5.4 Physical Environment

5.4.1 Introduction

This section of the Phase 1-Meliadine All-weather Access Road (AWAR) (the AWAR Project) Environmental Assessment discusses terrain and permafrost as a component of the terrestrial environment. This section includes a detailed assessment of effects on terrain (including permafrost) that could potentially be affected by the AWAR Project. There are strong links between terrain, soils, vegetation, wildlife and wildlife habitat that inhabit the landscape. Terrestrial ecosystem function relies on the interactions between climate, soils, the hydrological cycle, vegetation, and wildlife species. Natural and human-related disturbances can change the interactions between the physical and biological components of the terrestrial environment. As such, related assessments are provided in the following sections:

- Atmospheric and Acoustic Environment (Section 5.1);
- Surface Water Environment (Section 5.2); and
- Terrestrial Environment (Section 5.3).

5.4.2 Study Area

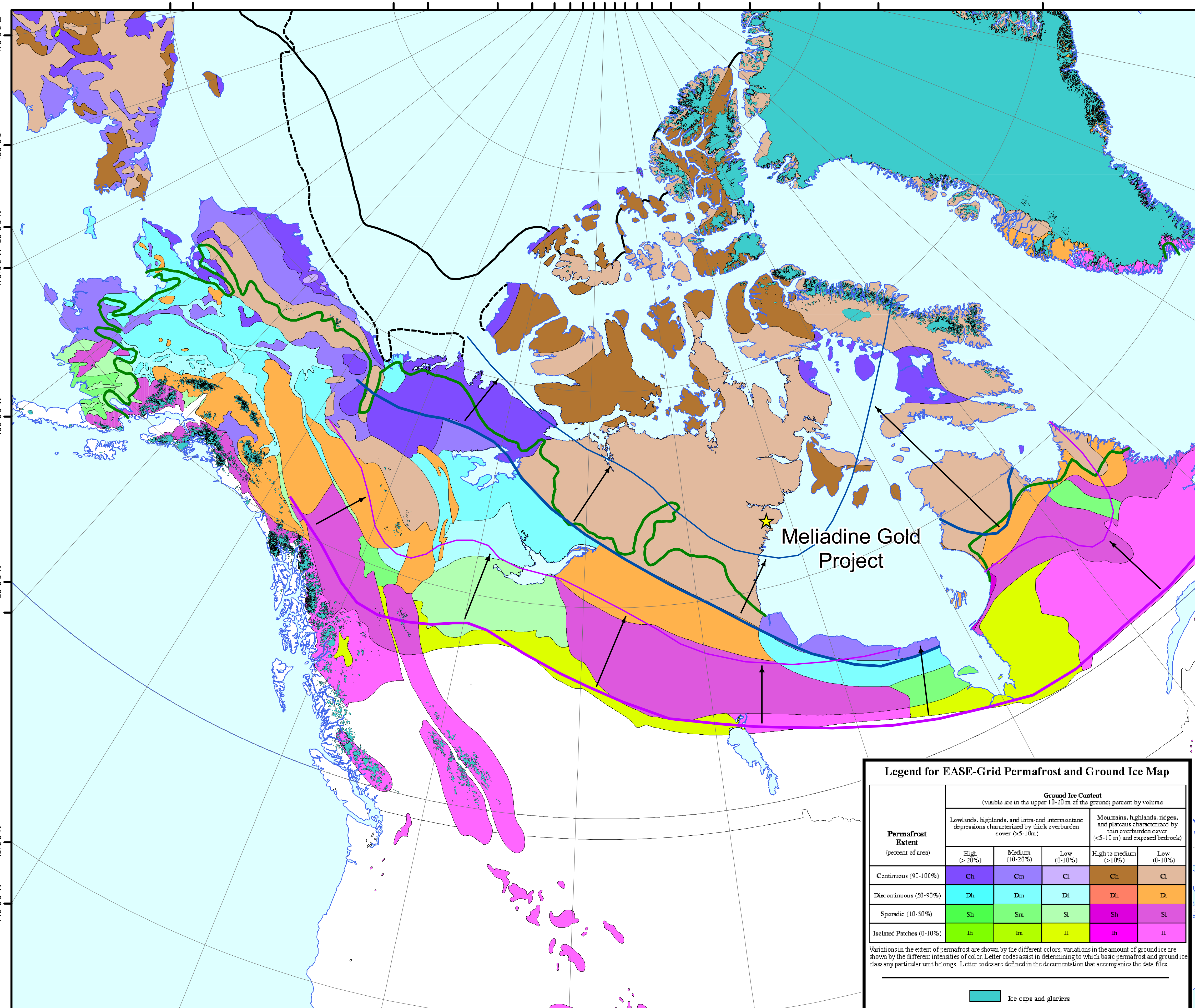
5.4.2.1 General Setting

The Phase 1 AWAR is a predevelopment component of the proposed Meliadine Gold Project. The road will be approximately 23.8 km in length, providing access to the Meliadine West Advanced Exploration site from Rankin Inlet. The proposed road alignment and study area are shown on Figure 3.1-1. The AWAR Project is located within the zone of continuous permafrost (Figure 5.4.2-1), and has an annual average air temperature of -10.6 ºC based on climate data from Rankin Inlet.

The Meliadine Gold Project is located in the Kivalliq Region of Nunavut, near the northern boundary of the Southern Arctic terrestrial ecozone, and within the Arctic Tundra climate region. Within this region daylight reaches a minimum of 4 hours per day in winter and a maximum of 20 hours in summer. The climate is extreme, with long, cold winters and very short, cool summers. Temperatures are cool, with mean temperatures of 12°C in July and -31°C in January. The mean annual air temperature at the site is approximately - 10°C.

Winds at the nearby Rankin Inlet A weather station are moderate to strong and generally originate from the north-northwest and north. The wind speeds from the north-northwest and the north can range from calm winds (less than 1 m/s) to winds speeds stronger than 15 m/s. Generally, the average wind speed ranges between 4 and 8 m/s.

The average annual precipitation for the Rankin Inlet A climate station is estimated to be 306 millimetres (mm), with approximately 60% as rainfall (181 mm) and 40% as snowfall (129 mm water equivalent). Snow falls in every month, and rain generally occurs only between May and October.



LEGEND

- MELIADINE WEST PROJECT
- SOUTHERN BOUNDARY OF CONTINUOUS PERMAFROST - PREDICTED
- SOUTHERN BOUNDARY OF CONTINUOUS PERMAFROST - PRESENT
- SOUTHERN BOUNDARY OF DISCONTINUOUS PERMAFROST - PREDICTED
- SOUTHERN BOUNDARY OF DISCONTINUOUS PERMAFROST - PRESENT
- TREELINE
- SEA-ICE EDGE LIMIT
- SUBSEA PERMAFROST LIMIT

REFERENCE

BROWN, J., O.J. FERRIANS JR., J.A. HEGINBOTTOM, AND E.S. MELNIKOV. 1998. CIRCUM-ARCTIC MAP OF PERMAFROST AND GROUND-ICE CONDITIONS. BOULDER, CO: NATIONAL SNOWN AND ICE DATA CENTRE/WORLD DATA CENTER FOR GLACIOLOGY. DIGITAL MEDIA. PREDICTED PERMAFROSTBOUNDARIES BASED ON WOO ET AL., 1992. DATUM: NAD83 PROJECTION: UTM ZONE 15

500 0 500
SCALE 1:20,000,000 KILOMETRES

PROJECT
AGNICO-EAGLE MINES LTD.
MELIADINE GOLD PROJECT
NUNAVUT

TITLE

PERMAFROST MAP OF CANADA

Golder Associates
Greater Vancouver Office, BC

PROJECT	10-1373-0076		PHASE No. 1700	
DESIGN	JC	12 Sep. 2011	SCALE AS SHOWN	REV. 0
GIS	AL	12 Sep. 2011	FIGURE: 5.4.2-1	
CHECK	JEK	12 Sep. 2011		
REVIEW	CJC	12 Sep. 2011		

N:\Bur-Graphics\Projects\2010\1373\10-1373-0076\Mapping\MXD\Soil&Terrain\Terrain&Permafrost\Figure_5.4.2-1_Permafrost_Map.mxd

5.4.3 Existing Environment

5.4.3.1 Terrain and Baseline Permafrost Studies

The term 'terrain' in this study refers to the geomorphology and surface geology, both soil and rock, that occurs along the proposed AWAR alignment. Permafrost is a 'state', or condition, that the terrain may or may not exist in, as described below.

Baseline studies to characterize the terrain and permafrost thermal regime were first implemented at the Meliadine Gold Project site in 1998. Since then, additional studies have been completed to collect baseline information with respect to the terrain and permafrost conditions at the site, as well as along the proposed AWAR. The studies that have been completed to characterize the terrain and permafrost thermal regime at the site, and which relate to the AWAR, include the following:

- a regional permafrost literature review study;
- local permafrost studies, including thermistor installations, define the permafrost regime and ground temperature profile;
- geotechnical drilling and sampling investigations to sample and describe the permafrost and terrain in the main gold exploration project area;
- geomorphological mapping and terrain classification along the proposed AWAR route corridor; and
- a preliminary evaluation of snow drift accumulation along the proposed AWAR road alignment.

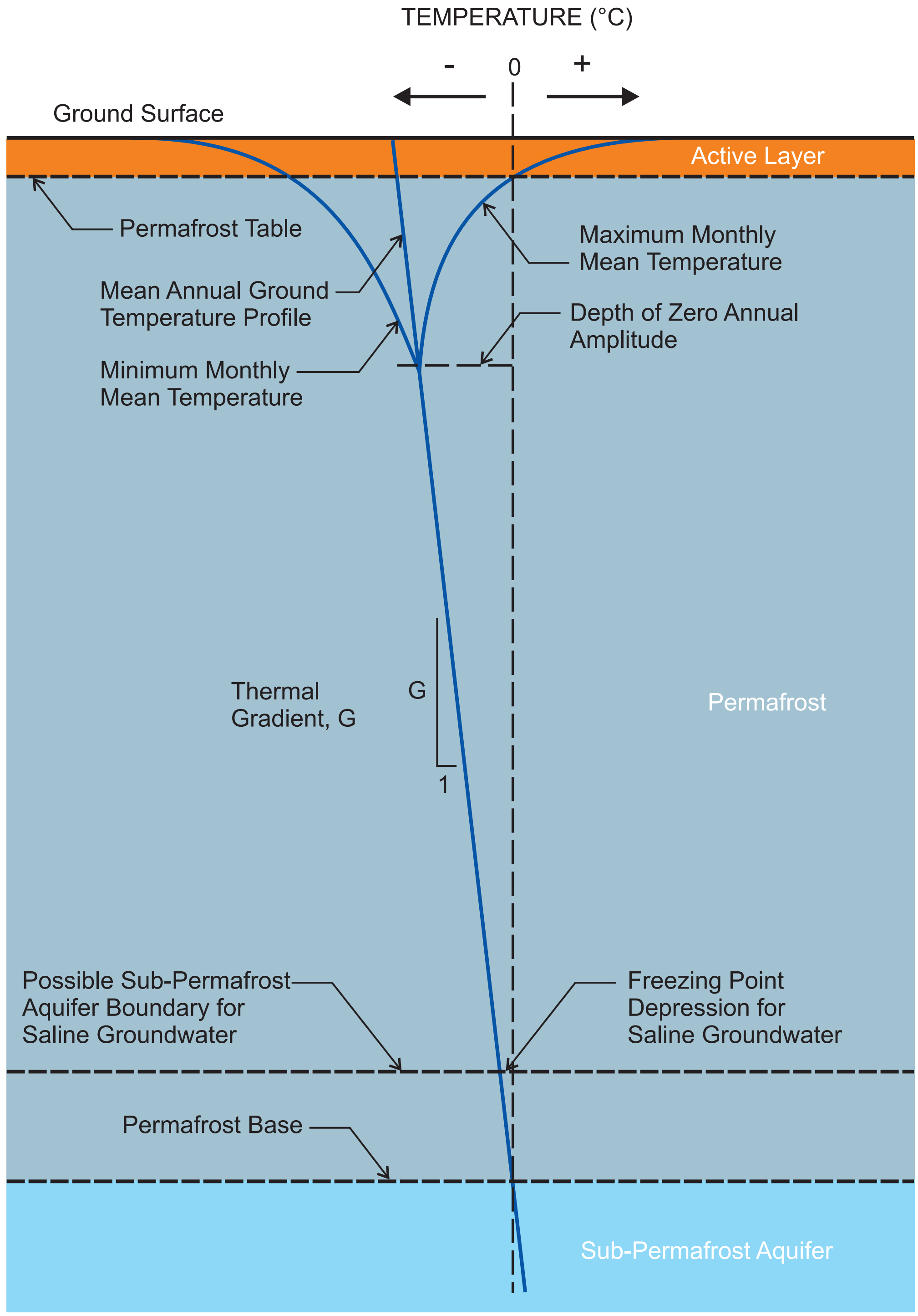
The terrain along the AWAR has been classified in broad terms as thaw-susceptible or thaw-stable, based on its expected response to transitioning between the frozen to thawed state.

Thaw-susceptible soils exhibit a high loss of strength when thawed. These are typically fine grained, saturated to poorly drained, or ice-rich soils. Such soils are easily disturbed by construction activities and cannot be used as construction materials.

Thaw-stable soils tend to retain their strength when thawed. These are typically free-draining, coarse grained, or granular soils. Such soils are preferred as construction materials due to their ability to retain strength under a variety of loading and drainage conditions.

Permafrost is the state or condition in which the terrain, or terrain materials, exist at a temperature below 0°C for 2 or more years. This state applies to any material, soil, rock, or water.

For descriptive purposes, a typical ground temperature profile in permafrost terrain is shown on Figure 5.4.3-1. Permafrost is typically described by the following terminology, which relates to the ground temperature profile:



PROJECT

AGNICO-EAGLE MINES LTD.
MELIADINE GOLD PROJECT
NUNAVUT

TITLE

TYPICAL GROUND THERMAL PROFILE IN PERMAFROST

Golder Associates

PROJECT No.	10-1373-0076		PHASE No. 3000	
DESIGN	CJC	31AUG11	SCALE NTS	REV.
CADD	GG	31AUG11	FIGURE 5.4.3-1	
CHECK	JG	20SEP11		
REVIEW	GRA	20SEP11		

DRAWING DATE: 30-Aug-11 COREL FILE: N:\Bur-Graphics\Projects\2010\1373\10-1373-0076\Drafting\3000\1013730076-3000-02.cdr

- Active layer: The active layer is the depth of annual freeze and thaw of surface materials. This depth can vary based on material type and water content, presence or absence of vegetation, proximity to water, and general topographic aspect (the direction the slope faces, either north, south, east, or west), but is relatively consistent over regional areas. The active layer is deeper in poorly drained low lying areas, and shallower in well drained areas, such as ridge lines. In poorly drained soils, or in subsurface depressions, stratified ground ice and ice lenses can form at the base of the active layer.
- Permafrost table: The permafrost table is the upper boundary of permafrost, at the base of the active layer. The ground temperature above the permafrost table is above 0°C for at least a portion of each year, and below the permafrost table is less than 0°C year round. The ground temperature varies with depth.
- Permafrost base: The permafrost base is the lower boundary of permafrost and is an undulating and uneven surface. The ground temperature above the permafrost base is less than 0°C and below the permafrost base is above 0°C. The depth of the permafrost base varies with latitude, elevation, and with proximity to large bodies of water. The depth of the permafrost base also depends on the thermal history of an area.
- Depth of zero annual amplitude: The depth of zero annual amplitude is the depth below ground surface at which there is no variability in ground temperature due to the influence of surface air temperature. It is the depth at which the minimum monthly mean temperature and maximum monthly mean temperatures are equivalent.
- Geothermal gradient: The geothermal gradient is the increase in ground temperature with depth, below the depth of zero annual amplitude. This is typically a linear relationship. The permafrost base can be estimated if the geothermal gradient is known at a given temperature by projecting the linear relationship down until it crosses from negative ground temperature to positive ground temperature.
- Mean annual temperature: The mean annual temperature is the temperature at the ground surface based on a projection upward of the geothermal gradient to intersect the ground surface.
- Sub-permafrost aquifer: The sub-permafrost aquifer is the deep-permafrost groundwater flow regime near or below the base of permafrost. The top of the sub-permafrost aquifer may or may not coincide with the base of permafrost; if the sub-permafrost aquifer is saline, it is possible that groundwater occurs as a fluid within the permafrost due to freezing point depression.

Permafrost is sometimes referred to as ‘warm’ or ‘cold’. The actual temperature ranges associated with such naming varies depending on source; however, Hammer et.al (1985) suggests that ‘warm’ permafrost has a temperature range of 0 to -4°C, and ‘cold’ permafrost has a temperature range colder than -4°C. The construction of surface infrastructure, such as roadways, in ‘warm’ permafrost is considerably more difficult than construction in ‘cold’ permafrost. This is because the balance between the frozen and thawed state for ‘warm’ permafrost is delicate, and minimal energy, such as ground disturbance during road construction, is required to change the state from a frozen to a thawed state.

5.4.3.2 Terrain of the Regional and Local Study Areas

Methods

A terrain mapping study based on air photo interpretation and field assessment was carried out by Golder to describe the geomorphology and surficial geology along the preliminary AWAR alignment (Golder 2010).

The air photo interpretation was undertaken prior to and during a field mapping and sampling investigation along the proposed AWAR route.

The following tasks were carried out as part of the assessment methodology:

- A review was completed of existing and available terrain maps.
- A terrain map of surficial materials, permafrost and periglacial processes, and soil drainage was prepared using 1:10 000 scale black and white and colour air photos provided to Golder.
- Mapping of the surficial materials and soil drainage followed the methods described for terrain mapping in BC (Resources Inventory Committee 1996). The classification of terrain types, surficial geology, soils, and geomorphic processes follows the classification system developed by Howes and Kenk in BC (Howes and Kenk 1997). The Howes and Kenk classification system encompasses the mapping of the surficial material, the genesis of that surficial material, the morphology of the underlying bedrock surface, and the prevailing geomorphic processes. This classification system evolved from a terrain mapping system originally developed by the Geological Survey of Canada.
- Terrain lines were located using stereoscopic interpretation and drawn by hand on laser photocopies of the 1:10 000 scale air photos provided to Golder. The air photos provided to Golder were archive copies. It was not possible to obtain and map on original air photos due to the loss of the original photo negatives. Typically laser photocopying, though better than regular photocopying, results in some loss of air photo resolution. Consequently, it should be assumed that the air photo interpretation and terrain mapping is not as accurate as can be achieved with original air photos.
- A series of ground traverses primarily along the proposed access road routes from Meliadine Lake to Rankin Inlet and other sites were used to calibrate and refine the preliminary mapping. The field program for ground confirmation of the mapped surficial materials, periglacial processes, and soils along substantial portions of the route was completed in July 2009. Access to the traverse locations was by helicopter. Weather during the field program varied from sunny days with light winds to cloudy days with moderate winds and occasional rain. Visibility was generally excellent except for occasional fog or low clouds that obscured more distant terrain.
- Following editing of the terrain mapping, the terrain lines were hand transferred to an orthophoto base to document the distribution of surficial material types and terrain conditions, digitized, and entered into ArcGIS. Orthophoto terrain maps were developed to display the various terrain types (surficial materials) in relation to the proposed AWAR location.
- An assessment matrix was developed linking terrain types and soil drainage class to potential road construction-related issues in permafrost terrain. This matrix provides preliminary engineering and hazard interpretations for the various terrain types mapped along the proposed route. A number, or number and letter, are used to identify the terrain type occupying each map polygon.

- The terrain types were classified according to their stability, their respective geomorphologic process, and their apparent soil drainage conditions.
- Maps were prepared to document the spatial distribution of different terrain types and potential terrain susceptibility to freeze/thaw processes. These maps present the different terrain type map units along the AWAR, as well as interpretation of freeze and thaw induced displacement hazards.

Results

The results of the mapping are presented in the following appendices:

- Appendix E-1 – Terrain Unit Descriptions and Interpretations
- Appendix E-2 – Terrain Classification Codes and Terminology
- Appendix F – Terrain Type Map Unit Figures

The proposed AWAR alignment crosses an area of low relief, which is generally gently to moderately sloping with short steep slopes occurring locally on some glaciofluvial, wave-washed bedrock surfaces. The terrain is dominated by veneers and blankets of washed till and shallow lakes.

Marine sediments comprising both beach and deltaic deposits occur locally and are extensive in some areas. Weathered (frost-shattered) bedrock (felsenmeer) and unweathered bedrock outcrops occur locally. There are limited areas of glaciofluvial materials, and shallow, discontinuous organic veneers occur in some poorly and very poorly-drained areas.

Archean mafic metavolcanics and associated metasediments of the Rankin Inlet Group (Tela 1994) underlie the southern section of the proposed AWAR to a point about 2 km northeast of the Meliadine River. From this point north to Meliadine Lake, metamorphic rocks (schists) derived from the Rankin Inlet Group rocks dominate the proposed road location. The proposed AWAR route crosses an east-northeast trending band of Archean felsic to intermediate volcanic and associated metasediments (Tela 1994) a few kilometres north of the Meliadine River, and the mid section of the AWAR route crosses a west-northwest trending band of Proterozoic granites 13 to 14 km north of Rankin Inlet.

Within the study area, changes in terrain type, material characteristics, and soil drainage conditions (soil drainage class) can be quite subtle, but highly variable, due to the low relief and subdued nature of the topography. As well, there has been extensive, but sometimes subtle modification of the landscape and surficial materials by complex coastal processes. The entire area was submerged at the end of the last glaciation, and has emerged over time. Consequently, much of the terrain within the study area exhibits relict (emergent) coastline features or materials. These features include relict shore platforms, rocky islets, low coastline scarps, gravelly beach berms or ridges, shell accumulations, and gently sloping mantles (veneers and blankets), or terraces composed of well to poorly sorted sands and gravels. Coarse cobble and/or boulder lags overlying morainal materials can be found vertically and spatially across the landscape. These coarse backshore and foreshore deposits are often found in close proximity to, or spatially intermixed with veneers comprising silty sandy to fine sandy silty diamictons (i.e., marine washed till) likely representative of lower energy, near-shore and/or offshore (below low tide) environments. These silty sandy to fine sandy silty surfaces often, but not always, contain shells.

Permafrost and periglacial processes have further modified these emergent coastal features creating a very complex landscape. Periglacial processes are most evident in areas underlain by morainal deposits and are typical of areas underlain by continuous permafrost. Surface expression is subdued in areas where there is a thin cover of surficial materials over bedrock and in areas of well-drained granular sediments.

A summary of the surficial geology units encountered along the AWAR route are described in Table 5.4.3-1.

Table 5.4.3-1: Summary of Surficial Geology Units

Map Unit Type[a]	Soil Cover	Ground Ice
Organic (generally only as a minor component of other terrain units)	Veneers (Ov), humic	Likely present
Marine (W)	Gravelly (can include boulders and/or cobbles) to sandy beach ridges, terraces and veneers. Both beach and deltaic deposits.	Limited near surface, but likely present at depth, especially where till is present under the marine sediments.
Washed Morainal surfaces (washed till) (Mbv-W)	Diamictons. Gravelly to silty sandy to fine sandy silty veneers and possibly blankets (Mbv-W)	Limited near surface but present at depth. Possible excess ice at depth.
Morainal (assumed present under most washed morainal surfaces)	Blankets and likely some veneers, rubbly clasts in a fine grained matrix (M)	Possible excess ice (ice detected in soil)
		Generally wet sites
Glaciofluvial (F^G)	Sand or sand and gravel deposits (F^G)	Material is easy to excavate.
Weathered Bedrock (D) (Felsenmeer)	Rubbly mantles (Db)	Generally limited
	Rubbly veneers (Dx, Dv) with veneers (Ov, Mv)	Generally limited
Bedrock (R)	None	Generally limited
	With blankets (Db, Mb-W)	Possible excess ice
	With veneers (Dv, Mv-W)	Generally limited

[a] Map unit type based on most abundant surficial material interpreted from the air photos. Letter codes correspond to Howes and Kenk (1997).

The terrain unit descriptions and interpretation are contained in Appendix E-1 and E-2. The terrain mapping along the proposed AWAR alignment is provided in Figures F-1 to F-12 in Appendix F.

The terrain mapping study indicated that freeze and thaw induced displacement of soil can be expected along the proposed AWAR alignment, although these displacements are more likely to occur in imperfectly to poorly-drained materials underlain by fine-grained morainal sediments. Physical weathering (frost wedging and frost shattering) is evident on exposed bedrock surfaces and in areas of rubbly, weathered bedrock.

5.4.3.3 Observed Periglacial Processes

Periglacial processes are most evident in areas underlain by morainal deposits and are typical of areas underlain by continuous permafrost. Surface expression is subdued in areas where there is a thin cover of surficial materials over bedrock and in areas of well-drained granular sediments.

The ground features and patterns observed on the air photos are typical of perglacial processes known to occur in permafrost terrain. The meaning and definition of the various geomorphic features and processes interpreted from the air photos follows the standard definitions given in Everdingen (1998).

The periglacial processes present in the area fall into 3 main processes types as follows:

- physical weathering of in situ materials:
  - frost shattering; and
  - frost wedging.
- freezing induced displacement of soils:
  - frost creep and creep of frozen ground;
  - frost heave (and cryoturbation in general);
  - frost jacking; and
  - frost sorting.
- thaw induced displacement of soils:
  - solifluction is very limited; and
  - thaw consolidation leading to thaw settlement.

The observed periglacial processes are typical of areas underlain by permafrost. The surface expression for these processes is locally subdued due to the thin cover of surficial materials and the generally well-drained conditions in shallower surficial materials in some areas.

Physical Weathering

Frost wedging and frost shattering occur on exposed bedrock and in coarse-grained block fields (felsenmeer).

Freezing Induced Displacement

Evidence of cryoturbation of the marine (W), washed morainal (M-W), weathered bedrock or felsenmeer (D), and glaciofluvial soils (F^G) occurs in the form of patterned ground, primarily small, low hummocks, "mud boils", and cracks. Occasional stone rings have been observed in areas of weathered bedrock or areas of mixed till or marine sediments and weathered bedrock. These terrain features indicate that periglacial processes such as frost sorting, frost heave, and frost creep are acting on the surficial materials within the study area. These processes result in uplift perpendicular to the ground surface during freezing. During thaw, the uplifted material settles vertically leading to some lateral displacement on sloping surfaces.

Thaw Induced Displacement

Thaw settlement was not discernable from the air photos, but is expected to occur in many areas along the proposed AWAR, as patterned ground is frequently present, especially in imperfectly and poorly-drained areas. Thaw consolidation leading to thaw settlement would be expected to occur following surface disturbance in areas where the surficial materials are thicker (e.g., greater than 2 m thick) and wetter (e.g., gently sloping or low-lying areas and low-lying areas near surface water). These areas likely will be more prone to thaw settlement than drier, thinner soils where bedrock is near the surface or well-drained, coarse marine sediments.

There is only very limited and very localized evidence for rapid mass-movement of slopes through detachment failures or retrogressive thaw slumping visible on the air photos. The likelihood of detachment failures and retrogressive thaw slumping within the AWAR Project area appears low. There were no observed instances of rapid thaw induced displacement on the traverses along the proposed AWAR route, and only rare, small, localized areas of slow movement (e.g., solifluction) were noted.

Susceptibility of Terrain to Periglacial Processes

The observations have been used to classify the terrain units based on their susceptibility to periglacial processes. Table 5.4.3-2 presents the classifications used to develop displacement hazard plans, which are presented in Golder (2010).

Table 5.4.3-2: Susceptibility of Terrain to Periglacial Processes

Active Layer Process	Description	Susceptibility		
		Low	Moderate	High
Physical weathering of in situ materials	Rockfall or Minor Rock Displacement Frost Shattering Frost Wedging	■ Non-bedrock areas. ■ Bedrock areas with slope gradients typically < 60%. ■ Rubbly gravelly beach ridges, platforms, and veneers (gWrv).	■ Bedrock areas with slope gradients typically > 60%.	■ Observed rockfall areas.
Freezing induced displacements of soils	Frost creep Frost Jacking Cryoturbation	■ Felsenmeer (rDb). ■ Bedrock (R). ■ Veneers of wave washed till and/or marine sediments over bedrock. ■ Gravelly to coarse sandy beach ridges, terraces blankets, and veneers. ■ Glaciofluvial deposits.	■ Similar terrain as “High” but with moderately well-drained to imperfectly-drained conditions.	■ Washed morainal veneers over deeper till or complexes of marine and morainal sediments. Imperfectly to poorly drained. ■ Polygons including obvious patterned ground dominated by frost boils and/or low soil hummocks.

Table 5.4.3-2: Susceptibility of Terrain to Periglacial Processes (continued)

Active Layer Process	Description	Susceptibility		
		Low	Moderate	High
Thaw induced displacements of soils	Thaw settlement Thaw Slumping	■ Felsenmeer (rDb). ■ Bedrock (R). ■ Veneers of washed till and/or marine sediments over bedrock ■ Gravelly beach ridges, terraces, blankets, and veneers. ■ Glaciofluvial deposits.	■ Similar terrain as “High” but with moderately well-drained to imperfectly-drained conditions.	■ Washed morainal veneers over deeper till or complexes of marine and morainal sediments. Imperfectly to poorly drained. ■ Polygons including obvious patterned ground dominated by frost boils and/or low soil hummocks.

5.4.3.4 Regional Permafrost Study

Methods

A literature review of the continental and regional permafrost conditions predicted at the site was undertaken to understand, in a regional sense, the permafrost regime of the Meliadine Gold Project area.

Results

The Meliadine Gold Project area, including the AWAR, is underlain by permafrost, with intervening taliks and thaw bulbs induced by lakes.

The ground ice content in the region is expected to be between 0 and 10% (dry permafrost) based on the regional scale compilation data and the Canada Permafrost Map published by Natural Resources Canada (1995). Ice lenses and ice wedges are locally present on land, as indicated by permafrost features such as palsas. These areas of local ground ice generally are associated with low lying areas of poor drainage.

The closest long-term permafrost monitoring station is located at Baker Lake as part of the Circumpolar Active Layer Monitoring (CALM) program. Regionally, ground temperatures have been monitored at Baker Lake since 1997 as part of the CALM program. The location of the CALM station is summarized in Table 5.4.3-3.

Table 5.4.3-3: Baker Lake CALM Location

Site Number	Latitude	Longitude	Elevation (m)	Location
C20	64°19.6’N	95°2.5’W	50	230 km northwest of Meliadine

km = kilometre; m = metre

Mean annual ground temperatures at a depth of 2 m (near top of permafrost) ranged from -6.6 to -8.4°C from 1998 to 2001. Annual active layer thaw depths from 1997 to 2004 are presented in Table 5.4.3-4. The data collection at the Baker Lake CALM site represents a short period of time, and there are no new data from the site. The average thaw depth measured at the Baker Lake CALM site is 1.7 m.

Table 5.4.3-4: Annual Thaw Depth at Baker Lake CALM Site

Site	Thaw Depth (cm)												Average
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
Baker Lake C20	120	170	174	189	193	-	-	178	-	-	-	-	171

'-' = not reported; data downloaded from CALM website. There are no new data on the CALM website.

5.4.3.5 Local Permafrost Studies

Methods

In total, 29 thermistors have been installed in the Meliadine Project area during geotechnical investigations in 1998, 2007, 2009, and 2011. Figure 5.4.3-2 shows the locations of the thermistors installed at the Meliadine Gold Project site. The thermistor installations provide ground temperature data to characterize the existing shallow (near surface) and deep (permafrost base) permafrost regimes to establish baseline conditions for environmental monitoring purposes, as well as to allow the appropriate engineering design of the project, including the open pits, underground openings, structural fills, and surface infrastructure, such as the proposed AWAR.

The thermistors were installed into boreholes that were drilled for either exploration purposes or for specific geotechnical purposes. The depth to which the thermistors were installed varies depending on the desired information to be obtained. Some thermistors are installed in boreholes that were drilled to shallow depths of 40 m or less. These provide detailed ground temperature information within the active layer, down to approximately the depth of zero annual amplitude. Some thermistors are installed in boreholes that were drilled to deeper depths, and thermistors were installed to vertical depths below ground surface ranging from about 125 m to about 581 m. These provide ground temperature data below the depth of zero annual amplitude to characterize the 'deep' permafrost regime, including the permafrost base, and to determine the geothermal gradient. The deep permafrost regime will not be impacted by the AWAR.

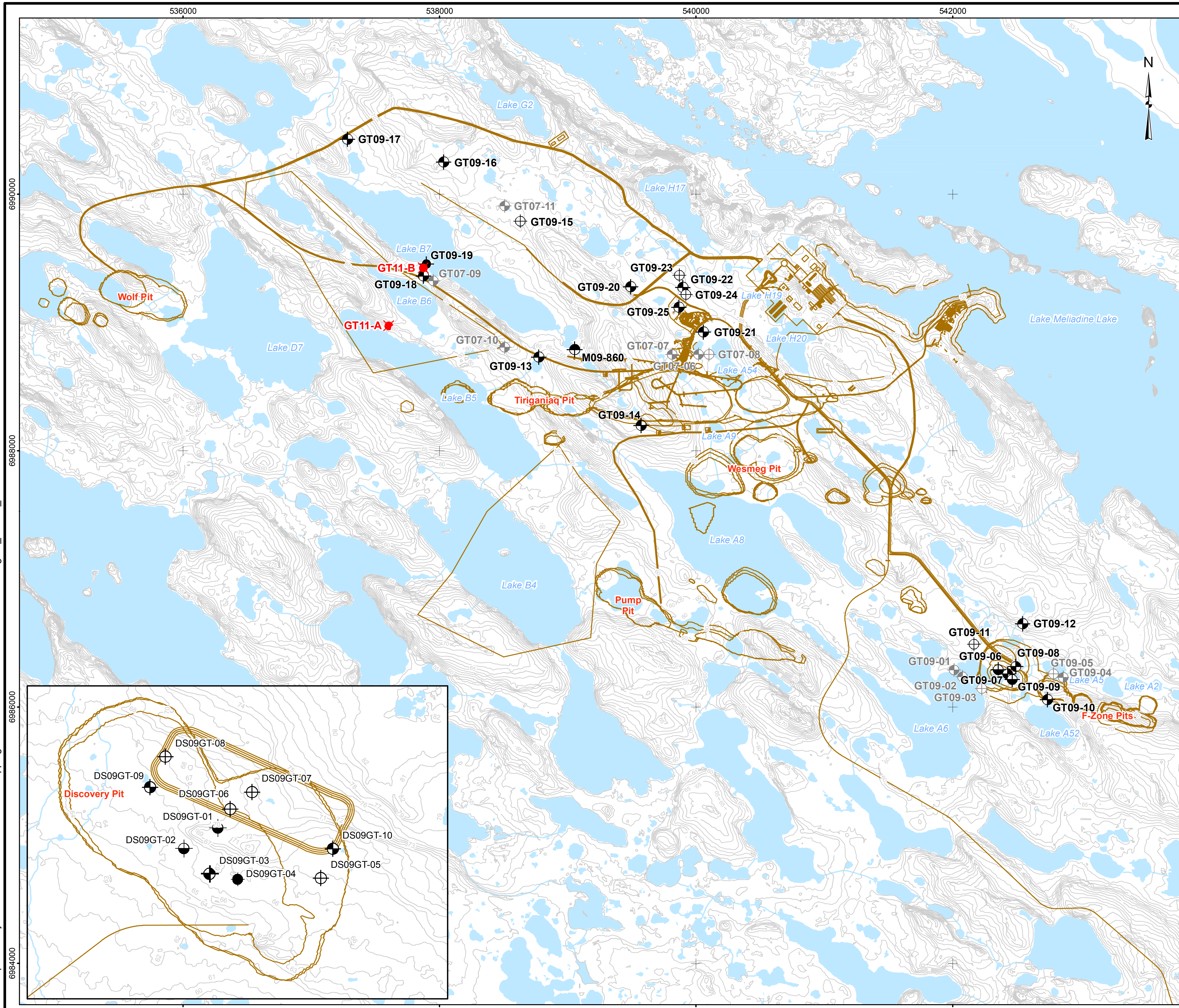
Results

Table 5.4.3-5 summarizes some important characteristics of the permafrost based on the existing studies. The Meliadine Gold Project area is in a region of cold permafrost, having an average annual surface temperature less than -4°C. The depth of permafrost and of the active layer will vary based on proximity to lakes, soils thickness, vegetation, climate conditions, and slope direction.

Table 5.4.3-5: Characteristics of the Permafrost Based on the Existing Studies

Depth of Zero Annual Amplitude (m)		Zero Amplitude Temperature (°C)			Geothermal Gradient (°C/m depth)			Mean Annual Surface Temperature (°C)			Active Layer Depth (m)			Permafrost Base (mbgs)		
Min.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.
15	35	-7.5	-6.3	-4.8	0.010	0.016	0.020	-8.7	-7.2	-6.0	1.2	2.3	3.2	292	412	495

°C = degrees Celsius; m = metre; min = minimum; max = maximum; avg = average; mbgs = metres below ground surface



N:\Bur-Graphics\Projects\2010\1373\10-1373-0076\Mapping\MXD\Soil&Terrain\Terrain&Permafrost\Figure_5.4.3-2_Location-Plan-Borehole-Thermistors.mxd

LEGEND

- Borehole Thermistor (installed for hydrogeological program)
- Geotechnical Borehole (2009)
- Geotechnical Borehole with Thermistor (2009)
- F-Zone Open Pit Geotechnical Borehole
- F-Zone Open Pit Geotechnical Borehole with Thermistor
- Historic Geotechnical Borehole
- Historic Geotechnical Borehole with Thermistor
- Hydrogeological Testing Borehole
- Hydrogeological Testing Borehole with Thermistor

Discovery Pit Borehole

- Inclined Geotechnical Borehole (2009)
- Inclined Geotechnical Borehole with Thermistor (2009)
- Inclined Geotechnical Borehole with Thermistor and Datalogger (2009)
- Vertical Geotechnical Borehole (2009)
- Vertical Geotechnical Borehole with Thermistor (2009)
- Existing and Proposed Site Infrastructure and Road Access
- Topographic Contour (1.0 m Interval above sea level)
- Watercourse
- Waterbody

REFERENCE

Base data obtained from Agnico-Eagle Mines Ltd (AEM).
Datum: NAD 83 Projection: UTM Zone 15

600 0 600
SCALE 1:30,000 METRES

PROJECT
AGNICO-EAGLE MINES LTD.
MELIADINE GOLD PROJECT
NUNAVUT

TITLE
LOCATION PLAN BOREHOLE THERMISTORS

Golder Associates
Greater Vancouver Office, B.C.

PROJECT NO. 10-1373-0076			PHASE No. 1700	
DESIGN	CJC	12 Sep. 2011	SCALE AS SHOWN	REV. 0
GIS	CDB	12 Sep. 2011	FIGURE: 5.4.3-2	
CHECK	CJC	12 Sep. 2011		
REVIEW	CJC	12 Sep. 2011		

5.4.3.6 Snow Drift Accumulation

Method

A preliminary assessment of the potential areas for snow build-up along the alignment of the proposed AWAR has been completed (Golder 2011a). The snow drift assessment considered snow fall and wind direction data in conjunction with the road alignment, air photo interpretation, and topographic contours.

The preliminary snow drift assessment was based on the information presented in Table 5.4.3-6.

Table 5.4.3-6: Summary of Data and Information

Data	Source
Meteorological Data	
Annual snowfall data	Golder 2009
Wind direction data	Golder 2009
Snow course data	Golder 2009
Surface Data	
Feasibility level road alignment[a]	Golder 2011
Topographic maps[a]	Golder 2011
1:10 000 scale air photos (black and white and colour)	Comaplex Ltd. dated 97/07/19 and 97/07/18
Site photographs taken during a snow course survey in April 2009	Golder 2009

[a] The feasibility level road design used 2 types of topographic data: topographic map data with a 1 m contour interval ("Schlencker Data"); and regular NTS topographic map data with a 7.7 m contour interval.

Topographic data, air photos, site photographs, and site knowledge were used to qualitatively identify potential locations where snow may accumulate along the proposed AWAR alignment.

Air photos were used to identify features along the road alignment indicative of potential locations of snow drifts, such as nivation hollows and changes in vegetative cover, as well as steeper lee slopes.

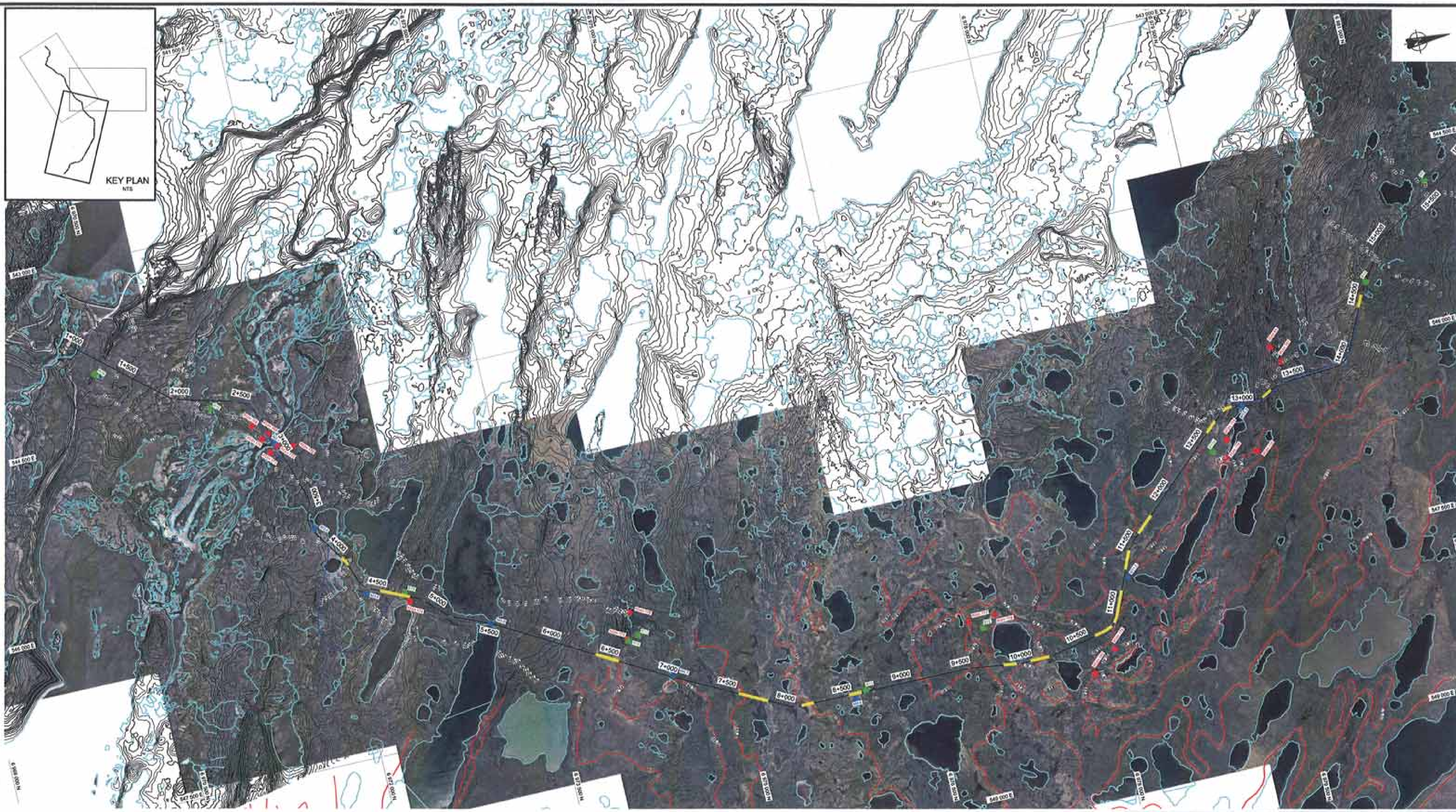
Results

The wind direction data from Rankin Inlet indicate dominant winds from the north-northwest, with sub-dominant winds from the north and, to a lesser degree, from the northwest, suggesting that southeast and south-facing slopes will be the dominant lee slopes. It is anticipated that short, steep, lee slopes (e.g., southeast and southwest facing slopes) and lake shorelines are more likely to accumulate snow than windward slopes and gently sloping hillsides.

Snow course survey data taken from topographical transects in several small watersheds in the Meliadine Gold Project area (1997 to 2000 and 2009) suggest that snow water equivalent depth accumulations average about 120 mm, which likely equates to average snow depths of 30 to 40 cm, depending on snow density. In 2009, snow depths were shallow on crest slopes and similar on lower slopes. The 2009 snow depths were deepest on southeast and southwest facing slopes, whereas northeast facing slopes had intermediate snow depths and northwest facing slopes had snow depths similar to crest slopes. Annual snowfall depths recorded at the Rankin Inlet A climate station between 1982 and 2009 ranged from a low of 76.2 cm in 1997 to a high of 304.4 cm in 2005 (Golder 2009).

Review of the April 2009 snow course site photographs confirmed that ridge crests, crests of gently sloping undulations and upper slopes along some hillsides tend to experience very shallow snow cover. These areas of shallow snow cover often include local areas where soil, rocks, and/or minor vegetation are exposed. Snow depths on gently sloping mid and lower slope hillsides also appear relatively shallow, but deeper than the ridge crests. A few site photographs showed short, steep, lee slopes below ridge crests with relatively deep accumulations of snow.

The proposed AWAR alignment proceeds in a northeast direction from the Char River turnoff to approximately CH 8+600, after which it trends northwest. The road alignment generally follows higher ground and windward slopes. Areas identified along the alignment that may accumulate snow drifts based on topography, wind direction, air photographs, and site photographs are shown in Figures 5.4.3-3 and 5.4.3-4.



0 150 300 450 600 750
SCALE IN METRES

LEGEND

- Archaeology Site
- Potential Quarry Location
- Watercourse Crossing
- Watercourse
- EXISTING MAJOR CONTOUR (5 m TOPO - SCHLENCKER DATA)
- EXISTING MINOR CONTOUR (1 m TOPO - SCHLENCKER DATA)
- 7.7 m EXISTING CONTOUR (NTS MAP SHEET DATA)
- POTENTIAL LOCATION OF SNOW DRIFT ACCUMULATION
- PROPOSED PHASE 1 AWAR ALIGNMENT
- ALTERNATIVE ALIGNMENT PROPOSED BY ASSOCIATED ENGINEERING

NOTES

1. ROAD WIDTH, FILL, AND EMERGENCY SHELTER LOCATIONS ARE NOT SHOWN.
2. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS NOTED OTHERWISE.
3. WATERCOURSE CROSSING LOCATIONS TO BE UPDATED DURING DETAILED DESIGN.

REFERENCES

1. BASE DATA OBTAINED FROM COMAPLEX MINERALS CORPORATION. BASE INFRASTRUCTURE AND PITS FROM COMAPLEX 04/12/09 (MELIADINE_PPD_SHAPEFILES_DEC09) AND TIRIGANIAQ PIT IS W24 PIT PROVIDED BY COMAPLEX, FEB 2010. DISPLACEMENT HAZARD MAPPING PROVIDED BY TERRY ROLLERSON (GOLDER, JULY 2009). PROJECTION: UTM ZONE 15 DATUM: NAD 83
2. TOPOGRAPHY PROVIDED BY COMAPLEX AS A COMBINATION OF GOVERNMENT ISSUED NTS MAP SHEETS AND DETAIL AERIAL SURVEY (SCHLENCKER DATA).

NOT FOR CONSTRUCTION

PROJECT

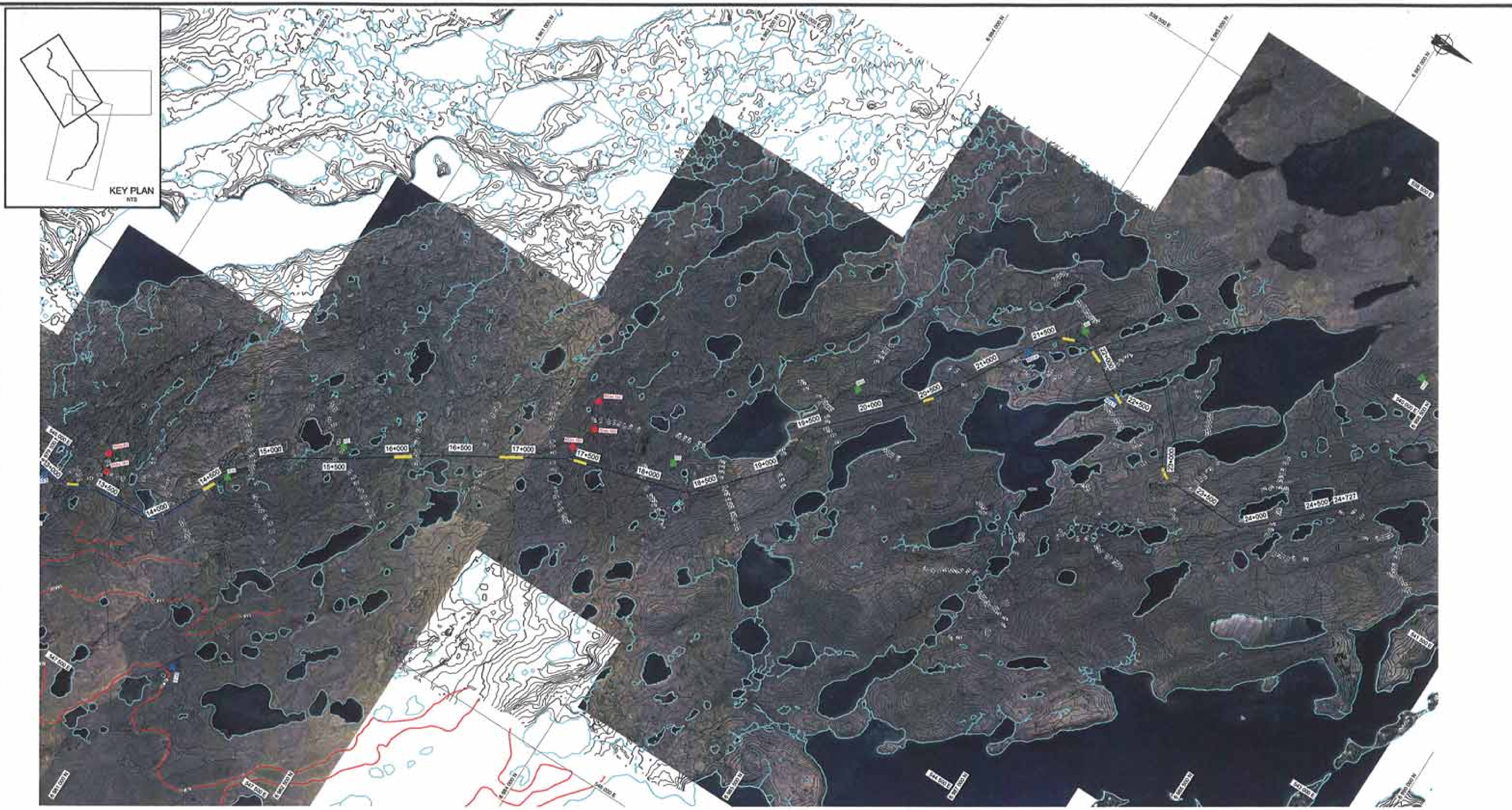
AGNICO-EAGLE MINES LIMITED
MELIADINE GOLD PROJECT
NUNAVUT

TITLE

POTENTIAL LOCATIONS FOR SNOW DRIFT ACCUMULATION CH. 1+000 TO CH. 14+000

Golder Associates
Greater Vancouver Office, BC

PROJECT No. 11-1428-0011			PHASE No. 9999	
DESIGN	AS	24MAY11	SCALE AS SHOWN	REV. 0
CADD	JH	24MAY11	FIGURE 5.4.3-3	
CHECK	AS	27MAY11		
REVIEW	CJC	27MAY11		



LEGEND

- Archaeology Site
- Potential Quarry Location
- Watercourse Crossing
- Watercourse
- EXISTING MAJOR CONTOUR (5 m TOPO - SCHLENCKER DATA)
- EXISTING MINOR CONTOUR (1 m TOPO - SCHLENCKER DATA)
- 7.7 m EXISTING CONTOUR (NTS MAP SHEET DATA)
- POTENTIAL LOCATION OF SNOW DRIFT ACCUMULATION
- PROPOSED PHASE 1 AWAR ALIGNMENT
- ALTERNATIVE ALIGNMENT PROPOSED BY ASSOCIATED ENGINEERING

NOTES

1. ROAD WIDTH, FILL, AND EMERGENCY SHELTER LOCATIONS ARE NOT SHOWN.
2. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS NOTED OTHERWISE.
3. WATERCOURSE CROSSING LOCATIONS TO BE UPDATED DURING DETAILED DESIGN.

REFERENCES

1. BASE DATA OBTAINED FROM COMAPLEX MINERALS CORPORATION. BASE INFRASTRUCTURE AND PITS FROM COMAPLEX 04/12/09 (MELIADINE_PPD_SHAPEFILES_DEC09) AND TIRIGANIAQ PIT IS W24 PIT PROVIDED BY COMAPLEX, FEB 2010. DISPLACEMENT HAZARD MAPPING PROVIDED BY TERRY ROLLERSON (GOLDER, JULY 2009). PROJECTION: UTM ZONE 15 DATUM: NAD 83
2. TOPOGRAPHY PROVIDED BY COMAPLEX AS A COMBINATION OF GOVERNMENT ISSUED NTS MAP SHEETS AND DETAIL AERIAL SURVEY (SCHLENCKER DATA).

NOT FOR CONSTRUCTION

PROJECT

AGNICO-EAGLE MINES LIMITED
MELIADINE GOLD PROJECT
NUNAVUT

TITLE

POTENTIAL LOCATIONS FOR SNOW DRIFT ACCUMULATION CH. 14+000 TO CH. 24+727

Golder Associates
Greater Vancouver Office, BC

PROJECT No. 11-1428-0011			PHASE No.	9999
DESIGN	AS	24MAY11	SCALE AS SHOWN	REV. 0
CADD	JH	24MAY11		
CHECK	AS	27MAY11	FIGURE 5.4.3-4	
REVIEW	CJC	27MAY11		

5.4.4 Effects Analysis

Infrastructure components, such as the AWAR, are generally insensitive to settlement and heave. Nevertheless, the engineering and construction methods used for the design and construction of the AWAR will be targeted at avoiding areas that are sensitive to ground disturbance, specifically thaw-sensitive soils. Where thaw-sensitive soils will be crossed by the AWAR, the design and construction of the road will minimize impact to the underlying terrain through the use of appropriate road fills and thicknesses, and the use of appropriate road construction methodologies and scheduling. Thick fills using thaw-stable construction materials will be used to preserve the permafrost, and appropriate drainage measures will be used to control and manage water adjacent to the roadway.

The construction of the AWAR will have some effects on the terrain components and the active layer. There will be no effects on the permafrost base.

For the effects assessment, the AWAR Project was considered to have 3 stages: construction, operation, and decommissioning. The following assumptions were made in regards to the construction of the AWAR Project:

- construction will occur predominately in the winter months with an initial rough trail advanced at the full base width of the Phase 1 AWAR from the southern end of the proposed road to the Meliadine West Advanced Exploration site so that the base of the road was laid down under winter frozen conditions;
- road fill material will be placed directly over the existing soil layer without cut, stripping, or grubbing to avoid disturbing the subgrade soils;
- soils will only be disturbed at stream crossings where culverts will be installed under winter frozen conditions, and such disturbance will be minimized to the extent possible by best management practices;
- culverts will be placed in a staggered sequence to minimize ponding water on the upstream side of the road during spring melt;
- only thick snow drifts will be removed before road fills are placed; and
- the road will be inspected routinely (during summer months) during the operational period of the road.

Results

The major AWAR Project activities that have the potential to effect changes to the terrain and soils, and the permafrost environment are summarized in Table 5.4.4-1 according to the time period in which they occur: construction, operation, and closure and decommissioning. Of these, construction activities resulting in physical loss or permanent alteration of terrain and soils within the AWAR footprint, and within the quarried areas represent the most potential effects on the terrain and permafrost.

Table 5.4.4-1: Potential Pathways for Effects to Terrain and Permafrost

Project Component/Activity	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
Construction: Dumping, dozing, and placement of road fills; trafficking on road surface during construction	Air emissions, dust deposition, or chemical contamination on the terrain and soils	Use of non-acid generating materials for road fills. Enforcing speed limits will assist in reducing dust emissions. Equipment and fleet equipped with industry-standard emission control systems. Operating procedures will be developed that reduce dust generation and air emissions (e.g., regular maintenance of equipment to meet emission standards).	No linkage
	Physical loss or permanent alteration of terrain and soils within the Phase 1 AWAR footprint.	The Phase 1 AWAR is narrow to minimize footprint area while maintaining safe construction and operation practices.	Primary
	Use of potential acid generating materials from road building materials can affect soil and terrain quality	Use of non-acid generating material for road construction.	No linkage
	Physical changes to the permafrost table and active layer in rock and soils beneath and adjacent to the Phase 1 AWAR resulting from ground disturbance during construction.	The road alignment has been chosen to avoid areas that are ice-rich and, therefore, more susceptible to disturbance. Thaw-stable construction fills will be used to construct the road. Fill thickness' is designed to preserve the permafrost and promote permafrost growth into the thaw-stable road fills. Road fill material will be placed directly over the existing soil layer without cutting, stripping, or grubbing to avoid disturbing the subgrade soils. Placement of much of the road construction materials during winter will minimize disturbance to the permafrost. Only thick drifted snow greater than 1 m thick will be removed before the road fills are placed.	Secondary

Table 5.4.4-1: Potential Pathways for Effects to Terrain and Permafrost (continued)

Project Component/Activity	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
Construction: Dumping, dozing, and placement of road fills; trafficking on road surface during construction (continued)	Placement of road fill materials during the summer could insulate warm temperatures in subgrade soils leading to permafrost degradation.	Coarse road fills will be placed in winter when soils are frozen and the road fill thickness will be designed with a minimum thickness to maintain frozen conditions in the soil subgrade. Top dressing will be finished in early summer.	No linkage
	Alteration of drainage paths adjacent to the Phase 1 AWAR alignment.	Road design includes the use of culverts or French drains to control and manage drainage adjacent to and under the road.	Secondary
Construction: Quarrying and crushing activities at borrow pits for road fills and surfacing	Air emissions and dust deposition on the terrain and soils	Minimize quarrying activities and use dust suppression measures where appropriate.	No linkage
	Physical changes to the permafrost table and active layer by quarry excavation.	Active layer and permafrost table will equilibrate to final quarry shape and profile. Minimize depth of quarrying to limit impact on active layer.	No linkage
	Use of quarried materials results in rock and soil volume loss in specific quarry locations.	Minimize volume of quarried materials required.	Secondary
	Physical loss or permanent alteration of terrain and soils within the quarried areas.	Minimize surface area to be quarried. Use best management practices to close quarry sites to minimize rock and soil cuts and restrict where possible the development of quarry lakes by promoting drainage from sites.	Primary
	Permafrost degradation due to borrow source and quarry development; development of closed taliks beneath quarry 'lakes' if quarries are improperly graded and drained	Quarries will be excavated and sloped for positive drainage. Maximum quarry depths of 3 m are currently planned. Excavations will be at least 100 m away from any watercourses. Drainage from quarries will not flow directly into any waterbodies or watercourses; drainage will be directed to swells before runoff can enter watercourses.	Secondary

Table 5.4.4-1: Potential Pathways for Effects to Terrain and Permafrost (continued)

Project Component/Activity	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
Construction: Quarrying and crushing activities at borrow pits for road fills and surfacing (continued)	Degradation of rock and soil slopes in quarries due to annual freeze-thaw processes.	Typical freeze/thaw processes. Quarries will be shallow excavations and will be closed on completion using best management practices.	No linkage
	Alteration of drainage paths adjacent to quarries.	Quarries will be excavated and sloped for positive drainage. Excavations will be at least 100 m away from any watercourses. Drainage from quarries will not flow directly into any waterbodies or watercourses; drainage will be directed to swells before runoff can enter watercourses.	Secondary
Operation: Road use and maintenance activities	Permafrost degradation and thaw settlement along road edges due to 1. snow drifting and snow accumulation in lee of road; 2. snow accumulation along toe of road shoulders from winter plowing; and 3. pooling of water and ice lens growth.	Install culverts to promote drainage. Where possible, construct road along exposed ridge lines to reduce potential snow accumulation. Where possible use thaw-stable road fills for construction. Annual road maintenance as required.	Secondary
	Freezing and plugging of culverts in the winter may result in 1. inadequate drainage during spring thaw and freshet, 2. over-topping and erosion of road surface releasing silt onto terrain and soils; 3. pooling of water adjacent to road flanks; 4. potential instability and thaw settlement of road shoulders; 5. thaw settlement beneath and adjacent to culverts; and 6. ice lens growth.	Use appropriate culvert design based on the site specific hydraulics. Use of staggered culvert configuration to promote drainage during spring thaw and freshet. Regular inspection of the road to identify any areas where ponding of water along the road represents a risk, and installing additional culverts or French drains to alleviate the risk.	No linkage

Table 5.4.4-1: Potential Pathways for Effects to Terrain and Permafrost (continued)

Project Component/Activity	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
Operation: Road use and maintenance activities (continued)	Air emissions, dust deposition, or chemical contamination on the terrain and soils	Dust suppression through regular surface maintenance (e.g., grading, adding coarse top material), and watering where the AEM road supervisor identifies areas prone to high dust levels, or areas where dust may be adversely affecting water quality or fish habitat . Use of non-acid generating materials for road bed and fills. Enforcing speed limits will assist in reducing dust emissions. Equipment and fleet equipped with industry-standard emission control systems. Operating procedures will be developed that reduce dust generation and air emissions (e.g., regular maintenance of equipment to meet emission standards).	No linkage
Closure and Decommissioning: Ripping and dozing activities; general decommissioning activities	Ripping of road surface and slopes can result in dust emissions and affect down-wind soil and terrain.	Minimize activity using appropriate equipment and re-establish drainage paths and promote permafrost re-equilibration within the decommissioned road bed. Make road surface impassable by vehicular traffic.	No linkage
	Sediment and contaminant releases during removal of culverts can affect downstream soil and terrain.	In-stream work will be limited to when watercourses are not flowing for ephemeral watercourses or when watercourses are frozen. If any of the culverts need to be removed when the watercourses are flowing, the work will be completed late in the summer, and best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management) will be employed.	No linkage

The following section discusses the potential pathways relevant to the terrain and permafrost.

5.4.4.1 Pathways with No Linkage

A pathway may have no linkage if the activity does not occur (e.g., effluent is not released), or if the pathway is removed by environmental design features so that the AWAR Project results in no detectable (measurable) environmental change and residual effects to the terrain and soils relative to baseline or guideline values. The following pathways are anticipated to have no linkage to terrain and soils, vegetation, and wildlife, and will not be carried through the effects assessment.

- **Air emissions and dust deposition on the terrain and soils.**
- **Ripping and dozing of road surface and slopes can result in dust emissions and affect down-wind soil and terrain.**

Dust from construction of the AWAR and traffic may deposit on the tundra down-wind of the road construction, affecting terrain and soils. Dust suppression methods to manage emissions include watering of the road surface in areas prone to high dust levels during post-winter construction and operation, regular maintenance of the road surface, and enforcing the posted speed limits. These management methods should reduce and control emissions, and subsequent potential effects of dust deposition.

- **Use of potential acid generating materials from road building materials can affect soil and terrain quality.**

The materials for constructing the road will be quarried from selected rock and soil borrow sources. During the geomorphological mapping of the AWAR route, samples of till were taken, and geochemical analyses were completed. The sites chosen for potential quarry and borrow sites along the AWAR alignment were tested for acid rock drainage and metal leaching. The results indicated no or very limited acid rock drainage and low metal leaching form the samples tested.

The road will be constructed using non-acid generating materials with low metal leaching potential.

- **Placement of road fill materials during the summer could insulate warm temperatures in subgrade soils leading to permafrost degradation.**

During the summer months, the active layer extends up to a 2 m depth below the ground surface. If the AWAR road was constructed when the surface soils are thawed, they will likely remain thawed for a period of time because the road fills would insulate the subgrade from the cold temperatures during the winter months. Over time the subgrade soils would refreeze.

To prevent insulation of thawed subgrade soils, to the greatest extent possible, the AWAR will be constructed in the winter when the subgrade soils are frozen. The rough base would be advanced at the full road width, so that the base of the AWAR will be laid down in winter frozen ground conditions. The stream crossing culverts would also be installed in the winter. Once the rough base and stream culverts are installed, the remainder of the construction will be completed by building up the rough base primarily under winter conditions, and placing the final topping materials during the spring and early summer.

The AWAR has been designed with a minimum fill thickness to maintain permafrost conditions within the subgrade soils. The thermal modeling indicated a minimum road fill thickness of 1 m is required above ice poor subgrade soil to maintain the soil in a frozen condition. Similarly, a minimum road fill thickness of at least 1.3 m is required above ice rich subgrade soils. The recommended road fill thickness provided here are minimum values based on assumptions and generalized conditions.

Thus the placement of the road bed is not expected to affect the underlaying permafrost regime.

- **Physical changes to the permafrost table and active layer by quarry excavation.**

The quarries will be excavated through the active layer and into the underlying materials by ripping, drilling, and blasting. The active layer will eventually re-equilibrate with the surrounding permafrost with no residual effects.

- **Degradation of rock and soil slopes due to annual freeze-thaw processes**

Physical weathering (frost wedging and frost shattering) is evident on exposed bedrock surfaces and in areas of rubbly, weathered bedrock. Freezing and thaw induced displacement of soil can be expected along the road alignment, although these displacements are more likely to occur in poorly-drained materials underlain by fine-grained morainal sediments.

Construction of the road bed is planned to occur primarily during winter while soils are frozen, and using thaw-stable fills, to minimize the potential for freezing and thaw induced displacement of the soils. The fills will be placed directly over the existing terrain without cut, stripping, or grubbing to avoid disturbing the subgrade soils. The placement of fills over rock during winter will minimize or reduce degradation of the rock due to annual freeze-thaw processes through aggradation of the active layer into the road fill materials.

- **Freezing and plugging of culverts in the winter.**
- **Alteration of drainage paths adjacent to the AWAR alignment**

The construction of the AWAR will result in alteration of drainage paths adjacent to the road alignment. Culverts or French drains will be used to re-direct drainage paths and to convey water from upstream areas to downstream areas across or under the AWAR, refer to Section 5.2.4.2.

It is expected that annual maintenance and clearing debris from the culverts will be required during the operational period of the road. This is common practice in northern climates. The “offset stacked” culvert configuration will assist in flow conveyance during the spring thaw and ice break-up period.

- **Sediment and contaminant releases during removal of culverts can affect downstream soil and terrain.**

Decommissioning of the AWAR will be accomplished by loosening compacted surfaces (ripping surface with a dozer mounted ripping unit), flattening side slopes, and removing all culverts, bridges (not including the Char River bridge as this would become the property of the Municipality of Rankin Inlet), and other potential obstructions to drainages paths. During these activities there is the potential for release of sediment and contaminants which may be deposited downstream on terrain and soils. To manage such releases, the following activities are planned:

- in-stream work (e.g., culvert removal) will be limited to the extent possible to when watercourses are not flowing for ephemeral watercourses or when watercourses are frozen; and

- if any of the culverts need to be removed when the watercourses are flowing, the work will be completed late in the summer, and best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management) will be employed.

5.4.4.2 Secondary Pathways

In some cases, both a source and a pathway exist, but the change caused by the AWAR Project is anticipated to result in a minor environmental change, and would have a negligible residual effect on terrain and soils, vegetation, and wildlife relative to baseline or guideline values. The following pathways are anticipated to be secondary, and will not be carried through the effects assessment:

- **Physical changes to the permafrost table and active layer in rock and soils beneath and adjacent to the AWAR resulting from ground disturbance during construction.**

The subgrade soil along the proposed AWAR alignment is highly variable and was classified by displacement hazard ratings. Low to medium displacement hazard ratings were considered “thaw stable” and included well drained soil, ice poor to frost shattered bedrock material. Medium-high to very high displacement hazard ratings were considered “thaw susceptible” and included poorly-drained, ice-rich, organic, or bog material. The subgrade soil near the toe of the road fill may experience deeper thaw penetration during each subsequent summer/spring season, which may lead to thaw consolidation. Thaw consolidation in ice rich soil at the toe of the embankment will result in the formation of tension cracks and small grabens inside the shoulder area. The side slopes of the road fill on ice poor soil, however, are unlikely to be susceptible to bearing capacity failure.

The potential of the subgrade soil to experience ice creep or thaw consolidation is dependent on the ice content of the soil and thaw conditions. Ice rich soils are expected to have high water contents and may experience excess pore water pressures upon thaw. The excess pore water pressures will contribute to strength loss in the soil, and could result in local bearing capacity failures. Where the terrain is characterized by low lying poorly drained areas of fine grained soils, these are extremely susceptible to ground disturbance and cannot be constructed on during thaw periods. In such areas, the disturbance of the ground cover and formation of localized depressions within the thawed active layer may increase the depth of the active layer leading to thawing of previously frozen soils, ponding of water, and/or growth of ground ice. Road construction methodology over poorly drained fine grained soils will be targeted at preserving the permafrost by building over the active layer once it is fully frozen during winter with a road pad of sufficient thickness so that the permafrost table migrates upward into the road fill material. This is equivalent to building permafrost into the road base resulting in a stable road section. These sections will have the highest priority for completion of the required road thickness during the winter period.

Where the terrain consists of well drained coarse granular soils, which may occur along ridge crests, these are thaw-stable and can be constructed on during frozen or thawed periods with little to no negative impact to the permafrost table. Depending on the road fill thickness, the permafrost table may migrate upward into the road section as with the winter construction methods. However, because the underlying ground is thaw-stable, the road fill thickness for construction in such areas can be thinner than for construction in thaw-susceptible areas.

Where the underlying terrain is rock, then little to no negative impact to the permafrost through the construction of infrastructure is expected.

The construction of the AWAR will have no impact on the permafrost base, the sub-permafrost aquifer, the geothermal gradient, or any other permafrost characteristic.

Mitigation and environmental design features to reduce the potential for permafrost degradation are as follows:

- the road alignment avoids, where possible, fine-grained, poorly drained, ice-rich, frost susceptible soil conditions as noted by geomorphologic mapping, due to susceptibility to thaw related settlement;
- regions of high ground relief (higher elevations) were sought to provide better drainage conditions, to minimize the potential for snow drifting and to avoid organic depressions and/or other poor ground conditions, which are more abundant in the low lying areas;
- road fill material will be placed directly over the existing soil layer without cutting, stripping, or grubbing to avoid disturbing the subgrade soils;
- only thick drifted snow will be removed before the road fills are placed; and
- the road fill thickness should be a minimum of 1 m in thaw-stable soils, and 1.3 m in thaw-sensitive soils.

- **Rock and soil volume loss in quarry locations.**

Rock and soil materials will be excavated from the quarry areas, transported to the AWAR route, and then used for construction of the AWAR. Consequently, although there is a relocation of rock and soil from quarry to road, there is no net loss of rock and soil volumes due to construction of the AWAR.

- **Permafrost degradation due to snow drifting and melt water.**

The active layer and permafrost table can be affected where snow accumulates along the toe of the road side slopes, either by drifting, or by active road clearing during winter. Snow acts as an insulating layer to the active layer, and can restrict the deep penetration of the freezing front through the active layer during winter. Over time, this may result in deepening of the active layer at the toe of the side-slope. Furthermore, melting of the snow in the summer can result in the accumulation of excess water in the toe area, leading to additional thermal erosion and potential thaw subsidence. Water can act as a thermal ‘sink’, retaining heat and contributing to deepening of the permafrost table. The presence of water at the side-slope toe may saturate the soils and provide a source of water for the development of ice lenses and ice layers, further exacerbating thaw-induced settlement along the road edges.

Maintenance will be required during operation to manage snow accumulation locally along the road alignment; however, most of the alignment is located along windward slopes and ridge crests where there should be limited tendency for snow to build-up.

Installation of culverts or French drains through the road fills in low lying areas will reduce the potential for ponding of snow melt water in the spring and summer.

The potential of the subgrade soil to experience ice creep or thaw consolidation is dependent on the ice content of the soil and thaw conditions. Ice rich soils are expected to have high water contents and may experience excess pore water pressures upon thaw. The excess pore water pressures will contribute to strength loss in the soil and could result in local bearing capacity failures.

The subgrade soil near the toe of the road fill may experience deeper thaw penetration during each subsequent summer/spring season, which may lead to thaw consolidation. Thaw consolidation in ice rich soil at the toe of the embankment will result in the formation of tension cracks and small grabens inside the shoulder area. The side slopes of the road fill on ice poor soil are unlikely to be susceptible to bearing capacity failure.

The recommended road fill minimum thickness' of 1 m in thaw-stable soils, and 1.3 m in thaw-sensitive soils are minimum values based on assumptions and generalized conditions. Maintenance will be required during operations to fix thaw related settlement.

- **Potential permafrost degradation due to borrow source and quarry development.**
- **Development of closed taliks beneath quarry 'lakes' if quarries are improperly graded and drained.**

Borrow and quarry development for the AWAR road is likely to occur in areas of low relief due to the generally flat topography along the road alignment. Where possible, the borrows and quarries will be graded to provide drainage, but this may not be possible in all areas due to the flat topography. If water collects in the borrows/quarries, it could lead to development of local taliks below the quarry 'lakes'. The borrows and quarries will be located predominantly within bedrock so the overall impact on the terrain is anticipated to be minor.

Currently, it is planned to excavate the quarries to a depth of 3 m or less. This is in part for ease of excavation, which will be predominantly in the active layer, and in part for ease of water management and closure. It is expected that, in most cases, it will be possible to design and develop the quarries to promote positive drainage from the quarry area, or to minimize the water depths that may accumulate within the quarries. The accumulation of water within the quarries will result in a deepening of the active layer. Provided that the water pool depths are less than approximately 2 to 2.5 m, water accumulating within the quarries will freeze fully during winter, which will limit the degree to which the active layer may be deepened.

5.4.4.3 Primary Pathways

The following primary pathways are analyzed and classified in the effects assessment.

- **Physical loss or permanent alteration of terrain and soils within the AWAR footprint.**

Construction of the AWAR will be undertaken predominately during winter months to minimize impact to permafrost and to limit potential thaw-settlement due to permafrost degradation. The road fills will be placed directly over existing terrain, including soils and vegetation, without stripping or grubbing to avoid disturbance of the subgrade soils. Consequently, a measureable loss of terrain types will occur. A summary of the general terrain types that will be covered over during construction of the AWAR, and the approximate area loss for the map unit types within the maximum road footprint area are presented in Table 5.4.4-2.

Table 5.4.4-2: Summary of Terrain Types to be Covered by All-weather Access Road

Terrain Code[a]	Terrain Unit[a]	AREA (m^2)	AREA (ha)	Cumulative (ha)	Percentage of Total Area Covered by Maximum Road
1	Beach Ridge	3 122	0.31	0.31	1%
2A	Beach Deposit	24 648	2.46	4.36	13%
2B		5 662	0.57		
2C		2 724	0.27		
2D		6 957	0.70		
2E		3 617	0.36		
3A	Deltaic Terrace, Level, and/or Ridge, Plain	4 811	0.48	2.31	7%
3B		2 602	0.26		
3C		5 130	0.51		
3D		10 542	1.05		
4A	Marine Sediment and Washed Till	22 125	2.21	4.45	13%
4B		6 700	0.67		
4C		13 249	1.32		
4D		2 454	0.25		
5A	Blanket and Veneer of Washed Till	26 006	2.60	17.54	52%
5B		34 434	3.44		
5C		9 585	0.96		
5D		40 338	4.03		
5E		42 026	4.20		
5F		22 999	2.30		
7A	Fluvial Level and/or Terrace	652	0.07	0.42	1%
7B		3 540	0.35		
9A	Weathered Bedrock and Washed Till or Marine Sediments, Lesser Bedrock	2 210	0.22	0.22	1%
10	Weathered Bedrock and Washed Till or Marine Sediments, Minor Bedrock	16 017	1.60	1.60	5%
11	Bedrock and Weathered Bedrock	4 300	0.43	0.43	1%
12A	Washed Till and/or Marine Sediment, Weathered Bedrock	12 899	1.29	2.01	6%
12B		3 814	0.38		
12C		3 373	0.34		
LAKE	Lake	444	0.04	0.04	0%[b]
Total		**336 980**	**33.70**	**33.70**	**100%**

[a] Terrain codes and terrain units are described in detail in Appendix E-1 and E-2.

[b] These are small lake bodies filled over by road, not lake loss under bridges. These are shallow waterbodies that will freeze to bottom during winter, and so not considered high quality habitiat.

ha = hectare; m^2 = square metre

- **Physical loss or permanent alteration of terrain and soils within the quarried areas.**

Construction materials for the road will be quarried from sites along the proposed route. The quarries will be developed at semi-regular intervals along the proposed AWAR route to optimize haulage distances while minimizing the number of quarries to be developed. Currently, it is planned to excavate the quarries to a maximum depth of 3 m. Depending on the material types overlying the bedrock, and the requirements for road construction, it is possible that much of the terrain and soil types will not be suitable for road construction; consequently these materials will be stripped and spoiled. Some, or all, of the spoil materials may be used to partially backfill quarry areas after quarrying is complete.

Table 5.4.4-3 summarizes the approximate areas of disturbance for the currently planned quarries, along with the quantities of materials proposed to be quarried from each site.

Table 5.4.4-3: Approximate Areas of Disturbance for the Proposed Quarries

Quarry	Area (ha)	Primary Map Unit or Terrain Type Code
Rock Quarries		
R19	1.3	11, 3D, 6A
R11	7.6	10, 11, 12C, 5E, 5F
R14	2.6	10, 12A, 5A
R2	2.1	4A, 5C, 5E, 5F
R5	26.1	10, 11, 12A, 12C, 4A, 9A
Eskers, Till/Gravel Pits		
B19	0.8	3B, 3D, 7B
B15	1.8	4A, 5C
B13	2.1	10, 2A, 4A
B12	7.9	11, 2A, 2B, 2C, 2E, 5E, Lake
B11A	17.4	2A, 2B, 4A, 5B, 5C, 5E, 5F, Lake
B10	2.0	10, 11, 12C, 2A, 8, 9A
R350	3.1	
B6A	17.2	2A, 2B, 4A, 4B, 5A, 5B, 5C, 5D, 5E, 5F
B5	18.8	1, 5B, 5C, 5D, 5E, 5F
B1A	24.2	1, 4A, ,5A, 5B, 5D, 5F, 8, Lake
Total	**133.7**	

ha = hectare

5.4.5 Effects Summary

Effects to the terrain, including rock, soil, and permafrost, are anticipated to be confined to the narrow footprint area of the AWAR. The construction of the road will have minimal, but measureable, effects on the terrain in that soil and rock materials will be directly covered over. The rock and soil along the AWAR route will be covered by fill materials. The thickness of the fill materials is designed to preserve the underlying permafrost in areas of thaw-stable soils, and to promote the aggradation, or building, of permafrost into the road structure in areas of thaw-sensitive soils. Appropriate maintenance of the road during winter will minimize the depth of snow drifting and snow accumulation along the road edges in areas of thaw-sensitive materials. Culverts or French drains will be placed in topographically low areas where water may accumulate against the road fills, and may result in thaw settlement.

The development of quarries to provide suitable road construction materials will result in open excavations on the landscape. The quarries are currently planned to a depth of 3 m or less, and so will generally freeze to their base during winter. As a consequence, the active layer beneath the quarries may be depressed slightly. This is not expected to have a measureable impact on the environment. Where possible the quarries will be designed to promote drainage from the quarries so that no water accumulation occurs. Closure of the quarries may include some backfilling of spoiled material, and re-grading. Nevertheless, these will remain once the AWAR Project has been completed.

5.4.6 Uncertainty

Mapping Uncertainty

In some areas, because of the complexity of the landscape, the intermixing of different surficial material, and soil moisture conditions, and total differences among and across air photo flight lines, map unit designations for terrain and soil drainage conditions may appear somewhat arbitrary and may not be entirely consistent from place to place. As noted above, the stereoscopic interpretation utilized laser photocopies of the original air photos, consequently there would have been some loss of resolution. As a result, the air photo interpretation and terrain mapping is likely not as accurate as might have been achieved with original air photos.

Small inclusions (i.e., ≤10%) of materials or soil drainage classes, for example, well- or moderately well-drained beach sediments within a larger area of poorly- to imperfectly-drained wave washed materials are typically not delineated or identified in the map unit (polygon) symbol, even though they may be visible in the field and/or on air photos. Because of these limitations, it is likely that the reader will encounter surficial materials and soil drainage conditions other than those suggested by the mapping.

In most, but not all cases, terrain units occupying slightly less than 1 cm^2 (i.e., ≤one hectare at 1:10 000 scale) on the map are not delineated. Other apparent discrepancies may occur due to changing water levels in shallow ponds and lakes. For example, while not entirely consistent, water levels observed during the July 2009 fieldwork appeared to be slightly lower than those visible on the July 1997 air photos used for the terrain mapping and for the base map orthophoto. It also was noticed that visible changes in water levels were noted in some small ponds following 1 or 2 days of moderate rain.

Thermal Modeling Uncertainty

Uncertainty in the current characterization of permafrost terrain and in the evaluation of the thermal effects of road construction on permafrost include the following:

- reliance on tabulated thermal properties for materials assumed in the thermal analyses;
- uncertainty in future climate change; and
- uncertainty in terrain mapping using air photo interpretation.

The potential for climate change was not considered in the thermal analyses as the road design life is less than 20 years. It should be noted that the thermal analyses were conducted based on estimated material properties and a series of assumptions.

5.4.7 Monitoring and Follow-up

A monitoring plan is addressed in the Phase 1 AWAR Operation and Maintenance Manual (Appendix A). Monitoring of the performance of the AWAR will include annual inspections of the road surface, shoulders, culverts, and bridges. Due to the nature and purpose of the AWAR, the nature of the construction materials, and the conditions under which the road will be constructed, it is anticipated that maintenance over areas identified during the annual inspection will be required, and will be part of the general annual mine maintenance activities carried out by AEM.

5.4.8 References

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6.0 CULTURAL ENVIRONMENT

6.1 Archaeology

6.1.1 Purpose and Scope

This section presents the impact assessment on archaeological resources for the proposed Phase 1 All-weather Access Road (AWAR) Project (the AWAR Project). The field assessment included the local study area (LSA) consisting of a 1 kilometre (km) wide area centered on the proposed road centerline, which extends 23.8 km from the Char River bridge turn-off to the Meliadine West Advanced Exploration site. Archaeological resources are critical for understanding the history of Nunavut and are valued by community members. Archaeological sites in Nunavut are protected by the Nunavut Land Claim Agreement Section 33 and the Nunavut Archaeological and Paleontological Site Regulations, which were developed pursuant to the Nunavut Act (Government of Nunavut 2003).

The Nunavut Archaeological and Paleontological Site Regulations defines an archaeological artifact as “any tangible evidence of human activity that is more than 50 years old and in respect of which an unbroken chain of possession or regular pattern of usage cannot be demonstrated, and includes a Denesuline archaeological specimen referred to in section 40.4.9 of the Nunavut Land Claims Agreement”. An archaeological site is defined as “a site where an archaeological artifact is found”.

Baselines studies are to be completed in advance of development to verify that archaeological resources present are identified and properly managed or mitigated. Archaeological field investigations in Nunavut can only be conducted under a Nunavut Archaeologists Permit issued by the Department of Culture, Language, Elders and Youth. The Meliadine Gold Project to date has been assessed for effects on archaeological resources, under Nunavut Archaeologists Permit 2008- 003A and 2010-005A. Prior to the establishment of Nunavut, a Northwest Territories Archaeology Permit (98-876) was issued by the Prince of Wales Northern Heritage Centre in relation to the Meliadine Gold Project area.

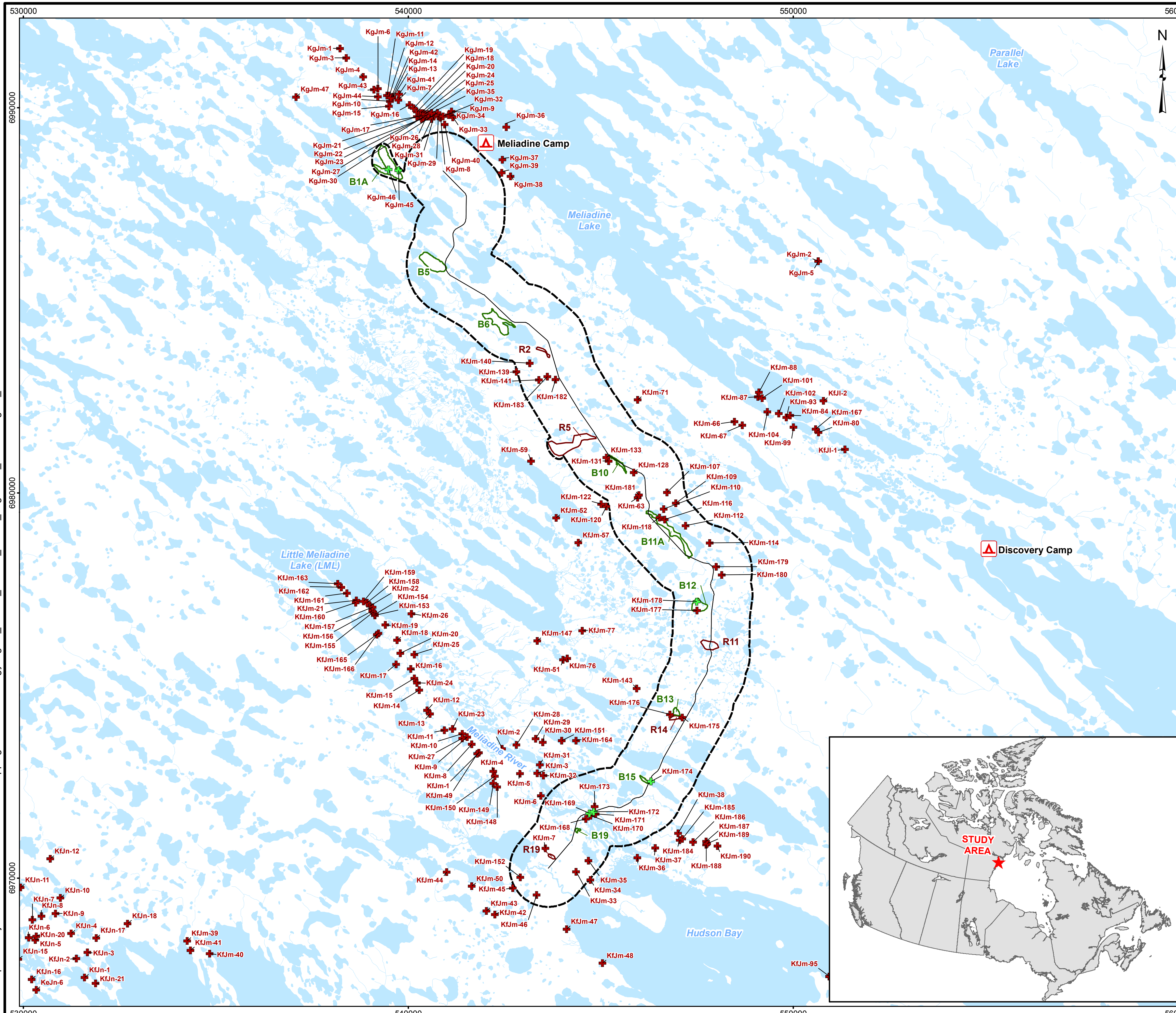
6.1.2 Study Area

General Setting

The AWAR Project area is situated in the eastern Barrenlands within a continuous zone of permafrost. The vegetation is classified as sub-arctic vegetation. The coastline predominately has low relief with occasional bedrock out crops and cliffs, which would influence prehistoric settlement pattern. The inland topography is flat and low lying and is predominately overlain by glacial depositions as well as marine sediments as the result of the postglacial Tyrrell Sea. Since deglaciation at approximately 9000 before present (B.P.), the area has been uplifting and the rising land provides a relative means to date archaeological sites located on these up-lifted features. Much of the study areas’ topography consists of an extensive esker system predominately located on the west side of Meliadine River.

6.1.3 Existing Environment

The proposed AWAR Project falls primarily on Inuit Own Land and the area was historically used by Caribou Inuit. The baseline research focused on the LSA but also included a regional study area (RSA) that focused on the areas north of Diana River and South of Meliadine Lake also referencing archaeological developments on the Barrenlands and within the larger geographic area of the Caribou Inuit. There are 33 sites within the LSA and 17 were recorded prior to the mine/exploration activity, and 16 sites were recorded as a result of archaeological investigations related to the Meliadine Gold Project (Figure 6.1.3-1).



LEGEND

- Camp
- Archaeological Site
- Archaeological Site (Mitigated)
- Local Study Area
- Borrow Area
- Rock Quarry
- Phase 1 AWAR Road Alignment
- Watercourse
- Waterbody

REFERENCE

Archaeological Sites obtained from the Government Nunavut Department of Culture, Language Elders and Youth. Base data obtained from Agnico-Eagle Mines Ltd (AEM).
Datum: NAD 83 Transverse Mercator Projection: UTM Zone 15

0 5
SCALE 1:100,000 KILOMETRES

PROJECT
AGNICO-EAGLE MINES LTD.
MELIADINE GOLD PROJECT
NUNAVUT

TITLE
PHASE 1 AWAR ROAD ALIGNMENT AND ARCHAEOLOGICAL SITES

Golder Associates
Greater Vancouver Office, B.C.

PROJECT NO. 10-1373-0076			FILE No.	
DESIGN	JR	26 Aug. 2011	SCALE AS SHOWN	REV. 0
GIS	AL	26 Aug. 2011		
CHECK	JR	16 Sep. 2011	FIGURE 6.1.3-1	
REVIEW	GRA	20 Sep. 2011		

N:\Bur-Graphics\Projects\2010\1373\10-1373-0076\Mapping\MXD\Archaeology\Figure_6.1.3-1_Phase1_AWAR_Alignment_Archaeological_Sites.mxd

Sites in the vicinity of the AWAR development were recorded using standard archaeological methods, recording site location, mapping, and photographing features.

6.1.3.1 Baseline Collection Methods

Procedures employed during the baseline studies were considered standard for projects of this nature in the region. The baseline studies include pre-field studies, field investigation, and recommendations for mitigation and formal reporting. Pre-field studies consisted of a review of existing archaeological data within the region, a review of available topographic and physical environmental data for the AWAR Project areas. These pre-field studies provided the cultural context for the AWAR Project and assisted in identifying key land forms with potential for archaeological features. Field investigations are designed based on the pre-field information, AWAR Project footprint, and development schedules. The pre-field studies and the field investigation, along with knowledge of the immediate and future infrastructure, provided the bases for recommendation for mitigation. These recommendations were provided to the Government of Nunavut and to AEM. Beyond just meeting the permit requirements, reports present the archaeological results and in situations where archaeological sites will be removed from the landscape as the result of AWAR Project development, the report was the ultimate stage of mitigation and pathway reduction. The report will ‘preserve’ the archaeological site data, which will not be left in situ and protected from disturbance. The archaeological data retained in reports are the bases for the development and interpretations of a regions’ pre-history.

6.1.3.2 Cultural Context

Pre-history

A brief outline of the regional culture history can be summarized as a result of the archaeological work completed in the region since the mid 20th Century. It should be observed that throughout the millennia, peoples who lived in the Barrenlands relied almost exclusively on caribou for subsistence. The annual migration patterns of these animals would dictate the seasonal round of the highly mobile hunting and gathering populations that inhabited the region.

Occupation of the Barrenlands of Nunavut began shortly after the recession of the glaciers approximately 9000 years B.P. The earliest recognized archaeological tradition is Northern Plano (8000 to 6500 B.P.), which is characterized by projectile points similar in form to Agate Basin points found in the plains of North America (Gordon 1996:219). These long lancelate points with tapered and ground bases were manufactured largely out of quartzite. Radiocarbon dates from the Migod site (KkLn 4) on Grant Lake suggest that Northern Plano dates from at least 8000 years BP (Gordon 1975). The concentration of Northern Plano materials on Grant Lake further suggest the Dubawnt and Thelon Rivers were major caribou migration corridors exploited by Northern Plano peoples (Gordon 1996:219).

Approximately 6500 years ago, Northern Plano evolved into Shield Archaic (6500 to 3500 B.P.) (Gordon 1996: 199). This cultural development coincided with a warming period that resulted in the expansion of the boreal forest as far north as Dubawnt Lake. Projectile points were also manufactured primarily out of quartzite, but differed from the preceding Northern Plano Tradition in that they were “side-notched lance heads with ground, rocker [convex] bases” (Gordon 1996:201).

The Shield Archaic Tradition was followed by the Pre-Dorset Tradition, which lasted from approximately 3450 to 2650 B.P. (Gordon 1996:149). Pre-Dorset is part of the Arctic Small Tool Tradition, well known in the high arctic. The migration of these early Pre-Inuit groups corresponded with a cooling trend that adversely affected maritime hunting. As a result, these arctic-adapted people were forced farther south in their quest for food. They were able to exploit migrating caribou herds on the Barrenlands as a result of the southward retreating forest edge. The Pre-Dorset Tradition is characterized archaeologically by very small, finely retouched tools manufactured from fine grained, banded chert. Distinct tools include end and side blades used for harpoons and arrows, burins, and microcores.

The Taltheilei Tradition is the latest precontact archaeological culture identified in the study area, and dates from approximately 2600 to 1200 B.P. (Gordon 1996). People representing this tradition moved into the region from the west after the preceding cooling period ended, and are generally regarded as ancestral Dene. The material culture of the Taltheilei Tradition is characterized by a continuum of lancelate and notched points, distinct discoidal hide-working tools known as chithos, and a variety of scraping tools. This archaeological culture has been divided into 3 Periods based on projectile point style, the Early Period (2600 to 1800 B.P.) characterized by long stemmed points, the Middle Period (1800 to 1300 B.P.) by unshouldered lancelate points, and the Late Period (1300 to 200 B.P.) by small side and corner-notched points (Gordon 1996).

During the 18th Century, Dene groups were decimated by European diseases and abandoned the Barrenlands in favour of the forests to the south to engage in the fur trade (Gordon 1996:51). As a result of this abandonment, the historic Caribou Inuit moved into the region approximately 200 years ago, either from the central arctic or the east coast of Hudson’s Bay (Burch 1979; Gordon 1996; Linnamae and Clark 1976). Their descendents have occupied much of the interior of Nunavut ever since, including the Kazan, Dubawnt, and lower Thelon drainage basins. The margins of these major rivers and lakes are dominated by Inuit sites, which are characterized by stone features including Inuksuit, tent rings, caches, hunting blinds, and kayak stands (Friesen 1989:4.7). The precontact origins of the Caribou Inuit ultimately lie in the Thule Tradition, which spread across the central and eastern arctic approximately 750 B.P.

In the 1950s the Canadian Government began a policy of settling the local Inuit into communities such as Baker Lake, Chesterfield Inlet, and Rankin Inlet (Stager 1977). Although year-round occupation of the Barrenland no longer occurs, seasonal caribou hunting and fishing are still important activities for local residents.

History

Early European exploration of the Barrenlands of what is now known as Nunavut began with the establishment of fur trade posts on the western shore of Hudson’s Bay in 1670. The most notable were the travels of Samuel Hearne from Fort Prince of Wales to the mouth of the Coppermine River between 1769 and 1772 (Tyrell 1911). However, the first scientific exploration of the Barrenlands would not occur until the expedition of James Tyrell of the Geological Survey of Canada (Tyrell 1898). In 1893, Tyrell travelled north from Lake Athabasca, eventually ascending the Dubawnt River to the Thelon River, then eastward through Aberdeen and Baker Lakes to Chesterfield Inlet. In 1900 Tyrell embarked on another expedition, this time travelling eastward from Great Slave Lake along a series of rivers and lakes to the Thelon River, then on to Chesterfield Inlet. David Hanbury (1900; 1903) also explored and mapped the rivers of the Barrenlands at the turn of the century in 2 separate expeditions. He travelled westward through the region by canoe in 1898-1899 from Chesterfield Inlet, along the Thelon River to Great Slave Lake. In the second expedition of 1901, he travelled eastward along a similar route, this time embarking from Great Slave Lake. In 1922, Knud Rasmussen entered the region as part of the Fifth Thule Expedition (Rasmussen 1926). Members of his party travelled inland from Chesterfield Inlet to Baker Lake, then south along the Kazan River to Yathkyed Lake to conduct geographic and ethnographic research.

One of the earliest archaeological assessments of the Nunavut Barrenland, however, began with artifact collections by the Moffat Canoe expedition of 1955 (Harp 1959). Members of the expedition travelled from Black Lake, Saskatchewan, along the Chipman and Dubawnt rivers to Baker Lake. In total, 9 archaeological sites were recorded along this route south of Aberdeen Lake. This expedition was followed by an archaeological survey conducted by Elmer Harp in 1958 along Beverly, Aberdeen, and Schultz lakes, as well as the lower Thelon River (Harp 1961). During this survey, 42 new sites were recorded. Harp proposed the first culture history of the region based on the data obtained from these sites. Subsequent research by Irving (1968) on the Upper Kazan River and in the North Henik and Dubawnt Lake areas would result in a revision of Harp's proposed cultural chronology.

Archaeological investigations continued in the western portion of the Barrenlands in the 1970s with more controlled excavations conducted at a number of sites first recorded by Harp. Wright (1972 a, b; 1976) excavated at the Aberdeen (LdLl 2) and Grant Lake (KkLn 2) sites, while Gordon (1976) conducted excavations at the Migod (KkLn 4) site located north of Dubawnt Lake. These multi-component sites were significant in further refining the continuum of precontact occupation in the region. Additional surveys also were conducted by Gordon (1974) in the vicinity of the Baker Lake settlement.

In the area around Rankin Inlet, archaeological assessments were conducted in 1975 by Urve Linnamae and Brenda Clark (1976), who recorded 29 sites. Additional areas were assessed in 1998 for WMC International Ltd. (WMC) at the Meliadine West Gold Project under Permit No. 98-876 by Elisa Hart (1998).

The heritage resource surveys by Linnamae and Clark were conducted between the Meliadine River and Meliadine Lake. Hart expanded the assessments in that area by surveying west and north of the Meliadine West Advanced Exploration site on the west side of Meliadine Lake, at the east and west quarry areas, and the winter roads. Twelve archaeological sites were located, and the sites recorded by Hart were subject to examination by elders from Rankin Inlet.

During these earlier studies, a combination of oral history and archaeology was used to interpret recent Inuit land use of the Rankin Inlet area. The local participation of the Elders Steering Committee and the provision of a member on the field team helped to identify dwellings, inuksuit, caches, hearths, kayak related structures, and other features.

The most recent heritage resource investigation conducted in the study area were undertaken in 2008 and 2010 and included the assessment of the AWAR Project road alignment and adjacent borrow source areas (Blower 2008; Murphy 2010).

Pre-field Studies

The pre-field studies started with a literature search relating to the cultural history of the AWAR Project area. A request to the Government of Nunavut for the archaeological site records related to the area between 62°00'N and 64°00'W and 90°00'W and 94°00'W was made. The search produced 314 recorded archaeological sites that temporally had a range from Pre-Dorset (~3500 B.P.) to recent times including Thule-Inuit and European sites. Of these sites, 17 were recorded within LSA prior to 2008. The review of the sites within the LSA and vicinity indicated that archaeological sites would most likely be situated on eskers and other elevated topographic features. The pre-field studies also highlighted unpublished archaeological reports specifically related to the archaeology of the AWAR Project area and would provide insight into the type of features which would be encountered in the AWAR Project area.

Field Investigations

Specifically related to the AWAR Project, 3 field investigations have been completed. These include Hart's 1998 investigation for WMC, Blower's 2008 road alignment survey, and Murphy's 2010 mitigation of archaeological sites proximal to the road alignment.

6.1.4 Methods

Three different archaeological impact assessments were completed by 3 archaeologists with different objectives, and the methods implemented each year varied slightly; however, all methods are consistent with modern archaeological impact assessment methodologies. In 1998, high potential areas were subject to a reconnaissance. Low potential areas were surveyed using helicopters and later in the season sites were mitigated. Test excavations were conducted at sites to determine the depth and extent of the cultural deposits.

During 2008, the LSA was subject to a reconnaissance using systematic low level helicopter over flights. The over flights covered the majority of the proposed borrow and quarry locations. In addition, 85% of the road alignment was subject to a walking reconnaissance; areas excluded from the walking reconnaissance had low archaeological potential. Potential was established during flyovers.

The 2010 field season included reconnaissance and mitigation work and, therefore, combined both types of standard field methodologies. Additional borrow sources and lay down areas were subject to a reconnaissance that included visual examination of surfaces and exposures contained within the proposed development areas for artifacts, including feature. Where sufficient vegetation ground cover was present, shovel testing would augment surficial examination. Mitigation occurred at sites that were within 30 m of the road right-of-way. An archaeological site's location, type, size, complexity, and individual features were documented. Test excavations were completed at sites to determine the depth and extent of the cultural deposits.

6.1.5 Pathway Analyses

In the context of this Environmental Assessment, all known and undiscovered archaeological sites are considered valued components (VC) and are protected under Federal legislation. The archaeological sites vary in their significance depending on their cultural, historical, or research (scientific) value. Alteration of the landscape can result in damage or complete destruction of archaeological sites unless steps are taken in advance to protect the resource and/or recover a sample of materials from the sites prior to impact. These alterations often involve displacement of artifacts resulting in the loss of valuable contextual information or may result in the complete destruction of artifacts and features leading to complete loss of data. Thus, any activity with the potential to cause ground disturbance may affect archaeological resources. The archaeological resources component of the EA focuses on the AWAR Project activities that have potential to cause ground disturbance, thereby having the potential to affect archaeological resources.

6.1.5.1 Methods

Pathway analysis identifies the linkages between AWAR Project activities and their potential effects on archaeological sites. A pathway analysis was completed for archaeological sites for AWAR Project-related pathways. The first step of the analysis identifies the potential pathways. This was followed by a summary of mitigation practices or design features that remove the pathway or limit the effects on archaeological sites. Knowledge of these possible mitigation strategies is then applied to the pathways to determine whether the pathways are no linkage, secondary, or primary. Each potential pathway is evaluated to determine if it could lead to ground disturbance that could directly or indirectly affect archaeological sites.

6.1.5.2 Mitigation

Mitigation refers to the practices taken to reduce or avoid damage to archaeological sites. Site avoidance and information recovery are the 2 main mitigation options applied to archaeological resources. The first option includes alteration of AWAR Project design features to avoid a negative effect. In this case, the locations of archaeological sites would be taken into consideration at the design stage of the AWAR Project to minimize potential conflicts. The distance created by alteration of AWAR Project design between an AWAR Project activity and an archaeological site can reduce the pathway assessment from a primary linkage to a no linkage pathway.

The second option applies archaeological field methods to activity reduce a negative effect. In this case, it usually refers to mitigative excavations designed to gather data so that sites can be reported on in detail, thereby limiting knowledge loss. Mitigation design features and practices incorporated into the AWAR Project to remove or limit effects to heritage resource sites are listed in Table 6.1.5-1. The effects that remain after mitigation are referred to as residual effects.

Table 6.1.5-1: Potential Pathways for Effects to the Archaeological Resources

Project Component/ Activity	Effects Pathways	Environmental Design Features	Pathway Assessment
Proposed Quarry and Borrow Source, and the Phase 1 AWAR Footprint	Construction activity leading to ground disturbance that affects physical archaeological resources	Complete archaeological assessment for the Phase 1 AWAR footprint. During route selection, avoid as many as possible of the previously recorded archaeological resource sites. 16 known archaeological sites were avoided during route selection	No Linkage
Proposed Quarry and Borrow Source, and the Phase 1 AWAR Footprint	Construction activity leading to ground disturbance that affects physical archaeological resources	Complete archaeological assessment for areas within Phase 1 AWAR footprint. Provide awareness training and a manual for recognizing archaeological resources to construction crews. Avoid previously recorded archaeological resource sites. Complete additional archaeological assessment for any changes to Phase 1 AWAR footprint in areas considered to have moderate to high potential to contain archaeological resources. Monitor condition of known heritage resource sites near the Phase 1 AWAR footprint. Complete more in-depth mitigation strategies if an avoidance mitigation strategy cannot be implemented.	Secondary

6.1.5.3 Results

The AWAR Project environmental effects occur when there is a pathway between an AWAR Project component/activity and a VC (archaeological site). Each pathway was evaluated to determine if it could lead to a change in environment (ground disturbance) that could affect an archaeological site. Environmental effects from some pathways may be reduced or eliminated through mitigation. Pathway validation is the process of screening each pathway to assess its expected contribution to the overall AWAR Project's residual effects on VCs after mitigation. In the pathway validation step, knowledge of the mitigation practices or mitigation design features is considered to assess how each pathway is affected by mitigation, and how residual effects may be reduced. Some pathways may not be affected by mitigation, while others may be reduced or eliminated. Each potential pathway is evaluated and characterized as follows:

- A no linkage pathway is a pathway that does not exist. In this case, the pathway was found to not have a connection to a VC; therefore, the project causes no detectable (measurable) residual effect relative to baseline values.
- A secondary pathway is a pathway where mitigation measures result in minor changes from baseline or guideline values. A secondary pathway has a negligible residual effect, but is not considered significant. In the case of archaeological sites, this would occur when very few archaeological sites or only archaeological sites of low significance are affected by the AWAR Project.
- A primary pathway is a pathway that contributes to residual effects on archaeological sites.

No linkage, secondary, or primary pathways are determined using scientific knowledge, and experience with similar developments. No linkage and secondary pathways have no, to negligible effects on the environment and therefore, are not carried forward into the effects assessment. A pathway is categorized as primary if a more detailed analysis is required to assess the effects. Residual effects assessment and classification would be required if a pathway is identified as primary.

The AWAR Project activities identified for the AWAR for archaeological sites include proposed borrow source locations and the proposed AWAR route, including the 30 m buffer required by the *Territorial Land Act*. The effects pathways include construction activity leading to ground disturbance that affects archaeological sites (Table 6.1.5-1).

6.1.5.4 Pathways with No Linkage

The following archaeological sites (Table 6.1.5-2) were avoided during the route selection for the AWAR, so are not expected to be affected because the activities from the AWAR Project construction will be located away from the archaeology site.

Table 6.1.5-2: Archaeology Sites With No Predicted Environmental Effects

Borden Number	Site Type/ Culture	Significance	Pathway	No Linkage
KfJm-7	Campsite/undetermined	Low	Proposed AWAR	site far from final ROW
KfJm-38	Undetermined	Low	Proposed AWAR	site far from final ROW
KfJm-63	Campsite/ Dorset	High	Proposed AWAR	site far from final ROW
KfJm-80	Campsite/undetermined	Low-Mod	Proposed AWAR	site far from final ROW
KfJm-107	Undetermined	Low	Proposed AWAR	site far from final ROW
KfJm-109	Undetermined	Low	Proposed AWAR	site far from final ROW
KfJm-110	Campsite/undetermined	Moderate	Proposed AWAR	site far from final ROW
KfJm-112	Undetermined	Low	Proposed AWAR	site far from final ROW
KfJm-114	Undetermined	Low	Proposed AWAR	site far from final ROW
KfJm-139	Undetermined	Low	Proposed AWAR	site far from final ROW
KfJm-140	Undetermined	Low	Proposed AWAR	site far from final ROW
KfJm-141	Cache/undetermined	Low	Proposed AWAR	site far from final ROW
KfJm-176	Caches/prehistoric, Indigenous historic	Low	Proposed Borrow source B13	site outside source
KfJm-180	Inukshuk/prehistoric	Moderate	Proposed AWAR	site far from final ROW
KfJm-181	Inukshuk/prehistoric	Low	Proposed AWAR	site far from final ROW
KfJm-183	Campsite/prehistoric	Low-Mod	Proposed AWAR	site far from final ROW

Note: Archaeological site data predating 2008 were obtained from the Government of Nunavut.
ROW = right-of-way

As these archaeological sites are located well away from the footprint of the AWAR and would not be affected by the AWAR Project, the linkage between project activities and the VC is broken, so the pathway is considered to be a no linkage pathway.

6.1.5.5 Secondary Pathways

A pathway may be classified as secondary if environmental design features (mitigation) result in only a minor change or reduce the risk of changes from baseline or guideline values. A secondary pathway has a negligible residual effect and the residual effects are not considered significant. As a result of the effects analysis, the effects pathways between AWAR Project related activities and the effects on archaeological resources that were located close to or within the AWAR Project footprint were identified as secondary pathways.

Two different environmental design features (scientific documentation and avoidance) were applied to the archaeological sites close to the 30 m buffer. Scientific documentation was done at 9 archaeological sites (Table 6.1.5-3). These sites could not be avoided and construction will displace these sites.

Avoidance is the environmental design feature that will be applied to 11 archaeological sites (Table 6.1.5-4). These sites are located close enough to the AWAR that during the construction of the road and use of the borrow sources/rock quarries that these sites are located in, will be actively avoided (e.g., 30 m buffer staked around them so they will not be disturbed during construction). Both awareness training and the implementation of a monitoring plan to verify compliance with an active avoidance strategy will assist in the success of this environmental design feature.

Table 6.1.5-3: Archaeological Sites Associated with Scientific documentation as an Environmental Design Feature

Borden Number	Site Type/ Culture	Significance	Pathway	Environmental Design Feature
KgJm-45	Campsite/Indigenous historic	Low	Proposed Borrow Source B1	Scientific documentation
KgJm-46	Campsite/Indigenous historic	Low	Proposed Borrow Source B1	Scientific documentation
KfJm-169	Fox traps/undetermined	Moderate	Proposed AWAR	Scientific documentation
KfJm-171[a]	Campsite/prehistoric	Moderate	Proposed AWAR	Scientific documentation
KfJm-172	Fox trap, Campsite 2 tent rings/prehistoric	Low	within right-of-way	Scientific documentation
KfJm-174	Marker/prehistoric, Indigenous historic	Low	Proposed Borrow Source B15	Scientific documentation
KfJm-175	Inuksuit, caches, Fox traps /prehistoric, Indigenous historic	Moderate	Proposed Borrow Source R14	Scientific documentation
KfJm-177	Markers/prehistoric, Indigenous historic	Low	Proposed Borrow Source B12	Scientific documentation
KfJm-178	Flakes/prehistoric	Moderate	Proposed Borrow Source B12	Scientific documentation

Note: Archaeological site data predating 2008 were obtained from the Government of Nunavut.

[a] Only some features associated with KfJm-171 were mitigated by field mapping, photo documentation, and partial feature excavation. The reminding features are being mitigated by active avoidance.

Table 6.1.5-4: Archaeological Sites Associated with avoidance as an Environmental Design Feature

Borden Number	Site Type/Culture	Significance	Pathway	Environmental Design Feature
KfJm-116	Cache, hearth/undetermined	Low	Proposed Borrow Source B11A	Avoidance during construction
KfJm-118	Cache, hearth/undetermined	Low	Proposed Borrow Source B11A	Avoidance during construction
KfJm-128	Undetermined	Low	Proposed AWAR	Avoidance during construction
KfJm-131	Undetermined	Low	Proposed AWAR	Avoidance during construction
KfJm-133	Undetermined	Low	Proposed AWAR	Avoidance during construction
KfJm-168	Campsite/prehistoric	Moderate	Proposed AWAR	Avoidance during construction
KfJm-170	Campsite/prehistoric	Moderate	Proposed AWAR	Avoidance during construction
KfJm-173	Marker/prehistoric, Indigenous historic	Low	Proposed AWAR	Avoidance during construction
KfJm-171	Campsite/prehistoric	Moderate	Proposed AWAR	Remaining features will be avoided during construction
KfJm-179	Campsite/prehistoric	Moderate	Proposed AWAR	Avoidance during construction
KfJm-182	Tent Ring/prehistoric	Low	Proposed AWAR	Avoidance during construction

Note: Archaeological site data predating 2008 were obtained from the Government of Nunavut.

6.1.5.6 Primary Pathways

No pathways were considered to be primary pathways since the sites in the LSA will either not be effected by a pathway, the sites will be avoided during construction, or they have been scientifically documented.

6.1.6 Effects to Archaeological Sites

The AWAR Project activities affect very few archaeological sites or only archaeological sites of low to moderate significance. The AWAR Project will have a limited effect on the local archaeological sites, as most have been avoided during initial route and borrow/quarry selection, or through active avoidance, or through scientific documentation. The baseline studies have contributed proportionately more to the knowledge of prehistoric and historic use of the area than the road construction will affect.

6.1.6.1 Residual Impact Classification and Significance

No residual impact classification was completed, as no long-term primary pathways were identified for archaeological sites. Only no linkage and secondary pathways where identified for archaeological resources, resulting in negligible effects to archaeological resources.

6.1.7 Uncertainty

It is evident from the archaeological history of the AWAR Project area, which any one archaeological survey may miss sites or features, or natural features may be mistaken for cultural features. The 1975 field work recorded KfJm-63 but missed Kfjm-181, which is only 125 m away and was recorded in 2008. In 2010, an additional feature was identified at KfJm-171, which was not identified in 2008. The feature count at KgJm-45 was reduced from 7 to 5 after excavation. Uncertainties are reduced by the number of archaeological assessments that are conducted in the area and the implementation of a monitoring plan. In addition to the 1973 and 1975 field programs, which were unrelated to the AWAR Project, at least portions of the AWAR Project activity areas have been subject to an archaeological assessment 3 times, thereby reducing the chance that sites or features have been missed.

6.1.8 Monitoring

Archaeological sites will be removed from the landscape owing to AWAR Project construction activities. Key environmental design features were implemented to reduce the potential for significant affects on archaeological resources. To reduce the chances of archaeological sites being accidentally damaged, an education and monitoring plan will be prepared (Appendix G). An archaeological awareness training manual will be provided to all AWAR Project staff. The training provides basic information regarding what archaeological resources in the LSA look like, that these resources are protected by law, and what actions need to be taken should AWAR Project activities come in to conflict with an archaeological site. In situations where the environmental design feature is avoidance, periodic site monitoring, by a permit archaeologist, will be required for the duration of the AWAR Project.

Should previously unrecorded archaeological sites be identified during road construction, borrow source use, or maintenance, the following steps will be taken:

- all construction activity in the vicinity of the site will stop;
- the AWAR Project archaeologist and the Territorial Archaeologist will be contacted;

- based on details provided by the AWAR Project archaeologist, the Territorial Archaeologist will consult with the Inuit Heritage Trust and local community to establish a mitigation plan. It should be noted, that should the remains be Human remains the Royal Canadian Mounted Police must be contacted and steps as outlined in the Nunavut's Human Remain Policy will be invoked; and
- the mitigation plan will be implemented at the cost of AEM.

6.1.9 References

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6.2 Inuit Qaujimajatuqangit

6.2.1 Purpose and Scope

The purpose of this Inuit Qaujimajatuqangit (IQ) section, as it relates to Traditional Land Use (TLU), is to provide information to assess potential pathways for TLU effects as they relate to the Phase 1-Meliadine All-weather Access Road Project (the AWAR Project), managed by Agnico-Eagle Mines Limited (AEM). Potential Pathways for TLU are listed in Table 6.2.1-1. This section assumes that the assessment of potential effects of the AWAR Project on traditional activities relates to the effects of the AWAR Project on the underlying resources required for those traditional activities. Detailed discussions of potential AWAR Project effects on the underlying resources used for traditional activities are found in the respective assessments as follows:

- Fish and Aquatic Habitat (Section 5.2);
- Wildlife (Section 5.3); and
- Vegetation (Section 5.3).

This section provides a summary of the literature review results relating to the AWAR Project regional study area (RSA) and local study area (LSA). This section also refers to the assessment results of other disciplines relevant to TLU, and associated monitoring and mitigation plans.

Table 6.2.1-1: Potential Pathways for Traditional Land Use Effects

Project Component/ Activity	Effect Pathways	Design Features and Mitigation	Pathway Assessment
General construction and operation of the all-weather access road	The AWAR Project may affect access for traditional activities.	Refer to Section 6.2.6.1	Primary
	The AWAR Project may affect traditional activities as related to the underlying resources.	Refer to Section 6.2.6.1	Secondary

6.2.2 Study Area

General Setting

For the purposes of describing TLU within this report, 2 study areas were defined, a TLU RSA and a TLU LSA. The TLU RSA is based on the Terrestrial Resources RSA (Section 5.3.2.2). Typically, the TLU RSA includes lands used to harvest traditional resources including wildlife and vegetation. It may also include areas of spiritual or historical significance based on oral tradition. Within this report, discussion pertaining to regional level TLU derived from the literature review overlaps, but may not be limited to, the RSA as specified in the Terrestrial Section. This is because TLU sources often describe aspects of wildlife (e.g., caribou) within a much larger geographical context (e.g., large migration patterns). For this reason, some of the baseline information presented below may relate to areas outside the RSA. The LSA is based on the AWAR Project footprint and buffer as described in the Terrestrial Section (Section 5.3.2.3, Figure 5.3.2-1).

6.2.3 Traditional Knowledge Program

6.2.3.1 Program Strategy and Status of Program

In 2010, AEM arranged to contract an Inuit-owned company in Rankin Inlet to undertake traditional knowledge (IQ) studies in Rankin Inlet, Whale Cove, and Chesterfield Inlet. At the time of this report, results were unavailable. When the results of the studies become available, they will be considered in AWAR Project planning.

6.2.3.2 Regional Traditional Knowledge Summary from Secondary Sources

6.2.3.2.1 Inuit Land Use and Occupancy Project

The Inuit Land Use and Occupancy Project (INAC 1976) collected TLU knowledge for northern Canada during 3 distinct chronological periods. This report summarizes the TLU knowledge for the South and North-East Keewatin Coast during Periods II (generally the early-mid 1900s), and Period III (mid 1900s-1974).

Period II

South Keewatin Coast (Whale Cover and Rankin Inlet) (1924-1959)

Winter Land Use

> Many of the Inuit people of the South Keewatin Coast, including those from Whale Cove and Rankin Inlet, wintered inland. Many lived near traplines in seal oil-heated snow houses. Caches stocked with caribou meat from the previous fall hunting season were located near inland traplines and provided the majority of the winter food supply. If food supplies ran low, ice fishing and additional caribou hunting were undertaken to supplement the Inuit diet. The Inuit who remained on the coast for the winter hunted seals and eider ducks at the flow edge (INAC 1976).
>
> Fox trapping (both arctic and coloured) was the primary occupation for the Inuit during the winter. Traps would be laid near food caches in stretches as long as 160 km. While the entire region was extensively trapped, the areas surrounding Seal, Hyde, Camp, Maguse, and Kaminak lakes, and the McConnell, Wilson, and Ferguson rivers were particularly popular. The traplines were also used as hunting routes in the winter months. Caribou, Arctic hare, ptarmigans, wolves, and wolverine were hunted when encountered during trapline checks, with both wolves and wolverines being particularly valued for their pelts (INAC 1976).

Spring and Summer Land Use

> During the early spring, the people of the Southern Keewatin Coast would supplement their food supplies through ice fishing. Between mid-May and early June, families would travel down river valleys to the sea coast where they would begin hunting seals in birth lairs, on the open ice, and at the floe edge. While seals were an important source of food for the Inuit, their fat and oil was the most important resource collected, being used later to heat and light the inland snow houses during the winter months. Ducks and both snow and Canada geese were also hunted in the spring. Goose and duck eggs were also harvested in the spring, with McConnell River being a particularly popular collection area (INAC 1976).
>
> During the ice break-up in June and July, canoes were used to hunt seals along the coast and in many harbours. Walrus were also hunted from large Peterhead boats along the northern coast near Rankin Inlet and Walrus Island. White (Beluga) whales migrated from southern waters in the summer, and were hunted

along the entire Keewatin coast, particularly at the mouths of rivers such as the Tha-anne, Thlewiaza, and Maguse rivers. The skin of the whales was valued as a delicacy; whereas the meat and fat was cached for winter dog food and trap bait (INAC 1976).

During late July and August, caribou would migrate to the seashore to avoid the inland insects. Here they were hunted from canoes by the Inuit. Late summer was also a time for the netting of Arctic char (INAC 1976).

Fall Land Use

Caribou hunting began in earnest during the fall. Camps were set at narrow river and lake crossings in anticipation of the southward caribou migration. Caribou were speared from kayaks as they swam at crossings such as Kaminak and Maguse lakes, and on the McConnell, Tha-anne, Thlewiaza, and Maguse rivers. Caribou meat was harvested and cached for the winter to come, and the skins were processed for clothing. While Inuit men hunted caribou, women would fish for char, whitefish, and lake trout. Occasionally, polar bears would also be hunted before the freezing-over of the sea ice (INAC 1976).

North-East Keewatin Coast (Chesterfield Inlet) (1912-1954)

Winter Land Use

Similar to the people of the Southern Keewatin Coast, the Inuit of the North-East Keewatin Coast subsided off of cache caribou and dried fish during the winter months. Seal oil was a less important fuel along the north-eastern coast, being supplemented with caribou fat (INAC 1976).

Trapping was the predominant winter activity on the north coast, with traps being set in arctic fox dens near caches. The bounds of the intensive trapping area of the north-eastern coastal peoples were 95 to 125 km both north and south of Chesterfield Inlet. Wolves and wolverines were actively hunted in the area due to their tendency to interfere with both food caches and traps in the area. The pelts of both species were considered valuable and were often traded during the spring and summer months. Arctic hare and ptarmigan were other notable species that provided additional sustenance during the winter months. Both were hunted near Inuit campsites (INAC 1976).

Spring and Summer Land Use

Similar to the practice in the more southerly regions of the Keewatin Coast, early spring ice fishing was an important source of food. Before the snow melted in late spring, families would begin to move toward Chesterfield Inlet down the Quoich River to St. Claire Falls, or to Cross Bay or Barbour Bay. Many people went to Chesterfield Inlet to trade or to hunt seals. Young seals were hunted in their lairs, while older seals were caught while basking on the ice. As the birds returned in the spring, ducks and geese were harvested, and eggs were collected. This was also the time that Arctic char began their downstream run, providing yet another source of food. The rivers flowing into Barbour Bay and Gibson and McManama lakes were known to be good char fishing areas in the spring (INAC 1976).

Summers were spent along the shores of Chesterfield Inlet, Cross and Barbour Bays, and on Hudson Bay. Seal harvesting continued, and, as in the southern regions, the hunting of migrating white whales occurred. Walrus were hunted in Hudson Bay and brought back to Chesterfield Inlet where they were cached for winter dog food. During the late summer, the Arctic char began their upstream migration, once again acting as an important food source (INAC 1976).

Fall Land Use

As with the more southerly Keewatin coastal people, fall marked the move inland for the north-eastern Inuit. Here, caribou were hunted for meat and for hides. Fall camps were usually located near lakes to facilitate ice fishing. Caribou meat and frozen or dried fish were cached in preparation of the winter months ahead, and the North-Eastern Keewatin Coast Inuit prepared for the winter trapping of the months to come (INAC 1976).

Period III

Whale Cove (1956-1974)

Except for a few persons employed by the government or the local collective, most families in Whale cove were still largely dependant on the land and sea for a living. Caribou, seals, fish, and other game animals (i.e., arctic hare and ptarmigans) still comprised a major part of the Inuit diet. The entirety of the coast was used for hunting sea mammals (excluding the now scarce walrus), while caribou hunting and trapping was generally carried out within 160 km radius of the community, with the areas of highest intensity use being within 80 to 115 km of the community. The most important rivers for hunting and trapping were the Ferguson and Wilson rivers (INAC 1976).

Spring camps were set up at many locations along the Keewatin Coast and on offshore islands near Whale cove, where hunting, egg gathering, and fishing occurred throughout the summer. As fall came, polar bears were hunted before the sea ice freeze-up from Bibby Island to Pork Peninsula. With the onset of winter, trapping began again (INAC 1976).

Rankin Inlet (1956-1974)

During the late-mid 20th century, most people living in Rankin Inlet had wage-labour jobs or were in primary or secondary school during the winter months. Recreation thus became an increasingly important endeavour. In spring and summer, many families would camp inland. The most important camping areas were Meliadine and Dianna lakes, the Meliadine and Dianna rivers, Scarab point, Baker Foreland, the Falstaff Islands area, Pangertot Peninsula, Corbett Inlet, and Pistol Bay (INAC 1976).

During summer camping, people would gather berries, fish, and eggs near their campsites. Hunting was limited to periods of vacation, or days off work. While the lifestyles of the people of Rankin Inlet became increasingly less traditional, caribou, seals, and fish still made up a large part of the Inuit diet (INAC 1976).

Chesterfield Inlet (1954-1974)

Compared to the other Keewatin peoples, those of Chesterfield Inlet used a small area of land for traditional pursuits. The traditional land use area of the Chesterfield Inlet Inuit extended 50 to 65 km south, 65 to 80 km west, 95 to 110 km northwest, and 110 to 130 km north of the community. This was largely due to the fact that a sufficient supply of game was to be found in close proximity to the community, and that the sharing of harvests was common among community members (INAC 1976).

As in Rankin Inlet, wage-labour jobs were the primary means of support in the community. Most of the Chesterfield people did not depend on trapping as a means of support during this period, and used it rather as a way to supplement wage-labour incomes. Caribou, arctic hare, bird, and seal hunting were still important for providing sustenance in this period. Hunting was, however, largely limited to days off, or while on vacation (INAC 1976).

6.2.3.2.2 Nunavut Atlas

The Nunavut Atlas (CCI and TFN 1992) collected TLU knowledge through interviews in the late 1980s and early 1990s and reported the knowledge both cartographically and textually. This report summarizes the TLU knowledge for the communities of Whale Cove, Rankin Inlet, Chesterfield Inlet, and the region surrounding these communities.

Whale Cove

Both the coast and the area offshore were used intensively year-round by the people of Whale Cove. During the winter, seals would be hunted at the floe edge. During the spring, after the ice break-up, the area was heavily fished for Arctic char and trout. Ducks and geese were hunted, and eggs were harvested in the spring and summer along the shore from Mistake Bay to Rankin Inlet. Summer was also the time for white whale hunting off the southern Keewatin coast. As summer transitioned into fall, polar bears were hunted from Morso Island north to Rankin Inlet. During the winter, families would camp inland to begin fox trapping and caribou hunting (CCI and TFN 1992).

Rankin Inlet

The seasonal land use of the Rankin Inlet Inuit was very similar to that of Whale Cove. The coastal and offshore areas were used intensively year round, with seals being harvested on the sea ice in spring, ducks, geese and eggs harvested on the shore, white whales fished in the open summer waters, and polar bears hunted on the fall sea ice. Ringed and Bearded seals were commonly found at the freshwater heads of bays in the spring and summer, while polar bears were commonly hunted on the Pangertot Peninsula in the late fall and winter. In the early winter, inland base camps were established to facilitate winter trapping and caribou hunting. Wolves were also hunted at the time, but typically only when encountered on a trapline (CCI and TFN 1992).

Chesterfield Inlet

The coast was an important resource base for the people of the North-East Keewatin Coast as well. Like the more southerly Inuit, the people of Chesterfield Inlet camped along the coast in the spring and summer, harvesting ducks, geese, and eggs in the spring, white whales in the summer, and polar bears in the winter. Ringed and bearded seals were hunted year-round by the people of Chesterfield inlet. Caribou hunting also occurred year round due to the migration of barren-ground caribou to the shore during the summer months. The offshore islands to the north of the community were important areas for fishing and sea bird hunting. Winter trapping continued to be less important for the people of Chesterfield Inlet than the more southerly Keewatin Inuit; however, caribou hunting still took place (CCI and TFN 1992).

6.2.3.3 Local Study Area Traditional Knowledge Summary from Secondary Sources

6.2.3.3.1 Nunavut Atlas

Information presented in the Nunavut Atlas indicates that the AWAR Project is in an area of high intensity use, including fishing, arctic fox trapping, and caribou and wolf hunting. The area was reported by Inuit hunters to be both a nesting habitat for raptors, such as the peregrine falcon and the roughlegged hawk, and the tundra wintering range for the Kaminuriak caribou herd. Both campsites and archaeological sites were noted as being nearby (CCI and TFN 1992).

6.2.3.3.2 Meliadine West Gold Project – Traditional Ecological Knowledge Report

The initial Traditional Ecological Knowledge report for the Meliadine West Gold Project (Nanuk Enterprises 1999) was conducted in 1999. Interviews with elders focused on traditional land use, past and present, and on the concerns of the local people regarding mining developments. This report describes the traditional land uses during the time at which the Traditional Ecological Knowledge report was written.

Traditional Land Use in the Rankin Inlet Area

The Meliadine West Gold Project Traditional Ecological Knowledge report (Nanuk Enterprises 1999) indicated that hunting and fishing were still important traditional pursuits in the Rankin Inlet area (extending towards Meliadine Lake). Caribou meat was still an important part of the Inuit diet, and skins were still valued for the production of warm clothing. Caribou were plentiful near Rankin Inlet during this time, and would migrate through the Meliadine area. The introduction of motorized vehicles allowed for swift access to caribou herds. This made weekend hunting trips feasible and complimentary to the growing wage-labour economy in the area. Motorized vehicles also allowed hunters to transport more meat back to the community, making the practice of caching less prevalent.

Traplines still exist throughout the larger region (including the LSA); however, their use was not as intense as in the past. Arctic foxes were still abundant in the area, and were still the primary species harvested by those trappers still active. Domestic fishing was still an important part of the Inuit lifeway, accounting for as much as 20% of the diet of the residents of Rankin and Chesterfield inlets. Most of the lakes in the Meliadine area were fished for lake trout and Arctic char.

Cabins were still used by the people of Rankin Inlet, one of which is potentially located in the LSA, but not overlapping the AWAR Project footprint. During the May and September fish runs, cabins would provide a base from which families could fish on the weekends. Cabins were never locked, and could be used by any who needed them during emergency situations. Motorized vehicles were used to reach cabins, with dog teams being used only for tourism and racing purposes.

6.2.4 Access

As stated in AEM's Operation and Maintenance Manual (Appendix A), the AWAR Project will be operated as a privately operated road with access controlled by a gate to be sited at the southern end of the road. The gate will be staffed by AEM on a 24 hour basis when weather permits. The proposed AWAR Project overlaps an existing ATV and snowmobile trails which is currently used as access to traditional activities, such as hunting, fishing, and recreation in the Meliadine Lake area. There are numerous cabins around Meliadine Lake that are used year round by residents of Rankin Inlet. The construction of the AWAR cannot block or alter the current access that residents of Rankin Inlet have to this area.

Since AEM will only control traffic turning onto the AWAR and will have no effect or control over traffic driving on the existing municipal road that continues on past the Char River, a system to enhance safe use of the AWAR will be implemented for both AEM and non-AEM traffic, prior to construction. All Inuit have rights of access to these Inuit Owned Lands, and thus, the construction of the AWAR cannot block or alter this type of access, so it would be better to devise systems to enhance safe use of the AWAR by both AEM and Inuit Beneficiaries.

6.2.5 Integration of Traditional Knowledge

6.2.5.1 Contribution to Project Design

Results of the IQ studies initiated in January 2010 will be used to inform the design of environmental monitoring programs and operational features of the AWAR Project. In addition, AEM has undertaken consultations in the communities related to the proposed AWAR Project. A summary on AEM's consultations relating to the AWAR can be found in Table 6.2.5-1.

Table 6.2.5-1: AEM Consultation on the All-weather Access Road

Date	Place	Parties Present and Subjects of Meeting
21/10/2004	Rankin Inlet	Presentation on project status to KIA Board of Directors with a request for a proposal of motion to support a future road from Rankin to the Tiriganiaq deposit site.
26/03/07	Chesterfield Inlet	Presentation to the KIA Board of Directors on the proposed underground program and 2007 Meliadine West Exploration plans. Verbal Motion of Support from the Board.
27/03/07	Rankin Inlet	Presentation of the proposed 2007 Meliadine West Exploration program to the Rankin Inlet CLARC.
28/03/07	Rankin Inlet	Presentation of the proposed 2007 Meliadine West Exploration program to the Kivalliq Chamber of Commerce.
28/03/07	Rankin Inlet	Town hall meeting - presentation of the proposed 2007 Meliadine West Exploration program.
04/07/07	Rankin Inlet	Briefing on project Status to Hamlet Council with specific discussions on road alignment and overwinter fuel storage in barge.
04/07/07	Rankin Inlet	Elders Luncheon at Nunavut Arctic College. Project Overview and Immediate Project Plans for underground exploration was presented by Mark Balog with a PPT slide show. Issues that were raised included the following: ■ employment opportunities for young people; ■ all-season road location and utility for other projects; and ■ soapstone from Newfoundland. Attendees: Hamlet Elders including Mr/Mrs Tatty, Mr/Mrs. Itinuar, Mr/Mrs Kabvitok, Mrs. Pissuk, others. Comaplex Minerals: Mark Balog, Ben Hubert. Arranged by John Hickes
6-8/05/09	Rankin Inlet	Multidisciplinary Advisory Group chairs be Bernie MacIssac, INAC: all regulatory groups in attendance. Presented the Project and All-Weather Road to regulators. Met regulators who will work on Project, including Jackson Lindell and Stephen Hartman, KIA, and Keith Morrison and Jorgan Aitaok, NTI.

Table 6.2.5-1: AEM Consultation on the All-weather Access Road (continued)

Date	Place	Parties Present and Subjects of Meeting
17/06/2009	Rankin Inlet	Meeting with Manager CED (Robert Connelly) and Nunavut Transport (Alan Johnson) regarding proposal to access federal infrastructure money for the Meliadine River bridge and Comaplex fund the road. Visit to the bridge site.
18/06/2009	Rankin Inlet	Discussion with Rankin mayor John Hickes, the SAO, and several council member. Project update and proposed application for road and bridge funding.
01/06/2010	Chesterfield Inlet	Mark Balog & John Witteman, Comaplex sponsored a town hall meeting providing an update on the Project and the building of an All-Weather Road. The road would link to the planned road to Chesterfield Inlet.
01/09/2010	Camp	John Witteman and Jacek Patalas (Golder) met with Gary Cooper and Nicola Johnson of DFO to discuss fisheries habitat and compensation issues relating to the development of the Meliadine Gold Project. Discussions regarding compensation for road crossing were also discussed.
02/06/2010	Rankin Inlet	Mark Balog & John Witteman, Comaplex sponsored a town hall meeting providing an update on the Project and the building of an All-Weather Road. The meeting was particularly well attended and there were no objections to the routing to the All-Weather Road. There were no objections to the proposed road alignment.
06/01/2011	Cambridge Bay	Eric Lamontange, Denis Gourde & John Witteman met with Ryan Barry, Kelli Gillard, & one more staff member, NIRB to describe the status of the Project and in particular the All Weather Road. AEM described what had been done in regards to gathering baseline information for the road, regulatory permits required and use of the road - having it open access.
7-9/02/11	Rankin Inlet	Larry Connell & John Witteman met with the Lands Division of KIA to discuss the road and other matters. A meeting with the HTO was cancelled due to a blizzard.
3/1/2011	Rankin Inlet	John Witteman, Bertho Caron & Selma Eccles of AEM attended a meeting with the HTO, Rankin Inlet. The HTO raised a number of concerns with the route of the road, bridge location over the Meliadine River, wildlife monitoring along the road, plans for the Itivia port area, fish concerns with the bridge. AEM talked to each of the concerns raised and were subsequently informed that the HTO Board were satisfied with the responses received.

6.2.5.2 Contribution to Impact Assessment

Information from the traditional knowledge literature review was shared with the leads of various disciplines. Discussions of how IQ contributed to the impact of each applicable discipline are found in the respective assessments as follows:

- Fish and Aquatic Habitat (Section 5.2);
- Wildlife (Section 5.3); and
- Vegetation (Section 5.3).

6.2.6 Monitoring and Mitigation

To address the TLU issues and concerns related to the AWAR Project, AEM has proposed various mitigations, including management, monitoring, and AWAR Project design strategies.

6.2.6.1 Mitigation

The following identifies AEM's mitigative commitments related to traditional use of the land:

- Dust can be mitigated by maintaining posted speed limits and by regular maintenance of the road surface to reduce impacts to wildlife and vegetation.
- Close to camp, the road will be watered to keep dust under control (the use of salt to reduce dust will be avoided, as it would serve as an animal attractant).
- The construction of a single-span bridge across the Meliadine River and efforts to keep all ancillary infrastructure above the ordinary high-water mark so that the road will not have any impact on the river or Arctic char using the river.
- The Char River will be crossed using a single-span bridge (installed in the winter) to replace an existing one to protect fish habitat and fish migration.
- Streams that are crossed using culverts will have a culvert seated 300 mm below grade to facilitate fish migration (installed in winter).
- All other water crossings will have bridges or culverts installed (when the AWAR Project is closed, culverts and bridges will be removed and the natural drainage re-established).
- When the road is closed, the area will be scarified, allowing a plant community to establish itself on the (former) road surface.
- The importance of caribou to the cultural, social, and economic well-being of Nunavummiut (people of Nunavut) is clearly known, and the protection of the caribou is foremost in all developments.
- Measures to mitigate effects on caribou due to drivers will include observing the speed limits, giving animals the right-of-way, and coming to a stop if necessary.
- If a consultation process determines that it is required, the road could be closed when large herds of caribou are present.
- AEM has consulted with the KIA and the Municipality of Rankin Inlet on the processes and procedures that will be used to control non-project related access onto the Phase 1 AWAR. These procedures were previously discussed in Section 3.3.2 and are included in the "Operations and Maintenance Manual for the Phase 1 All-Weather Access Road (Appendix A).

6.2.6.2 Monitoring

AEM proposes the following monitoring activities to help manage the potential effects of the AWAR Project on resources that support TLU activities:

- To document any residual effects resulting from the road, including deposits of dust in nearby waterbodies, AEM will undertake water-monitoring.

- AEM will work with local HTO and the KIA, to develop a wildlife monitoring program that will focus on caribou, bear, muskox, migratory birds, and raptors.
- Wildlife monitoring is anticipated to take place on a regularly scheduled basis and would include logging wildlife observations, estimated numbers, and nearest kilometre marking.

6.2.7 Effects to Traditional Land Use

Information from the literature review indicates that the AWAR overlaps areas used for traditional fishing, arctic fox trapping, and caribou and wolf hunting. The potential effects to wildlife, fish, and vegetation resources have the potential to affect traditional harvesting of those resources. A full assessment and pathway analysis of the potential effects of the AWAR Project on those resources can be found in Section 5.3.4.

Regarding access to areas for traditional activities, the proposed controlled-access of the AWAR Project will have an effect on TLU. The AWAR Project is proposed to replace an ATV and snowmobile trail which is currently used for access to traditional activities. This effect is considered to be low as other trails are expected to be easily established, and a system to enhance safe use of the AWAR for non-AEM traffic will be implemented.

6.2.8 References

CCI and TFN (Canadian Circumpolar Institute and Tungavik Foundation of Nunavut). 1992. Riewe, R. (Ed). Nunavut Atlas. Edmonton, AB. Canadian Circumpolar Institute.

INAC (Indian and Northern Affairs Canada). 1976. Inuit land use and occupancy project. Freeman, M. (Ed). Ottawa, ON: Thorn Press Limited.

Nanuk Enterprises. 1999. Inuit Qaujimajatuqangit. Nanuk Enterprises Ltd. Rankin Inlet, Nunavut.

6.3 Socio-Economics

6.3.1 Introduction

This section presents Agnico-Eagle Mines Limited's (AEM) assessment of the socio-economic impact that the proposed Phase 1 All-weather Access Road (AWAR) (the AWAR Project) will have on the community of Rankin Inlet and to a lesser extent on the other communities within the Kivalliq Region. It is primarily a qualitative assessment. AEM currently has a consultant carrying out a baseline assessment of the existing socio-economic conditions with the Kivalliq Region of Nunavut that will become part of the socio-economic assessment of the full proposed Meliadine Gold Project contained within the Draft Environmental Impact Statement that AEM is targeting to submit to the Nunavut Impact Review Board (NIRB) in early 2012. This baseline is currently not available and thus for the socio-economic assessment of the proposed AWAR Project, AEM has relied upon its extensive consultation on this road with the Kivalliq Inuit Association, the Municipality of Rankin Inlet, the Rankin Inlet Hunters and Trappers Organization, and on information collected from public meetings held in the Community of Rankin Inlet on the proposed AWAR.

6.3.2 Study Area

The proposed AWAR will connect the Meliadine West Advanced Exploration site with the community of Rankin Inlet. It will be a "gated" road with controlled public access primarily to allow for ongoing traditional use purposes and to allow Rankin Inlet residents, who currently travel via a network of existing trails, to their cabins in the Meliadine Lake area to continue to have such access. The road will not connect with any of the other Kivalliq communities. Consequently, the community most affected by the proposed AWAR Project is Rankin Inlet. Rankin Inlet is the community closest to the Meliadine site, and its residents will receive preference when it comes to the employment and business opportunities that will flow from building the road and later, from servicing the underground exploration program, surface drilling, and the camp. There will be some spillover effects into the other Kivalliq Communities, most notably Chesterfield Inlet (the next nearest community by distance) and Arviat (as a source of employees who will travel to the Meliadine West Advanced Exploration site on a rotational work schedule).

The construction phase of the proposed AWAR will be in the order of 6 months (tentatively March thru August of 2012). The operational phase of the Meliadine West Advanced Exploration program as serviced by the AWAR Project is approximately 2 years (2012 and 2013) by which time it is expected that the proposed Meliadine Gold Project will either transition into a mine development project or be in the process of winding down either due to a negative feasibility study or because the AWAR Project failed to pass successfully through the NIRB environmental and socio-economic assessment process.

6.3.2.1 Spatial and Temporary Boundaries

For this socio-economic impact assessment, the spatial and temporal boundaries used are summarized by the following:

- Spatial Boundary – Rankin Inlet with some spill over to other Kivalliq Communities.
- Temporal Boundaries – Construction in 2012, Operation and Maintenance in 2012 thru 2013, Phase 2 in 2014, if approved.

6.3.3 Effects Analysis

6.3.3.1 Valued Components

Based on discussions that AEM has had with community representatives in Rankin Inlet over the past year (including one public meeting held in 2011 on the Meliadine all-weather access road), the following valued components were selected for the assessment of the socio-economic impacts of the proposed AWAR Project:

- employment and training opportunities;
- local business opportunities; and
- community wellness (specifically impact on local accommodation such as hotel space, and potential for increased use of alcohol and drugs associated with the new disposable income that will accrue to local residents through new employment wages generated as a direct result of the proposed road construction and operation).

6.3.3.2 Effects Analysis

Pathway analysis methodology was applied by AEM to identify the linkages between the construction and operational activities associated with the AWAR Project and their potential effects on employment and training levels in Rankin Inlet, local business opportunities in Rankin Inlet, and on the community wellness of Rankin Inlet. These potential pathways or linkages are presented in Table 6.3.3-1. This was then followed by a summary of the mitigation practices that will be applied by AEM and its selected contractors to enhance the positive effects and minimize, where possible, the negative effects of these pathways or linkages. AEM then applied its judgment and knowledge derived from its interaction with the community to determine whether these pathways are no linkage, secondary, or primary. Each pathway was evaluated to determine if it could lead to lasting positive or negative effects on the social and economic well-being of the community of Rankin Inlet (residual effects).

Mitigation refers to the practices or actions taken by AEM and its contractors to enhance or maximize the positive effects and to avoid or minimize the negative effects on the economic and social well-being of the community from the proposed construction and operation of this road during the advanced exploration program. For example, AEM has already entered into an arrangement with a local Inuit Owned firm to build of the AWAR Project outlined in this application. As part of this arrangement, and as a result of negotiations with the Kivalliq Inuit Association (KIA), the selected local contractor has agreed to establish and meet a 50% target for local Inuit employees working on the construction of the AWAR Project. This is estimated to translate into 25 person-years of new employment for local Inuit beneficiaries (50 local employees each working for a 6 month period). A further mitigation benefit of this commitment is reduce to the maximum extent possible the amount of demand for hotel rental space that the AWAR Project will have on Rankin Inlet because local people will not need to be housed in local hotels. Hotel accommodation in Rankin Inlet is often tight, and thus, while local businesses want to see their rental space fully occupied, over demand for the available rental space limits other business activity in the community such as inability to host regional meetings because no hotel space is available. This has been an issue noted by the community of Rankin Inlet in 2010 and 2011 while the new territorial prison and expanded Government of Nunavut fuel storage facilities were being constructed.

Table 6.3.3-1: Potential Pathways for Socio-Economics

Project Component/Activity	Valued Component	Effects Pathways	Planned Mitigation Measures	Pathway Assessment
Phase 1 AWAR Construction	Employment & Training Opportunities	Construction of the Phase 1 AWAR will create new local employment for approximately 6 months	Commitments have been made to the KIA by AEM and its road contractor to maximize local employment (set a target of 50%) during Phase 1 AWAR construction.	Secondary
		Construction will create some new heavy equipment training opportunities	AEM has worked with the municipality of Rankin Inlet, Nunavut Arctic College and the road contractor to use the Phase 1 AWAR construction to create new heavy equipment training opportunities.	Secondary
	Local Business Opportunities	Construction of the Phase 1 AWAR will create new local business opportunities	Road construction will be carried out by a local Inuit Owned firm.	Secondary
	Community Wellness	Construction has potential to result in increased problems associated with alcohol and drug use in Rankin Inlet	Work with Municipality to monitor potential problem and develop mitigation.	Secondary
		Construction will create increased demand for hotel space making finding rental accommodation more difficult for a 6 month period	To the greatest extent possible maximize local workforce who will not require temporary rental accommodation.	Secondary
		Construction will create new income for residents in Rankin Inlet (and to a lesser extent in Chesterfield Inlet and Arviat)		Secondary

Table 6.3.3-1: Potential Pathways for Socio-Economics (continued)

Project Component/Activity	Valued Component	Effects Pathways	Planned Mitigation Measures	Pathway Assessment
Phase 1 AWAR Operation & Maintenance	Employment & Training Opportunities	Ongoing operation and maintenance of the Phase 1 AWAR will create new local employment on a year round basis	Commitments have been made to the KIA by AEM to maximize local employment for ongoing operation and maintenance activity on the road.	Secondary
		Road operation and maintenance will create some new heavy equipment training opportunities	Ongoing road maintenance and operation activity creates an opportunity to create new heavy equipment training opportunities.	Secondary
	Local Business Opportunities	Ongoing road operation and maintenance of the Phase 1 AWAR will create new local business opportunities	AEM will work to maximize local employment on road maintenance and road operational contracts.	Secondary
		Access to the Meliadine West Advanced Exploration site by road will create new local business opportunities		Secondary
	Community Wellness	New employment income has the potential to result in increased problems associated with alcohol and drug use in Rankin Inlet (and to a lesser extent in other Kivalliq communities, specifically Chesterfield Inlet and Arviat)	Work with Municipality to monitor potential problem and develop mitigation.	Secondary
		New employment will create new income for residents in Rankin Inlet (and to a lesser extent in Chesterfield Inlet and Arviat		Secondary

The following sections discuss the potential pathways relevant to the socio-economic environment.

6.3.3.3 Secondary Pathways

For all of the pathways or linkages assessed, AEM determined that the residual impact would be best classified as negligible. This conclusion was reached on the basis that the residual impacts from the AWAR Project will be relatively short-term in duration (6 months in most cases and no greater than 2 years) and will not materially alter or leave a long-term impact on the valued components assessed, namely employment and training, local business opportunities, and community wellness.

6.3.3.4 Project Specific Effects

The positive socio-economic benefits that are predicted to be realized by building the AWAR are summarized as follows:

- Conversion of current employment activity at the Meliadine Advanced Exploration Project from seasonal to a year round basis that provide enhanced employment stability to both our Nunavut and southern based workers. At 30 June 2011, the workforce at the Meliadine Advanced Exploration Project was 208 employees, 34 directly working for AEM and 174 working for contractors (diamond drilling, rehabilitation of the underground decline and extracting the new bulk sample and support activity). Currently most of these positions are temporary in nature tied to the specific activity being contracted. Twenty-nine of these employees are Nunavummiut (14%), mostly on the AEM payroll. Conversion of the ongoing exploration and decline development from a seasonal to a year round basis will enable AEM to stabilize these positions moving more of the jobs to full time roles.

- Increased early employment opportunities at Meliadine for local Nunavummiut through additional advanced exploration work and in construction and maintenance of the AWAR in 2012, and 2013. Construction of the road is projected to employ 100 people for approximately 6 months, with 50% expected to be Inuit Beneficiaries from the Kivalliq Region. Ongoing road maintenance, freight and fuel transportation, and the transport of our workforce to and from the site is projected to employ a further 50 people year round with most of those being Inuit Beneficiaries from the Kivalliq Region.

- Construction of the AWAR in 2012 will provide an opportunity for AEM, working with its community partners, to use construction of the AWAR to train approximately 30 new heavy equipment operators in 2012 (a program that was in development with a partnership of AEM, the Municipality of Rankin Inlet, and Nunavut Arctic College). These local residents would be in a position to gain both the skills and experience that they would need to obtain employment at the Meliadine Mine at the start of mine construction. Construction of the AWAR will allow for this hands-on training in 2012 so that people would be ready for employment in mine construction (pit development) in 2014, if the proposed Meliadine Gold Project is approved.

- Construction of the AWAR in 2012 will provide enhanced opportunities for the local business community in Rankin Inlet. The construction of the AWAR Project prior to mine development (if approved) will provide substantial advantage to the Rankin Inlet business community by providing access and developing business links with the proposed Meliadine Gold Project. This early access will help these businesses understand the proposed Meliadine Gold Project needs, as well as build their ability to access business opportunities earlier in the construction phase of the proposed Meliadine Gold Project. For example, the

AWAR makes it much easier and more economic for the proposed Meliadine Advanced Exploration Project to access a welder from Rankin Inlet to affect a repair, rather than have to have a welder on standby on-site. This is just one example of what are likely to be numerous such opportunities for the local business community through having easy road access to the Meliadine West Advanced Exploration site.

New business opportunities will occur directly from construction of the AWAR Project as AEM has made arrangements to hire local contractors to build the road and install the bridges. Based on the Request for Proposal's and tendering activity already initiated by AEM, AEM predicts that the road would be built under contract by a Kivalliq based business that is also a registered Inuit Firm. In addition, other indirect positive economic impacts will be seen at hotels, restaurants, and stores in Rankin Inlet.

Some of the negative socio-economic effects that are predicted will include the following:

- Contractors will likely require 'block bookings' of hotel rooms to accommodate workers from outside Rankin Inlet. This would result in fewer hotel rooms being available over the 6 month period, which could crowd out other economic activities that rely on the availability of hotel rooms.
- A substantial increase in air traffic is unlikely, although airline companies may have to add more seats while reducing the space for air freight.

The construction period for the road will be short; however, once the AWAR is complete, the road will lead to increased economic activity at the Meliadine site. Year-round underground exploration and bulk sampling can be expected. Businesses in Rankin Inlet that service the underground program, surface drilling, and camp will likely keep their workers employed year-round. Workers will be involved in activities, such as the delivery of fuel, materials and other supplies, maintenance and service contracts, and expediting. The Meliadine West camp will remain open year-round and provide continued employment to those normally laid off when the camp closes for the winter. Eventual long-term employment and business impacts can be expected to increase with the success of the underground program and surface drilling programs, as success will tend to lead to expansion of these exploration programs.

6.3.3.5 Residual Effects Assessment

The AWAR Project is not expected to bring social change. Its impact on individual and community wellness cannot be predicted with any certainty, but is expected to be minor. Consequently, AEM does not feel that the AWAR Project will have any significant adverse or negative residual impact on the Community of Rankin Inlet or on the Kivalliq Region. There will be positive residual effects in the form of new skills obtained through training and in ongoing new business opportunities for local business at the Meliadine West Advanced Exploration site.

It is AEM's hope that the additional social and economic activity resulting from the road's construction will motivate Nunavut-based individuals to advance their marketable skills by enrolling in the recently opened trade school in Rankin Inlet, or at other educational institutions. Long-term, well-paying jobs are best obtained by having skills that are needed in the mining industry.

All businesses and workers involved in the construction of the road will be required to provide safe, competitive, reliable, and cost-effective goods and services. Participation in the construction by people and businesses from the Kivalliq Region is very important to AEM. Project managers will expect the same standards of effort, conduct, and commitment from all employees and contractors, regardless of where they may be based.

6.3.4 Cumulative Effects

In conducting this assessment, AEM also evaluated what, if any, were the likely cumulative impacts on the 3 valued components of employment and training, local business opportunities, and community wellness. The first step in this cumulative effects assessment was to determine what other activities are currently under way or likely to be initiated in the near future in Rankin Inlet. AEM identified 2 such activities:

1) **The Territorial Prison**, which is nearing completion of the construction and the resultant commissioning of this facility in Rankin Inlet. While the construction related employment and local business opportunities are winding down in 2011 and will be past when the proposed AWAR Project is due to start construction, there will be overlap of employment and training opportunities and new local business opportunities resultant from the start of operations at this facility.

2) **The Proposed Meliadine Gold Project**, which is currently under a Part 5 Environmental and Socio-Economic Review under the NIRB process, is expected to become a mine development project in 2014 with start-up of mine production in early 2016. This is predicated on the AWAR Project successfully passing through the NIRB assessment process and the subsequent permitting phase and upon AEM concluding a successful economic feasibility assessment for the proposed Meliadine Gold Project.

AEM then evaluated how the residual impacts from the AWAR Project would impact the 3 valued socio-economic components assessed when the effects are taken in aggregate or in cumulated fashion with these 2 other development activities. The results of this evaluation are summarized as follows:

- Employment and training opportunity – the territorial prison and the AWAR Project will draw upon different employment skills; therefore, is not expected to be direct competition between these 2 activities for the same employee base. While Rankin Inlet alone may not be able to meet the employment demand for all 3 of these projects, the increased employment demands can be met by drawing employees from other Kivalliq communities. Both the Meliadine West Advanced Exploration program and the future Meliadine Gold Project will be set-up with a work rotational schedule which will allow for employees to be sourced from Rankin Inlet and the other Kivalliq communities. These 3 projects will each provide new training opportunities, which AEM feels can be met within the Kivalliq Region and that these new opportunities will result in a positive cumulative impact on both Rankin Inlet and the Kivalliq Region.

- Local Business Opportunities – These 3 projects will all create increased opportunity for local businesses based in Rankin Inlet and in the wider Kivalliq Region. However, AEM's assessment concluded that the cumulative impact on local business opportunity will be positive. Based on AEM's experience in the region over the past 3 years, it is AEM's view that the local business community will expand through growth and increased joint venture arrangements with outside suppliers to meet these increased opportunities.

- Community Wellness – The combination of these 3 projects will have a positive impact on employment levels and average disposable incomes in Rankin Inlet and in the Kivalliq Region. The 3 projects will combine to reduce reliance on social assistance and will provide much needed employment and training opportunities for the large youth population in the region who will be entering the local workforce. Offsetting these positive cumulative impacts, there are potential negative impacts that may arise from the expected increase in disposable income in Rankin Inlet and the Kivalliq Region expected to accrue from the 3 projects. People may not always make wise choices with their new income; consequently, there is potential for increased use of alcohol and illicit drugs that would adversely affect community wellness.

However there will also be many good decisions made on how this increased disposable income will be spent (i.e., new homes, better necessities' for local families) that will help balance the poor choices made, and thus, community wellness will also see positive effects.

7.0 TRANSPORTATION MANAGEMENT PLAN

Agnico-Eagle Mines Limited (AEM) has developed an Operations and Maintenance Manual for the All-weather Access Road (Appendix A), otherwise known as a Transportation Management Plan. The purpose of this manual is to provide the planned operating and maintenance procedures that will be employed by AEM and its contractors for this road. These procedures were developed using experience from AEM's operation of the Meadowbank all-weather access road linking the Hamlet of Baker Lake to the Meadowbank mine.

The objective of creating the manual is to provide all of the information required by AEM employees, contractors, and other stakeholders is available in one document to help facilitate the movement of equipment, supplies, and personnel from Rankin Inlet to the Meliadine West Advanced Exploration site for the safety of all road users, while minimizing the potential for incidents or malfunctions. Operating procedures included cover maintenance, road inspection, traffic management, wildlife management, emergency response, and environmental monitoring. In addition, the manual summarizes the information on road design and construction. It will be updated on an annual basis at a minimum or more often as change in circumstances require.

This manual will be used as a reference for road inspection, road maintenance, personnel training, and information sessions to be held with road users. A copy of this manual is included in Appendix A of this document.

8.0 SCHEDULE

Agnico-Eagle Mines Limited (AEM) is hoping to receive all authorizations in time to start construction of the All-weather Access Road by 1 March 2012. AEM's objective is to have much of the road constructed during the late winter months in the first half of 2012, with completion by August so that the road can be used to move fuel to the Meliadine West Advanced Exploration site by September. This would allow AEM to move exploration and development activity at the site to year round operation starting in 2012 and allowing AEM to meet its planned advanced exploration schedule leading to completion of the Feasibility Study by the end of 2012.

AEM believes that the installation of the 3 clear span bridges will be the critical part of the construction timeline (the schedule critical path). The bridges will be pre-assembled on the shore of the respective stream crossing starting on 1 March 2012 and then slid into place using a crane coupled with use of supporting dollys that have to pass across the ice to move the bridge structure across the stream. Because of the large spans, there are no cranes of sufficient lifting capacity available in Rankin Inlet capable of lifting these assembled spans and swinging them directly into place. Thus, the critical timeline becomes getting the bridges in place before the ice bearing capacity is lost (expected in April).

As with many industrial activities in the north, the schedule for the construction of the proposed all-weather road is based on a balance of logistical and technical considerations, and on the timing of regulatory approvals. The road and bridges will take approximately 6 months to build.

9.0 AUTHORIZATIONS

9.1 Applicable Acts, Regulations, and Guidelines

The lead authorizing agencies for the Phase 1 All-weather Access Road (AWAR) are the Nunavut Planning Commission (NPC), the Nunavut Impact Review Board (NIRB), the Nunavut Water Board (NWB), and the Kivalliq Inuit Association (KIA).

In April of 2011, the NPC issued a determination indicating that the proposed Phase 2 Meliadine AWAR conforms with the Keewatin Regional Land Use Plan. It will be necessary for AEM to request that NPC re-visit its April conformity decision to determine whether it remains applicable to the AWAR Project or whether NPC needs to re-assess their original conformity decision based on AEM's proposed revised phased approach to constructing this road.

Once the issue of conformity with the Land Use Plan is settled, then AEM will ask the NIRB to assess the Phase 1 AWAR as a pre-development activity under the Part 5 Environmental Assessment of the proposed Meliadine Gold Project being led by the NIRB. A positive environmental screening decision on this pre-development component of the proposed Meliadine Gold Project from NIRB is required before any other agency can issue any permits, leases, or authorizations that would allow AEM to commence construction of this road.

Applicable acts, regulations, and guidelines that govern the all-weather road are provided in Appendix H.

9.2 Current Licences, Permits, Agreements, and Approvals

The larger part of the proposed road is to be located on lands owned by the Inuit (Inuit Owned Lands). The surface ownership of the land encompassing the road right-of-way was transferred to the KIA when the Nunavut Land Claims Agreement came into effect. Land and environmental management in this area are generally governed by the provisions of the Nunavut Land Claims Agreement. Closer to Rankin Inlet, 2.3 km of the road will be within the municipal boundary, which extends to the Meliadine River. This land is held by the Department of Community and Government Services for the benefit of the Municipality of Rankin Inlet. There is also a 200 m wide strip of Crown Land on the north shore of the Meliadine River at the proposed bridge crossing. AEM holds a mineral claim for this crown land and will require a Land Use Lease from Aboriginal Affairs and Northern Development Canada for this portion of the road.

Table 9.2-1 lists the current licenses, authorizations, and permits held by AEM for its Meliadine Advanced Exploration Project.

Table 9.2-1: Current Licenses and Permits Held by Agnico-Eagle Mines Limited for its Meliadine Advanced Exploration Project

License Number	Explanation	Issued By	NIRB File	Expiry	Remarks
KVL100B195	Meliadine Prospecting – Land Use	KIA		31-Oct-11	General land-use permit applying to exploration and drilling
KVL302C268	NTI Parcel Drilling	KIA		01-Jul-12	Drilling on RI-01 Inuit-owned land
KVCL102J168	Commercial Lease	KIA	07EN044	30-Jun-12	Commercial lease for exploration and underground activities
KVRW98F149	Meliadine Right-of-Way	KIA		30-Apr-12	Winter road across Prairie Bay & various Lakes (renewed annually)
KVRW07F02	Overland Right-of-Way	KIA	07AN063	26-Oct-11	Winter road along proposed all-weather road route (renewed annually)
KVCA07Q08	Mainland Esker Quarry Permit	KIA		15-Sep-11	Tiriganiaq Esker quarry (currently being renewed)
KVL308C07	Mel E Exploration RI01	KIA		13-Jun-12	Renewed
N2010C0002	PB1, Geotech Drilling Permit	INAC	10EN006	11-Apr-12	Geotechnical drilling within 31 m of water
N2007Q0040	Mel Lake Islands - Quarrying	INAC	05EN006	13-Apr-12	Land-use permit for quarry on federal land
2010QP0129	Quarrying Meliadine Islands	INAC	08EN005	18-Nov-11	Re-enter quarries on Meliadine Islands for granular material
	WCB Program Authorization	WCB		31-Dec-11	Annual renewal
	Hamlet Disposal Authorization	Rankin Inlet		Aug-11	Not to be renewed, as landfill is planned for site.
2BB-MEL0914	Bulk Sampling -Water License	NWB	07EN044	31-Jul-14	Amendment for extension of the underground program granted
2BE-MEP0813	Exploration - Water License	NWB	08EN043	31-Oct-13	Assigned to Comaplex, camp reclaimed

9.3 Required Licenses, Permits, Agreements, and Approvals

No land use lease, operating permit, authorization, or license can be issued by any regulatory agency that would allow AEM to start construction on the AWAR until the NIRB has completed its environmental review and issued a recommendation that would allow this work to proceed as a pre-development activity for the proposed Meliadine Gold Project currently under environmental assessment by the NIRB.

As the Meliadine Gold Project is on Inuit Owned Land, a number of permits from the KIA will be required to build the road. A list of anticipated permits, licenses, agreements, authorizations, and approvals for the AWAR is presented in Table 9.3-1.

Table 9.3-1: Required Licenses, Permits, Agreements, and other Approvals for the Phase 1 All-weather Access Road

Authorization	Authority	Basis
Conformity determination with Keewatin Regional Land Use Plan	Nunavut Planning Commission	Allows project to proceed to screening
Pre-development Project Screening	Nunavut Impact Review Board	Allows project to proceed to authorizations to build and operate the road as a pre-development activity
Type B Water License	Nunavut Water Board	Allows for construction of the Phase 1 AWAR and installation of culverts
Road Water Compensation Agreement	Kivalliq Inuit Association	Compensation for Inuit Water Rights under NLCA Section 20
Right-of-way Lease	Kivalliq Inuit Association	Allows right-of-way for all-weather road across Inuit lands
Right-of-way Lease	Rankin Inlet and Community & Government Services	Allows right-of-way for all-weather road across municipal lands
Land Use Lease	Aboriginal Affairs and Northern Development Canada – Lands Division	Allows right-of-way for all-weather road across Crown Lands
Quarry License	Kivalliq Inuit Association	Various quarry sites along the right-of-way for building the road to the Meliadine site
Quarry Approval	Rankin Inlet and Community & Government Services	Granular materials and/or rock quarry for road construction
Navigable Waters Permit	Transport Canada	The building of a bridge across the Meliadine River and the KM 5.0 unnamed stream crossing
Explosive Magazine Permit Renewal	Workers' Safety & Compensation Commission	Permits an explosive magazine on-site and at other approved locations
Class 2 Permit for Heritage Sites (obtained by qualified professional archaeologist)	Department of Culture, Language, Elders, & Youth	Unavoidable impacts of all-weather road on heritage sites have been mitigated

10.0 RECLAMATION

As stated previously, the Phase 1 All-weather Access Road (AWAR) will be a private road constructed primarily on Inuit Owned Lands leased by Agnico-Eagle Mines Limited (AEM) from the Kivalliq Inuit Association (KIA). The road will be constructed, inspected, and maintained by AEM with its primary purpose being to support advanced exploration and development activity at the Meliadine West Advanced Exploration site. Consequently AEM has sole responsibility for the construction, operation, and decommissioning of this road, including the road bed, the bridges, the culverts and the borrow/quarry sites used in the construction of the road.

The AWAR will be decommissioned and reclaimed by AEM if the proposed Meliadine Gold Project fails to pass either the Feasibility stage or Environmental Assessment phase. This would take place within a year of the road no longer being required to complete the reclamation of the Meliadine West Advanced Exploration site.

If the proposed Meliadine Gold Project advances to become a mine, then AEM will construct the Phase 2 AWAR by widening the Phase 1 AWAR. In this circumstance, AEM will decommission and reclaim the road once the proposed Meliadine Gold Project has been decommissioned and reclamation completed. This would take place within a year of the road no longer being required to complete the reclamation of the proposed Meliadine Gold Project.

In both circumstances, it is AEM’s responsibility to decommission and reclaim the road once its activity in the area is complete. For a third party to take over the road, that third party would have to complete its own arrangements with the land owner (the KIA) and then complete its own environmental assessment and permitting process covering future use. AEM does not own the land on which the road is constructed on and, thus, it cannot transfer future ownership or use privileges to any third party. AEM must complete its obligation to decommission and reclaim the Phase 1 AWAR unless directed otherwise by a combination of the land owner and other regulatory agencies who issued permits/authorizations for the road.

Decommissioning of the AWAR will be accomplished by loosening compacted surfaces (ripping surface with a dozer mounted ripping unit), flattening side slopes, removing all culverts, and bridges (not including the Char River bridge as this would become the property of the Municipality), and other potential obstructions to drainages paths. The objective is to make the road surface impassable by vehicular traffic by ripping the entire road bed and removing all bridges and culverts along the route.

The ripping of the road bed will be accomplished utilizing a CAT D8 dozer with a “ripper” attachment on the back. Successive passes with the dozer longitudinally along the road bed will eliminate the level road surface and make travel difficult (Figure 10.1-1). It is anticipated that, in this way, the abandoned former all-weather access road will not be useable by wheeled vehicles (i.e., cars, trucks, and pickups). The road bed would still be useable by ATV or snowmobile and, thus, even after final reclamation, the reclaimed roadbed would offer similar passage to the existing set of trails that currently exist and are used by the residents of Rankin Inlet for traditional use purposes.

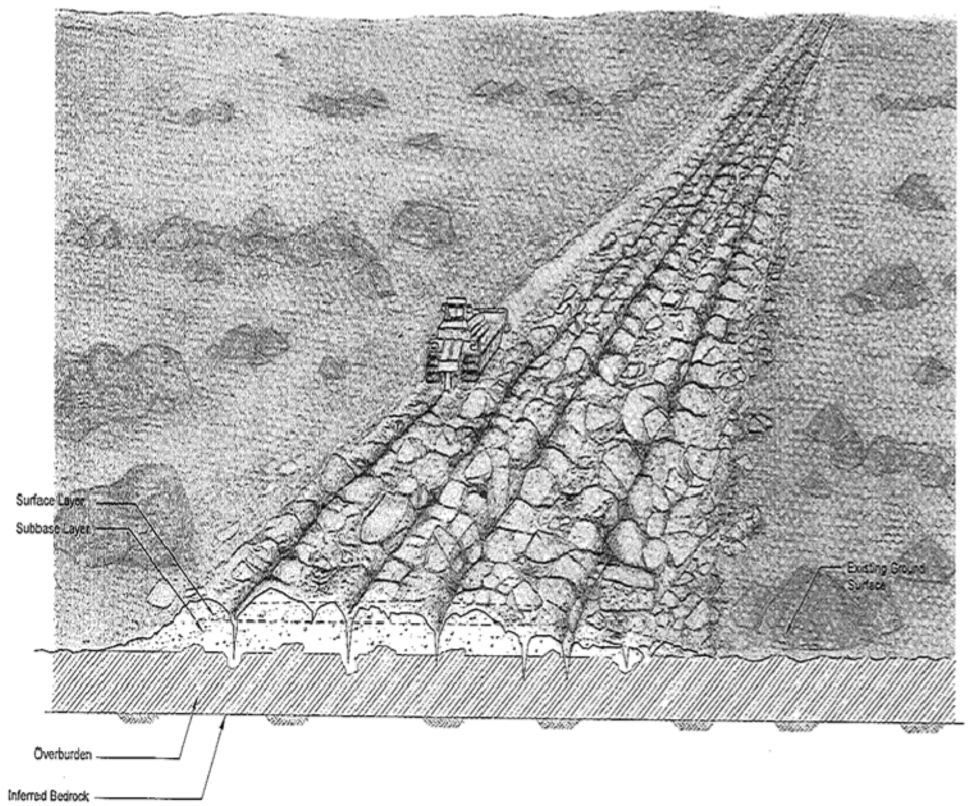

Figure 10.1-1: Schematic View of the Roadbed after Dozer Ripping (not to scale)

The road deactivation works will be carried out as necessary to stabilize any slopes where potential for slope erosion may exist. Stabilization measures may require pulling back of side-cast fills on locally steep slopes, or buttressing and/or re-contouring of steepened out slopes using non-acid generating material. These measures would also be applicable to borrow pits/quarries located adjacent to the roadway. As much as practical, deactivated surfaces will be graded to blend with the existing topography.

To the extent practical, the decommissioning would also restore the natural pre-road hydrology. Natural drainage courses would be restored primarily through the removal of all culverts and bridges (excluding the Char River bridge, which will belong to the Municipality of Rankin Inlet), and through rehabilitation of channels and banks at the crossing sites. Cross-drain structures (cross-ditches) will also be installed where necessary between culvert sites. Where armouring rock (riprap) is required, this rock will be non-acid generating for the protection of aquatic life. Where affected watercourses are fish bearing, the timing of work will have to be restricted to within the designated DFO fisheries work window (16 July through 30 April). For these sites, appropriate fish exclusion measures will be undertaken prior to the in-stream works. All in-stream works will be carried out using best management practices for erosion and sediment control.

Decommissioning of the road will start from the proposed Meliadine Gold Project end of the road and progress south towards Rankin Inlet. Stream crossings will be rehabilitated as they are encountered during the progression of the work. The culverts and bridges will be removed from the crossings using a backhoe and crane, and the removed materials (i.e., culvert steel, bridge decks, abutment steel, etc.) will be transported to

Rankin Inlet using a semi-tractor and a low-boy trailer, for disposal and salvage. To facilitate revegetation of the roadway, site preparation will be followed by seeding with native plant species (if they can be commercially located) as approved by the Government of Nunavut Department of Environment.

Quarry Sites and Borrow Sources

All quarry sites and borrow sources developed during the construction of the road have been selected to generate only non-acid generating / low metal leaching materials. Water quality monitoring and testing will be undertaken periodically during the construction and operational period of the road to measure the quality of water draining from the open quarry/borrow sites and from the road base materials.

During decommissioning of the road, should acid-generating bedrock be exposed along the roadway or in borrow pit/quarries, these areas will be covered with a minimum 2 m thick layer of non-acid generating soil or rock to direct water away from the surface, and the surface will be re-vegetated.

10.1 Estimate of Reclamation Liability

In July of 2011, Aboriginal Affairs and Northern Development Canada (AANDC 2011) completed an estimate (based on information traded back and forth between AEM and Aboriginal Affairs and Northern Development Canada Water Resources staff) that included a calculation of the reclamation liability associated with the decommissioning and reclamation of 23.8 km of all-weather road between Rankin Inlet and the Meliadine West Advanced Exploration site. This estimate did not include the cost of removing the clear span bridges at KM 5.0 and across the Meliadine River. AEM has consequently adjusted the estimate to incorporate this additional work. The revised total estimate for the decommissioning and reclamation of the Phase 1 AWAR is $476 106 with the breakdown shown in Table 10.1-.1.

Table 10.1-1: Estimate of Reclamation Liability for Meliadine All-weather Access Road

Activity/Material	Units	Quantity	Unit Cost	Cost	% Land	Land Cost	Water Cost
Scarify road	km	30	$3250	$77 675	50%	$38 838	$38 838
Remove 8 water crossings	each	8	$4000	$32 000	0%	$ -	$ 32 000
Remove 2 clear span bridges	each	2	$35 000	$70 000	0%	$ -	$70 000
Block Road with 100 m^3 rock	m^3	100	$15	$1500	100%	$1500	$ -
Reclaim road borrow sources (325+Dozer)	hrs	132	$455	$60 060	0%	$ -	$60 060
Camp support and supplies	m-days	300	$250	$75 000	50%	$37 500	$37 500
Mobilization (dozer, hiab, dump, 2 scoops)	allow	1	$ 25 000	$25 000	50%	$12 500	$12 500
Demobilization (dozer, hiab, dump, 2 scoops)	allow	1	$25 000	$25 000	50%	$12 500	$12 500
			Sub-Total	*$366 235*		*$102 838*	*$263 398*
Indirect Costs	**Percentages**						
Engineering	5%			$18 312		$5142	$13 170
Project Management	5%			$18 312		$5142	$13 170
Contingency	20%			$73 247		$20 568	$52 680
Total				**$476 106**		**$133 689**	**$342 417**

10.2 References

AANDC (Aboriginal Affairs and Northern Development Canada). 2011. Technical review memorandum to Nunavut Water Board from Indian and Northern Affairs Canada Water resources. Dated 8 July 2011, Doc. CIDMS#47308, File #9545-2-2.2BB.MELA, entitled “2BB-MEL0914 – Meliadine West Gold Project – Agnico-Eagle Mines Limited – Reclamation Liability Estimate, Including All-weather Road.