARCH MT. NANSEN AREA, YUKON

## Terrain Map

PROJECTION: UTM Zone 8
DATUM: NAD83
Scale: 1:50,000
800 400 0 800
Meters
FILE NO.: W14101220_TerrainMap02.mxd
PROJECT NO.: W14101220
DWN: MEZ
CKD: JD
REV: 0
OFFICE: EBA-VANC
DATE: September 30, 2009

Government of Yukon
Energy, Mines and Resources,
Yukon Assessment and
Abandoned Mine Branch

EBA Engineering Consultants Ltd.

**Figure 3.2**

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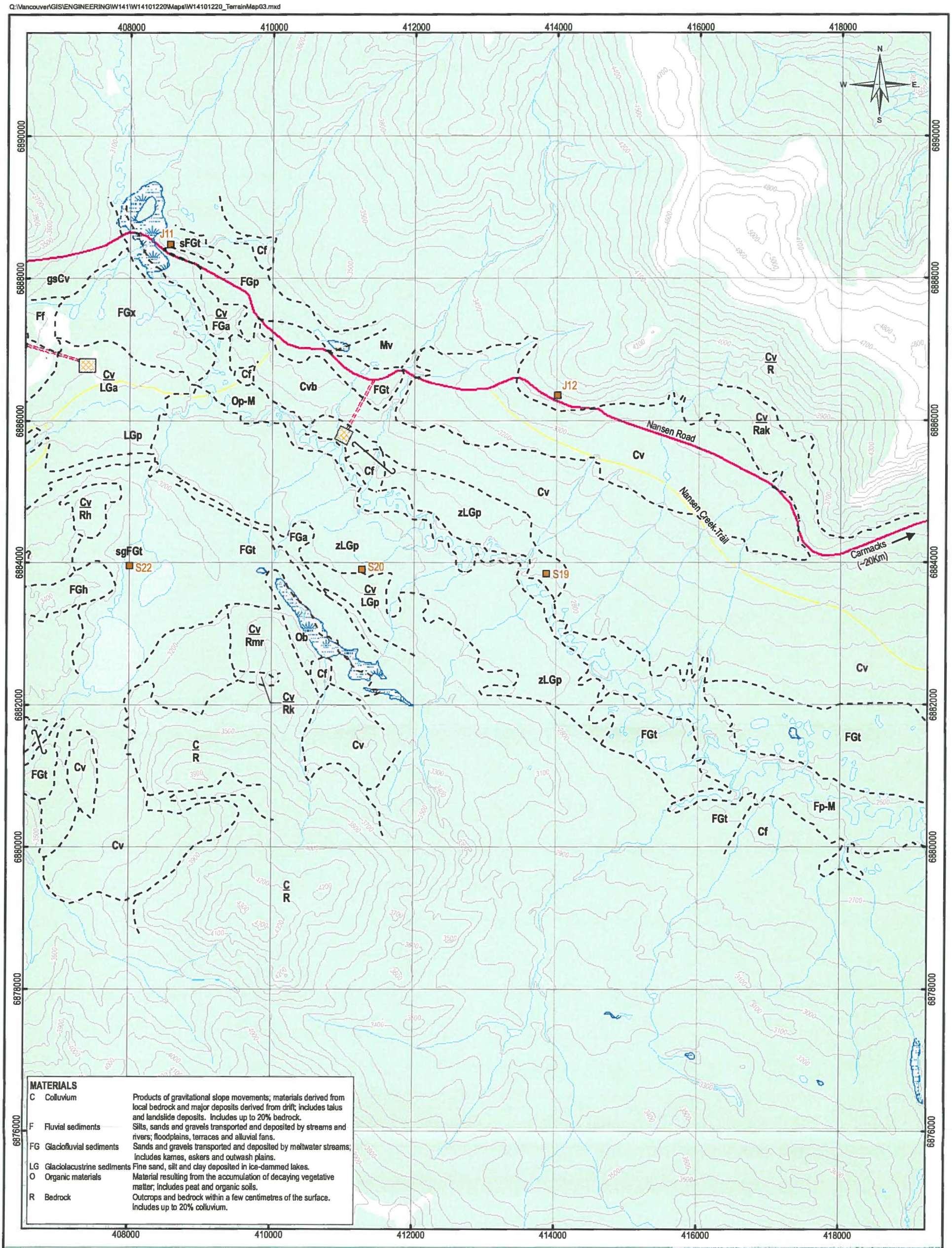


## LEGEND

- Terrain Polygon Boundary (approximate)
- Field Station
- Potential Borrow Site (fine-textured material)
- Potential Access Route
- Trail
- Road
- Contour (100ft)
- Watercourse
- Waterbody
- Wetland
- Vegetation

### TERRAIN UNIT SYMBOLS

surficial material — initiation zone
texture → aCk - R"b ← geomorphological process subclass
surface expression — geomorphological process

Cv / Rr — Indicates that "Cv" overlies "Rr"

### TEXTURE

| | | |
|---|---|---|
| z | silt | 2 - 62.5 µm |
| s | sand | 62.5 µm - 2 mm |
| g | gravel | mixture of pebbles (p), cobbles (k), boulders (b) and up to 20% sand |

### GEOMORPHOLOGICAL PROCESSES

| | | |
|---|---|---|
| V | Gullying | Slope affected by gully erosion. |
| X | Permafrost processes | Processes related to the presence of permafrost, permafrost aggradation and degradation. |

### SURFACE EXPRESSION

| | | |
|---|---|---|
| a | moderate slope(s) | predominantly planar slopes; 15-26° (28 - 49%) |
| b | blanket | material >1-2 m thick with topography derived from underlying bedrock (which may not be mapped) or surficial material |
| f | fan | a fan-shaped surface that is a sector of a cone; slopes 3-15° (5-27%) |
| h | hummocky | steep-sided hillocks and hollows; many slopes 15° (27%) and steeper |
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| p | plain | 0-3° (0-5%) |
| t | terrace(s) | stepped topography and benchlands |
| v | veneer | material <1-2 m thick with topography derived from underlying bedrock (may not be mapped) or surficial materials; may include outcrops of underlying material |

**NOTES**
Base data source: NTS 1:50,000



# TERRAIN MAPPING AND MATERIALS SEARCH MT. NANSEN AREA, YUKON

## Terrain Map

| | | | |
|---|---|---|---|
| PROJECTION: UTM Zone 8 | | DATUM: NAD83 | |
| Scale: 1:50,000 (800 400 0 800 Meters) | | | |
| FILE NO.: W14101220_TerrainMap03.mxd | | | |
| PROJECT NO.: W14101220 | DWN: MEZ | CKD: JD | REV: 0 |
| OFFICE: EBA-VANC | DATE: September 30, 2009 | | |

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Energy, Mines and Resources,
Yukon Assessment and
Abandoned Mine Branch

EBA Engineering Consultants Ltd.

**Figure 3.3**

# APPENDIX

## APPENDIX A GENERAL CONDITIONS

## GEOTECHNICAL REPORT – GENERAL CONDITIONS

This report incorporates and is subject to these "General Conditions".

### 1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of EBA's Client. EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA's Client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

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Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. EBA's instruments of professional service will be used only and exactly as submitted by EBA.

Electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

### 3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

### 4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

### 5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

### 6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

# APPENDIX

## APPENDIX B AIR PHOTOGRAPH INVENTORY AND FIELD STATION SUMMARY

| Table 1 Inventory of Air Photographs – Mt. Nansen Area | | | | | | |
|---|---|---|---|---|---|---|
| LINE No. | FLIGHT LINE | PHOTOGRAPH No. | | SCALE | YEAR | TYPE |
| | | FROM | TO | | | |
| 1N | A28154 | 23 | 27 | 1:20,000 | 1994 | B & W |
| 2N | A28154 | 59 | 66 | 1:20,000 | 1994 | B & W |
| 2N | A28154 | 75 | 80 | 1:20,000 | 1994 | B & W |
| 3N | A28154 | 93 | 114 | 1:20,000 | 1994 | B & W |
| 4N | A28154 | 146 | 157 | 1:20,000 | 1994 | B & W |
| 4N | A28155 | 1 | 12 | 1:20,000 | 1994 | B & W |
| 5N | A28155 | 24 | 44 | 1:20,000 | 1994 | B & W |
| 6N | A28155 | 76 | 90 | 1:20,000 | 1994 | B & W |
| 7N | A28155 | 205 | 218 | 1:20,000 | 1994 | B & W |
| 1E | NW35985 | 71 | 86 | 1:12,000 | 1985 | B & W |
| 2E | NW35985 | 40 | 55 | 1:12,000 | 1985 | B & W |
| 3E | NW35985 | 87 | 91 | 1:12,000 | 1985 | B & W |
| 3E | NW35985 | 94 | 102 | 1:12,000 | 1985 | B & W |
| 4E | NW35985 | 56 | 61 | 1:12,000 | 1985 | B & W |
| 4E | NW35985 | 63 | 70 | 1:12,000 | 1985 | B & W |
| 5E | NW35985 | 15 | 26 | 1:12,000 | 1985 | B & W |
| 6E | NW35985 | 27 | 39 | 1:12,000 | 1985 | B & W |
| 7E | NW35985 | 1 | 14 | 1:12,000 | 1985 | B & W |
| 1-SE | NW45985 | 79 | 95 | 1:12,000 | 1985 | Colour |
| 2-SE | NW45985 | 45 | 62 | 1:12,000 | 1985 | Colour |
| 3-NW | NW45985 | 96 | 101 | 1:12,000 | 1985 | Colour |
| 3-NW | NW45985 | 104 | 111 | 1:12,000 | 1985 | Colour |
| 4-NW | NW45985 | 63 | 78 | 1:12,000 | 1985 | Colour |
| 5-SE | NW45985 | 14 | 22 | 1:12,000 | 1985 | Colour |
| 5-SE | NW45985 | 24 | 29 | 1:12,000 | 1985 | Colour |
| 6-NW | NW45985 | 30 | 39 | 1:12,000 | 1985 | Colour |
| 6-NW | NW45985 | 41 | 44 | 1:12,000 | 1985 | Colour |
| 7-NW | NW45985 | 1 | 13 | 1:12,000 | 1985 | Colour |

Table 2 - Summary of Field Stations

| Station No. | Material Description | Terrain Symbol | Location | | Comments |
|---|---|---|---|---|---|
| | | | Easting | Northing | |
| J-1 | SAND some gravel and trace silt to ~.5m, the GRAVEL with sand, boulders and cobbles | gsCv/Rj | 386818 | 6881838 | |
| J-2 | SAND, some gravel (well sorted sand, schist gravel lithology) | gsMb | 390897 | 6880687 | |
| J-3 | SAND (well sorted) | sFGp | 397969 | 6883687 | |
| J-4 | SAND, some gravel, well sorted | FGt/gsFGa | 388007 | 6875674 | |
| J-5 | SAND, trace gravel | sFGh | | | location estimated - GPS malfunction |
| J-6 | SAND, trace gravel | sFGt | | | |
| J-7 | SAND, trace gravel | sFGt | | | location estimated - GPS malfunction |
| J-8 | SAND, trace gravel | sFGa | 405182 | 6886241 | |
| J-9 | SAND over gravel and sand over bedrock | (Mv?)sFRv/sgCv/R | 403899 | 6884575 | |
| J-10 | SAND with gravel | gsCv | 405175 | 6886255 | |
| J-11 | cross bedded SAND, some silt | sFGa | | | location estimated - gps malfunction |
| J-12 | borrow pit - colluvium | Cv/R | 414006 | 6886355 | |
| S-1 | SAND trace to some gravel trace boulders and cobbles | gsFGt | 383897 | 6882330 | |
| S-2 | GRAVEL with sand over course granitic gneiss | Cv/R | 386305 | 6882382 | |
| S-3 | SAND and gravel | Cv | 389600 | 6880921 | |
| S-4 | SAND trace pebbles and cobbles | gsFt | 391189 | 6880301 | |
| S-5 | SAND trage gravel | sFGa | 392106 | 6879620 | |
| S-6 | well sorted fine SAND | sFp | 392406 | 6878574 | |
| S-7 | SAND with trace gravel | gsFGp | 391973 | 6877022 | |
| S-8 | SAND | sFf (FG?) | 391529 | 6880859 | |
| S-9 | SAND with gravel | gsFGt | 391399 | 6881023 | |
| S-10 | very fine SAND with trace silt over gravelly bouldery SAND over bedrock | Cv/R | 388286 | 6883291 | |
| S-11 | SAND with silt and trace gravel over SAND and trace gravel and x | (Mx/Cv?) | 387345 | 6884590 | moist soil |
| S-12 | SAND with trace gravel (~1%) | sFGp | 391913 | 6878930 | water at surface |
| S-13 | SAND with gravel and 5cm thick silt layer | sFGp | 397850 | 6883053 | |
| S-14 | PEAT over ORGANIC SILT, SAND and permafrost at ~34cm depth | Ov/Af | 395963 | 6879719 | |
| S-15 | SAND with trace gravel | sFGp | 396749 | 6789633 | |
| S-16 | SAND with gravel over SAND with gravel coluvium | FGv/C | 403082 | 6884454 | |
| S-17 | SAND some gravel over SAND | Cv/gsFG | 402160 | 6883926 | |
| S-18 | SAND some gravel | gsCb/(sFGt?) | 402504 | 6884044 | |
| S-19 | SILT trace sand | xAt | 413860 | 6883857 | sample: S19 |
| S-20 | SILT with trace sand and gravel | xAt | 411263 | 6883926 | sample: S20 |
| S-21 | thick organic layer over ash+sand over organics | sFGt | 406365 | 6886272 | sample - S21 |
| S-22 | GRAVEL with sand and trace silt | xsgAt | 407999 | 6883971 | sample - S22 |
| S-23 | SAND with some gravel | gsFG | 403577 | 6882721 | sample - S23 |
| S-24 | SAND | sFG | 393671 | 6885738 | sample - S24 |
| S-25 | SAND with gravel and cobbles | gsFGt | 391865 | 6883545 | sample - S25 |
| S-26 | SAND with some gravel | gsFGt | 384759 | 6877370 | |
| S-27 | organic silt over well sorted SAND | sFGt | 389055 | 6878840 | sample - S27 |

CREATING AND DELIVERING BETTER SOLUTIONS