CONSTRUCTION AND OPERATION OF AN ACCESS ROAD AND BORROW SOURCES AT REPULSE BAY, NU

Environmental Screening

FINAL

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EXECUTIVE SUMMARY

Nunami Stantec Ltd. (Nunami), on behalf of the Government of Nunavut Department of Community and Government Services and the Hamlet of Repulse Bay, are submitting regulatory applications for permitting the construction of an access road to granular resources, and subsequent operation of borrow sources. The Hamlet of Repulse Bay needs to develop granular resources to allow for municipal road construction and other community projects. Six granular deposits (borrow sources) have been identified northwest of the Hamlet and a final design for a road to access these sites has been prepared. The Project in question involves the construction of an 8.729 km long access road to these borrow sources, and ensuing extraction of granular resources from three of the six borrow sources.

This Environmental Screening document contains information regarding the construction and operation of the all-weather access road, and development and operation of the borrow sources. It has been developed to fulfill the Project Specific Information Requirements of the Nunavut Impact Review Board and the General Water Works Supplemental Information requirements of the Nunavut Water Board. Based on these, Nunami has complied information about the Project and Repulse Bay area into the following sections:

- General Project Information: provides an overview of Project information including the need for the Project, alternatives to the Project, Project schedule, equipment, water use, solid waste generation, fuel and chemical use, and public involvement/traditional knowledge.
- Project Specific Information: provides specific details on the construction of access road and development of borrow sources; includes road and culvert design and construction methods, as well as borrow source activities, such as excavation volumes, safety and environmental considerations and mitigation measures.
- Existing Environment: provides a description of the existing physical, biological and socioeconomic environment of the Project and Repulse Bay area.
- Environmental Assessment: provides an assessment of environmental effects of the Project on identified physical, biological and socioeconomic Valued Environmental Components (VECs).
- Cumulative Effects: provides an assessment of the interaction between any residual environmental effects of the Project and any past, present or reasonably foreseeable future projects.

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ABBREVIATIONS

ATV ..... All-Terrain Vehicle

CSP ..... Corrugated Steel Pipe

DFO ..... Department of Fisheries and Oceans Canada

DMP ..... Dust Management Plan

FSC ..... FSC Architects and Engineers

FMA ..... FMA Heritage Incorporated

GN-CGS ..... Government of Nunavut Department of Community and Government Services

GN-CLEY ..... Government of Nunavut Department of Culture, Language, Elders and Youth

Hamlet ..... Hamlet of Repulse Bay

HRIA ..... Heritage Resource Impact Assessment

HTO ..... Hunters and Trappers Organization

km^2 ..... square kilometres

m^2 ..... square metres

m^3/s ..... cubic metres per second

NIRB ..... Nunavut Impact Review Board

NPC ..... Nunavut Planning Commission

Nunami ..... Nunami Stantec Ltd.

NWB ..... Nunavut Water Board

OS ..... Operational Statement

1 INTRODUCTION

Nunami Stantec Ltd. (Nunami), on behalf of the Government of Nunavut Department of Community and Government Services (GN-CGS) and the Hamlet of Repulse Bay (the Hamlet), are submitting regulatory applications for permitting the construction of an access road to granular resources, and operation of the borrow sources. This Environmental Screening document contains information regarding the construction and operation of the all-weather access road, and development and operation of the borrow sources. It has been developed to fulfill the Project Specific Information Requirements of the Nunavut Impact Review Board (NIRB) and the General Water Works Supplemental Information requirements of the Nunavut Water Board (NWB).

The Hamlet of Repulse Bay is located at the south-western end of the Melville Peninsula at the Rae Isthmus (66° 31' N, 86° 14' W) in the Kivalliq Region of Nunavut. Six granular deposits have been identified northwest of the Hamlet. The proposed access road to these sites is 8.729 km long, will be constructed of granular materials and measure a minimum of 11 m wide, with additional width for increased shoulders and culverts in some areas. Road construction will follow the typical cut and fill method, utilizing granular materials from road cuts, the Hamlet's existing granular source and two of the identified granular deposits. The Hamlet began construction of the road in 2007 and completed approximately 2.9 km. Construction continued in 2009 and 2010 and approximately 4.4 km of the access road are currently constructed. The Hamlet has also began digging borrow areas at several locations along the constructed road to find suitable material for the road construction; no other infrastructure exists within the Project area.

1.1 Background

In 2001, FSC Architects and Engineers (FSC) completed an aggregate study for the GN-CGS to identify natural deposits of suitable granular material in the Repulse Bay area. FSC noted that the existing granular deposit being used by the Hamlet was approximately 50% depleted with an estimated quantity of 30,000 m^3 of course and fine granular fill (FSC 2002). During the aggregate study, FSC identified six major new deposits of granular aggregate west of the community following a well-established all-terrain vehicle (ATV) trail. The newly identified granular deposits have estimated quantities of materials ranging from 10,000 to 225,000 m^3 (FSC 2002). However to develop these six granular deposits, construction of a suitable access road is required. FSC completed preliminary design of the proposed road to granular resources later in 2002.

In 2008-2009, Nunami completed an environmental survey of the preliminary road route to collect data on the existing terrain, wildlife and vegetation, and collect detailed information on watercourses crossed or potentially impacted. Nunami, on behalf of the Hamlet, submitted regulatory applications for the proposed access road to the NIRB, the NWB, and the Nunavut Planning Commission (NPC). During the regulatory review process, the NWB identified the need for a project-specific Spill Contingency Plan and submission of signed and stamped construction drawings for road design and culvert installation. Further, the Department of Fisheries and Oceans (DFO) requested the completion of a project review under the Fish Habitat Protection Provisions of the *Fisheries Act*.

In efforts to obtain signed and stamped construction drawings for the road design, FSC completed a more comprehensive road survey in August 2010. FSC's survey included completion of an as-built survey of the constructed portion of the road and amendment and upgrading of the 2002 preliminary design for the remainder of the road route. As 4.4 km of the access road had already been constructed by the Hamlet, FSC made efforts during the final road design to follow the existing road where possible and include design upgrades to meet requirements. However due to engineering constraints, portions of the existing road had to be re-routed in the final road design; this is inclusive of sections within 0+800 to 4+400 of the constructed road.

Additionally, following the environmental survey in 2009, Nunami recommended a Heritage Resource Impact Assessment (HRIA) be completed prior to construction of the access road. The Government of Nunavut Department of Culture, Language, Elders and Youth (GN-CLEY) concurred with this recommendation and, in September 2010, Nunami, through FMA Heritage Inc. (FMA) completed the HRIA of the proposed access road route. The HRIA included a desktop site file search and a field inventory and assessment program.

2 GENERAL PROJECT INFORMATION

2.1 General Information

Need for Project

The Hamlet of Repulse Bay needs to develop granular resources to allow for municipal road construction and other community projects. Six granular deposits (borrow sources) have been identified northwest of the Hamlet (FSC 2002) and a final design for a road to access these sites was prepared by FSC in late 2010. The Project in question involves the construction of an 8.729 km long road to access these borrow sources, and subsequent extraction of granular resources from three of the six borrow sources (Deposit Nos. 1 to 3). The access road will be constructed of granular materials and measure a minimum of 11 m wide, with additional shoulder and culvert space in some portions. The proposed route, watercrossings and granular resource sites are identified on Figures 1 to 3 in **Appendix A**; final road design drawings are presented in **Appendix B**.

Alternatives to the Project and Alternative Methods

Alternatives to the Project, and viable technical and economic alternatives for carrying out the Project, have been considered. The alternative to the Project is to not construct the proposed road and not develop the identified borrow sources. This is not considered feasible; however, as the Hamlet requires these granular resources to support future municipal projects and community economic growth initiatives.

Alternative means of carrying out the Project focused on constructing the proposed road in an alternate location to access the identified borrow sources. This option is also not considered feasible as the cost of locating and designing a new route would be prohibitive as the Hamlet and GN-CGS have already completed final road design, environmental survey, HRIA and permit applications for the present routing. The proposed Project routing was finalized by FSC in 2010 based on comprehensive field study considering ease of construction, minimizing construction and maintenance costs, and avoiding environmentally and culturally sensitive areas. An assessment of the environmental effects of project alternatives was not undertaken as there was not considered a practicable alternative to the proposed route.

Project Schedule

Pending successful permitting through the regulatory review process, the construction of the access road and operation of the first borrow source is expected to begin in July 2011. Construction activities are expected to continue through the summer until September/October 2011 and re-start in July 2012. Project completion is expected to occur in September/October 2012.

Legislation and Required Permits

The lands affected by the Project are Municipal Lands located inside the municipal boundary of the Hamlet of Repulse Bay (NLCA Section 14.1.1; KIA 2007). Applicable legislation includes *the Nunavut Land Claims Act*, the *Nunavut Waters and Surface Rights Tribunal Act*, the *Fisheries Act*, *Commissioner's Lands Act* and Regulations, *Heritage Resources Act* and Regulations, *Environmental Protection Act* and Spill Contingency Planning and Reporting Regulations.

The Project will require a water license from the NWB and an authorization from DFO to construct the access road and install culverts at stream crossings. A Land Use Permit and a Quarry Permit from the Lands Administration Division of the GN-CGS will also be required for construction of the access road and development of the borrow sources. Pending a request from an Authorizing Agency, the Project may also require a screening determination from the NIRB.

2.2 DFO Operational Statement Conformity

DFO Operational Statements (OS) which apply to the Project include:

- In-Water Construction Timing Windows (Version 3.0; DFO 2007a)
- Culvert Maintenance (Version 3.0; DFO 2007b)

These OS' are designed to protect the fish and fish habitat of fish-bearing waters when carrying out specific in-water activities. The Project will cross several waterbodies and in-water work will be unavoidable. During construction of the Project, measures to protect fish and fish habitat detailed in the applicable DFO OS' will be met; see **Appendix C** for the signed statement of confirmation. Some of these measures include limitations on the timing of in-water construction activities, the protection of the downstream environment from increased sedimentation, the protection of stream banks from erosion and prevention of the release of deleterious substances into waterbodies

2.3 Transportation

The proposed route originates from an existing municipal road running northeast from the Hamlet. Presently, 4.4 km of the proposed access road has been constructed by the Hamlet. The Project site will be accessed using this existing municipal road and constructed portions of the new road as it is completed; all supplies for road construction will be brought along existing roads and the newly constructed access road as it progresses. The constructed road and proposed access road route are illustrated in Figure 1 in **Appendix A**.

The borrow sources will be accessed by the construction of short access roads originating from the access road. An airstrip will not be used to access the Project site or bring materials to the Project site.

2.4 Camp Site

A camp will not be set up during Project activities. All Project personnel will be local residents or be accommodated in the Hamlet.

2.5 Equipment

Equipment required for construction of the access road and development of the borrow sources is listed below. Digital photos of the equipment are not available.

- Dozer and loaders – transporting and arranging loads of granular material for road construction and excavation of borrow sources
- Haul/Dump trucks – transporting loads of granular material for road construction and other municipal requirements
- Grader – grading and contouring of the constructed road surface
- Pick-up truck – crew transportation
- Corrugated steel pipe (CSP) – used as culvert material; to be installed at stream crossings and general drainage culverts

2.6 Water

The proposed road route crosses several water bodies, including six (6) streams and the tip of the tidal flat area of Tariugaq Inlet. Water will not be withdrawn from these water bodies for use during the Project.

Stream flow is expected to be negligible in three of the six streams during in-stream construction (culvert installation) with low water flow in the other three streams. Temporary cofferdams will be installed up and downstream of the crossing sites at these streams to enable culvert installation in-the-dry. A water pump around system may be installed to transfer the natural stream flow directly downstream of the work site. The rate of pumping will correspond to the stream flow. An appropriately sized fish screen will be placed on the pump intake to prevent fish entrapment. The downstream pump outlet will also be stabilized, if necessary, to prevent unnecessary scouring and erosion.

The proper installation of temporary cofferdams, silt curtains and silt fences are intended to prevent any potential increases in suspended sediments of waters downstream of the Project. Therefore surface water and groundwater will not be monitored during road construction or borrow source development (see Section 5 for detailed description of mitigation measures).

2.7 Wastewater and Solid Waste

Waste generated during the construction of the access road and development of the borrow sources may include, but not be limited to:

- Waste oil
- Domestic waste from workers daily activities
- Potential contaminated soil/snow

- Overburden and excavated material from culvert installation

Waste generated during the Project, including domestic waste, waste oil and any contaminated soil/snow, will be transported back to the community daily and disposed of or held at approved locations within the municipal solid waste facility. Any waste which is left on-site (i.e., before daily removal), will be stored in approved containers situated at least 100 m from the high water mark of any waterbody. Waste oil and any contaminated soil/snow would ultimately be shipped out of the community to an approved disposal facility during the Hamlet's backhaul program (see also **Appendix D** for the Spill Contingency Plan).

Overburden and material excavated during culvert installation will be stockpiled. The piles will be situated a minimum 100 m from the high water mark of any waterbody to prevent any material from entering any waterbody. The piles will also be sloped a minimum 2:1 horizontal to vertical ratio to prevent wind and water erosion.

The Project will only include the use of the municipal solid waste facility; its location is illustrated in Figure 1 in **Appendix A**. A land farm is not required.

2.8 Fuel

Fuel use during the construction of the access road is estimated in Table 2-1. All fuel used will originate from the municipal tank farm and no fuel will be stored along the Project route. Fuel will be transported to site within the equipment's fuel tank, via pick-up truck equipped with tidy tanks, or via the approved community fuel truck. Fuel use during operation of the borrow sources has not been estimated.

Table 2-1 Estimated fuel use during construction of the proposed access road, Repulse Bay, NU

Type of Fuel	Quantity	Method of Storage	Containment
Diesel	20,000 L	Existing municipal bulk fuel storage facility	Lined Berm Containment Cell
Gasoline	2000 L	Existing municipal bulk fuel storage facility	Lined Berm Containment Cell

Secondary containment is provided within the lined bermed storage area of the municipal tank farm which is expected to meet the CCME Code for Aboveground Fuel Storage Tanks.

Fuel will be transferred through the fuel transfer station at the bulk fuel facility for pick-up trucks and any ATVs. On-site fuelling will likely be required for heavy equipment; this will be performed via hand pump (wobble pump) or electrical pump (on pick-up or fuel truck) over spill pads and minimum of 100 m from the high water mark of any waterbody.

A project-specific Spill Contingency Plan has been developed for construction and operation of the access road and borrow sources and is included in **Appendix D**.

2.9 Chemicals and Hazardous Materials

Chemicals and hazardous materials used during the construction of the access road are estimated in Table 2-2. All chemicals and hazardous materials used will be stored at an approved location, either within the bulk fuel storage facility or within the Hamlet Garage, and transported to site via pick-up truck. Chemicals and hazardous materials used during operation of the borrow pits has not been estimated as operation is expected to last for several years.

Table 2-2 Estimated chemical and hazardous material use during construction of the proposed access road to granular resources, Repulse Bay, NU

Type of Fuel	Quantity	Method of Storage	Containment
Oil and Lubricants	200 L	5 L pails	In lined and bermed storage area

Secondary containment will include a lined and bermed storage area either within the bulk fuel storage facility or within the Hamlet Garage. No chemicals or hazardous materials will be stored at construction sites.

Chemicals (i.e., oils and lubricants) will be transferred via a hand pump into equipment. This will occur within the garage during regular equipment maintenance or, if required, out at site over spill pads and minimum of 100 m from the high water mark of any waterbody.

A project-specific Spill Contingency Plan has been developed for construction and operation of the access road and borrow sources and is included in **Appendix D**.

2.10 Workforce and Human Resources/Socio-Economic Impacts

A Qualified Professional with expertise in northern road building projects will be contracted to manage construction of the access road. The Project will primarily be constructed using local employment and equipment. Local employment will include those individuals presently employed by the Hamlet of Repulse Bay and hiring of other residents, knowledgeable in the use of required heavy equipment. Where possible, training of local Inuit beneficiaries will occur for operation of heavy equipment.

The Project is expected to be completed over two summer construction periods (July to September/October 2011 and 2012) and operate 12 hours a day, five days a week (Monday to Friday). Workers will be transported from the Hamlet to the advancing Project site via passenger vehicle and will be transported back to the Hamlet at the end of each work day.

The Hamlet does not have specific hiring policies for Inuit beneficiaries however will employ as many local Inuit beneficiaries as needed.

2.11 Public Involvement/Traditional Knowledge

Parties most affected by this Project include the Hamlet of Repulse Bay and the Naujaat Hunters and Trappers Organization (HTO). During Nunami's site visit to Repulse Bay in June 2008, consultation occurred with members of the Hamlet of Repulse Bay and the Naujaat HTO. GN-CGS also consulted with the Hamlet regarding the road route during the preparation of the preliminary road design in 2002. Additionally, Elders were involved with and accompanied Nunami during the HRIA conducted in September 2010.

The project is fully supported by the Hamlet. Nunami is not aware of any concerns of residents with the project or its proposed location.

Local knowledge was informally collected by Nunami during their 2008 visit to Repulse Bay. At that time, Nunami was accompanied by the Hamlet foreman (Mr. Roland Tungilik) and a local Elder (Mr. Sata Kidlapik) during their environmental survey and local knowledge of the Project area was obtained.

Local cultural and traditional knowledge were informally collected and incorporated into the HRIA in 2010. A local Elder (Mr. Sata Kidlapik) and a Community Project Support Officer (Mr. Manasie Oingoinn) accompanied Nunami during the field assessment and provided information on aspects of past and current land use.

Information regarding wildlife and plant species, fish presence, and heritage sites were incorporated into the overall assessment and provided excellent background about the Project area.

There are no future consultation plans for the Project. The construction of the access road and operation of the borrow sources are fully supported by the Hamlet and the Hamlet has begun construction of the access road.

3 PROJECT SPECIFIC INFORMATION

3.1 Roads/Trails

3.1.1 Project Information

Field Investigations

In 2002, following their aggregate study, FSC conducted a field survey to identify the proposed route and complete a preliminary road design. FSC completed a more comprehensive road survey in 2010 to establish an appropriate level of accuracy and produce a final road design. Nunami also completed an HRIA to identify sensitive cultural and heritage sites along the road route and suggest mitigative options. The final road route was altered slightly to avoid specific cultural and heritage sites. This final road route is illustrated in Figure 1 in **Appendix A** while the typical road cross-section and culvert detail are presented in Drawing C03 01 in **Appendix B** with the final road design drawings.

Type of Traffic, Access & Maintenance

The proposed road is being constructed to access six previously identified granular resource sites (borrow sources) (FSC 2002). When one or more of the borrow sources are developed, trucks and equipment will travel the road to enable granular resource extraction for use in the community. Granular resource activity will primarily occur during summer months. The road will also be accessible by the public year-round and will be travelled by passenger vehicles, ATVs and snowmobiles.

Regular maintenance on the road will occur during the snow free season in association with maintenance of other roads in the Hamlet. The road will not be maintained or ploughed in the winter for vehicle access.

The proposed access road is located wholly within the Nunavut Settlement Area. Only Nunavut regulatory requirements must be met.

3.1.2 All-Weather Road

3.1.2.1 Road Design and Construction

Road Design for Permafrost

FSC has designed the road for construction in a permafrost area. The road cross-section (Drawing C03 01 in **Appendix B**) is typical permafrost region design, ensuring permafrost degradation is reduced and kept to a minimum. Design features include a minimum 1.0 m deep road sub-base to help insulate the underlying soil, assisting in the development of a solid trail base, and a sloped

shoulder with a 2:1 horizontal to vertical ratio to minimize erosion of the shoulder and prevent cracking.

Construction Materials

As illustrated in the road cross-section of Drawing C03 01 (**Appendix B**), the road bed will be constructed with general granular material. A total of 200,670 m^3 will be required for construction of the access road; this includes 187,360 m^3 for the road sub-base and 13,330 m^3 for the road base (A. Johnson, *pers. comm.*). Granular material will be provided from cuts and fills, the Hamlet's existing granular source and utilization of two identified borrow sources (Deposit Nos. 1 and 3).

The road base will be comprised of a 200 mm layer of 19 mm Granular 'A' or select pit run material; this will be placed over the road sub-base to provide a smooth, safe and low maintenance driving surface. The finished road top will measure 7 m wide. The embankment will have a minimum 2:1 slope with a minimum road sub-base of 1 m high, providing the minimum 11 m wide footprint.

Construction Techniques

As stated previously the road will be constructed following the standard cut and fill method where higher grades will be cut down and lower grades will be filled. Construction will occur during the summer months (July to September) and granular material will be placed over bedrock and surface soils to a minimum of 1 m depth. The road bed will be surfaced with a fine, processed gravel (200 mm layer of 19 mm Granular 'A' or select pit run material). Road bed material will be end-dumped along the leading edge of the advancing road to eliminate direct contact with existing terrain and prevent terrain damage.

Traffic Speed & Dust Management

Road speed will likely be set at 30 km per hour, similar to other municipal roads. The road and road speed will be regulated by the Hamlet in accordance with local bylaws and territorial legislation.

A dust management plan for the operation of the access road had been developed and is included in **Appendix F**. The dust management plan will be implemented during construction and operation of the access road and borrow sources.

3.1.2.2 Culvert Design and Construction

General Culvert Information

Watercrossings and culvert locations are illustrated on Figure 1 in **Appendix A** while typical culvert detail is presented in Drawing C03 01 in **Appendix B**. A total of 11 culverts will be installed along the proposed access road; this includes seven watercrossings and four general drainage culverts. The watercrossings include six streams and the tip of the sand and boulder tidal flat of the marine Tariugaq Inlet. To the knowledge of Nunami, the six streams are unnamed. Culvert locations and Project watercrossing names are provided in Table 3-1 below.

Table 3-1 Culvert locations, watercrossings and Project watercrossing names along the proposed access road, Repulse Bay, NU

Culvert No.	Waterbody	Project Name	Location		
			Kilometre	Latitude	Longitude
1	-	-	0+130	66° 33' 6" N	86° 16' 57" N
2	Tidal flat of Tariugaq Inlet	Cross-1	0+258	66° 33' 5" N	86° 17' 6" W
3	-	-	0+470	66° 33' 2" N	86° 17' 18" W
4	-	-	0+538	66° 33 0" N	86° 17' 20" W
5	Stream #1	Cross-2	2+330	66° 33' 31" N	86° 19' 11" W
6	-	-	3+790	66° 33' 29" N	86° 20' 12" W
7	Stream #2	Cross-3	4+050	66° 33' 23" N	86° 20' 15" W
8	Stream #3	Cross-4	5+020	66° 33' 23" N	86° 21' 32" W
9	Stream #4	Cross-5	5+520	66° 33' 28" N	86° 22' 11" W
10	Stream #5	Cross-6	6+863	66° 33' 8" N	86° 23' 36" W
11	Stream #6	Cross-7	7+880	66° 32' 53" N	86° 24' 35" W

Since the Hamlet began construction of the access road in 2007 and again in 2009 and 2010, three watercrossings have been built. This includes the tidal flat of Tariugaq Inlet (Cross-1), Stream #1 (Cross-2) and Stream #2 (Cross-3). Cross-1 was constructed with granular material and no culverts were installed; rudimentary culverts were installed at Cross-2 and Cross-3.

Culvert Installation

The proposed start date for all construction activities is July 15, 2011. Access road construction is expected to take place over two summers and the predicted completion date is September/October 2012. Construction will begin at the end of the previously constructed portion of the access road (approximately km 4+400) however will include re-routing of several sections between km 0+800 to 4+400; road construction will move successively westward along the proposed route. As mentioned, culverts will be installed at all waterbody crossings, including already constructed crossings of Cross-1 and Cross-2. The installed culvert at Stream #2 (downstream of Cross-3) will be removed and a new culvert installed at the Cross-3 site.

Stream flow is expected to be negligible in three of the six streams (Cross-2, Cross-4 and Cross-7) during construction activities (after the freshet) and low water flow is anticipated in the remaining three streams (Cross-3, Cross-5 and Cross-6). Temporary cofferdams will be installed up and downstream of the crossing sites at Cross-3, Cross-5 and Cross-6 to enable culvert installation in-the-dry. Cofferdams will be constructed using sandbags and 6 mil sheet plastic and be of sufficient height and strength to prevent collapse or overtopping. A water pump-around system will be used to transfer water from the upstream cofferdam to the area downstream of the work site. An appropriately sized fish screen (as per DFO [1995]) will be placed on the pump intake. The downstream pump outlet will be stabilized, if necessary, to prevent unnecessary scouring and erosion. At Cross-1, silt curtains will be installed around the culvert installation site to protect the

downstream area from increased sediments. All temporary in-stream works will be removed following culvert installation and in-stream construction.

FSC sized culverts based on design methodology developed by the California Department of Highways, as well as professional judgement and past experience due to insufficient information on terrain and mapping for the Repulse Bay area (FSC 2011). Corrugated steel pipe (CSP) culverts were sized to either 800 mm or 1600 mm diameter for the access road due to adequacy of flow capacity (outlet control) and construction logistics. The 1 in100 year flood head has been set at culvert diameter plus 400 mm. The two chosen culvert sizes then allows the following flows and drainage areas for the 100 year return period:

- 800 mm: Maximum design flow of 1.21 m^3/s
  Equates to a runoff area of 225,000 m^2 (0.225 km^2) given a slope of 5%
- 1600 mm: Maximum design flow of 4.06 m^3/s
  Equates to a runoff area of 1,163,000 m^2 (1.163 km^2) given a slope of 5%

For more information on culvert design and rationale of selected design, please see FSC (2011) in **Appendix B**. Details on all culvert installations are provided in Table 3-2.

Table 3-2 Culvert sizing and excavation volumes along the proposed access road, Repulse Bay, NU

Culvert No.	Km	Watercrossing	Diameter (mm)	Length (m)	Apron Length[1]		Total Area Excavated (m^2)[2]	Total Volume Excavated (m^3)[3]
					Upstr	Dwnst		
1	0+130	-	800	15.4	1.6	2.4	46.6	28.4
2	0+258	Tariugaq Inlet tidal flat (Cross-1)	1600	26.7	3.2	4.8	166.6	128.3
3	0+470	-	1600	19.3	3.2	4.8	131.0	100.9
4	0+538	-	1600	14.8	3.2	4.8	109.4	84.3
5	2+330	Stream #1 (Cross-2)	800	25.8	1.6	2.4	71.5	43.6
6	3+790	-	800	24.5	1.6	2.4	68.4	41.7
7	4+050	Stream #2 (Cross-3)	1600	23.7	3.2	4.8	152.2	117.2
8	5+020	Stream #3 (Cross-4)	800	13.6	1.6	2.4	42.2	25.8
9	5+520	Stream #4 (Cross-5)	800	14.8	1.6	2.4	45.1	27.5
10	6+863	Stream #5 (Cross-6)	800	19.3	1.6	2.4	55.9	34.1
11	7+880	Stream #6 (Cross-7)	800	15.6	1.6	2.4	47.0	28.7

NOTES:

[1] Apron length set at twice culvert diameter on upstream (Upstr.) and three times culvert diameter on downstream (Dwnst.)
[2] Total area excavated estimated from the excavation of three times the culvert diameter, the culvert length and apron length
[3] Total volume excavated estimated from total area excavated with culverts buried to 20% of their diameter

A backhoe will be used to prepare and grade the culvert bed; all culverts will be installed at a decreasing grade less 0.5%. The installation site will be dug out to three times the width of the culvert (see Table 3-2) and will follow the natural slope and course of the stream channel at the crossing; excavation of the streambeds will be kept to a minimum. A geotextile will be laid down on top of the terrain or streambed to slow culvert settlement to extend its useful life. For this purpose, FSC (2011) specifies a mid-weight, non-woven geotextile of at least 250 g/m^2.

A type 1 fill bedding layer of crushed gravel will be laid over top of the geotextile; the culvert bed will be a minimum of 0.30 m (300 mm) thick. A 0.15 m (150 mm) thick layer of crushed gravel will be placed over the bedding and compacted. The culvert will be placed on top of this layer and covered with a minimum 0.30 m layer of the crushed gravel. Both the bed and overlying layers of crushed gravel will be compacted to 95% standard proctor density in maximum 150 mm lifts. The road base will be applied over top of the compacted gravel. Riprap (100 mm to 150 mm) or sand bags will be or hand placed around the culvert on the road shoulder for stabilization. See Drawing C03-01 in **Appendix B** for a diagram of culvert installation.

All culverts will be buried a minimum of 20% of the culvert diameter at both the upstream and downstream ends. Culvert bottoms will not purposely be covered with substrates, however natural streambed material will eventually accumulate along the culvert bottom. The embedded culverts will retain the stream substrates and provide unimpeded fish passage in streams with the potential for fish presence. The stream channel and its flow capacity should not be altered after culvert installation.

Aprons will also be constructed at the upstream and downstream ends of each culvert to prevent erosion and scouring. Aprons will be constructed of 100 mm to 150 mm riprap and measure twice the culvert diameter on the upstream end and three times the culvert diameter on the downstream end.

Culvert Maintenance

Culverts will be maintained in accordance with the DFO Nunavut Operational Statement for Culvert Maintenance (DFO 2007b). Culverts will be inspected annually by the Hamlet for indications of scour degradation, culvert blockage, diversion of stream flow, bank erosion and flooding.

Culverts may eventually need to be cleaned of debris (e.g., vegetation debris, garbage, ice build-up) to enable unobstructed water passage. If it appears the culvert needs to be cleaned, any materials inside or lodged at the inlet of the culvert will be removed and disposed of away from the stream channel. If sediment accumulation becomes large (i.e., culvert greater than 50% full of sediment), some sediment will be cleared out. Sediment clearing will occur during the low flow period and, if required, sediment control measures (e.g., silt fences) will be installed prior to any sediment clearing in non-ephemeral streams.

3.2 Pits and Quarries

Borrow Source Activities and Material to be Extracted

As mentioned, the Hamlet has already begun digging potential borrow areas at several locations along the constructed access road and ATV trail in search of suitable granular material for road construction. Of the four locations recorded by field crews in 2010, the Hamlet-dug borrow areas are situated near identified Deposit Nos. 1, 2 and 3 (see Figure 3 in **Appendix A**).

Activities included in the project proposal include construction of a road to access granular resources (see Section 3.1) and use of identified granular resources (borrow sources). Deposit Nos. 1 and 3 will be developed first (within two years) and used for construction of the access road. Deposit No. 2 will likely be developed next (within five years) and used by the Hamlet for municipal projects. Table 3-3 outlines activities that may take place at the specific borrow sources, as well as description of the resource, the volume and dimensions.

Table 3-3 Borrow source activities, descriptions, volumes and dimensions; Repulse Bay, NU

Deposit No.	Activities	Description	Volume of Material (m^3)	Dimensions (m)		
				Width	Length	Depth
1[a]	Overburden removal (if any) and pitting	Good ridge of granular material with a readily accessible binder soil nearby	10,000 to 15,000	100[b]	100[b]	1[b]
2	Overburden removal (if any), pitting and quarrying (e.g., cutting, digging and stockpiling)	Excellent source of aggregate; ample supply of course rock (0.2 – 0.3 m), binder material and granular (60 – 100 mm)	75,000 to 100,000	150	150	2.5 to 3.0
3[a]	Overburden removal (if any) and pitting	Primarily contains granular pit material	10,000	75	200	0.75
4	Overburden removal (if any) and pitting	Primarily contains granular pit material	10,000	100[b]	100[b]	1[b]
5	Overburden removal (if any), pitting and quarrying (e.g., cutting, digging and stockpiling)	Contains a large supply of granular material and sufficient binder material and coarse rock (200 – 300 mm) nearby	225,000	100	200	0.75 to 1.0
6	Overburden removal (if any) and pitting	Contains beach ridges of gravel	85,000	75	150	0.75

NOTES:
[a] Deposit Nos. 1 and 3 will primarily be used for access road construction
[b] Dimension of the deposit are estimated

Field Investigations

In 2001, FSC completed an aggregate study in the vicinity of the Hamlet of Repulse Bay to identify new, natural deposits of suitable granular material that would not require drilling and blasting. In September 2001, FSC visited the community and traversed a well-established ATV trail to the west. Six new granular deposits (borrow sources) were located along this ATV trail and are illustrated in Figure 3 in **Appendix A**. Blasting is not required and will not be used to access the granular resources in identified borrow sources. The depth of overburden in the Repulse Bay ranges according to site and is expected to average less than 1m.

The Canada-Nunavut Geoscience Office (CNGO) is also currently completing a surficial geology and aggregate resource analysis of the Repulse Bay area (S. McCuaig, *pers. comm.*); additional information regarding these six deposits may arise following completion of this study.

A carving stone study has not been completed. However as the six identified granular deposits are for borrow purposes, they likely do not contain suitable stones for carving.

Studies for acid-generating and metal leaching potential of granular materials in the borrow sources have not been completed.

Thermokarst & Slumping Potential

The Repulse Bay and Project area are characterized by the presence of thermokarst processes and permafrost-related landforms (e.g., patterned ground, ice-wedge polygons, sorted circles) and is subject to processes such as weathering (e.g., frost shattering) and mass movement (e.g., solifluction, frost creep). Excavation of material at the identified borrow sources will expose underlying permafrost to warming and may cause permafrost thaw and slumping.

FSC (2002) reported depths of the identified borrow sources between 0.75 m and 3.0 m and depth to permafrost in the Repulse Bay area has been reported at 0.60 m (Collins 1991) or greater (S. McCuaig, *pers. comm.*), depending on the terrain and landform. Therefore it is likely that permafrost will be encountered during excavation, particularly in the deeper borrow sources (i.e., Deposit Nos. 2 and 5). Some melt back of the upper permafrost is likely to occur following excavation.

Mitigation measures will be established to protect the underlying permafrost of borrow sources to prevent excessive thaw and subsequent slumping. These mitigation measures include:

- restricting excavation to the active layer in shallow borrow sources;
- ensuring positive drainage away from the pit face to avoid ponded water; and,
- establishing progressive reclamation of depleted sources (smaller pits) or depleted areas of larger borrow pits.

The location of the six deposits will prevent excavation of ice-rich permafrost. The six deposits are located on raised beach ridges, which typically contain course-grained glaciomarine deposits and are less likely to contain ice-rich permafrost (S. McCuaig, *pers. comm.*).

Flood Potential

The six identified borrow sources are situated on raised landforms with well-drained sediments (FMA 2010) and, with the implementation of permafrost mitigation measures described above, the potential for flooding at the borrow sources will be reduced. The establishment of a minimum 100 m undisturbed buffer between the borrow source and the high water mark of any waterbody will further mitigate against flooding potential.

If flooding does become an issue at one or more borrow source, drainage ditches will be constructed to promote drainage away from the pit. Silt fences will be installed downstream of any drainage to permit reduction of suspended solids and any downstream impacts to surface water quality and fish habitat.

Erosion & Sedimentation Potential

To reduce the potential for wind and water erosion of the pit face, floor and stockpiles, all excavated slopes and piles will have a minimum horizontal to vertical ratio of 2:1. Silt fences will also installed downstream of any drainage to reduce suspended solids (sedimentation) in run-off and prevent downstream impacts to surface water quality and fish habitat.

Ground Moisture

The typical moisture content of the ground in the Repulse Bay area is unknown. However according to S. McCuaig (*pers. comm.*), large ice wedge cracks appear on small beaches northeast of the Hamlet near the ocean, and on beach ridge deposits to the northeast and southwest. Well developed ice wedge polygons were rare in the area, but elongate polygons occurred in finer-grained beach ridge deposits in the northeast. Mud boils (frost boils) were observed at many sites in the Repulse Bay area, and form only in low-lying areas between bedrock ridges with glaciomarine diamicton. Where found on slopes, the mudboils are elongated downslope.

Safety Measures

Applying the appropriate health and safety measures at the active borrow source(s) is important for ensuring the health and safety of Hamlet workers and the public. All active borrow sources will be identified with stakes and flagging and access barriers will be installed. The Hamlet will inform all residents of active borrow areas via the local radio and posting of notices; information disseminated will include location of activities, scheduled times of activities, and equipment transport paths.

All Hamlet staff working within the borrow areas will be required to carry handheld radios, wear appropriate personal protective equipment (PPE) (i.e., hardhats, steel-toe boots, reflective vests and appropriate clothing), and work with a buddy system (not alone). Tailgate safety meetings will be held with all borrow source staff prior to the day's activities; these meetings will serve to inform all staff of the day's tasks, potential hazards, mitigation measures, required PPE and emergency procedures.

4 EXISTING ENVIRONMENT

4.1 Physical Environment

4.1.1 Terrain

The Hamlet of Repulse Bay and Project area are located within the Wager Bay Plateau ecoregion of the Northern Arctic ecozone. The region is characterized by broad sloping uplands, plains and valleys (ESWG 2005). Bedrock geology consists primarily of Archaen and early Proterozoic rocks with undifferentiated gneisses, granites and metasediments (Okulitch 1991).

Much of the Project area is covered by large bedrock outcrops and hills, interspersed by valleys and lowlands. Bedrock outcrops observed during the environmental survey were unvegetated, except in depressions where soil had accumulated. Well-drained cobble, gravel and sandy substrates typically occurred on the tops of small hills and on steeper slopes; these sites were dry with little to no standing water. Saturated areas occurred within valley bottoms, on flatlands and shallow slopes where standing and running water from snow melt and streams were present. These areas appeared to have greater soil development and cobbles and boulders were generally interspersed throughout the area.

Large scale surficial geology mapping of the Repulse Bay area indicates the rugged highlands and uplands of the Project area are pre-quaternary Archaen rocks (Dredge 1994). Dredge (1994) also indicates that non-glacial blankets (>1 m) and veneers (<1 m) of offshore and sub-littoral deposits comprise the remaining surficial geology of the Project area. These stratified sand and silt deposits are spread among the undulating bedrock outcrops, have few ice-rafted boulders, and may be gravelly near the surface in some areas. Roche mountonées (whalebacks), generally trending in northwest-southeast direction, are also present within the Project area; however, are more prevalent northeast of the Project area.

Permafrost is continuous throughout the region and Project area, implying the area is underlain by 90 to 100% permafrost (ESWG 2005). Very little site specific information related to permafrost conditions is available for the Repulse Bay area however depth to permafrost is estimated at 0.60 m (Collins 1991) or deeper (S. McCuaig, *pers. comm.*), depending on the terrain and landform. Sitting directly on the Arctic Circle, the area is characterized by the presence of permafrost-related landforms (e.g., patterned ground, ice-wedge polygons, sorted circles) and is subject to processes such as weathering (e.g., frost shattering) and mass movement (e.g., solifluction, frost creep). Fine-grained glaciolacustrine and glaciomarine sediments are more likely to be ice rich than coarse-grained glaciofluvial and till deposits.

Soils are classified primarily as orthic turbic cryosols (CLBRR 1996). This mineral soil type typically has permafrost within 2 m of the surface and generally show marked evidence of cryoturbation (i.e., patterned ground). An organic layer is present at the surface of this mineral soil (up to 15 cm thick)

and is developed from mosses and woody materials in an intermediate state of decomposition (AgriCan 1998).

The preliminary access road route was marked by survey stakes during Nunami's 2008 environmental survey. The well-used ATV trail was also present along the majority of the Project route; this trail leads to the North Pole River and has not been constructed or improved. ATV traffic on this trail appears to have affected permafrost, particularly in low-lying areas, and several sections of the trail have rutted and muddy conditions, indicating ground thaw.

4.1.2 Hydrology

The Project is situated wholly within the Foxe Basin – Repulse Bay watershed of the Hudson Bay ocean watershed. The Project route crosses six streams (Streams #1 to #6) and the tip of a sand and boulder tidal flat of the Tariugaq Inlet. The tidal flat area contained large rocks and boulders. Three ponds and three small lakes are also present within the Project area, located adjacent to or near the proposed access road.

The previously constructed portion of the access road crosses three watercourses (Tariugaq Inlet, Stream #1 and #2) while the ATV trail crosses three other watercourses (Stream #3 to #5); a separate, less used ATV trail also crosses Stream #6. Stream crossing improvements have not been installed at any trail crossing sites and effects to streambeds from ATV traffic are apparent. The stream banks have been eroded from ATV traffic at most of the existing stream crossings. Continued ATV and bank erosion has resulted in widening of the channel and further erosion as travelers search for easier locations to cross. Stream banks and channels are in natural conditions where a well developed trail is not present, usually immediately upstream or downstream of the current crossing.

Nunami completed its environmental survey in June 2008 and all six streams had high spring flows. Stream widths ranged from 0.68 to 3.4 m and the greatest stream flow rate was encountered in Stream # 3, being estimated at less than 0.3 m/s; all other stream flow rates were estimated at less than 0.2 or 0.1 m/s. Based on encountered flow and water depth in 2008 and information received from Mr. Kidlapik and Mr. Tungilik, three streams (Stream #1, #3 and #6) are expected to be ephemeral and flow during the freshet or significant precipitation events only. The remaining three streams (Streams #2, #4 and #5) are expected to flow throughout the ice-free season though freeze to bottom during winter.

The three ponds are situated near kms 2+330 (Cross-2), 3+700 and 8+540 while the three lakes are located near kms 2+330 (300 m north), 4+460 and 7+700. All three ponds were observed to be shallow (less than 1 m deep) during the 2008 environmental survey though depth of the lakes is unknown. These six waterbodies had flooded banks during the spring freshet and the three small lakes were partially ice covered. Spring thaw of freshwater lakes and streams typically occurs in mid June in the Repulse Bay area while freeze up generally happens in early October (S. Mapsalak, *pers. comm.*).

4.2 Biological Environment

4.2.1 Vegetation

Generally the Wager Bay Plateau ecoregion is characterised by a discontinuous cover of tundra vegetation, including dwarf birch (*Betula glandulosa*), willow (*Salix* spp.), northern Labrador tea (*Ledum groelandicum*), avens species (*Dryas* spp.) and ericaceous shrubs (e.g. *Vaccinium* spp.) (ESWG 2005). Willows and sedge dominate in wet areas of this ecoregion.

As part of the 2008 environmental survey, vegetation of the Project area was examined. Nunami's visit took place in June so the vegetation survey was completed at an early time in the growing season; as a result many species were difficult to distinguish due to the lack of vegetative growth. Snow cover was also present in many areas along the proposed route, including at the foot of many slopes, along north-facing slopes, and in other areas with less sun exposure (e.g., shaded by overtopping hills).

Overall, the Project area is dominated by bedrock outcrops with vegetation largely restricted to low-lying and depressional areas where soil and moisture have accumulated. Lichens were the dominant species across the Project area, being found on higher well-drained sites, bedrock depressions, and along the banks of streams and ponds. Purple saxifrage (*Saxifraga oppositifolia*) and Arctic white heather (*Cassiope tetragona*) were also prevalent throughout the Project area and occurred in several habitat types.

As noted, well-drained sites along the Project area were primarily located at the tops of small hills, on sandy soils, and on steep slopes. Lichens comprised a large percentage of the vegetation community in these sites (up to 60%). Other species found on the well-drained dry sites included moss, purple saxifrage, Arctic white heather, mountain avens (*Dryas integrefolia*), moss campion (*Silene acaulis*), bearberry (*Arctostaphylos* spp.), dwarf fireweed (*Chamerion latifolium*), some willows, including net-veined willow (*Salix reticulata*), and grass and sedge species.

Grass and sedge species were the dominant cover in wet lowland and depressional areas, and along the banks of streams and ponds. Lichens were also present in these areas though to a lesser extent. Other vegetation species found here included moss, purple saxifrage, mountain avens, cottongrass (*Eriophorum* spp.), water sedge (*Carex aquatilis*), woolly lousewort (*Pedicularis lanata*), nodding campion (*Silene uralensis*), and several willow species, including Alaska willow (*Salix alaxensis*), net-veined willow and others unidentified.

Table 4-1 lists all vegetation species identified during Nunami's 2008 environmental survey of the Project area. Each species' territorial conservation ranking is provided. No vegetation species identified during the EIS are given rankings by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) or under the *Species at Risk Act* (SARA). It should be noted that the vegetation survey conducted during the EIS was not exhaustive and additional species may be present in the Project area.

Table 4-1 Vegetation species identified along the proposed road route to access granular resources, Repulse Bay, NU

Common Name	Latin Name	Territorial Ranking[1]
Bog rosemary	*Andromeda polifolia*	Secure
Bearberry spp.	*Arctostaphylos spp.*	Secure *A. uva-ursi* ranked as Sensitive; likely outside of Repulse Bay area[2]
Water sedge	*Carex aquatilis*	Secure
Fragile-seed sedge	*Carex membranacea*	Secure
Sedge spp.	*Carex spp.*	-
Arctic white heather	*Cassiope tetragona*	Secure
Mouse-ear chickweed	*Cerastium arcticum*	Secure
Dwarf fireweed	*Chamerion latifolium*	Secure
Mountain aven	*Dryas integrifolia*	Secure
Common horsetail	*Equisetum arvense*	Secure
Tall cotton-grass	*Eriophorum angustifolium*	Secure
Arctic cotton-grass	*Eriophorum scheuchzeri*	Secure
Club-moss spp.	*Lycopodium spp.*	*L. annotinum* ranked as Secure; may occur in the Repulse Bay area[2] *L clavatum* ranked as Sensitive; likely outside of Repulse Bay area[2]
Mountain sorrel	*Oxyria digyna*	Secure
Capitate lousewort	*Pedicularis capitata*	Secure
Woolly lousewort	*Pedicularis lanata*	Secure
Lousewort spp.	*Pedicularis spp.*	*P. groenlandica* and *P. parviflora* (syn *P. parviflora var macrodonta*) ranked as May Be At Risk; likely outside of Repulse Bay area[2]
Alpine bistort	*Bistorta vivipara* *(Persicaria vivipara)*	Secure
Lapland rosebay	*Rhododendron lapponicum*	Secure
Alaska willow	*Salix alaxensis*	Secure
Arctic willow	*Salix arctica*	Secure
Net-veined willow	*Salix reticulata*	Secure
Willow spp.	*Salix spp.*	-
Snow saxifrage	*Saxifraga nivalis*	Secure
Purple saxifrage	*Saxifraga oppositofolia*	Secure
Prickly saxifrage	*Saxifraga tricuspidata*	Secure
Moss campion	*Silene acaulis*	Secure

Common Name	Latin Name	Territorial Ranking[1]
Nodding campion	*Silene uralensis*	Secure
Campion spp.	*Silene spp.*	-
Starwort spp.	*Stellaria spp.*	*S. borealis* ranked as Sensitive; may occur in Repulse Bay area[2] *S. longifolia* ranked as May Be At Risk; likely outside of Repulse Bay area[2]
False asphodel	*Tofieldia pusilla*	Secure
Bilberry	*Vaccinium uliginosum*	Secure
Mountain cranberry	*Vaccinium vitis-idaea*	Secure
Horsehair lichen spp.	*Bryoria spp.*	-
Green reindeer lichen	*Cladina mitis*	-
Cladonia lichen spp.	*Cladonia spp.*	-
Green beard lichen	*Usnea spp*	-
White worm lichen	*Thamnolia subuliformis*	-
Curled snow lichen	*Flavocetraria nivalis*	-
Mushroom spp.	-	-
Moss spp.	-	-

NOTES:
[1] Territorial ranking data from CESCC (2006)
[2] Species occurrences approximated from Porsild and Cody (1980)

4.2.1.1 Rare Plant Species

Rare plant species were not identified during Nunami's 2008 environmental survey of the Project area. However rare plant species may be present. A rare plant can be defined as a species that, because of its biological characteristics or because it occurs at the edge of its main range, exists in low numbers or in very restricted areas (Lucas and Synge 1978). McJannet *et. al.* (1995) list approximately 20 plant species identified as rare in Nunavut (the Inuit Settlement Region of the Northwest Territories at the time of publication); Table 4-2 lists these species and habitat where they have been known to occur.

It should be noted that accurate locations of the following rare plant species within Nunavut could not be determined due to the limited accuracy within the source documents and inherent in the original and historical records. Original sightings of several species occurred prior to the development of accurate positioning systems (e.g., GPS), therefore have resulted in a larger possible area for that species location today. Vascular plant species are also likely under recorded in the region due to the limited vegetation surveys completed and the likelihood that completed surveys did not thoroughly document species location. The following information in Table 4-2 then indicates which species are known or expected to occur in Nunavut, based on nearest known location and/or habitat required. Due to the paucity of data available for rare plants in Nunavut, a list specific to the Repulse Bay area

could not be developed. Rare plant species included in Table 4-2 were not observed during the 2008 EIS.

Table 4-2 Rare plant species known or expected to occur within Nunavut

Common Name	Latin Name	Habitat	Nearest Location[1]	SARA Listing
Alpine Bartsia	*Bartsia alpina*	Moderately well drained areas with high organic content; sunny, grassy slopes[2]	Near Iqaluit & Kimmirut, NU	-
Snowbed sedge	*Carex rufina*	Wet stony places, often by the edge of ponds or on snow beds[2]	Near Arviat, NU	-
Tufted hair grass	*Deschampsia alpina (Deschampsia cespitosa* ssp. a*lpina)*	Calcareous rocks and gravel (decomposed schist, granite and limestone); with low organic content[2]	West end of Meta Incognita Peninsula	-
Norwegian Whitlow-grass	*Draba norvegica*	Imperfectly drained moist areas, river terraces; calcareous rocks, gravel with low organic content[2]	Southhampton Island, Baffin Island and west of Arviat	-
Northern fescue	*Festuca vivipara* ssp. *Glabra*	Imperfectly drained moist areas; tundra turf, gravel, and moist herb mats[2]	Near Alert, NU	-
Moor rush	*Juncus stygius* spp. a*mericanus*	Wet margins of bogs and marly seepages[3]	At Hudson Bay, near Nunavut / Manitoba border	-
Highland Rush	*Juncus trifidus*	Seepage slopes, or dry, gravel, sand. On Baffin Island occurs on springy or sandy slopes, or sheltered sandy sites, often in iron-rich sands on the Beekman Peninsula[2]	Baffin Island (3 locations)	-
Northern Mudwort	*Limosella aquatica*	Wet, muddy, or sandy pond margins[3]	Near Chesterfield Inlet, NU	-
Drummond Bluebell	*Mertensia drummondii*	Substrates: ridges; dry; gravel, sand[2]	Victoria Island and Coronation Gulf area	-
Porsild's Bryum	*Mielichhoferia macrocarpa*	Sites constantly moist during growing season with complete desiccation during the winter season; grows in cracks and cliffs of	One location on Ellesmere Island	-

Common Name	Latin Name	Habitat	Nearest Location[1]	SARA Listing
		calcareous rock, limestone, basalt, sandstone, and shale[4]		
Gray's Point-vetch	*Oxytropis podocarpa*	Imperfectly drained, or moderately well drained hummocks and tundra; acidic, or calcareous; gravel, sand[2]	Southampton Island and Baffin Island	-
Muskeg Lousewort	*Pedicularis parviflora (syn P. parviflora var macrodonta)*	Bogs and marshes[3]	Near Arviat, NU	-
Fowler Knotweed	*Polygonum fowleri* spp. *hudsonianum* (*Polygonum caurianum* spp. *hudsonianum*)	Gravelly pond margins and lake shores[3]	Near Arviat, NU	-
Blunt-leaf Pondweed	*Potamogeton obtusifolia*	Shallow lakes and ponds[3]	Near Baker Lake, NU	-
Dwarf Alkali Grass	*Puccinellia pumila (Puccinellia kurilensis)*	Imperfectly drained moist areas; halophytic; sand, silt; in poorly drained sand or on wet mud at the seashore[2]	Southampton Island, Baffin Island and near Chesterfield Inlet	-
Arctic Alkali Grass	*Puccinellia arctica* (includes *Puccinellia borealis ?, Puccinellia poaceae, Puccinellia agrostidea*)	Alkaline, salt or carbonate encrusted soil, may be the dominant grass in the immediate vicinity; hummocks, stream banks, river terraces, lake shores, slopes, seashore; dry, moderately well drained; sand, silt, clay (of flood plains)[2]	Ellesmere Island	-
Allen Buttercup	*Ranunculus allenii*	Wet tundra[3]	Baffin Island (3 locations)	-
Felt-leaf willow	*Salix silicicola*	Near Athabasca occurs on large, open, active sand dunes, and as scattered individuals or small patches on shallow shifting sands of gravel flats; sometimes on the broad sandy beaches	Pelly Lake, NU	Special Concern, Schedule 1

Common Name	Latin Name	Habitat	Nearest Location[1]	SARA Listing
		and beach terraces of Lake Athabasca. Nothing known about habitat at Pelly Lake, NU.[4]		
Cushion Saxifrage	*Saxifraga eschscholtzii*	Calcareous rocks, particularly gravel, in crevices, and on rocky ledges[2]	Near Resolute, NU	-
Roseroot Stonecrop	*Rhodiola rosea (Sedum rosea)*	Dry tundra, slopes, talus ridges, moist cliffs; imperfectly drained moist areas, or on seepage slopes; rocks, gravel, till; with low organic content; typically occur in crevices or among mats of moss, often near shores, and sometimes in rather rich substrates[2]	Baffin Island (3 locations)	-
Eelgrass spp.	*Zostera marina*	Sheltered tidal flats[3]	Near Arviat, NU	-

NOTES:
[1] Nearest location information from Porsild and Cody (1980), McJannet et. al. (1995), and/or SARA Registry (2011)
[2] Habitat information from Porsild and Cody (1980)
[3] Habitat information from McJannet et. al. (1995)
[4] Habitat information from COSEWIC

4.2.2 Wildlife

Due to the elusive nature of many wildlife species, few species were actually observed during Nunami's 2008 environmental survey of the Project area. Wildlife species observed were primarily avifauna, including Canada geese (*Branta canadensis*), common raven (*Corvus corax*), ptarmigan (*Lagopus* spp.), gulls (*Larus* spp.), Lapland longspur (*Calcarius lapponicus*) and other unidentified songbird species; one mammal, the Arctic ground squirrel (sik sik; *Spermophilus parryii*), was also observed. Wildlife signs were noted at several locations throughout the Project area and this included Arctic fox (*Vulpes lagopus*), caribou, and unidentified geese scat, as well as caribou and sandhill crane tracks. Ninespine sticklebacks (*Pungitius pungitius*) were also observed in two waterbodies along the Project route.

As few wildlife species were actually observed during Nunami's environmental survey, the following sections detail wildlife species that are known or expected to occur in the Repulse Bay area. If a species is known or expected to occur in the Repulse Bay area, it is assumed they may also occur within the Project area. Each species status under territorial conservation ranking is provided, as well as any rankings by the COSEWIC and SARA.

4.2.2.1 Terrestrial Mammals

As previously mentioned, the Arctic ground squirrel was the only terrestrial mammal observed during Nunami's 2008 environmental survey. Evidence of Arctic fox and caribou use of the area were also noted. There are an estimated 24 terrestrial mammalian species known or expected to occur in the Repulse Bay area, with all of the species being non-migratory or resident to Nunavut. These species are listed in Table 4-3. As this Project is primarily a terrestrial project, marine mammals were not considered.

Table 4-3 Terrestrial mammal species known or expected to occur in the Repulse Bay area[1]

Common Name	Latin Name	Migration Habit	Ranking		
			Territorial[1]	COSEWIC	SARA
Arctic fox	*Alopex lagopus*	Resident	Secure	-	-
Arctic grey wolf	*Canis lupus arctos*	Resident	-	Data Deficient	-
Northern grey wolf	*Canis lupus occidentalis*	Resident	Sensitive	Not at Risk	-
Northern collared lemming	*Dicrostonyx groenlandicus*	Resident	Secure	-	-
Victoria collared lemming	*Dicrostonyx kilangmiutak*	Resident	Secure	-	-
Richardson's collared lemming	*Dicrostonyx richardsoni*	Resident	Secure	-	-
Collared lemming	*Dicrostonyx torquatus*	Resident	-	-	-
Wolverine	*Gulo gulo*	Resident	Sensitive	Special Concern	-
Hoary bat	*Lasiurus cinereus*	Resident	Undetermined	-	-
Brown lemming	*Lemmus trimucronatus*	Resident	Secure	-	-
Arctic hare	*Lepus arcticus*	Resident	Secure	-	-
Tundra vole	*Microtus oeconomus*	Resident	Undetermined	-	-
Meadow vole	*Microtus pennsylvanicus*	Resident	Secure	-	-
Ermine	*Mustela erminea*	Resident	Secure	-	-
Least weasel	*Mustela nivalis*	Resident	Secure	-	-
American mink	Mustela vision	Resident	Undetermined	-	-
Muskox	*Ovibos moschatus*	Resident	Secure	-	-
Barren-ground caribou	*Rangifer tarandus groenlandicus*	Migratory / Resident	Sensitive	-	-
Barren-ground shrew	*Sorex ugyunak*	Resident	Undetermined	-	-

Common Name	Latin Name	Migration Habit	Ranking		
			Territorial[1]	COSEWIC	SARA
Arctic ground squirrel	*Spermophilus paryii*	Resident	Secure	-	-
Red squirrel	*Tamiasciurus hudsonicus*	Resident	Undetermined	-	-
Grizzly bear	*Ursus arctos*	Resident	Sensitive	Special Concern	-
Polar bear	*Ursus maritimus*	Migratory / Resident	Sensitive	Special Concern	-
Red fox	*Vulpes vulpes*	Resident	Secure	-	-

NOTES:
[1] Known or expected to occur data and territorial rankings from CESCC (2006).

No terrestrial mammal species occurring in the Repulse Bay area are listed under SARA, however three (3) species, the Wolverine (*Gulo gulo*; the Western Population), Grizzly Bear (*Ursus arctos*) and Polar Bear (*Ursus maritimus*), are nationally ranked as Special Concern by COSEWIC. Of these species, the Grizzly Bear and Polar Bear are also territorially ranked as Sensitive (CESCC 2006). Barren-ground Caribou (*Rangifer tarandus groelandicus*) herds of the Repulse Bay area are territorially ranked as Secure and have not been nationally ranked. However there has been growing concern over their population as many herds have reported declines throughout the range. Based on suggestions from wildlife management boards and other resources, the territorial ranking of Barren-ground Caribou within the Northwest Territories was modified to Sensitive in 2006.

Wolverines are found throughout Nunavut and the population has been estimated at 2,000 to 2,500 individuals. Wolverines utilize a variety of habitats though have specific denning habitats, including boulders, under deadfall, or in snow tunnels on the tundra (COSEWIC 2003). Similarly, Grizzly Bear are found over much of Nunavut and confirmed observations have been reported from the Repulse Bay area. Little is known on the population size or population trend of Grizzly Bears in Nunavut, but the population has been roughly estimated between 800 and 2,000 bears (COSEWIC 2002). Grizzly Bears are known as habitat generalists and, depending on the season, can be found in bedrock habitats, wetland areas with good cover, eskers, and mesic and mat tundra sites (Gau 1998).

Polar bears of the Foxe Basin subpopulation can be found within the Repulse Bay area; this subpopulation has been estimated at 2,100 to 2,300 bears (COSEWIC 2008, Sahanatien and Derocher 2010). Their habitat is closely associated with that of ring seal and sea ice (COSEWIC 2008). In the summer, Polar Bears of the Foxe Basin subpopulation tend to concentrate on Southampton Island and along the Wager Bay coastline, though can also be found on the islands and coastal regions throughout the Foxe Basin area (COSEWIC 2008).

Barren-ground Caribou of the Wager Bay herd are principally found in the Repulse Bay area, typically during their migration in spring through fall; caribou of the Wager herd tend to winter southwest of Wager Bay. Barren-ground Caribou of the Lorillard herd have also been tracked into the Repulse Bay area in spring and summer though their range typically remains south of Wager Bay

year-round (Campbell 2005). Both of these herds are part of the Northeast Mainland caribou, which also includes the Melville and Ahiak herds.

Residents from Repulse Bay harvest Barren-ground Caribou and caribou sign (scat and tracks) were recorded at several locations in the Project area. Mr. Kidlapik, the accompanying Elder during Nunami's environmental survey, reported that caribou are usually present within the Project area during spring, however they were not observed during the survey in June 2008.

Communities within the range of the Northeast Mainland caribou herds have reported general declines in the caribou health and numbers, and a significant decline in caribou from 1983 estimates was noted in 1995 following aerial surveys (Campbell 2005). Subsequent surveys from 1999 to 2004 have been completed and population estimates for the Wager herd stand at 28,128 (± 5,962) individuals in 2004 and 12,155 (± 3,697) individuals for the Lorillard herd in 2003 (Campbell 2005). Population estimates during the latest survey were interrelated due to the discovery that both herds move into and out of each other's range.

4.2.2.2 Avifauna

An estimated 44 avian species are known or expected to occur in the Repulse Bay area; these species are listed in Table 4-4. Only six species are recognized as non-migratory or resident to Nunavut while the remaining 38 species either breed or migrate through the Repulse Bay area (Cornell 2008).

Table 4-4 Avifauna known or expected to occur in the Repulse Bay area

Common Name	Latin Name	Migration Habit	Ranking		
			Territorial[1]	COSEWIC	SARA
Known to Occur[2]					
Spotted sandpiper	*Actitis macularius*	Migratory	Undetermined	-	-
American pipit	*Anthus rubescens*	Migratory	Secure	-	-
Canada goose	*Branta canadensis*	Migratory	Secure	-	-
Rough-legged hawk	*Buteo lagopus*	Migratory	Secure	Not at Risk	-
Lapland longspur	*Calcarius lapponicus*	Migratory	Secure	-	-
Baird's sandpiper	*Calidris bairdii*	Migratory	Secure	-	-
Semipalmated sandpiper	*Calidris pusilla*	Migratory	Sensitive	-	-
Common redpoll	*Carduelis flammea*	Migratory	Secure	-	-
Semipalmated plover	*Charadrius semipalmatus*	Migratory	Secure	-	-
Long-tailed duck	*Clangula hyemalis*	Migratory	Secure	-	-
Common Raven	*Corvus corax*	Resident	Secure	-	-
Horned Lark	*Eremophila alpestris*	Migratory	Secure	-	-

Common Name	Latin Name	Migration Habit	Ranking		
			Territorial[1]	COSEWIC	SARA
Peregrine falcon	*Falco peregrinus anatum/tundrius*	Migratory	Secure	Special Concern	No Status
Pacific loon	*Gavia pacifica*	Migratory	Secure	-	-
Red-throated loon	*Gavia stellata*	Migratory	Secure	-	-
Rock ptarmigan	*Lagopus mutus*	Resident	Secure	-	-
Herring gull	*Larus argentatus*	Migratory	Secure	-	-
Iceland gull / Thayer's gull	*Larus glaucoides / Larus thayeri*	Migratory	Secure	-	-
Glaucous gull	*Larus hyperboreus*	Migratory	Secure	-	-
Snowy owl	*Bubo scandiacus (Nyctea scandiaca)*	Resident	Secure	Not at Risk	-
Snow bunting	*Plectrophenax nivalis*	Migratory	Sensitive	-	-
Common eider	*Somateria mollissima*	Migratory	Sensitive	-	-
Arctic tern	*Sterna paradisaea*	Migratory	Secure	-	-
Expected to Occur[3]					
Greater white-fronted goose	*Anser albifrons*	Migratory	Secure	-	-
Brant	*Branta bernicla*	Migratory	Secure	-	-
Sanderling	*Calidris alba*	Migratory	Sensitive	-	-
Dunlin	*Calidris alpina*	Migratory	Secure	-	-
White-rumped sandpiper	*Calidris fuscicollis*	Migratory	Secure	-	-
Pectoral sandpiper	*Calidris melanotos*	Migratory	Secure	-	-
Hoary redpoll	*Carduelis hornemanni*	Resident / Migratory	Secure	-	-
Snow goose	*Chen caerulescens*	Migratory	Secure	-	-
Ross's goose	*Chen rossii*	Migratory	Secure	-	-
Tundra swan	*Cygnus columbianus*	Migratory	Secure	-	-
Gyrfalcon	*Falco rusticolus*	Resident	Secure	Not at Risk	-
Yellow-billed loon	*Gavia adamsii*	Migratory	Secure	Not at Risk	-
Sandfill crane	*Grus canadensis*	Migratory	Secure	-	-
Willow ptarmigan	*Lagopus lagopus*	Resident	Secure	-	-
Red phalarope	*Phalaropus fulicarius*	Migratory	Sensitive	-	-
American golden plover	*Pluvialis dominica*	Migratory	Sensitive	-	-
King eider	*Somateria spectabilis*	Migratory	Sensitive	-	-
Long-tailed jaeger	*Stercorarius longicaudus*	Migratory	Secure	-	-

Common Name	Latin Name	Migration Habit	Ranking		
			Territorial[1]	COSEWIC	SARA
Parasitic jaeger	*Stercorarius parasiticus*	Migratory	Secure	-	-
Pomarine jaeger	*Stercorarius pomarinus*	Migratory	Secure	-	-
Sabine's gull	*Xema sabini*	Migratory	Secure	-	-

NOTES:
[1] Territorial rankings obtained from CESCC (2006)
[2] Known to occur data from CBIF (2005); data sources include the Canadian Museum of Nature Bird Collection and the Northwest Territories and Nunavut Bird Checklist
[3] Expected to occur data from habitat range information obtained from Cornell (2008)

A single species, the Peregrine Falcon (*Falco peregrinus anatum/tundrius*), is listed as Special Concern under COSEWIC (Table 4-4). The Peregrine Falcon *anatum/tundrius* was originally listed as two separate subspecies, however genetic evidence now shows they are the same (ENR 2010). The Peregrine Falcon had undergone a dramatic decline in population between the 1950s and 1970s, primarily resulting from increased egg mortality from the eggshell thinning effect of pesticides (e.g., DDT). Since the mid-1970s however, the number of nesting pairs has increased and COSEWIC down-listed the Peregrine Falcon from Threatened to Special Concern in early 2007 (COSEWIC 2007). At this time, the Peregrine Falcon was also taken off of the SARA registry and currently has no status.

The Peregrine Falcon breeds in Nunavut and the Repulse Bay area. Exact habitat use or requirements in the Repulse Bay area are unknown, however near Rankin Inlet, it has been reported to nest in south- or southwest-facing vertical coastal cliffs (Court *et al.* 1988a) or in rocky bluffs in inland tundra areas (Court *et al.* 1988b). Similarly, the number of nesting pairs in the Repulse Bay area are unknown but 22 were reported from the Rankin Inlet area in 2000, and over 400 nest sites have been reported in Nunavut as a whole (COSEWIC 2007). Small mammals, including lemmings and juvenile Arctic ground squirrels, can make up an important portion of a Peregrine Falcon's diet though they have also been shown to consume ptarmigans, shorebirds and small songbirds in tundra areas (COSEWIC 2007).

4.2.3 Fisheries

4.2.3.1 Watercrossings

The Project route crosses six streams (Cross-2 to Cross-7) and the tip of a sand and boulder tidal flat of Tariugaq Inlet (Cross-1). The tidal flat area contained large rocks and boulders. Three ponds and three small lakes are also present within the Project area, located adjacent to or near the proposed access road. The following sections outline the site conditions and existing habitat at each watercrossing location, observed during Nunami's 2008 environmental survey.

Tidal Flat of Tariugaq Inlet (Cross-1)

Site Conditions

This crossing spans approximately 107 m and is located between km 0+178 to 0+285 of the access road. An unnamed freshwater lake drains into the tidal area of Tariugaq Inlet approximately 80 m north of the crossing. The crossing has been previously constructed (in 2007) by the Hamlet though no culverts were installed and water drains through the large riprap at the base of the constructed access road. At the crossing site, Tariugaq Inlet is bound to the north, east and west by large bedrock outcrops. See Table 4-5 for site-specific characteristics and Photos 1 to 8 in **Appendix E**.

Table 4-5 Site-specific characteristics at the tidal flat of Tariugaq Inlet (Cross-1) in June 2008

Parameter		Characteristics[1]	
		Upstream (North Side of Crossing)	Downstream (South Side of Crossing)
Slope of crossing		0.30 % [2]	
Substrate	Fines (< 2 mm)	5 %	80 %
	Gravel (2 – 64 mm)	35%	-
	Cobble (64 – 256 mm)	45 %	10 %
	Boulder (> 256 mm)	5 %	10 %
Vegetation	In-stream	Epilithic algae	Epilithic algae Alaska willow, dwarf fireweed, grass and sedge[2]
	On Bank	None (bedrock)	None (bedrock)
Channel Width	Bankfull width	107 m	-
	Wetted width	107 m	-
Water Depth	Mid-channel	0.30 m	-
Flow Rate		≤ 0.2 m/s	-
Channel Pattern		No channel	No channel

NOTES:
[1] As the access road was already constructed at this crossing in 2008, values are given for the upstream and/or downstream sides of the road
[2] Slope value given for entire crossing site
[3] Vegetation present on flooded flats and in-between riprap

Future re-construction of this crossing will include the installation one CSP culvert, installed as per the typical culvert detail illustrated in Drawing C03 01 in **Appendix B**. The only vegetation which may be removed during future improvements at this crossing is that which is between riprap or on an adjacent sand flat. Water flow is expected to be less than 0.2 m/s during any future construction activities at this crossing.

Existing Habitat

No fish species were observed within the tidal flat of Tariugaq Inlet during the environmental survey. The freshwater lake, which drains into the tidal flat north of Cross-1, was reported to potentially freeze to bottom in the winter (S. Kidlapik and R. Tungilik, *pers. comm.*). Both Mr. Kidlapik and Mr. Tungilik commented that Arctic char (*Salvelinus alpinus*) may have swam up the drainage area (approximately 60 m long) between the lake and tidal flat during the summer, before the crossing was constructed, however any fish would have died in the winter when the lake froze. The crossing site of the Tariugaq Inlet tidal flat is reportedly only affected by tides in the summer when the current is strong (S. Kidlapik and R. Tungilik, *pers. comm.*) and may periodically contain fish during these events. The upstream freshwater lake may also contain fish if it does not freeze to bottom, and due to its previous connection to Tariugaq Inlet.

As the crossing has already been constructed and no culverts were installed, it is possible the crossing has removed a potential migration route between the freshwater lake and Tariugaq Inlet. The improvement and proper installation of a culvert at this site will aim to restore this connection and improve water flow and potential fish passage under the access road.

Stream #1 (Cross-2)

Site Conditions

The crossing at Stream #1 is located at km 2+330 of the proposed access road and is located in a shallow valley. In June 2008, the crossing location was vegetated and relatively large amount of standing and flowing water, spread wide, was present on either side of the road due to the spring freshet. This crossing appeared to drain the surrounding hills during the spring, as well as a small pond, located approximately 100 m southwest of the crossing. The water was clear and drained through a sloped vegetated area into a small lake approximately 300 m north of the crossing. Due to the lack of a defined channel up or downstream and primary overland shallow drainage, this crossing is likely ephemeral.

Stream #1 is situated within the previously constructed (2007) portion of the road and a crossing has been installed. One culvert made of 205 L steel drums was installed and water from the upstream side of the road drains north through this culvert. Water may also seep through the large riprap of the road sub-base as flow patterns downstream were not confined to a single channel. See Table 4-6 for site-specific characteristics and Photos 11 to 14 in **Appendix E**.

Table 4-6 Site-specific characteristics at Stream #1 (Cross-2) in June 2008

Parameter		Characteristics[1]	
		Upstream (South Side of Crossing)	Downstream (North Side of Crossing)
Slope of crossing		0.13 % [2]	
Substrate	Fines (< 2 mm)	95 %	93 %
	Gravel (2 – 64 mm)	-	-

Parameter		Characteristics[1]	
		Upstream (South Side of Crossing)	Downstream (North Side of Crossing)
	Cobble (64 – 256 mm)	3 %	5 %
	Boulder (> 256 mm)	2 %	2 %
Vegetation	In-stream	Grass and sedge, common horsetail, moss	Grass and sedge, moss
	On Bank	Purple saxifrage, common horsetail, Arctic white heather, mountain aven, willows, grass and sedge	Purple saxifrage, Arctic white heather, mountain aven, willows, grass and sedge
Channel Width	Bankfull width	No channel	No channel
	Wetted width	5 – 7 m	3 – 5 m
Water Depth	Mid-channel	< 0.30 m	< 0.30 m
Flow Rate		< 0.1 m/s	< 0.1 m/s
Channel Pattern		No channel	No channel

NOTES:
[1] As the access road was already constructed at this crossing in 2008, values are given for the upstream and/or downstream sides of the road
[2] Slope value given for entire crossing site

The drum culvert currently installed at Cross-2 crossing will be replaced with a CSP culvert during future improvements of the constructed access road. Little vegetation will need to be removed during this operation. The pond upstream of the crossing was reported to be present throughout the ice-free season (S. Kidlapik, *pers. comm.*), however as construction will take place after freshet, water flow through the culvert is expected to be negligible.

Existing Habitat

During the 2008 environmental survey, all streams assessed had high spring freshet flows. Based on information received from Mr. Kidlapik and Mr. Tungilik, Stream # 1 at Cross-2 is expected to be ephemeral, flowing during the spring freshet or significant precipitation events only. Due to the lack of defined channel and primary overland shallow drainage, it is unlikely Stream #1 is utilised as a migration corridor or contains suitable habitat for spawning, rearing or food supply.

A ninespine stickleback was observed in the ponded water adjacent to the roadway during the 2008 environmental survey and likely originated from the small pond upstream of the crossing. The small lake downstream of Cross-2 reportedly does not contain fish (S. Kidlapik, *pers. comm.*) though regardless, the area between the small lake and upstream pond appears to be impassable to fish. The improvement of this crossing and installation of a properly sized CSP culvert will improve water drainage under the access road and should not affect any fish habitat potential.

Stream #2 (Cross-3)

Site Conditions

Stream #2 is situated at the toe of an east-facing hillside within a valley, bounded to the east and west by large bedrock hills and outcrops. The valley slopes south towards Talun Bay of Repulse Bay. During the 2008 environmental survey, snow was still present on the south and west facing slopes of the valley.

The crossing at Stream #2 (Cross-3) is located at km 4+050 of the proposed access road. During Nunami's 2008 environmental survey, this portion of the access road was not constructed and though the ATV trail was present. The stream was affected by trail use as ATVs crossed directly through the stream and bank and channel structure were altered at the crossing site. In 2009/2010, the Hamlet continued construction of the access road and this section of the road was constructed, including the stream crossing at the original ATV crossing site; a CSP culvert was installed.

Due to engineering constraints, this portion of the access road has been re-routed in the final road design. The access road and a new crossing location are now situated approximately 90 m upstream of the constructed crossing.

The stream channel was natural upstream and downstream of the ATV crossing in 2008, with slight undercut banks; the banks were overflowed at the time of the environmental survey due to the spring freshet. Stream #2 flows south and was turbulent though clear during June 2008; channel measurements were taken approximately 30 m upstream of the ATV crossing site (60 m downstream of the new crossing) to better reflect the natural conditions of the stream. See Table 4-7 for site-specific characteristics and Photos 16 to 21 in **Appendix E**.

Table 4-7 Site-specific characteristics at Stream #2 (Cross-3) in June 2008

Parameter		Characteristics[1]	
		Upstream (North Side of Crossing)	Downstream (South Side of Crossing)
Slope of crossing		0.24 % [2]	
Substrate	Fines (< 2 mm)	-	10 %
	Gravel (2 – 64 mm)	-	65 %
	Cobble (64 – 256 mm)	-	20 %
	Boulder (> 256 mm)	-	5 %
Vegetation	In-stream	-	None
	On Bank	-	Grass and sedge, bog rosemary, willows, Arctic cotton-grass, purple saxifrage
Channel Width	Bankfull width	-	3.40 m
	Wetted width	-	2.74 m
Water Depth	Mid-channel	-	0.35 m

Parameter	Characteristics[1]	
	Upstream (North Side of Crossing)	Downstream (South Side of Crossing)
Flow Rate	-	≤ 0.3 m/s
Channel Pattern	-	Meandering

NOTES:
[1] As the access road was not constructed at this crossing in 2008, values are given for the downstream areas of the new road crossing (upstream of the previous ATV crossing)
[2] Slope value given for entire crossing site

As the final road design re-routed the access road and crossing 90 m upstream of the constructed crossing, the current CSP culvert installed at this site will be removed. At the new crossing location, some on-bank vegetation will be lost during access road and crossing construction. Stream #2 reportedly flows throughout the ice-free season (S. Kidlapik and R. Tungilik, *pers. comm.*) therefore water will be present during crossing improvements. In-stream works will be completed after the freshet during low flow conditions.

Existing Habitat

During the 2008 environmental survey, all streams assessed had high spring flows. Based on information received from Mr. Kidlapik and Mr. Tungilik, Stream # 2 at Cross-3 is expected to flow throughout the ice-free season. Stream #2 may originate from a small lake approximately 2.0 km to the northeast (NAPL 1995) and flows into Talun Bay, approximately 450 m downstream of Cross-3.

Mr. Kidlapik noted that the headwater lake of Stream #2 likely contains fish and may include lake trout (*Salvelinus namaycush*) however the stream is not expected to contain resident fish species since it likely freezes to bottom in winter (S. Kidlapik and R. Tungilik, *pers. comm.*). Fish presence or movement was not verified during the environmental survey; however due to the stream's connection to Talun Bay and potential fish-bearing headwater lake, Stream #2 may provide a migration route and have suitable fish habitat for spawning, rearing and food supply in the open water season.

Stream #3 (Cross-4)

Site Conditions

Stream #3 is located at km 5+020 of the proposed access road and is situated in a gently sloping valley, bounded to the north, east and west by bedrock hills and outcrops. The proposed access road was not constructed here in 2008 or in 2009/2010; the remainder of the access road route westward has not been constructed though the ATV trail is present.

Boulders were present across the bedrock outcrops and valley slopes however terrain within the valley was largely obscured by snow cover during the 2008 environmental survey. The banks of the stream were also snow covered by a 0.5 to 2.0 m deep snowpack during the survey and stream flow occurred through an open channel between and underneath the snowpack. Though Stream #3 appears to originate from a small lake approximately 700 m north of the crossing (NRCan 2008), Mr.

Kidlapik (*pers. comm.*) reported that the stream only flows during the spring freshet. See Table 4-7 for site specific characteristics and Photos 24 to 26 in **Appendix E**.

Table 4-7 Site-specific characteristics at Stream #3 (Cross-4) in June 2008

Parameter		Characteristics[1]	
		Upstream (North Side of Crossing)	Downstream (South Side of Crossing)
Slope of crossing		0.14 % [2]	
Substrate	Fines (< 2 mm)	5 %	10 %
	Gravel (2 – 64 mm)	15 %	20 %
	Cobble (64 – 256 mm)	70 %	60 %
	Boulder (> 256 mm)	10 %	10 %
Vegetation	In-stream	None	None
	On Bank	Grass and sedge, willows	Grass and sedge, willows, tall cotton-grass
Channel Width	Bankfull width	Unknown[3]	Unknown[3]
	Wetted width	1 – 6 m	1 – 6 m
Water Depth	Mid-channel	0.2 – 0.5 m	0.2 – 0.5 m
Flow Rate		< 0.10 m/s	< 0.10 m/s
Channel Pattern		Meandering	Meandering

NOTES:

[1] As the access road was not constructed at this crossing in 2008, values are given for the upstream and/or downstream areas of the crossing

[2] Slope value given for entire crossing site

[3] Bankfull channel width was not measured due to extensive snowpack

Future construction activities at Cross-4 would include the installation of a CSP culvert and the subsequent construction of the access road; the culvert will be installed as per the typical culvert detail illustrated in Drawing C03 01 in **Appendix B**. Due to the snowpack, little vegetation was visible within the valley though some was visible along the exposed stream banks. Any vegetation which is present at Cross-4 will be lost as construction material and riprap are placed over top. Construction activities will begin after the spring freshet, and as the stream was reported as ephemeral (S. Kidlapik, *pers. comm.*), the flow rate will be negligible during construction of the crossing.

Existing Habitat

During the 2008 environmental survey, all streams assessed had high spring freshet flows. Though Stream #3 appears to originate from a small lake approximately 700 m north of the crossing (NRCan 2008), it is expected to be ephemeral, flowing during the spring freshet or significant precipitation events only (S. Kidlapik and R. Tungilik, *pers. comm.*). Stream #3 had clear water and merges with Stream #4 approximately 130 m downstream (southwest) of Cross-4 and empties into Talun Bay (approximately 700 m downstream of Cross-4). As a result, Stream #3 may be used as a migration route during high spring flows but likely does not have suitable habitat for spawning, rearing or food

supply during the short freshet. The installation of a properly sized culvert at this crossing will allow water and any potential fish species to move through the stream and under the access road.

Stream #4 (Cross-5)

Site Conditions

Stream #4 is located at km 5+520 of the proposed access road. The stream is situated on a gently sloping south-facing valley, bounded to the east and west by bedrock hills. Portions of the valley floor and west-facing bedrock hills were snow covered at the time of the EIS.

The channel at Cross-5 was natural and has not been impacted by ATV crossings; it is situated approximately 370 m upstream of the ATV trail crossing site. Stream #4 had clear water and flowed southeast, eventually into Talun Bay (approximately 1.1 km downstream of Cross-5), and reportedly flows throughout the ice-free season (S. Kidlapik and R. Tungilik, *pers. comm.*). See Table 4-8 for site specific characteristics and Photos 28 to 30 in **Appendix E**.

Table 4-8 Site-specific characteristics at Stream #4 (Cross-5) in June 2008

Parameter		Characteristics[1]	
		Upstream (North Side of Crossing)	Downstream (South Side of Crossing)
Slope of crossing		0.14 % [2]	
Substrate	Fines (< 2 mm)	30 %	40 %
	Gravel (2 – 64 mm)	55 %	20 %
	Cobble (64 – 256 mm)	15 %	25 %
	Boulder (> 256 mm)	< 1 %	20 %
Vegetation	In-stream	Grass and sedge (some)	None
	On Bank	Grass and sedge, Arctic white heather, willows, tall cotton-grass, purple saxifrage, moss	Grass and sedge, Arctic white heather, willows, tall cotton-grass, purple saxifrage, moss
Channel Width	Bankfull width	2.00 m	-
	Wetted width	1.18 m	-
Water Depth	Mid-channel	0.46 m	-
Flow Rate		< 0.20 m/s	< 0.20 m/s
Channel Pattern		Meandering	Meandering

NOTES:
[1] As the access road was not constructed at this crossing in 2008, values are given for the upstream and/or downstream areas of the crossing
[2] Slope value given for entire crossing site

Future construction activities at this crossing include the installation of a CSP culvert and the subsequent construction of the access road. Shoreline vegetation immediately within the road route will be lost. This stream was reported to flow throughout the ice-free season and some flow will likely

be present during construction. In-stream works will be completed after the freshet when stream flow will be minimal.

Existing Habitat

During the 2008 environmental survey, all streams assessed had high spring flows. Stream #4 appears to originate from a lake approximately 1.4 km northwest of Cross-5, and merges with Stream #3 approximately 475 m downstream of Cross-5; this stream then flows into Talun Bay (NRCan 2008).

Based on information received from Mr. Kidlapik and Mr. Tungilik, Stream # 4 at Cross-5 is expected to flow throughout the ice-free season. Stream #4 is not expected to contain resident fish species since it likely freezes to bottom in winter (S. Kidlapik and R. Tungilik, *pers. comm.*) but may provide a migration route and have suitable fish habitat for spawning, rearing and food supply.

Stream #5 (Cross-6)

Site Conditions

Stream #5 is located at km 6+863 of the proposed access road. The stream is located in a slight valley bounded by higher terrain and bedrock hills to the north, east and west. No defined stream channel was present at the proposed crossing site (Cross-6) though the terrain was saturated with water. A defined stream channel with clear water was present approximately 20 m upstream of the Cross-6 site; the water flowed south from the upstream channel through the saturated terrain. Here, the channel divided into several small channels with wide spread flow (Cross-6); a defined channel reformed approximately 5 m downstream of Cross-6.

The ATV trail was also present through this saturated terrain. ATV traffic through this area appears to have contributed to the lack of defined channel here; many ATV tracks were observed across sections of the stream and had caused widened flow areas. The terrain in this area was hummocky with very soft and muddy conditions, due in part to the saturated ground. See Table 4-9 for site-specific characteristics and Photos 32 to 35 in **Appendix E**.

Table 4-9 Site-specific characteristics at Stream #5 (Cross-6) in June 2008

Parameter		Characteristics[1]	
		Upstream (North Side of Crossing)	Downstream (South Side of Crossing)
Slope of crossing		0.19 % [2]	
Substrate	Fines (< 2 mm)	60 %	35 %
	Gravel (2 – 64 mm)	35 %	30 %
	Cobble (64 – 256 mm)	5 %	30 %
	Boulder (> 256 mm)	< 1 %	5 %
Vegetation	In-stream	Grass and sedge	Grass and sedge
	On Bank	Grass and sedge, mountain	Grass and sedge, purple

Parameter		Characteristics[1]	
		Upstream (North Side of Crossing)	Downstream (South Side of Crossing)
		aven, willows, Arctic cotton-grass, moss	saxifrage, mountain aven, willow, moss
Channel Width	Bankfull width	1.34 m	1.60 m
	Wetted width	0.64 m	1.40 m
Water Depth	Mid-channel	0.60 m	0.10 m
Flow Rate		< 0.20 m/s	< 0.20 m/s
Channel Pattern		Meandering	Meandering

NOTES:

[1] As the access road was not constructed at this crossing in 2008, values are given for the upstream and downstream areas of the crossing

[2] Slope value given for entire crossing site

Future construction activities at Cross-6 include the installation of one CSP culvert and the subsequent construction of the access road; the culvert will be installed as per the typical culvert detail illustrated in Drawing C03 01 in **Appendix B**.

Existing Habitat

During the 2008 environmental survey, all streams assessed had high spring freshet flows. Stream #5 appears to originate from a small headwater lake approximately1.4 km northwest of Cross-6, and flow into a larger lake approximately 1.3 km downstream of the crossing; this lake is connected to Talun Bay by a short stream (NRCan 2008).

Based on information received from Mr. Kidlapik and Mr. Tungilik, Stream # 5 at Cross-6 is expected to flow throughout the ice-free season and the downstream lake may contain fish. Stream #5 is not expected to contain resident fish species since it likely freezes to bottom in winter (S. Kidlapik and R. Tungilik, *pers. comm.*) but may provide a migration route and have suitable fish habitat for spawning, rearing and food supply.

Due to the wide spread flows of the saturated area at Cross-6, it is unknown if fish would currently be able to move past this crossing site. The construction of the access road and proper installation of a culvert will remove direct ATV traffic on this terrain and facilitate natural rehabilitation of the stream channel, potentially improving fish passage if it is used as a migration corridor.

Stream #6 (Cross-7)

Site Conditions

Stream #6 is located at km 7+880 of the proposed access road. The stream at Cross-7 is present within a shallow upland, sandy valley bounded to the east and west by bedrock hills. The terrain slopes gently towards the south. A defined and shallow stream channel with clear water was present during the 2008 environmental survey and a separate, less used ATV trail traverses the stream approximately 7 m upstream of Cross-7. The stream has been impacted by ATV traffic as eroded

banks and widened flow were apparent. See Table 4-10 for site-specific characteristics and Photos 37 to 40 in **Appendix E**.

Table 4-10 Site-specific characteristics at Stream #6 (Cross-7) in June 2008

Parameter		Characteristics[1]	
		Upstream (North Side of Crossing)	Downstream (South Side of Crossing)
Slope of crossing		0.16 % [2]	
Substrate	Fines (< 2 mm)	50 %	48 %
	Gravel (2 – 64 mm)	30 %	20 %
	Cobble (64 – 256 mm)	15 %	30 %
	Boulder (> 256 mm)	5 %	2 %
Vegetation	In-stream	Common horsetail	None
	On Bank	Grass and sedge, purple saxifrage, Arctic white heather, mountain aven, willows	Grass and sedge, purple saxifrage, Arctic white heather, mountain aven, willows
Channel Width	Bankfull width	1.25 m	0.68 m
	Wetted width	1.10 m	0.56 m
Water Depth	Mid-channel	0.05 m	0.11 m
Flow Rate		< 0.10 m/s	< 0.10 m/s
Channel Pattern		Meandering	Meandering

NOTES:
[1] As the access road was not constructed at this crossing in 2008, values are given for the upstream and downstream areas of the crossing
[2] Slope value given for entire crossing site

Future construction activities at Cross-7 include the installation of one CSP culvert and the subsequent construction of the access road; the culvert will be installed as per the typical culvert detail illustrated in Drawing C03 01 in **Appendix B**.

Existing Habitat

During the 2008 environmental survey, all streams assessed had high spring flows. Stream #6 appears to originate from the small headwater pond at km 8+540, approximately 450 m northwest of Cross-7. The stream then flows into the small lake located near km 7+700, approximately 160 m to the southeast (NRCan 2008). Due to the shallow depth and low flow encountered during the spring freshet, Stream #6 is expected to be ephemeral; this was confirmed by Mr. Kidlapik (*pers. comm.*) who reported that the stream only flows during precipitation events. No fish were observed in Stream #6 though Mr. Kidlapik noted the downstream lake may contain fish.

Based on encountered water depth and flow conditions during the spring freshet and ephemeral nature, Stream #6 is unlikely to be used as a migration corridor or have suitable habitat for spawning,

rearing or food supply. The installation of a culvert at this site should not affect any fish habitat potential.

4.2.3.2 Fish and Fish Habitat

As mentioned in the preceding sections, fish were observed in two waterbodies: the small pond which drains at Cross-2 and one small lake adjacent to the proposed route (see Figure 2 in **Appendix A**). Both waterbodies contained ninespine stickleback. Additionally, fish may be present in the upstream or headwater lakes of Cross-1 and Cross-3, and downstream lakes of Cross-6 and Cross-7 (S. Kidlapik, *pers. comm.*); this was not verified during the environmental survey however. The watercrossings of Cross-1, Cross-3, Cross-5 and Cross-4 also drain into the marine environment of Talun Bay.

Ninespine stickleback were the only species actually observed during Nunami's 2008 environmental survey. Lake trout (*Salvelinus namaycush*) and Arctic char (*Salvelinus alpinus*) are known to be present in several lakes in the Repulse Bay area; (CBIF 2005, KIA 2007, S. Kidlapik, *pers. comm.*) however, due to the relative paucity of data on freshwater fish species in the Repulse Bay area, a list of fish species known or expected to occur within Nunavut are provided in Table 4-11. The access road does cross a tidal flat area of Tariugaq Inlet and, though the crossing area is only affected by tides during strong currents (S. Kidlapik and R. Tungilik, *pers. comm.*), potential intertidal marine fish species were also included.

An estimated 24 freshwater fish and 11 marine fish species are known or expected to occur within Nunavut (Table 4-11). Four species are listed as Sensitive within Nunavut, including Arctic cisco (*Coregonus autumnalis*; freshwater and marine), least cisco (*Coregonus sardinella*), Arctic char (*Salvelinus alpines*; freshwater and marine) and Arctic grayling (*Thymallus arcticus*). No species are listed by COSEWIC or given status under SARA.

Table 4-11 Freshwater fish known or expected to occur within Nunavut[1,2]

Common Name	Latin Name	Ranking		
		Territorial[2]	COSEWIC	SARA
Freshwater Species				
Longnose sucker	*Catostomus catostomus*	Undetermined	-	-
White sucker	*Catostomus commersonii*	Undetermined	-	-
Cisco	*Coregonus artedii*	Secure	-	-
Arctic cisco	*Coregonus autumnalis*	Sensitive	-	-
Lake whitefish	*Coregonus clupeaformis*	Secure	-	-
Broad whitefish	*Coregonus nasus*	Secure	-	-
Least cisco	*Coregonus sardinella*	Sensitive	-	-
Slimy sculpin	*Cottus cognatus*	Undetermined	-	-
Spoonhead sculpin	*Cottus ricei*	Undetermined	Not at Risk	-
Lake chub	*Couesius plumbeus*	Undetermined	-	-

Common Name	Latin Name	Ranking		
		Territorial[2]	COSEWIC	SARA
Northern pike	*Esox lucius*	Secure	-	-
Goldeye	*Hiodon alosoides*	Undetermined	-	-
Burbot	*Lota lota*	Secure	-	-
Capelin	*Mallotus villosus*	Not Assessed	-	-
Fourhorn sculpin (freshwater form)	*Myoxocephalus quadricornis*	-	Data Deficient	Special Concern, Schedule 3
Deepwater sculpin	*Myoxocephalus thompsonii*	Undetermined	Not at Risk	-
Rainbow smelt	*Osmerus mordax*	Undetermined	-	-
Yellow perch	*Perca falvescens*	Not Assessed	-	-
Trout-perch	*Percopsis omniscomaycus*	Undetermined	-	-
Round whitefish	*Prosopium cylindraceum*	Undetermined	-	-
Ninespine stickleback	*Pungitius pungitius*	Secure	-	-
Arctic char	*Salvelinus alpinus*	Sensitive	-	-
Dolly varden	*Salvelinus malma*	Undetermined	-	-
Lake trout	*Salvelinus namaycush*	Secure	-	-
Arctic grayling	*Thymallus arcticus*	Sensitive	-	-
Marine Species				
Blackline prickleback (Pighead prickleback)	*Acantholumpenus mackayi*	-	Data Deficient	-
Polar cod	*Boreogadus saida*	Not Assessed	-	-
Arctic cisco	*Coregonus autumnalis*	Sensitive	-	-
Arctic staghorn sculpin	*Gymnocanthus tricuspis*	Not Assessed	-	-
Twohorn sculpin	*Icelus bicornus*	-	-	-
Capelin	*Mallotus villosus*	Not Assessed	-	-
Arctic sculpin	*Myoxocephalus scorpioides*	Not Assessed	-	-
Rainbow smelt	*Osmerus mordax mordax*	Undetermined	-	-
Banded gunnel	*Pholis fasciata*	Not Assessed	-	-
Arctic char	*Salvelinus alpinus*	Sensitive	-	-
Fourhorn scuplin (marine form)	*Triglopsis quadricornis (Myoxocephalus quadricornis)*	-	-	-

NOTES:
[1] Known to occur data from CBIF (2005); data sources from the Canadian Museum of Nature Fish Collection
[2] Expected to occur data and Territorial rankings from CESCC (2006)

4.3 Socioeconomic Environment

4.3.1 Local Economy and Traditional Land Use

The population in Repulse Bay was estimated at 748 in 2006, an increase of approximately 22.2% from 2001 (StatsCan 2007). The unemployment rate was reported at 34.5%, up from 28% in 2001, with the sales and service sector being the primary occupation type of the total experienced labour force in Repulse Bay, providing approximately 31% of employment (StatsCan 2007). Occupations in the retail trade, educational and business services are the second and third greatest occupation types in Repulse Bay, retaining approximately 15% and 11% of the total experienced labour force, respectively (StatsCan 2007). Occupations listed as 'other services' employ the greatest amount of the total experience labour force in Repulse Bay at 35%.

The economy of Repulse Bay is largely traditional and many residents engage in traditional hunting and fishing. Repulse Bay is also known for its carvings in bone, ivory and stone. Residents have formed the Aivilik Arts Society to help promote and market Repulse Bay carvings. Tourism opportunities in Repulse Bay include outfitter hunting for caribou, wildlife watching, and access to Ukkusiksalik National Park. Wildlife viewing opportunities include narwhal (*Monodon monoceros*) and other marine mammals, as well as the hundreds of birds that nest on cliffs north of the community.

According to the Kivalliq Inuit Association (KIA), the Project area is located in a high density area of Inuit harvesting (KIA 2007). Species typically harvested by Repulse Bay residents include caribou, Arctic fox, wolf and polar bear (NWMB 2004). Marine mammals, including narwhal and beluga (*Delphinapterus leucas*) are also harvested, though ringed seals (*Pusa hispida*) make up the largest proportion of the marine mammal harvest. Arctic char are also an important species harvested by residents; an average of 4,283 fish are harvested annually for both subsistence and local commercial sale (NWMB 2004).

4.3.2 Heritage Resources

Following an initial site file search conducted in 2008, Nunami recommended a Heritage Resource Impact Assessment (HRIA) be completed prior to construction of the access road. The Government of Nunavut Department of Culture, Language, Elders and Youth (GN-CLEY) concurred with this recommendation and, in September 2010, Nunami completed the HRIA of the proposed access road route. The HRIA included a desktop site file search and a field inventory and assessment program.

During the course of the HRIA, 27 archaeological sites (MdHs 17 to 21 and MdHt 2 to 23) were newly recorded; no historic or traditional land use sites were identified. Features associated with the archaeological sites include 10 caches, four fox traps, three hearths, three hunting blinds, nine marker stones (Inuksuit), two Inukshuk lines, two quarry locations, five tent rings, one stone arc, and one stone feature. It was recommended that a buffer zone of 20 m be established around these site features to facilitate avoidance by the proposed development footprint. If avoidance was not possible then additional mitigative measures would be recommended.

A copy of this report has been submitted to GN-CLEY for their review and comment on findings and proposed mitigation.

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5 ENVIRONMENTAL ASSESSMENT

5.1 Overview

This environmental assessment has been completed using the standard corporate methodological framework developed by Nunami to meet the requirements of the *Nunavut Land Claims Agreement Act* and other legislation. The environmental effects assessment method is based on a structured approach that:

- Considers mandatory and discretionary factors;
- Focuses on issues of greatest concern;
- Affords consideration of all federal and territorial regulatory requirements for the assessment of environmental effects;
- Considers all issues raised by the public, aboriginal people and public stakeholders; and,
- Integrates engineering design and programs for mitigation and monitoring into a comprehensive environmental planning process.

The environmental assessment focuses on specific environmental components (called Valued Environmental Components [VECs]) that are of particular value or interest to regulators and other stakeholders. VECs for the biophysical environment typically represent major components or aspects of the physical and biological environment (e.g., Atmospheric Environment and Aquatic, Terrestrial and Marine Ecosystems) that might be altered by the Project, and are widely recognized as important for ecological reasons. VECs for the Socio-cultural and Economic Environment are aspects of the human environment that include such components as Economy, Employment, Land Use, Traditional Land and Resource Use, etc.

Interactions between Project activities and the environment were considered according to the potential for an activity to interact with one or more VECs of the biophysical or human environment. Project interactions with the environment were considered based on the following:

1. No interaction
2. Interaction occurs however based on past experience and professional judgment, the interaction would not result in a significant environmental effect, even without mitigation; or, interaction would not be significant due to the application of codified environmental protection practices that are known to effectively mitigate the predicted environmental effects
3. Interaction could result in an environmental effect of concern; the potential environmental effects are considered further in the environmental assessment

The assessment of each Project environmental effect begins with a description of the mechanisms whereby specific Project activities and actions could result in the environmental effect. Where

possible, the temporal and spatial extent of these changes (i.e., where and when might the environmental effect occur) is also described. Mitigation measures that will help reduce or eliminate an environmental effect are then described, with an emphasis on how these measures will help alter the environmental effect.

Potential adverse effects of the Project on the identified VECs of the biophysical and human environments of the Project area are listed in the NIRB Table1 (Nunami Table 5-1). Proposed mitigation measures for the potential adverse effects are described below and outlined in the NIRB Table 2 (Nunami Table 5-2). Decommissioning activities have not been considered for the access road as it planned to be a permanent feature. Reclamation activities are considered for the borrow sources.

5.2 Physical VECs

5.2.1 Permafrost

5.2.1.1 Access Road

Construction

Construction of the access road can have an adverse effect on permafrost by disturbing the surface soil (e.g., use of heavy equipment and ongoing travel) and lead to potential warming and melt back of the upper permafrost layer. In low-lying areas on fine-grained poorly drained soil, the existing ATV trail (along or near the proposed road route) has had an effect on the permafrost as rutting and muddy conditions are present. The use of heavy equipment on the terrain during road construction could exacerbate this effect and create a larger impact area as equipment is forced around muddy conditions.

To mitigate the potential effect from heavy equipment on the terrain, the end dump method of construction will be applied. Here, granular material will be dumped off the leading edge of the advancing road, eliminating the need for construction equipment to travel on the existing ground surface (see Table 5-2). The constructed road bed will provide a stable driving surface and will prevent direct impact to terrain while also reducing the required footprint as all site preparation and construction activities will be confined to the road alignment.

In areas where the trail is located on fine-grained soils which have been damaged from use, FSC through its final road design, abandoned the trail alignment and situated the proposed access road on natural ground surface. This approach provides several benefits including:

- Eliminating the need to repair the existing alignment before upgrading;
- Enabling the alignment to be properly constructed, allowing for reduced maintenance and increased longevity; and,
- Allowing for natural rehabilitation of impacted trail areas.

For access road sections situated on raised, dry granular soils or in rocky areas, the existing trail alignment is utilized. The layer of granular road material over the terrain will also help insulate the underlying soil, assisting in the development of a solid road base.

Operation

During access road operation, potential environmental effects can arise from increased use of the road and surrounding area. While it is expected that construction of the access road will focus recreational users to a single trail, the provision of the access road will encourage more use than currently occurs. Unrestricted travel off the access road may cause impacts to the surrounding environment, as the vegetation and soil is disturbed by off-road travel. These potential problems cannot be prevented but can be minimized through education and enforcement. Off-road travel by ATVs will be discouraged and/or limited by the Hamlet as much as possible to protect the surrounding terrain and permafrost.

Therefore with applied mitigation, adverse environmental effects of construction and operation of the access road on permafrost are considered mitigable and not significant (see Table 5-1). Residual effects are not expected.

5.2.1.2 Borrow Sources

Construction and Operation

Use and operation of the borrow sources can have an adverse effect on permafrost by removing the surface soil layer and exposing the underlying permafrost to enable warming and melting. The use of heavy equipment for material excavation and transportation can further disturb the surface soil or exposed permafrost and exacerbate warming and thaw.

Very little site specific information for permafrost is available for the Repulse Bay area and depth to permafrost depends on the terrain and landform type. Collins (1991) reported permafrost at a depth 0.60 m in a large beach reach complex approximately 10 km northwest of the community, while initial results from the CNGO aggregate study indicate permafrost depth on beach ridges greater than 0.60 m (S. McCuaig, *pers. comm.*). FSC (2002) reported depths of the borrow sources between 0.75 m and 3.0 m and encountering permafrost during excavation is likely, particularly in deeper borrow sources (i.e., Deposit Nos. 2 and 5). Therefore melt back of the upper permafrost layer may occur following excavation.

However, mitigation measures will be established to protect the underlying permafrost of the borrow sources to prevent excessive thaw. These mitigation measures include restricting excavation to the active layer in shallow borrow sources, ensuring positive drainage away from the pit face, and establishing progressive reclamation of depleted sources. If it becomes known that pit faces or areas may become unstable due to erosion and permafrost melt, additional mitigation will be implemented. This will include temporary reclamation at borrow sources which will be used seasonally (i.e., summer only). At these sources, an organic layer will be placed over the excavated face(s) in the fall to provide insulation and protect face(s) from thaw and erosion during spring.

The location of the six deposits will prevent excavation of ice-rich permafrost. The six deposits are located on raised beach ridges, which typically contain coarse-grained glaciomarine deposits and are less likely to contain ice-rich permafrost (S. McCuaig, *pers. comm.*). However if a borrow source proves to have ice-rich permafrost and avoidance is not possible, mitigation measures will be established to protect this permafrost layer. Measures may include conducting excavation work in winter and replacing an organic layer prior to spring to provide an insulating layer, protecting against thaw.

Therefore with applied mitigation, adverse environmental effects of development and operation of the borrow sources on permafrost are considered mitigable and not significant (see Table 5-1). Residual effects are not expected.

TABLE 5-1 - IDENTIFICATION OF ENVIRONMENTAL EFFECTS ARISING FROM CONSTRUCTION AND OPERATION OF AN ACCESS ROAD AND BORROW SOURCES, REPULSE BAY, NU

		ENVIRONMENTAL COMPONENTS	PHYSICAL	designated environmental areas (ie. Parks, Wildlife Protected areas)	ground stability	permafrost	hydrology/ limnology	water quality	climate conditions	eskers and other unique or fragile landscapes	surface and bedrock geology	sediment and soil quality	tidal processes and bathymetry	air quality	noise levels	other VEC:	other VEC:	other VEC:	BIOLOGICAL	vegetation	wildlife, including habitat and migration patterns	birds, including habitat and migration patterns	aquatic species, incl. habitat and migration/spawning	wildlife protected areas	other VEC:	other VEC:	other VEC:	SOCIO-ECONOMIC	archaeological and cultural historic sites	employment	community wellness	community infrastructure	human health	other VSEC
	PROJECT ACTIVITIES																																	
CONSTRUCTION	**ACCESS ROAD**																																	
	Transportation of workers					M														M	M	M							M	P		P		
	Transportation of granular fill					M														M	M	M							M	P		P		
	Placement of granular fill					P	M	M												N									M	P		P		
	Use of heavy equipment					M	M	M												N	M	M							M	P		P		
	Culvert installation						M	M															M							P		P		
	BORROW SOURCES																																	
	Overburden Removal					M	M	M						M						M	M	M							M	P		P		
OPERATION	**ACCESS ROAD**																																	
	General operation					P		M												M	M	M	M							P		P		
	Traffic (light & heavy vehicles)							M						M							M	M												
	Maintenance						M	M															M							P				
																				M			M											
	BORROW SOURCES																																	
	Excavation of granular material				M	M	M	M												M	M	M	M							P		P		
	Transportation of granular material							M						M									M							P		P		
	Piling of overburden and granular material							M						M																P				
DECOMMISSIONING	**ACCESS ROAD**																																	
	None - not applicable																																	
	BORROW SOURCES																																	
	Reclamation					P	P	P												P	P	P												

Notes: Please indicate in the matrix cells whether the interaction causes an impact and whether the impact is:

- ***P*** *Positive*
- ***N*** *Negative and non-mitigatable*
- ***M*** *Negative and mitigatable*
- ***U*** *Unknown*
- ***If no impact is expected then please leave the cell blank***

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TABLE 5-2 - MITIGATION AND MONITORING DURING CONSTRUCTION AND OPERATION OF AN ACCESS ROAD AND BORROW SOURCES, REPULSE BAY, NU

	PROPOSED MITIGATION MEASURE	IMPLEMENTATION SCHEDULE	RESIDUAL IMPACTS	PROPOSED MONITORING SCHEDULE	REPORTING SCHEDULE
IMPACTS (IDENTIFIED IN TABLE 5-1)					
ACCESS ROAD					
Construction: - Transportation of workers - Transportation of granular fill - Use of heavy equipment	• Minimize spatial extent of granular material placement and activity • Re-routing of final road route to natural ground, away from areas damaged by ATV trail use • Regular inspection of all equipment for leaks • Implementation of Spill Contingency Plan & Dust Management Plan • Limit duration of construction period • Avoid critical periods (e.g. bird breeding season)	July - October 2011 July - October 2012	None	None	
Construction: - Placement of granular fill	• Minimize spatial extent of granular material placement and activity • Regular inspection of all equipment for leaks • Utilizing clean equipment and granular material to protect against deposition of deleterious substances • Implementation of Spill Contingency Plan & Dust Management Plan • Limit duration of construction period • Avoid critical periods (e.g. bird breeding season) • If in-stream for culvert installation, installation of temporary cofferdams to enable work-in-the-dry	July - October 2011 July - October 2012	None	None	
Construction: - Culvert installation	• Restriction of in-stream works to periods of low or no flow • Utilizing clean equipment and granular material to protect against deposition of deleterious substances • Regular inspection of all equipment for leaks • Installation of temporary cofferdams to enable work-in-the-dry • Installation of silt fences (up-shore of ponds/lakes) • Retention of vegetated banks • Implementation of mitigation measures outlined in DFO's Operational Statements for Timing Windows and Culvert Maintenance • Implementation of the Spill Contingency Plan	July - October 2011 July - October 2012	None	None	
Operation: - General operation - Traffic - Maintenance	• Implementation of Dust Management Plan • Implementation and enforcement of road speeds • Discourage and/or limit off-road ATV travel • Implementation of mitigation measures outlined in DFO's Operational Statement for Culvert Maintenance • Minimize spatial extent of any maintenance activity	July - October 2011 July - October 2012	None	None	

	PROPOSED MITIGATION MEASURE	IMPLEMENTATION SCHEDULE	RESIDUAL IMPACTS	PROPOSED MONITORING SCHEDULE	REPORTING SCHEDULE
BORROW SOURCES					
Construction: - Overburden removal	• Restriction of excavation to the active layer in shallow borrow sources • Ensure positive drainage away from pit faces • Establishing progressive reclamation of depleted sources; includes temporary reclamation at seasonal borrow sources • Avoidance of ice-rich permafrost areas • Implementation of Dust Management Plan • Ensuring any all piles and walls are sloped with a minimum 2:1 horizontal to vertical ratio • Minimizing spatial extent of excavation • Establishment of minimum 100 m buffer between any borrow pit and the high water mark of any waterbody • Installation of down-gradient silt fences • Restriction of borrow pit operations to non-critical wildlife periods	July - October 2011 July - October 2012	None	None	
Operation: - Excavation of granular material - Transportation of granular material - Piling of overburden and granular material	• Restriction of excavation to the active layer in shallow borrow sources • Ensure positive drainage away from pit faces • Establishing progressive reclamation of depleted sources; includes temporary reclamation at seasonal borrow sources • Avoidance of ice-rich permafrost areas • Implementation of Dust Management Plan • Ensuring any all piles and walls are sloped with a minimum 2:1 horizontal to vertical ratio • Discourage and/or limit off-road travel • Minimizing spatial extent of excavation • Establishment of minimum 100 m buffer between any borrow pit and the high water mark of any waterbody • Installation of down-gradient silt fences • Restriction of borrow pit operations to non-critical wildlife periods	July - October 2011 July - October 2012	None	None	

5.2.2 Air Quality

5.2.2.1 Access Road and Borrow Sources

Construction and Operation

Construction and operation of the access road and borrow sources could have an adverse effect on local air quality due to the potential for fugitive dust in the Project area. Fugitive dust may be generated by use of the access road by ATV, light and heavy equipment, as well as development of the borrow sources. As no blasting, crushing or screening activities will be occurring within the borrow sources, dust generation is only expected from excavation, stockpiling, and transport activities.

A Dust Management Plan (DMP) has been developed for operation of the access road and borrow sources (see **Appendix F**). Mitigation measures for dust management of the access road and borrow sources involve suppression, reduction and effect-minimizing activities, such as:

- Watering of the access road as well as smaller access roads to the borrow sources during dry summer periods;
- Ensuring all material piles are sloped with a minimum 2:1 horizontal to vertical ratio to reduce wind erosion;
- Orienting pit faces with consideration to prevailing winds to direct any generated dust away from the community and other land uses (e.g., access road);
- Closing borrow source excavation on high-wind days;
- Limiting speeds of heavy equipment and/or haul/dump trucks to reduce generation of fugitive dust during material transport; and,
- Watering of the pit floor if the above mitigation measures prove inadequate to control dust generation from the borrow sources.

Therefore with applied mitigation, adverse environmental effects of construction and operation of the access road and borrow sources on air quality are considered mitigable and not significant (see Table 5-1). Residual effects are not expected.

5.2.3 Hydrology / Water Quality

5.2.3.1 Access Road

Construction

Access road construction can affect stream hydrology and water quality from the placement of granular material, the use of heavy equipment, and culvert installation. Adverse effects may include altered stream hydrology, the release of and/or increase in downstream sediments, and the deposition of deleterious substances (e.g., fuel spills). Two ATV trails have affected five of six

streams along the Project route since ATV traffic traverses directly on the streambeds. Construction of the water crossing structures (Section 3.1.2.2) should result in a net environmental benefit as the bank erosion and sedimentation currently occurring will be eliminated.

However potential adverse effects to stream hydrology and water quality during in-stream work will be avoided by restricting any in-stream construction to periods of low or no flow, construction of temporary cofferdams to enable work in-the-dry, and confining heavy equipment to the constructed portion(s) of the access road only. Permanent alteration of the stream channel is not required for the installation of any culverts and any effects to stream hydrology and downstream water quality will be temporary and short-term. Installation of culverts may result in a minor positive effect on stream hydrology as traffic will be expected to use the constructed stream crossings rather than travelling within the streambeds. Removal of ongoing disturbance from ATV crossings will facilitate natural rehabilitation of the stream channel and stream flow patterns.

Potential adverse effects to water quality may result from the potential release of a deleterious substance(s), including use of contaminated materials or fuel leaks/spills; an increase in suspended sediments may also occur in adjacent ponds/lakes and at Cross-1. Clean equipment and clean granular materials will be used for work near or in any waterbody (see Table 5-2). Regular equipment inspection and maintenance, installation of silt fences (upshore of ponds/lakes) and silt curtains (at Cross-1), and retention of vegetated banks will also prevent and mitigate potential effects to water quality. An emergency spill kit will be kept on-site with working equipment and, in the event of spill, the Spill Contingency Plan (**Appendix D**) will be immediately initiated. Many of these mitigation strategies are also detailed in DFO's OS' for timing windows and culvert maintenance. These OS' will be adhered to for in-stream works to help mitigate any effect on hydrology and downstream water quality (see **Appendix C** for signed statements of confirmation).

Operation

Increased dust in the Project area and completion of as-needed culvert maintenance during access road operation can negatively affect water quality; potential effects include increased turbidity/total suspended solids and heavy metals. These effects will be mitigated with the methods outlined in the DMP (see **Appendix F**) and adhering to the prescribed procedures in the DFO OS' for Culvert Maintenance.

Therefore with applied mitigation, adverse environmental effects of construction and operation of the access road on hydrology and water quality are considered mitigable and not significant (see Table 5-1). Residual effects are not expected.

5.2.3.2 Borrow Sources

Construction and Operation

Development of the borrow sources could have an adverse effect on hydrology by altering natural surface drainage patterns (through removal of natural vegetation and contours) and potential destabilisation of any banks or shores. These effects will be mitigated by minimizing the borrow pit footprint and necessary vegetation removal; ensuring there is no obstruction of natural drainage, no

flooding or channel diversion; and, establishing a minimum of a 100 m undisturbed buffer between any borrow pit and the high water mark of a waterbody.

Similar to access road construction and operation, development and excavation of the borrow sources may negatively affect water quality by causing an increase in turbidity/total suspended solids. This effect could be caused by increased dust in the Project area, increased sedimentation in run-off from the borrow pits.

The potential for fugitive dust will be controlled by methods outlined in the DMP (**Appendix F**). Increased sediment in pit run-off and drainage water will be mitigated by reducing the potential for erosion (ensuring any pit walls or piles are sloped with a minimum 2:1 horizontal to vertical ratio), and installation of silt fences down-gradient of any drainage within the borrow source(s).

Therefore with applied mitigation, adverse environmental effects of development and operation of the borrow sources on hydrology and water quality are considered mitigable and not significant (see Table 5-1). Residual effects are not expected.

5.3 Biological VECs

5.3.1 Vegetation

5.3.1.1 Access Road

Construction

Access road development will have a total footprint of approximately 95,955 m^2 (0.096 km^2; 8.729 km road length by 11 m wide road base). Vegetation within the access road route will be covered by granular materials as a result of road construction and lost. The removal of the vegetation community will have minor adverse effect on biodiversity and natural vegetation communities in the Project area.

Loss of vegetation underneath the road bed is unavoidable and unmitigable. However to minimize the loss of native vegetation communities and associated biodiversity, the area of disturbance during access road construction will also be minimized (see Table 5-2). The mitigation measures described for permafrost in the Section 5.1.1.1 (i.e., site preparation and construction confined to the road alignment, minimize number of vehicles required, and restrict heavy equipment to constructed portions of the road) will minimize the area of native vegetation disturbed and therefore the potential loss of biodiversity.

Operation

Operation of the access road can adversely affect the habitat quality and productivity of vegetation as a result of increased dust in the Project area, or from further effects to vegetation from potential off-road travel by ATVs (see Table 5-1). Increased dust cover on vegetation can cause increased heat absorption and reduced transpiration while off-road travel can further affect natural vegetation communities and biodiversity.

Dust effects to vegetation during road operation will be mitigated with methods outlined in the DMP (**Appendix F**). Off-road travel by ATVs will also be discouraged and limited by the Hamlet during road operation.

Therefore with applied mitigation, adverse environmental effects of construction and operation of the access road on vegetation are considered mitigable and not significant (see Table 5-1). Residual effects are not expected.

5.3.1.2 Borrow Sources

Construction and Operation

Development of the first three borrow sources (Deposit Nos. 1 to 3) in the next two to five years will have a total footprint of 47, 500 m^2 (0.0475 km^2). Development of all six borrow sources will have a total footprint of approximately 88,750 m^2 (0.089 km^2). Vegetation within the borrow source footprints, though scarce in some areas, will be removed as a result of borrow source excavation; this effect is unavoidable and unmitigable.

The removal of the vegetation community within the borrow source footprints will have minor adverse effect on biodiversity and natural vegetation communities. To mitigate against unnecessary loss of native vegetation communities and associated biodiversity, the borrow source footprint during operations will be minimized. Progressive reclamation the borrow sources following subsequent depletion of granular materials will also be completed (see Table 5-2). To facilitate progressive reclamation, any organics and overburden removed during borrow pit development will be properly salvaged and stored to enable use during reclamation.

Operation of the borrow pits may have an adverse effect on the habitat quality and productivity of vegetation in the Project area due to fugitive dust (see Table 5-1). Increased dust cover on vegetation can cause increased heat absorption and reduced transpiration. The potential for fugitive dust will be controlled by methods outlined in the DMP (**Appendix F**).

Therefore with applied mitigation, adverse environmental effects of development and operation of the borrow sources on vegetation are considered mitigable and not significant (see Table 5-1). Residual effects are not expected.

5.3.2 Wildlife

5.3.2.1 Access Road and Borrow Sources

Construction

Direct effects to wildlife (avifauna and mammals) are expected to be minimal during access road construction or borrow pit development; most wildlife species are mobile and are not likely to suffer mortality or injury due to direct contact with construction/excavation equipment or materials during placement. However if wildlife are encountered during road construction or borrow pit development, activities will be halted until the animal(s) has moved away from the Project area. It may also be necessary to limit or avoid construction or excavation activities if evidence of migrating caribou cows

and/or calving is present within the Project area. Any wildlife encountered during road construction or borrow pit development will not be harassed and all wildlife fatalities, if any, will be immediately reported to the local Wildlife Officer.

Sensory disturbance effects (i.e., habitat avoidance) on wildlife may also occur as a result of road construction and borrow source excavation activities. The Project area has been subject to a moderate level of human use as a result of its proximity to the community and its access trail to the North Pole River. Despite the area's use by residents, evidence of several resident and migratory wildlife species, including caribou, Arctic fox, Arctic ground squirrel, Canada geese, common raven, ptarmigan, sandhill crane and songbirds, were observed within the Project area during the 2008 environmental survey.

Sensory disturbance effects to wildlife will be mitigated by restricting access road construction and borrow source development to non-critical periods (e.g., after early July for nesting avifauna) and the temporary and/or short-term nature of the Project. The access road will be constructed over two summer seasons and any sensory disturbance effects to wildlife would be temporary and short-term. Excavation of borrow sources will only occur during the summer and in localized areas so though sensory disturbance effects may occur annually, they would be short-term and very small on a geographic scale. As a result of road construction and borrow source development, wildlife that may currently use the immediate Project area may temporarily avoid the area, however similar habitat is available adjacent to the Project area.

Construction of the access road and development of borrow pits will result in an unavoidable minor amount of habitat loss (combined approximate total of 0.185 km^2; includes access road footprint and six borrow sources). The Project area does provide habitat for several migratory wildlife species, however due to the small amount of habitat lost, direct habitat loss due to Project construction is considered not significant. Habitat of similar quality is available for wildlife in the immediate surrounding areas.

Peregrine falcon nests may be present in the Project area however interaction with these nests is not expected; nests are typically located on rocky bluffs and cliffs and the access road route and borrow sources locations are not situated in these areas. However if any active Peregrine falcon or other raptor nests are encountered during access road construction or borrow source development, a buffer of 100 m will be established around the nests; the nests will remain undisturbed and will be reported to the local Wildlife Officer.

Operation

Additional sensory disturbance effects, such as permanent avoidance of the area by some wildlife species, may arise during access road and borrow pit operation due to increased heavy equipment and light vehicle traffic in the area. As mentioned, the area has been subject to a moderate level of human use and several wildlife species were observed in the Project despite this. Some wildlife avoidance of the Project area during access road and borrow pit operation will be unavoidable. However the restriction of pit operation to non-critical periods, limiting road speeds, and the primary use of the road and borrow pits in summer will help mitigate against long-term wildlife avoidance.

Operation of the access road may negatively affect wildlife mortality (i.e., increase mortality) due to the increased potential for vehicle-wildlife collisions, particularly with small mammals and avifauna (e.g., Arctic ground squirrels, songbirds). The new access road will be frequented by ATV traffic as well as some heavy equipment during borrow pit operation. Road kills to larger mammals, such as caribou and wolves, will be prevented by reducing access road speed limits and giving wildlife the right of way. The new road is expected operate under the same municipal laws and regulations as the rest of the Hamlet roads. To reduce the potential for wildlife road kills, these restrictions may need to be placed on the new road and particularly enforced during times of the year when evidence of caribou and other wildlife are present in and adjacent to the Project area.

During operations, the access road will provide the improved access to the Project area and the North Pole River, potentially resulting in increased access to harvest wildlife. It is expected that the HTO and residents will monitor resource harvesting activity and implement any controls, if/when necessary.

Therefore with applied mitigation, adverse environmental effects of construction and operation of the access road and borrow sources on wildlife are considered mitigable and not significant (see Table 5-1). Residual effects are not expected.

5.3.3 Fisheries

5.3.3.1 Access Road

Construction

As there is potential for fish presence in or downstream of Cross-1, Cross-3, Cross-5 and Cross-6 during culvert installation, in-stream construction will need to be restricted within a timing window to avoid sensitive life stages; fish presence downstream of ephemeral streams (e.g., Cross-2, Cross-4 and Cross-7) was not considered as flow will be negligible during in-stream work.

In the DFO Nunavut Operational Statement for In-Water Construction Timing Windows (DFO 2007a), the timing window recommended for spring and fall spawning fish, or unknown species, will be adopted for all in-stream construction activities at these crossing sites. The recommended window, when in-stream work is allowed, for waterbodies in the Repulse Bay area (Zone 2) is July 15th to August 15th, inclusive. This timing window has been applied as the presence of spring spawning fish (i.e., Arctic grayling [*Thymallus arcticus*] or northern pike [*Esox lucius*]) was not confirmed and the presence of fall spawners (i.e., Arctic char, lake trout, and whitefish) was indicated. The July 15th to August 15th timing window is also ideal for in-stream construction at the non-fish bearing streams (Cross-2, Cross-4 and Cross-7) as it occurs after the spring freshet and stream flow will be negligible in these streams.

From the preceding discussion on Hydrology and Water Quality for the access road (Section 5.2.3.1), effects to water bodies and fish habitat during construction may arise from sedimentation during road construction and other depositions of deleterious substances. The mitigation measures described in Section 5.2.3.1 (restriction to periods of low or no flow, work in-the-dry, clean

equipment, etc) will mitigate effects to fish or other aquatic life and fish habitat in streams and adjacent water bodies during construction (see Table 5-2). The additional mitigation measures for in-stream work outlined in DFO's OS' for timing windows and culvert maintenance will also be followed to help mitigate any potential adverse effect on hydrology and downstream water quality (see **Appendix C** for signed statements of conformation).

Stream flow is expected to be negligible in three of the six streams (Cross-2, Cross-4 and Cross-7) during construction activities (after the freshet) however low water flow is anticipated in the remaining three streams (Cross-3, Cross-5 and Cross-6). Temporary cofferdams upstream and downstream of the crossing sites with a pump around system will be used to enable culvert installation in-the-dry. An appropriately sized fish screen will be placed on the pump intake and the downstream pump outlet will be stabilized, if necessary, to prevent unnecessary scouring and erosion. At Cross-1, silt curtains will also be deployed around the culvert installation site to protect the downstream area from increased sediments.

Silt fences will be installed up-shore of the three ponds and three small lakes adjacent to the access road route to protect water quality and potential fish habitat within. During the 2008 environmental survey, ninespine stickleback were observed within one pond and one small lake adjacent to the ATV trail and proposed access road (see Figure 2 in **Appendix A**) and other species may be present, particularly in the small lakes. With these applied mitigation measures, sedimentation is not expected to have a significant or permanent adverse effect on fish and aquatic life in waterbodies along the access road route. Furthermore, construction of the access road is expected to be completed over two summer seasons and any potential adverse effects on fish and aquatic life are expected to be temporary and short-term.

Operation

Residents currently utilize the North Pole River for fishing and recreation. The new access road will provide improved access to the North Pole River and other fishing locations and enable more people to access the North Pole River; this may result in more use of the fisheries resource. It is expected that local authorities will monitor fishing activity and implement controls to preserve populations if necessary.

Fugitive dust arising from access road operation could also negatively impact fish habitat in the Project area through increased sedimentation and reduced water quality. Culvert maintenance activities may also increase downstream sediment. These effects will be effectively mitigated with methods outlined in the DMP to control fugitive dust (**Appendix F**) and the compliance with the DFO OS' for Culvert Maintenance. With mitigation, adverse environmental effects from road operation on fisheries would then be considered not significant (see Table 5-1).

Therefore with applied mitigation, adverse environmental effects of construction and operation of the access road on fisheries are considered mitigable and not significant (see Table 5-1). Residual effects are not expected.

5.3.3.2 Borrow Sources

Construction and Operation

As mentioned in the preceding discussion on Hydrology and Water Quality for the Borrow Pits (Section 5.2.3.2), effects to waterbodies and fish habitat during borrow source development may arise from alteration of natural drainage patterns, increased sedimentation from increased dust or potential pit run-off and drainage, and other depositions of deleterious substances (i.e., fuel spills, etc). The mitigation measures described in Section 5.2.3.2 (minimum 100 m natural buffer from the high water mark of any waterbody, minimum 2:1 ratio for slopes, installation of down-gradient silt fences, collection of drainage water if necessary), as well as the Spill Contingency Plan (**Appendix D**), will mitigate effects to fish or other aquatic life and fish habitat in streams and adjacent water bodies during development and operation of the borrow sources (see Table 5-2).

Therefore with applied mitigation, adverse environmental effects of development and operation of the borrow sources on fisheries are considered mitigable and not significant (see Table 5-1). Residual effects are not expected.

5.4 Socioeconomic VECs

5.4.1 Local Economy and Traditional Land Use

5.4.1.1 Access Road and Borrow Sources

Construction

Construction of the Project will have a short-term positive effect on the Repulse Bay economy by creating seasonal jobs for Repulse Bay residents as equipment operators, foremen and other construction and excavation personnel (see Table 5-1).

Operation

The construction and operation of the access road will have a positive effect on community infrastructure by providing access to granular resources needed for community development. With permanent access to and operation of the borrow pits, improvements to community infrastructure and new projects requiring granular material could be completed.

Access road completion results in a new road which can be used by all residents to access the North Pole River, an area currently frequented by community members. A properly constructed road will provide a defined and safe driving surface that will allow all ATV access to the North Pole River, without the fear of getting lost or stuck along the way. This will open up the North Pole River area to more residents than currently visit the area due to poor trail conditions.

Development of the road also improves access to land beyond for hunting and other traditional activities. Land beyond the Project area ranges from rock outcrop to rolling tundra and ATVs or snowmobiles will be required. Though vehicular traffic (e.g., passenger cars, trucks) will increase on the new access road, it is not expected to increase use of the areas beyond the road. Since the land

beyond the Project area is presently accessible from the existing trail by use of ATVs or snowmobiles, use of this land is not expected to significantly increase as a result of access road completion.

Completion of the Project is expected to have a positive but negligible effect on community wellness and human health. The access road may enable more people to get on the land and pursue traditional activities as well as increase potential consumption of country foods (e.g., Arctic char).

The access road is proposed for local and municipal use, however over time, tourists may use the road to access the North Pole River for sightseeing, wildlife viewing, and potential fishing opportunities. Increased tourism opportunities can generate increased economic benefits in the form of guiding opportunities and increased expenditures resulting from longer stays in the community by tourists.

Therefore a net positive effect on local economy and traditional land use is expected with construction and operation of the access road and borrow sources (see Table 5-1). Limited positive residual effects are expected.

5.4.2 Heritage Resources

5.4.2.1 Access Road and Borrow Sources

Construction

Construction of the access road and development of borrow sources could potentially alter, disturb or destroy heritage sites along the access road route and within borrow source footprints. From FMA (2010), due to the fact that precontact archaeological, historical and traditional land use sites represent discrete episodes of past activities, they are non-renewable and are susceptible to alteration or removal by modern development. Precontact and historic archaeological sites are comprised of residues of past cultures or societies. Although the cultural entities responsible for deposition of the archaeological material are not available for observation, the preserved context and associations in which the remains functioned can reveal many clues about past human behaviour, adaptations and relationships to the natural world. The key to the interpretation of these remains, however, is in their pattern of cultural deposition. The pattern of deposition is the product of unique processes and conditions of preservation. Consequently, once they are disturbed, the context of the remains cannot be replaced or re-created. As a result, because of the specific nature of their origin and preservation, archaeological resources are finite in quantity and are increasingly susceptible to destruction and depletion through natural and cultural disturbances. Unfortunately, one large tent ring and adjacent Inuksuit identified during Nunami's 2008 environmental survey have been destroyed by previous construction of the access road and a staging area (near Stream #2/Cross-3).

Adverse effects to archaeological sites, identified prior to the construction stage of development, can be significantly reduced or eliminated through avoidance or adequate study. Site avoidance can be achieved by relocation of the proposed project or by restriction of the construction within the development zone. Adequate study of archaeological sites generally involves scientific investigations

which are designed to systematically explore and reconstruct the activities that are represented at the site.

FMA (2010) recommended a minimum of a 20 m buffer zone around each of the 27 archaeological sites that were newly identified and recorded during their field investigations. These recommendations were communicated to FSC prior to final road design and were considered; several sections of the road design were re-routed to avoid identified archaeological sites and provide the minimum 20 m or greater buffer zone. The recommended buffer zone or greater will also be applied during borrow source development.

Operation

Operation of the access road and borrow sources could impact identified or unidentified archaeological sites if off-road traffic (i.e., ATVs, snowmobiles) or heavy equipment infringes on the buffer zones and/or archaeological sites. Off-road travel will be discouraged and/or limited by the Hamlet during access road operation. At borrow sites, the boundary of the allowable excavation will be clearly marked to reduce the potential for infringing on buffer zones of archaeological sites.

Therefore with applied mitigation, adverse environmental effects of construction and operation of the access road and borrow sources on heritage resources are considered mitigable and not significant (see Table 5-1). Residual effects are not expected.

6 CUMULATIVE EFFECTS

From the NIRB Guide #2, *Guide to Terminology and Definitions*, a cumulative effect is described as "…an impact on the biophysical and socio-economic environment that results from the incremental effects of a development when added to other past, present and reasonably foreseeable future developments, regardless of what agency or person undertakes such other developments. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time". From this definition, cumulative effects from the construction and operation of the access road construction and borrow sources have been assessed and the following key questions considered:

1. Are there residual Project-related adverse environmental effects?
2. Do identified residual Project-related adverse environmental effects overlap with (i.e., act in combination with) those of other existing projects and activities?
3. What is the contribution of the Project to those overlapping cumulative environmental effects of present projects, if any?
4. Do the combined Project and cumulative environmental effects of present projects or activities overlap with those of any approved or proposed projects that will be carried out?

These questions were considered for each VEC to the extent that they are applicable within the environmental effects investigation conducted in Section 5. Those VECs which may have cumulative effects from construction and operation of the access road and borrow sources, and known previous, current or reasonably foreseeable future developments are considered below.

6.1 Physical VECs

Residual effects of construction and operation of the access road and borrow sources were not identified for permafrost, air quality, or hydrology and water quality. Further, there are no known previous, current or reasonably foreseeable developments within the Project area which might affect the permafrost, air quality or hydrology and water quality of the Project area, Repulse Bay area, or geographic region.

6.2 Biological VECs

Residual effects of construction and operation of the access road and borrow sources were not identified for vegetation, wildlife or fisheries. Further, there are no known previous, current or reasonably foreseeable developments within the Project area which might affect the vegetation, wildlife or fisheries of the Project area, Repulse Bay area or geographic region.

6.3 Socioeconomic VECs

6.3.1 Local Economy and Traditional Land Use

Within the Project area, there are no known previous developments which might affect the Repulse Bay economy or traditional land use within the Project area, Repulse Bay area or geographic region during construction and operation of the access road and borrow sources.

Presently, Stornoway Diamond Corporation has mineral claims on 451,900 acres of land near and north of Repulse Bay. Prospecting and diamond drilling has been undertaken by Stornoway and kimberlite bodies have been identified, representing a potential mineral deposit between 21.9 to 26.7 million carats of diamonds (Stornoway 2010). Due to the proximity of the mineral claims to the community, it is anticipated that residents and businesses may be engaged by Stornoway to assist with annual field investigations and camp support.

Due to the short-term and limited positive effect of the Project on local economy and traditional land use, current or future development of the Stornoway project should not act cumulatively with any positive Project effects.

6.3.2 Heritage Resources

Within the Project area, there are no known previous developments which might affect heritage resources of the Project area, Repulse Bay area or geographic region during access road construction or operation.

As mentioned in the preceding section, Stornoway currently operates a prospecting and drilling operation near and north of the Repulse Bay. It is assumed Stornoway is required to complete some level of heritage resource assessment within its holdings for its current development and would be required to complete archaeological assessments if their project proceeds to future development. Due to this, cumulative effects to heritage resources are not expected.

7 SUPPORTING DOCUMENTATION

Supporting documentation includes:

- Appendix A: Figures, including the proposed access road route (Figure 1), culvert and watercrossing locations (Figure 2) and approximate borrow source footprints (Figure 3)
- Appendix B: FSC Architects and Engineers Repulse Bay Road Final Design
- Appendix C: DFO Statement of Conformation
- Appendix D: Spill Contingency Plan
- Appendix E: Photographs
- Appendix F: Road to Granular Resources Dust Management Plan

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APPENDIX A

Figures

Construction and Operation of an Access Road and Borrow Sources at Repulse Bay, NU

Repulse Bay Final Road Design

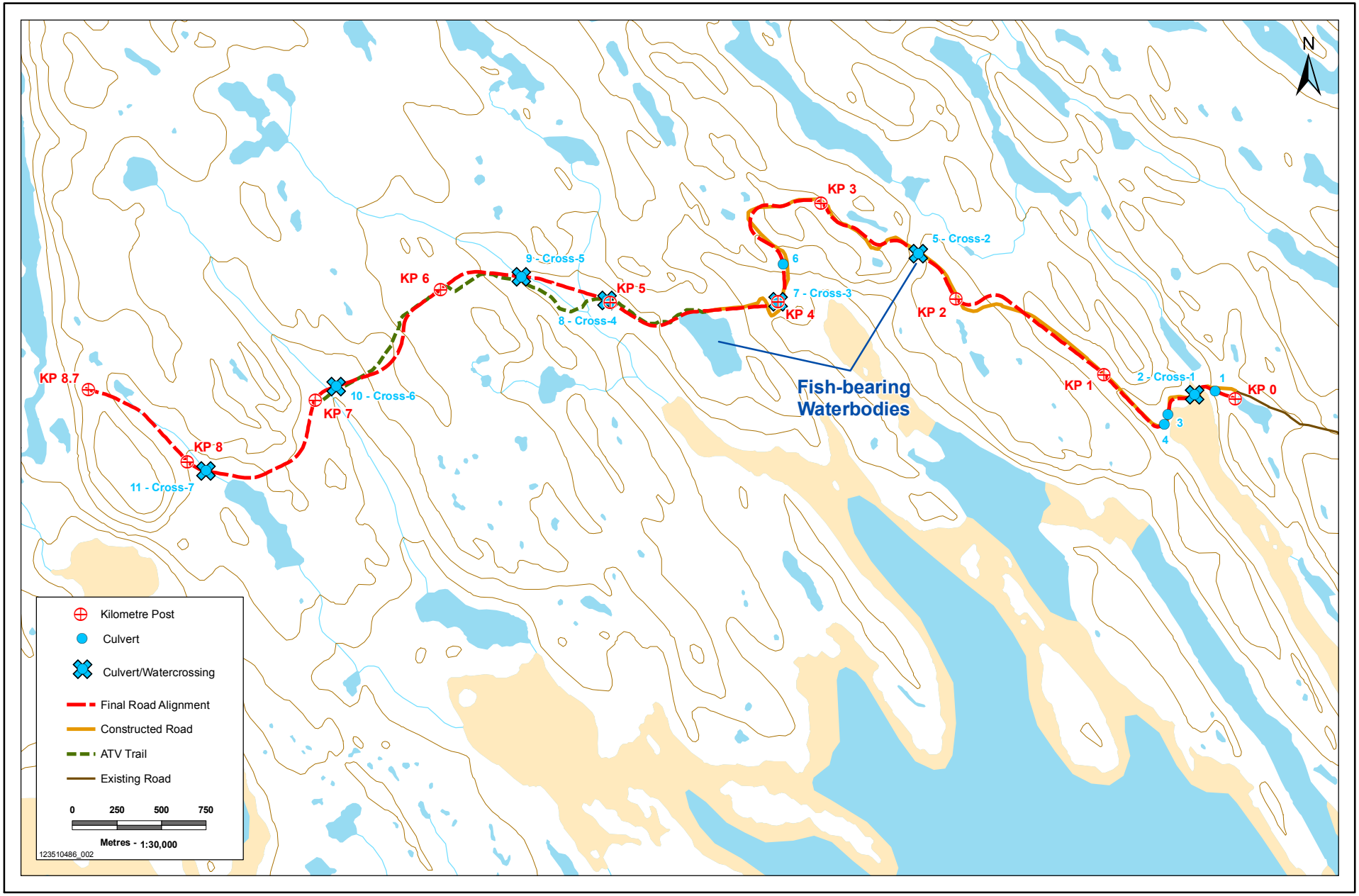
Acknowledgements: Original Drawing by Nunami Stantec; NTS Data: Sheet 046L09, 1:50,000 provided by Government of Canada, Natural Resources Canada, Centre for Topographic Information

PREPARED FOR
NUNAMI STANTEC

PREPARED FOR

FIGURE NO.
1

Last Modified: March 8, 2011 by pselmo



Construction and Operation of an Access Road and Borrow Sources at Repulse Bay, NU

Repulse Bay Final Road Design and Watercrossings

Acknowledgements: Original Drawing by Nunami Stantec; NTS Data: Sheet 046L09, 1:50,000 provided by Government of Canada, Natural Resources Canada, Centre for Topographic Information

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FIGURE NO. **2**

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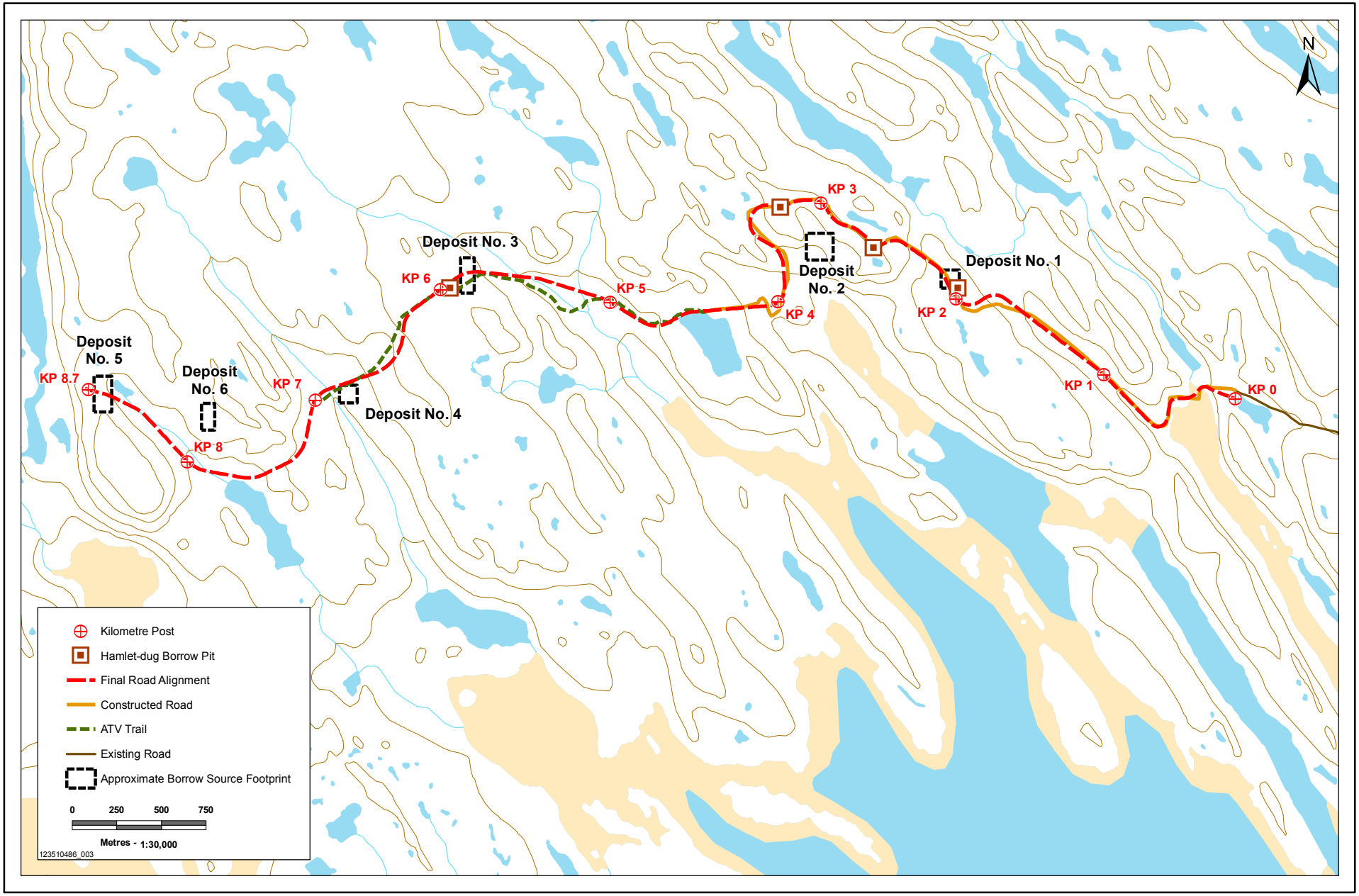

Construction and Operation of an Access Road and Borrow Sources at Repulse Bay, NU

Repulse Bay Final Road Design and Borrow Source Locations

Acknowledgements: Original Drawing by Nunami Stantec; NTS Data: Sheet 046L09, 1:50,000 provided by Government of Canada, Natural Resources Canada, Centre for Topographic Information

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FIGURE NO.
3

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APPENDIX B

FSC Architects and Engineers Repulse Bay Final Road Design

REPULSE BAY ROAD

FSC
ARCHITECTS & ENGINEERS

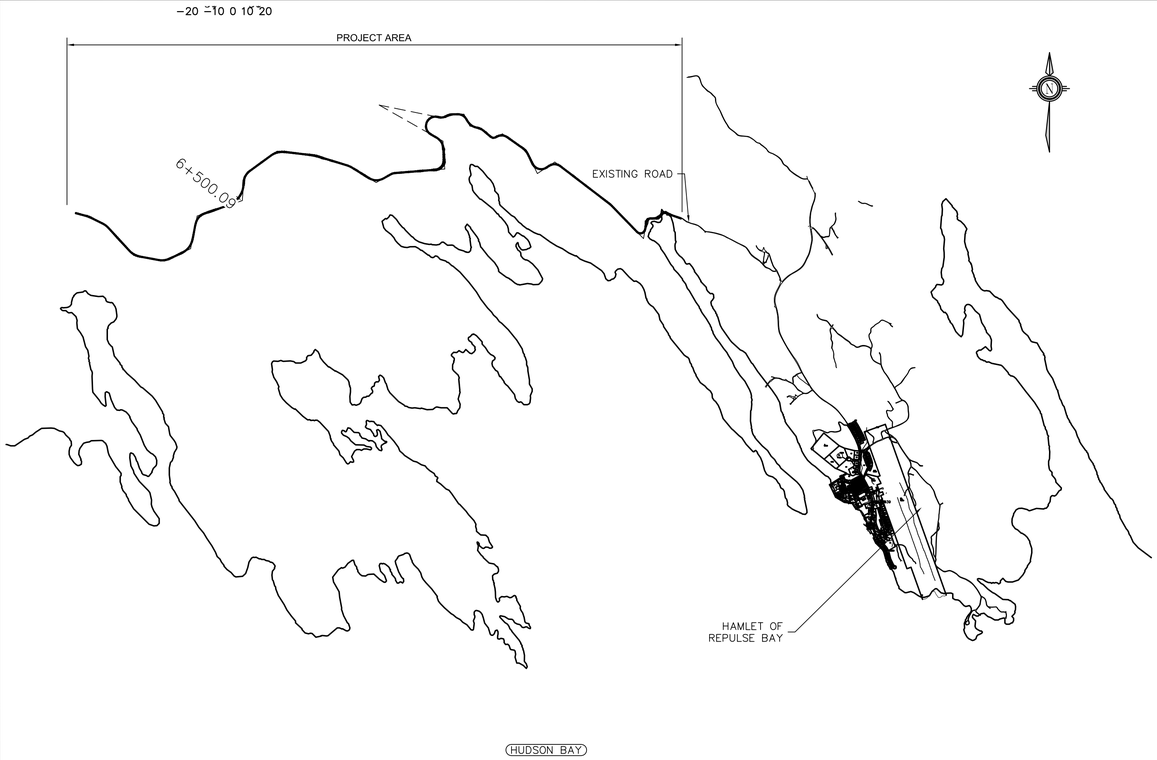
4910 - 53rd Street, P.O. Box 1777,
Yellowknife, NT, X1A 2P4, Canada
Tel: (867) 920-2882 Fax: 920-4319

Nunavut

FINAL DESIGN

DRAWING LIST

FSC Job # 2010-0880
FEBRUARY 3, 2011



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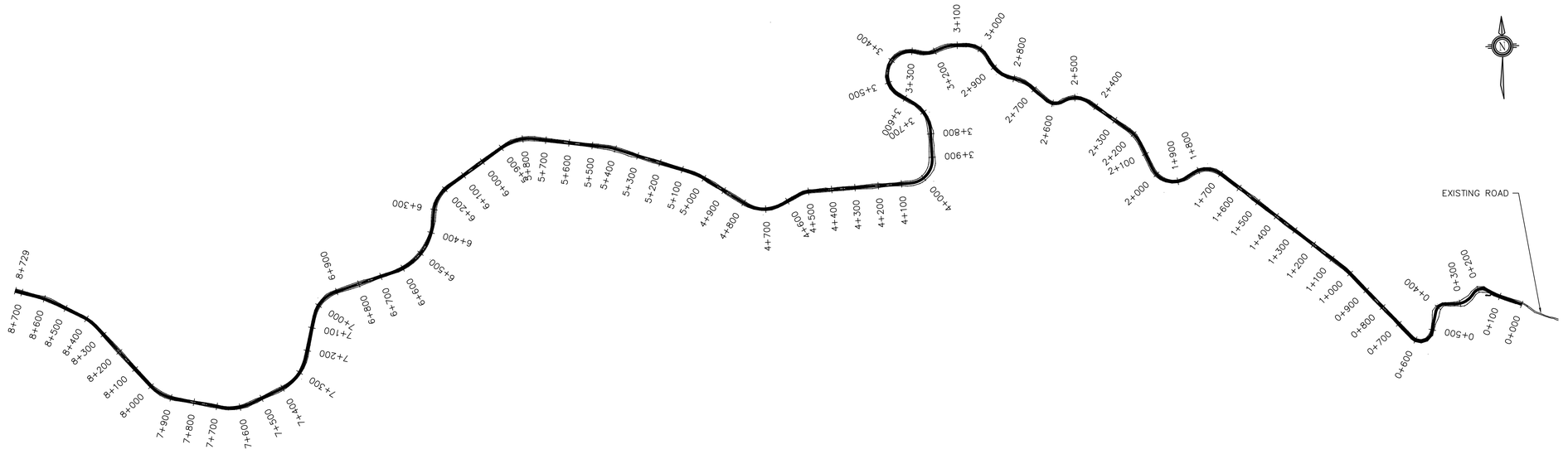

2 / C01-01 OVERALL LAYOUT OF ROADWAY
SCALE: 1:30000

NO.	REVISION DESCRIPTION	DATE ISSUED
3	FINAL DESIGN REV 1	2011/02/03
2	FINAL DESIGN	2010/11/30
1	ISSUED FOR INTERNAL REVIEW	2010/11/17

PROFESSIONAL SEAL / PERMIT TO PRACTICE

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Date 03 FEB 2011
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REGISTERED PROFESSIONAL ENGINEER
A.F. JOHNSON
NWT/NU
2010 0880

FSC
ARCHITECTS & ENGINEERS
4910 - 53rd Street, P.O. Box 1777
Yellowknife, NT, X1A 2P4, Canada
T 867.920.2882 | F 867.920.4319

PROJECT TITLE
REPULSE BAY ROAD

LOCATION
REPULSE BAY, NUNAVUT

DRAWING TITLE
PROJECT LAYOUT
-
-
-

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AJ	-

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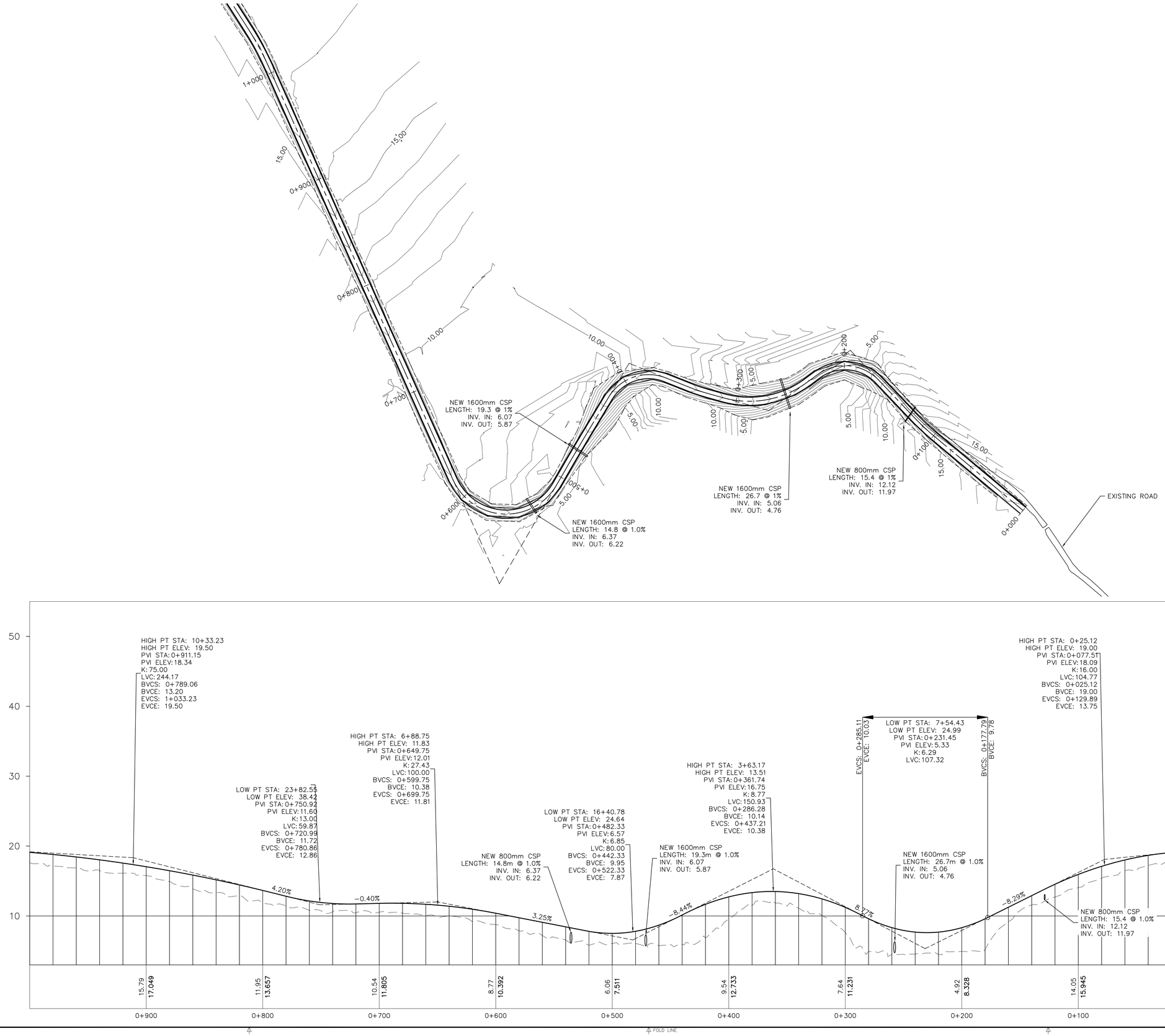
2010 0880

DRAWING NO.
C01 01



Nunavut

LEGEND:

- 15 MAJOR CONTOUR LINE
- MINOR CONTOUR LINE
- CENTRELINE
- TOE OF SLOPE
- EDGE OF ROAD
- HERITAGE FEATURE

Note: Existing ground information utilized for design includes areas which are interpolated from field survey and other available information. Actual ground elevations are to be confirmed by Contractor prior to initiation of construction. Variations in actual ground elevation are to be reported to the Engineer for review and possible grade line adjustment prior to construction.

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P.Eng.
NWT/NU

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T 867.920.2066 | F 867.920.2359

PROJECT TITLE

REPULSE BAY ROAD

LOCATION
REPULSE BAY, NUNAVUT

DRAWING TITLE
PLAN AND PROFILE
0+000 TO 1+000
-
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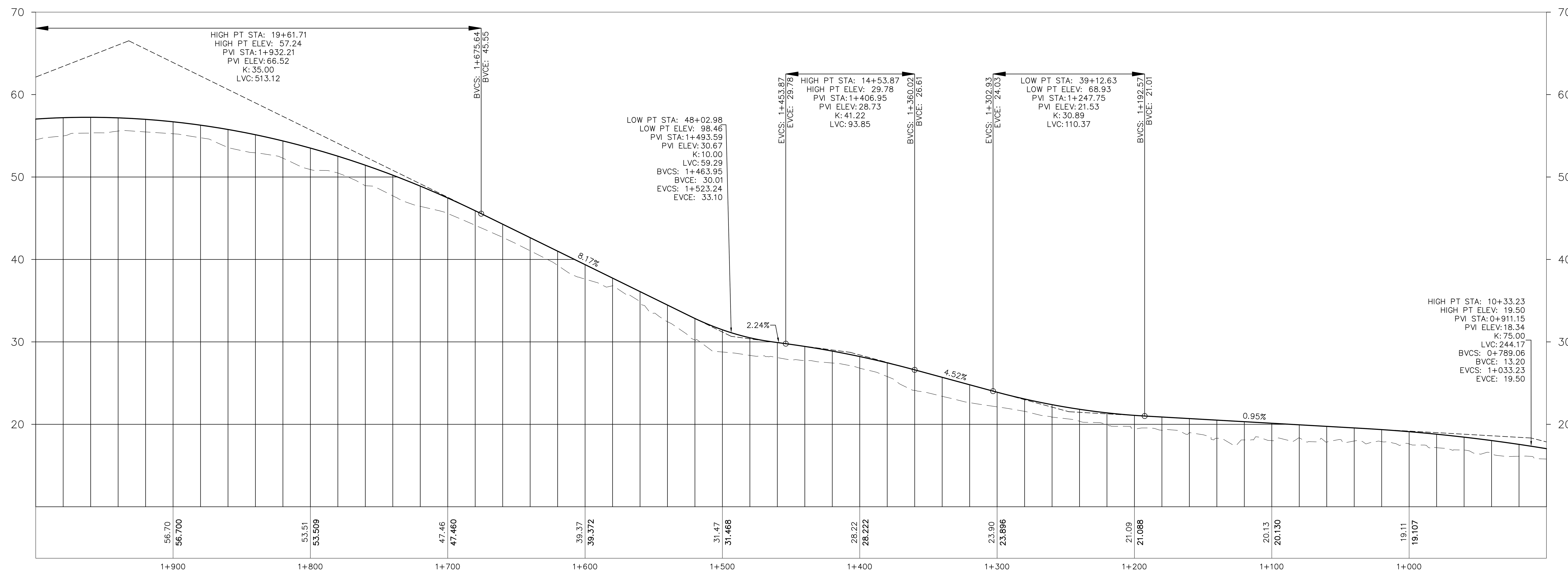
FSC PROJECT NO.
2010 0880

DRAWING NO.
C02 01



Nunavut

LEGEND:

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- MINOR CONTOUR LINE
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A.F. JOHNSON
NWT/NU

FSC
ARCHITECTS & ENGINEERS

PROJECT TITLE

REPULSE BAY ROAD

LOCATION
REPULSE BAY, NUNAVUT

DRAWING TITLE
PLAN AND PROFILE
0+900 TO 1+900
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JD	H 1:1500 V 1:250
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FSC PROJECT NO.
2010 0880

DRAWING NO.
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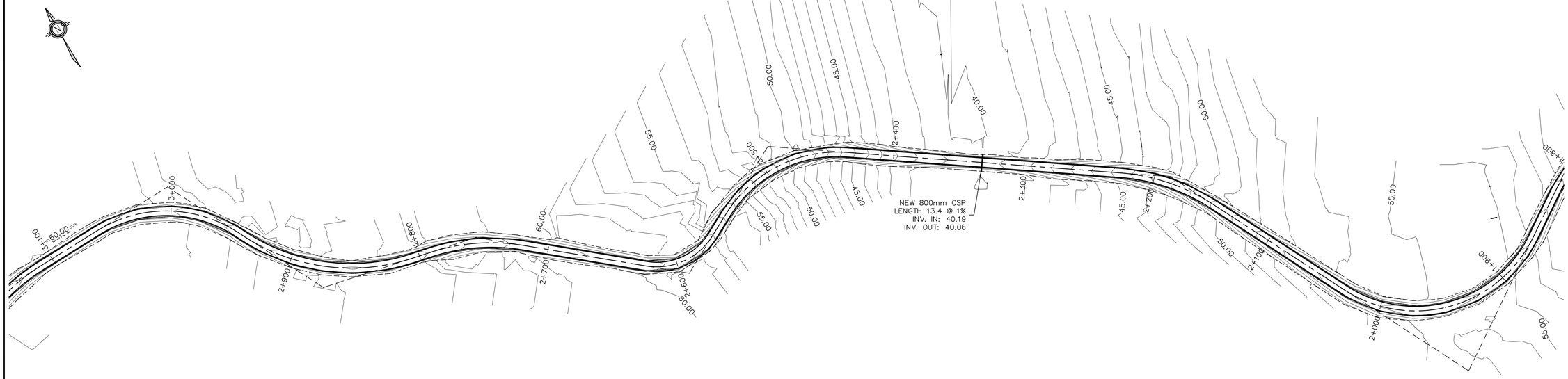

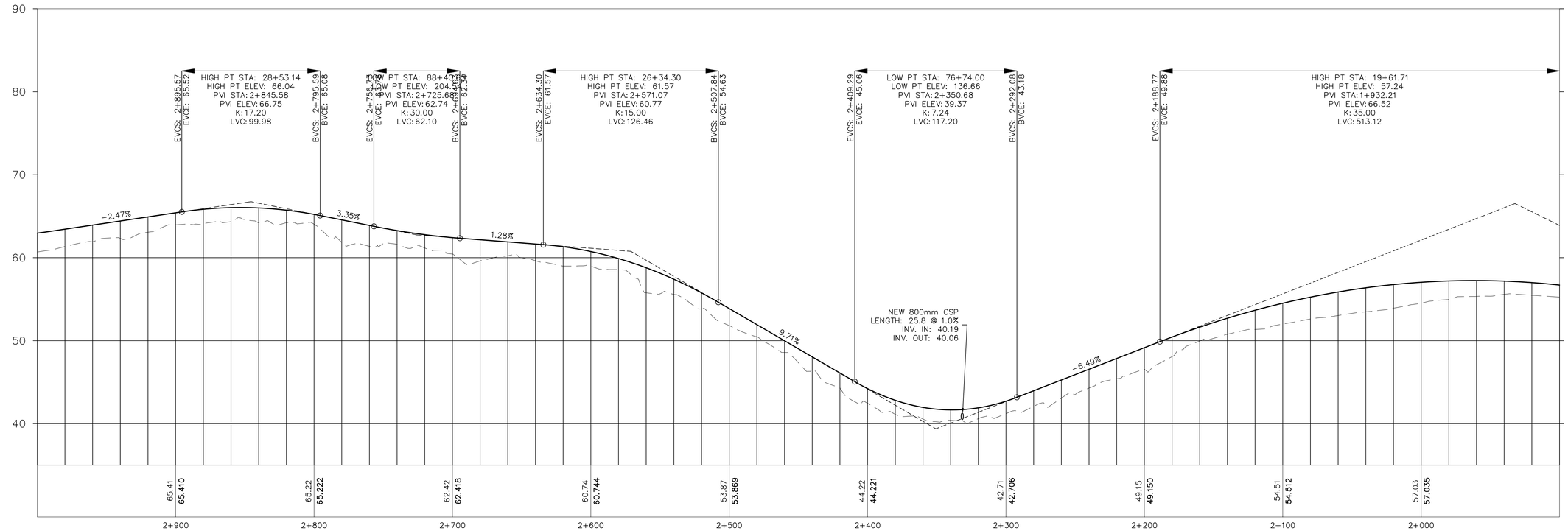

LEGEND:

- 15 — MAJOR CONTOUR LINE
- MINOR CONTOUR LINE
- CENTRELINE
- TOE OF SLOPE
- EDGE OF ROAD
- HERITAGE FEATURE

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NWT/NU

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T 867.920.2888 | F 867.920.2889

PROJECT TITLE

REPULSE BAY ROAD

LOCATION
REPULSE BAY, NUNAVUT

DRAWING TITLE
PLAN AND PROFILE
1+900 TO 3+000
-
-

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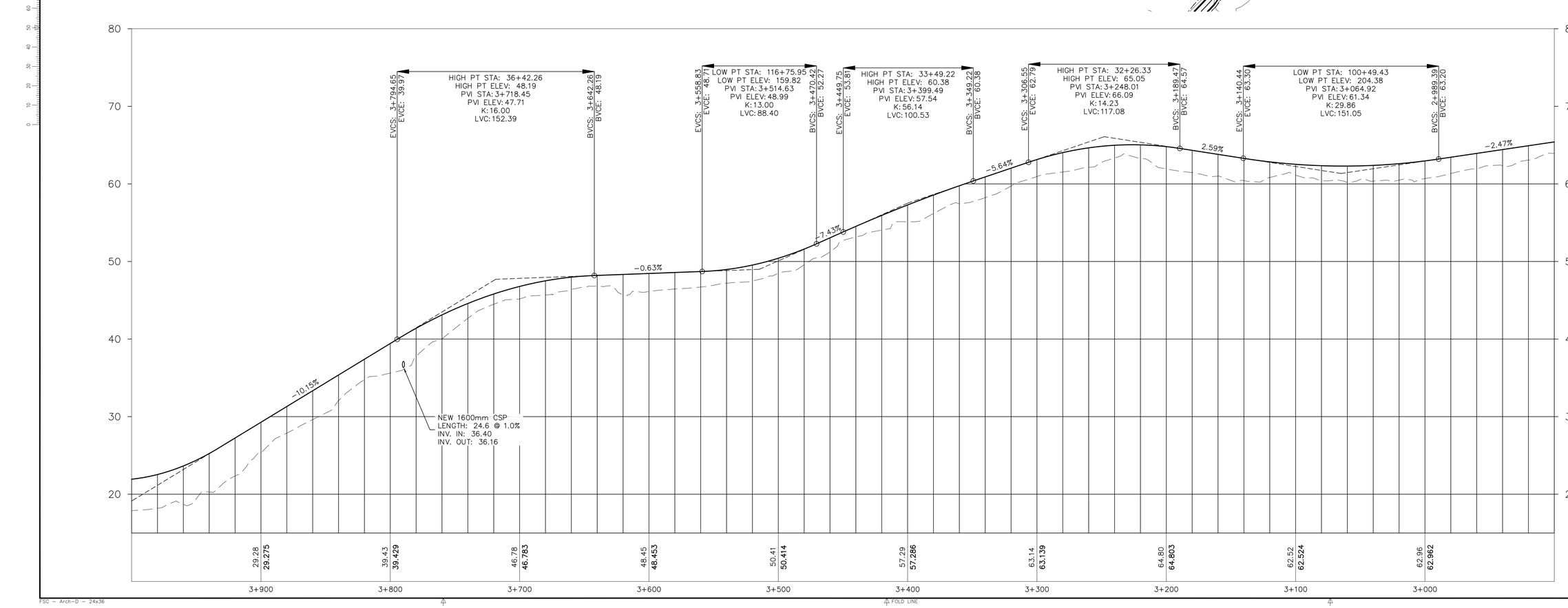

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- CENTRELINE
- TOE OF SLOPE
- EDGE OF ROAD
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REPULSE BAY ROAD

LOCATION
REPULSE BAY, NUNAVUT

DRAWING TITLE
PLAN AND PROFILE
3+000 TO 4+000
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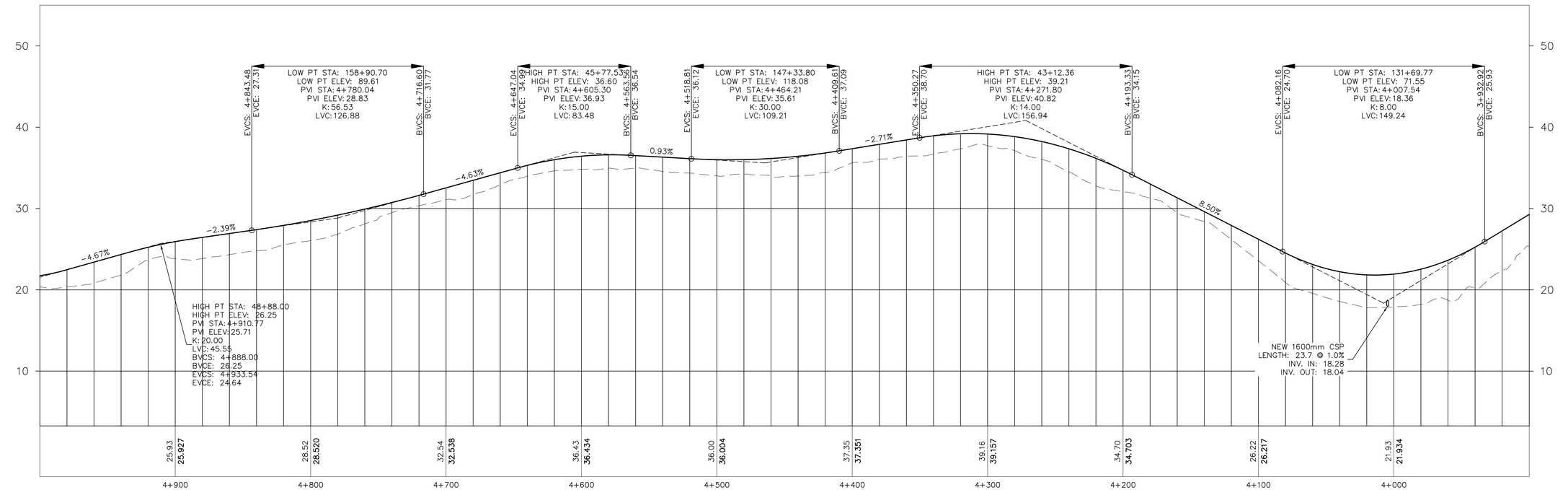

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T 867.920.2882 | F 867.920.2883

PROJECT TITLE

REPULSE BAY ROAD

LOCATION
REPULSE BAY, NUNAVUT

DRAWING TITLE
PLAN AND PROFILE
3+900 TO 5+000
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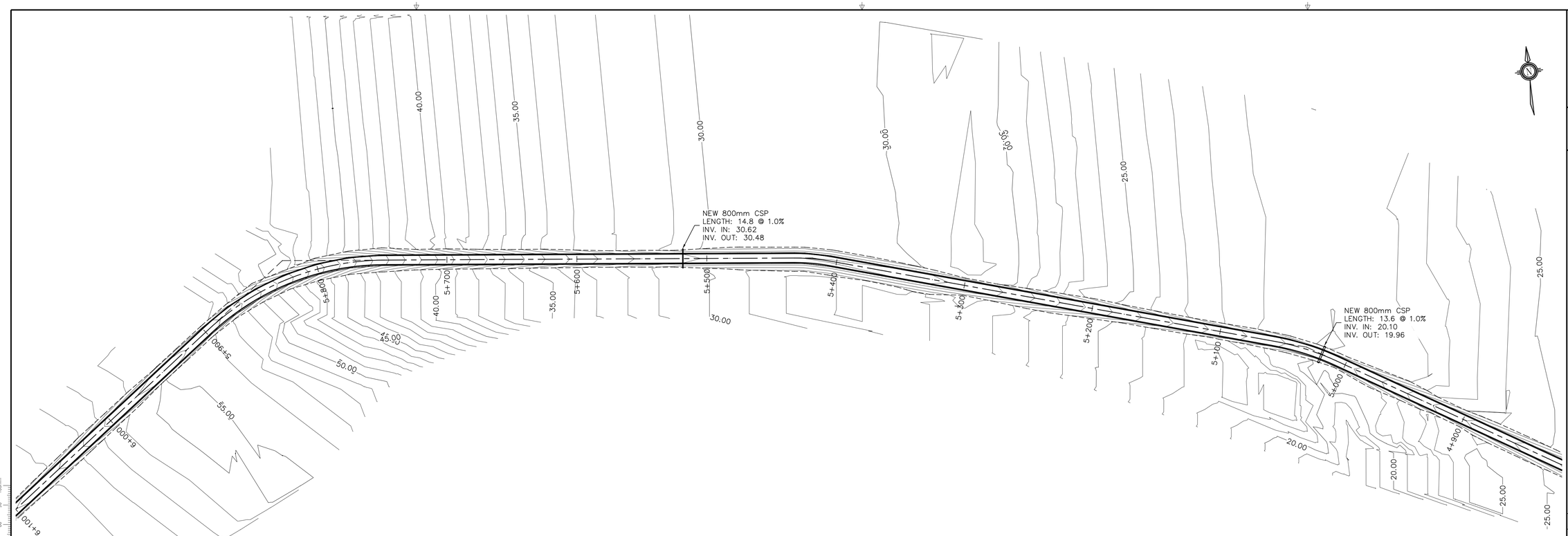

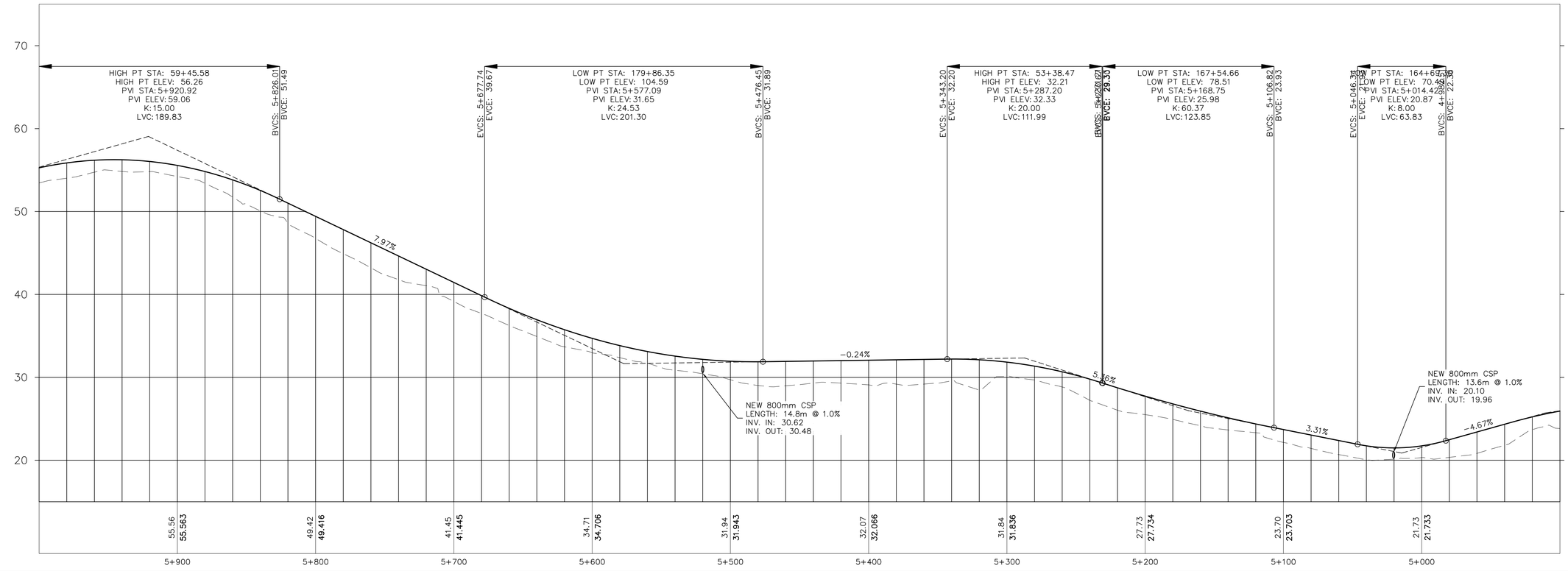

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NWT/NU

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T 867.920.2066 | F 867.920.2359

PROJECT TITLE

REPULSE BAY ROAD

LOCATION
REPULSE BAY, NUNAVUT

DRAWING TITLE
PLAN AND PROFILE
4+900 TO 6+000
-
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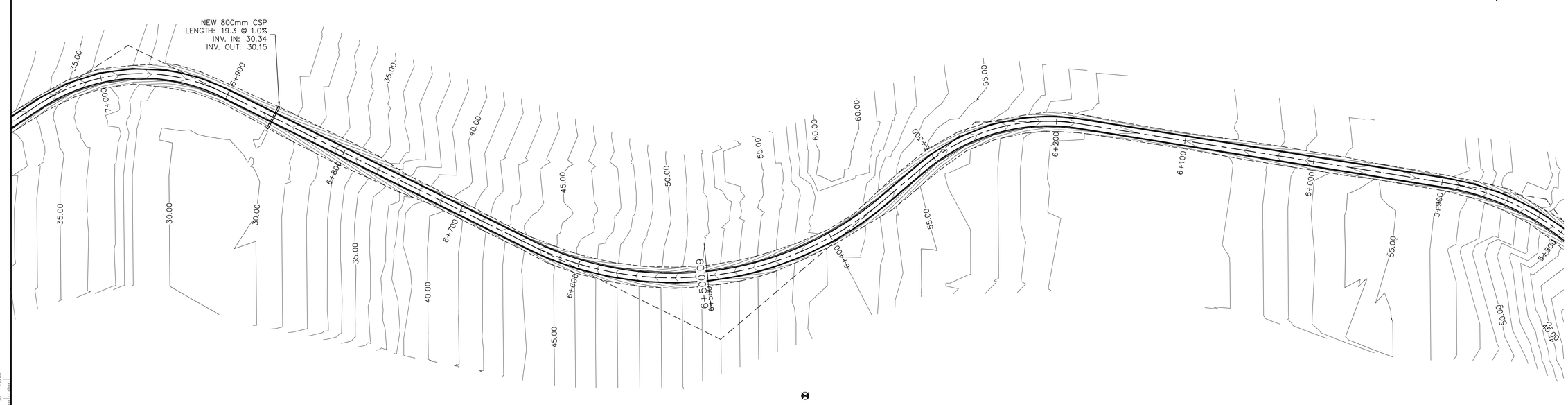

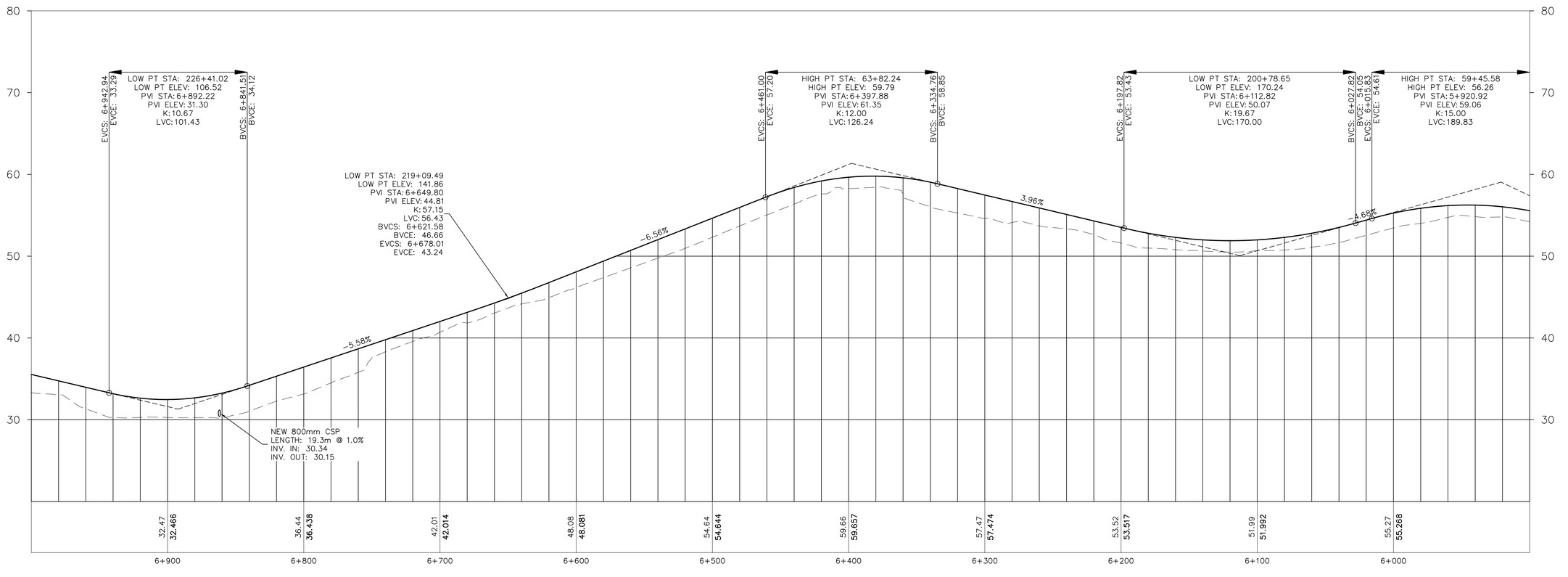

LEGEND:

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2	FINAL DESIGN	2010/11/30
1	ISSUED FOR INTERNAL REVIEW	2010/11/17

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FSC ARCHITECTS AND ENGINEERS
(5107 NWT LTD.)
Signature
Date 03 FEB 2011
PERMIT NUMBER: P0457
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REGISTERED PROFESSIONAL ENGINEER
A.F. JOHNSON
NWT/NU

FSC ARCHITECTS & ENGINEERS
T 867.920.2888 | F 867.920.2889

PROJECT TITLE

REPULSE BAY ROAD

LOCATION
REPULSE BAY, NUNAVUT

DRAWING TITLE
PLAN AND PROFILE
5+900 TO 7+000
-
-

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CHECKED BY	CLIENT PROJECT NO.
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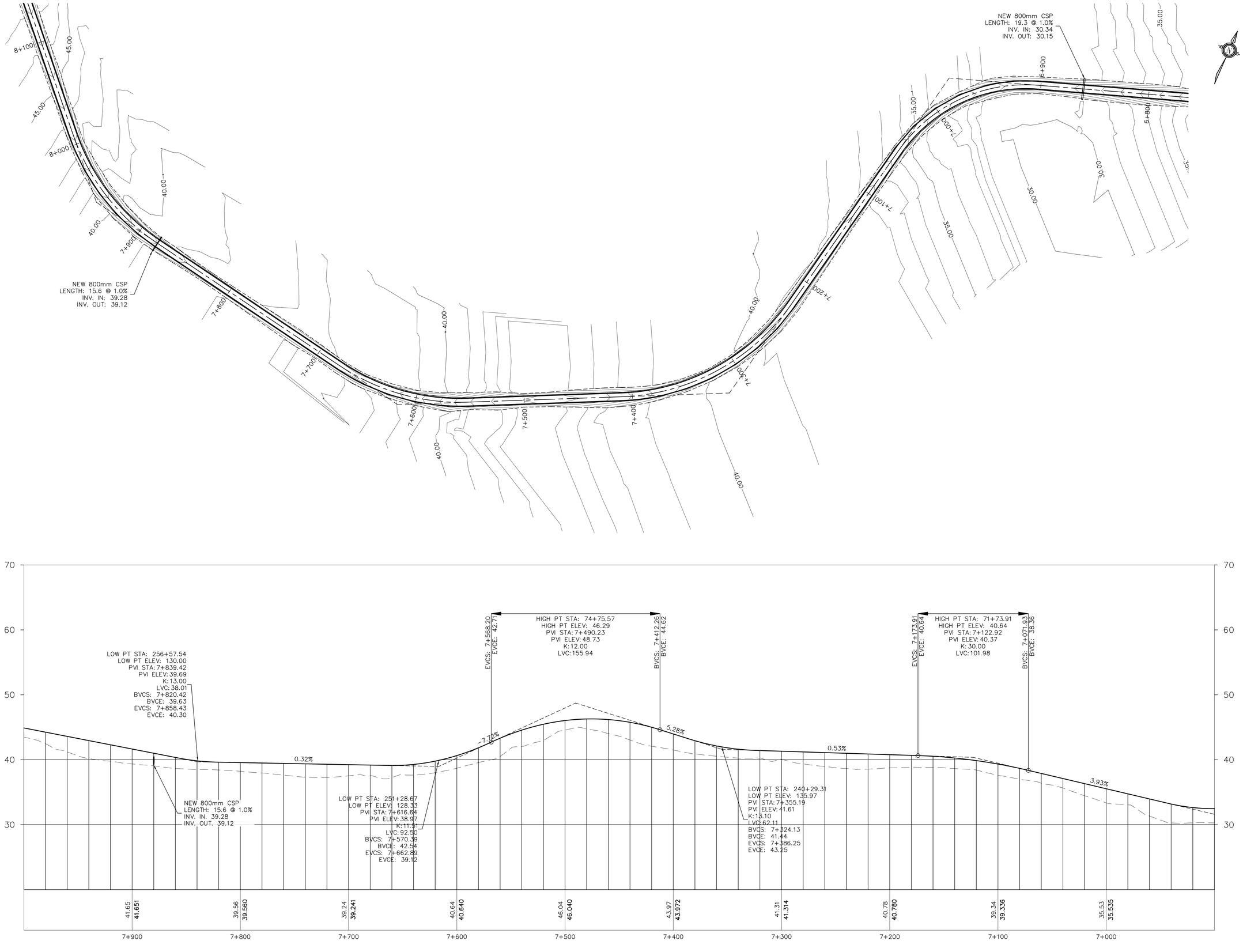

Nunavut

LEGEND:

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- TOE OF SLOPE
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REGISTERED PROFESSIONAL ENGINEER A.F. JOHNSON P.Eng. S-711 NWT/NU 2010 DEC 20

FSC
ARCHITECTS&ENGINEERS
T 867.920.9888 | F 867.920.2358

PROJECT TITLE

REPULSE BAY ROAD

LOCATION
REPULSE BAY, NUNAVUT

DRAWING TITLE
PLAN AND PROFILE
6+900 TO 8+000
-
-

DRAWN BY	SCALE
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2010 0880	

DRAWING NO.
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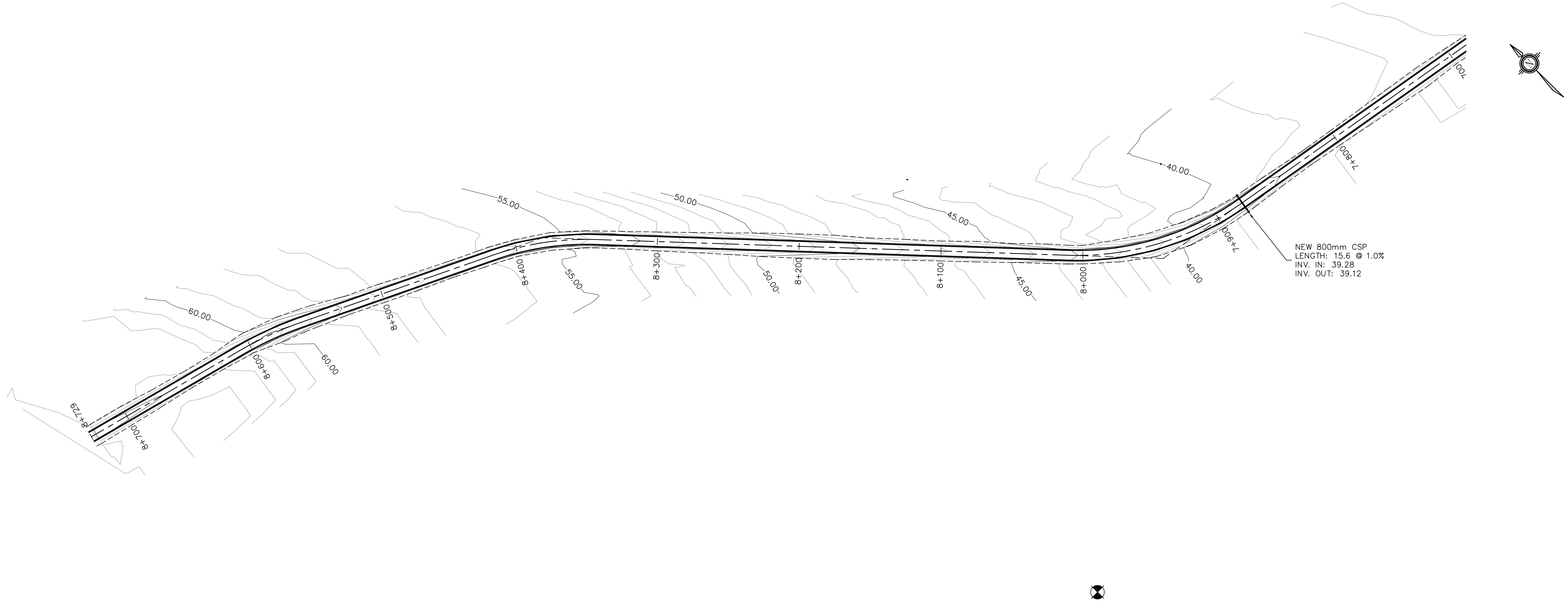
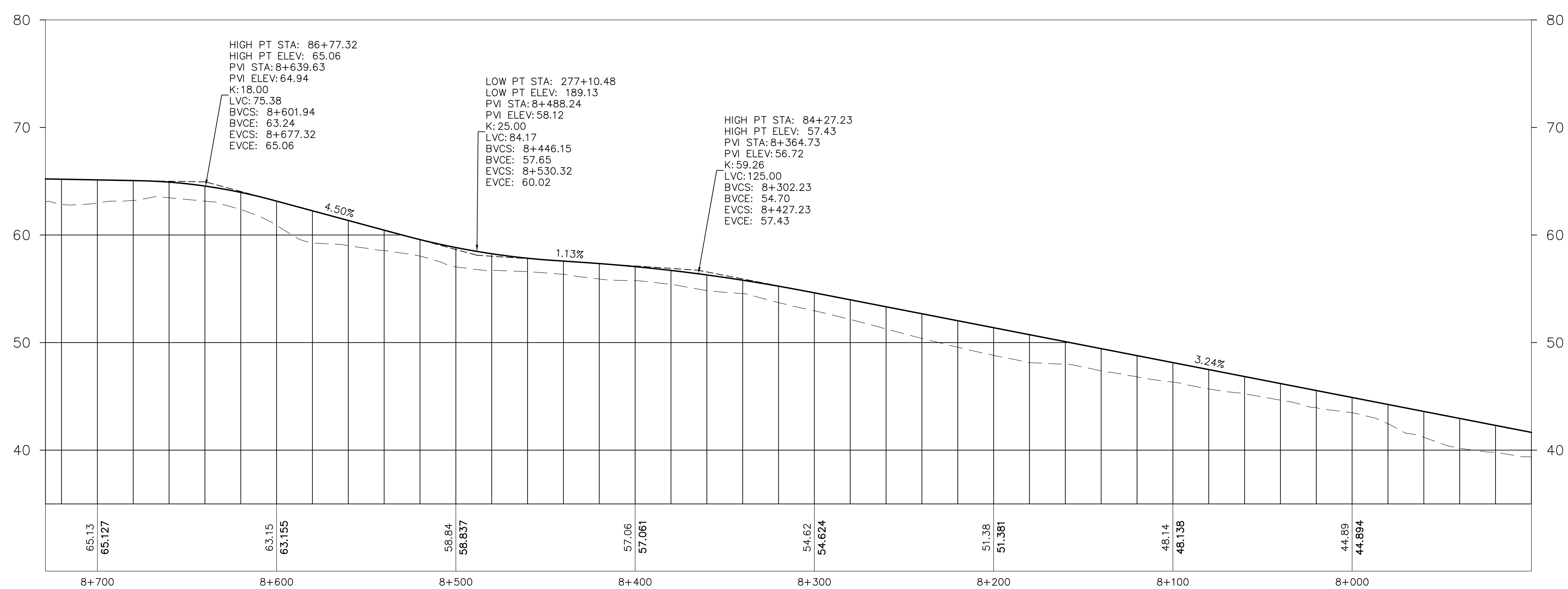
9 OF 11





Nunavut

LEGEND:

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- EDGE OF ROAD
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PROJECT TITLE

REPULSE BAY ROAD

LOCATION
REPULSE BAY, NUNAVUT

DRAWING TITLE
PLAN AND PROFILE
7+900 TO END
-
-

DRAWN BY	SCALE
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FSC PROJECT NO.
2010 0880

DRAWING NO.
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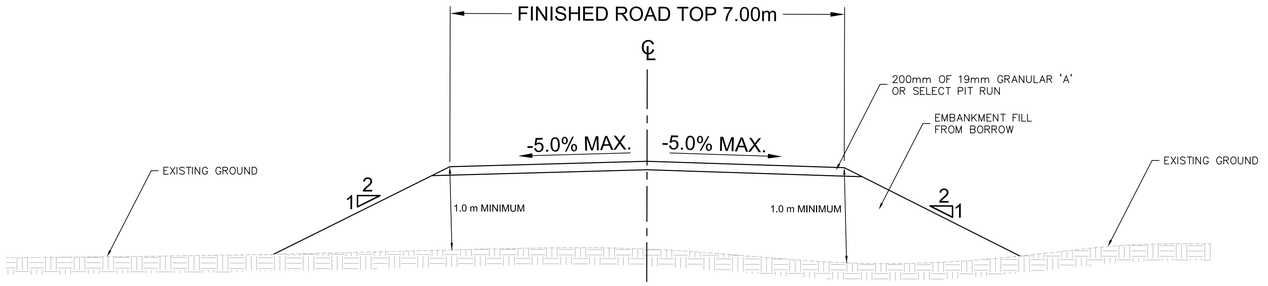
FSC – Arch-D – 24x36

FOLD LINE



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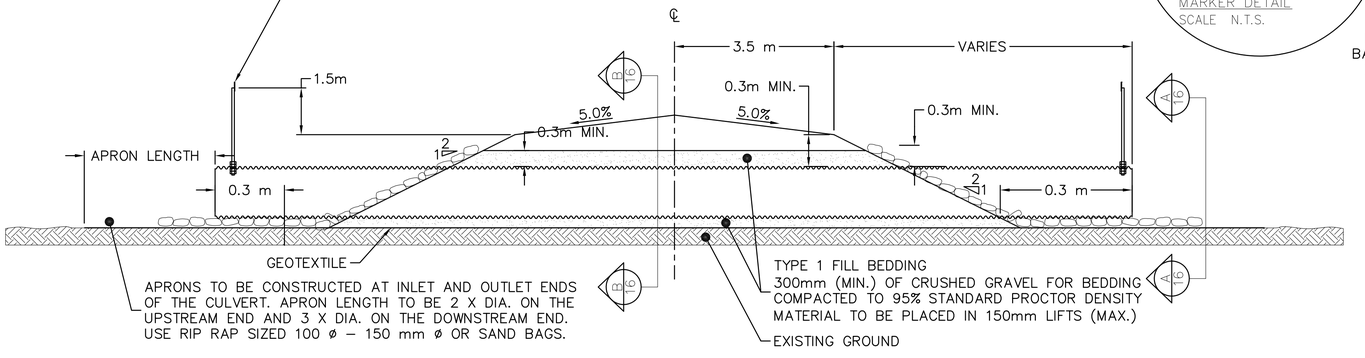
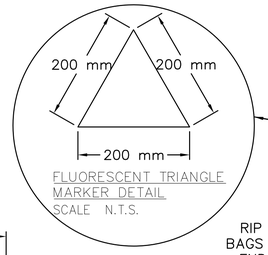
SCALE: NTS



NOTES:
1– 100 mm MIN. GRADE BETWEEN UPSTREAM INLET TO DOWNSTREAM OUTLET.
2– GRADES TO BE SET AS SHOWN.
3– LENGTH AS SHOWN ON DRAWINGS.

TYPICAL ROADWAY CULVERT DETAIL 1/16
SCALE N.T.S.



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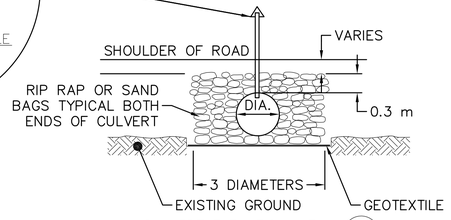

CULVERT ELEVATION VIEW A/16
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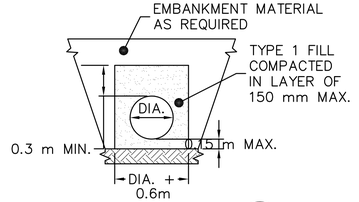

TYPICAL CULVERT BEDDING B/16
SCALE N.T.S.

2 / 003-01 TYPICAL CULVERT BEDDING
SCALE: NTS

NO.	REVISION DESCRIPTION	DATE ISSUED
3	FINAL DESIGN REV 1	2011/02/03
2	FINAL DESIGN	2010/11/30
1	ISSUED FOR INTERNAL REVIEW	2010/11/17

PROFESSIONAL SEAL / PERMIT TO PRACTICE

PERMIT TO PRACTICE
FSC ARCHITECTS AND ENGINEERS (2007 NWT LTD.)
Signature
Date 03 FEB 2011
PERMIT NUMBER: P0457
The Association of Professional Engineers, Geologists and Geophysicists of the NWT/NU

REGISTERED PROFESSIONAL ENGINEER A.F. JOHNSON NWT/NU 2010 03 30

FSC
ARCHITECTS & ENGINEERS
4910 - 53rd Street, P.O. Box 1777
Yellowknife, NT, X1A 2P4, Canada
T 867.920.2882 | F 867.920.4319

PROJECT TITLE
REPULSE BAY ROAD

LOCATION
REPULSE BAY, NUNAVUT

DRAWING TITLE
CULVERT AND ROAD CROSS SECTION DETAILS
-
-

DRAWN BY	SCALE
JD	
CHECKED BY	CLIENT PROJECT NO.
AJ	-
FSC PROJECT NO.	
2010 0880	
DRAWING NO.	
C03 01	

FSC File: 2010-0880-41

10 February 2011

Stantec
5021 - 49th Street PO Box 1680
Yellowknife NT
X1A 2N4
Attn: Carey Sibbald, B.Sc., EPt

Re: <u>Repulse Bay Road - Response to Nunavut Water Board</u>

Dear Ms. Sibbald,

In your email of January 28th, 2011, you informed us that:

> Specifically, the NWB requests:
>
> *The design flood flow in cubic metres per second and its return period for the type of structure proposed.*
> *An explanation of the rationale for the selected design flow flood and its return period.*
>
> The NWB also requests technical specifications of any geotextile used (so under culverts); I know you may not have exact details but do you have any specifications for this based on your design? (NWB requests "*If geotextile is used or a similar material to prevent the transport of sediment into a watercourse, provide the technical specifications for the proposed material as well as the location, extent and placement method for the material.*")

We will attempt to provide adequate answers to these questions, and requests for information, following.

1.1 GENERAL

For this project, we found early in the design, that the available terrain information, both from the field survey program and from available mapping data was not sufficient to allow a fully detailed design of the drainage and stream crossing culverts.

We were forced to rely on past experience and judgment to size the culverts in such a way as to exceed probable design flows over a reasonable rate of return for the roadway.

We have determined to use wherever possible one of two possible culvert sizes due partially to construction logistics. 800 mm and 1600 mm for the project.

The culverts were sized to a minimum diameter of 800 mm, for general drainage culverts and areas of low flow runoff. This size allows some settlement with degradation of permafrost following installation (which is a common concern in roadways in this region) while still allowing adequate cross sectional area for light drainage and equalization purposes.

Culverts have a hydraulic capacity for water flow that depends upon several factors. These include diameter, slope, length, type of pipe, and type of pipe end treatment.

The capacity of any particular culvert also depends upon how much surcharge if any is at the inlet and outlet of the culvert. Depending on that surcharge the culvert will either be in what is called 'inlet control' or in what is called 'outlet control'. Design is based upon evaluation of both inlet and outlet control, and accepted the lower value as controlling the capacity of the culvert.

The design methodology for this project is based upon a method developed by the California Department of Highways and subsequently used around the world by most highway design agencies.

It states that the 1 in 10 year flood is to be designed to be passed with the installed culvert flowing without any inlet surcharge.

The 1 in 100 year flood is to be passed utilizing the available head above the culvert.

The geometric design basis for this particular roadway calls for a minimum of 400 mm of cover above the top of any culvert to the shoulder of the road.

In the culvert hydraulic calculations, we set the 1 in 100 year head to be the diameter plus 400 mm.

1.1.1 Inlet Control Design Capacity

Culverts can flow water either in 'Inlet Control' or in 'Outlet Control'. In general, inlet control applies to steep gradient culverts, and outlet control applies to 'flat' culverts.

Inlet control flow capacity is determined through the use of an 'Inlet Control Nomograph', taken from the 'Handbook of Steel Drainage and Highway Construction Products – Canadian Edition'.

Inlet control assumes that inlet losses are larger than the friction losses in the culvert, and thus that the inlet controls the overall flow capacity of the culvert.

The Inlet Control Nomograph gives us the following capacities for the three sizes noted, using the above noted surcharges.

	800 mm	1600 mm
1:10 Year	0.62 cu.m./s	4.20 cu.m./s
1:100 Year	0.85 cu.m./s	5.10 cu.m./s

For this project we will find that typically inlet control does NOT govern the culvert design.

1.1.2 Outlet Control Design Capacity

Outlet control assumes that the friction losses in the culvert are larger than inlet losses, and thus that the culvert geometry, controls the overall flow capacity of the culvert.

Outlet control considers the length, type of pipe, inlet losses, and slope of the culvert pipe. We have prepared design spreadsheets for outlet control each of the significant crossings. The results are presented in Section 4 and 5.

Under outlet control, for a single culvert we calculate these capacities.

Outlet Control	800 mm	1600 mm
1:10 Year	410.9 L/s	2,076.6 L/s
1:100 Year	1,208.4 L/s	4,122.6 L/s

Thus, outlet control governs these cases being lower than inlet control.

1.2 RATIONAL METHOD RUNOFF ANALYSIS

We have utilized the Rational Method of runoff analysis for determining the runoff flow rates for rainfall.

Using the Rational method:

- Q (Flow Rate) = C (Runoff Coefficient) * I (Intensity) *A (Area of Drainage Basin)
- T (Time of Concentration) = 0.0078 (L / S^0.5) ^ .77
- Where S (Slope) = H (Elevation Change) / L (Length of Drainage Basin)
- Rainfall intensity I varies with time.
- The Time of Concentration is the time that it takes the most remote area of the Drainage Basin to run to the outfall structure.

Given these parameters, each drainage structure has a calculated peak flow rate, for different design periods.

In the absence of site specific data for Repulse Bay, we have used the following criteria for design taken from a similar arctic coastal community:

- 10 Year return period: I=10^(LOG (10)+(-0.63)*LOG (T/60))
- 25 Year return period: I=10^(LOG (13.5)+(-0.63)*LOG (T/60))
- 100 Year return period: I=10^(LOG (16.21)+(-0.63)*LOG (T/60))

1.3 CULVERT RUNOFF AREAS AND DESIGN FLOWS

The chosen culvert sizes allow the following flows, and drainage areas, for the 100 Year return period.

- 800 mm A maximum design flow of 1.21 cu. m. per second. This equates to a runoff area of 225,000 sq. m, given a 5% slope.
- 1600 mm A maximum design flow of 4.06 cu. m. per second. This equates to a runoff area of 1,163,000 sq. m, given a 5% slope.

1.4 GEOTEXTILE

The use of geotextile under the culverts is not to prevent sediment transport. It is used to slow the typical settlement of a culvert installed in permafrost, and so extend the useful life of the culvert.

For the record, we specify a mid-weight, non-woven geotextile of at least 250 g/m^2.

1.5 CONCLUSION

We trust the above meets your requirements, and that of the Nunavut Water Board. Please let us know if you require anything in addition.

Sincerely,
FSC ARCHITECTS & ENGINEERS

Walter Orr, P. Eng.
Principal Engineer

Cc: file

APPENDIX C

DFO Statement of Conformity

Fisheries and Oceans Canada (DFO) Operational Statement

Statement of Conformation

This document officially states that the Hamlet of Repulse Bay will comply with the mitigative measures contained within the following DFO Operational Statements:

- In-Stream Construction Timing Windows
- Culvert Maintenance

These procedures will be followed during the construction and operation of an access road and borrow sources, northwest of the community. The mitigative measures within the Operational Statements pertain, but may not be limited to, the following activities: placement of granular fill, stockpiling, use of heavy equipment, and in-stream works, including culvert installation.

Signed: _____ Steve Mapsalak
Signature Print Name

Senior Administrative Officer
Position

January 28/11
Date

Witness: _____ ELIZABETH KUGLUGAK
Signature Print Name

Finance Director
Position

January 28/11
Date

APPENDIX D

Spill Contingency Plan

SPILL CONTINGENCY PLAN FOR CONSTRUCTION AND OPERATION OF AN ACCESS ROAD AND BORROW SOURCES

Repulse Bay, NU

FINAL

Prepared for:

Community & Government Services
Government of Nunavut
P.O. Box 002
Rankin Inlet, NU X0C 0G0

Prepared by:

Nunami Stantec
P.O. Box 188
Rankin Inlet, NU X0C 0G0
Tel: (867) 645-2805 Fax: (867) 645-2063

Project No.:

123510486

March 2011

NUNAMI STANTEC

NUNAMI STANTEC

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ABBREVIATIONS

GN-CGS.....Government of Nunavut Department of Community and Government Services

Hamlet..... Hamlet of Repulse Bay

INAC ..... Indian and Northern Affairs Canada

SAO ..... Senior Administrative Officer

SCP..... Spill Contingency Plan

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1 INTRODUCTION

This Spill Contingency Plan (SCP) has been developed for use by the Government of Nunavut Department of Community and Government Services (GN-CGS) and the Hamlet of Repulse Bay (the Hamlet) during construction and operation of an access road to granular resources (Access Road) and development and operation of borrow sources in Repulse Bay, NU. The purpose of this SCP is to provide a guide to operators and other Hamlet personnel in the event of an accidental release of fuel or other waste during construction of the Access Road and/or development of borrow sources. The SCP can also be used during operations of the Access Road and borrow sources. The SCP was developed based on NWTWB (1987) and INAC (2007) and is planned to be protective of the local environment and public and personnel health and safety.

All persons involved with construction and operation activities along the Access Road route and borrow sources footprints should read and be familiar with this SCP. To be effective, it is important that all personnel are familiar with their responsibilities and steps to take in the event of a spill. Personnel should not be reading the SCP for the first time during an emergency.

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2 SITE DESCRIPTION

Figure 1 in **Appendix A** shows the routing of the access road and borrow source areas. The Access Road is 8.729 km in length and, as of January 2011, the first 4 km of the Access Road were constructed. Completion of the Access Road is anticipated by fall 2012. Six borrow sources have been identified for use by the Hamlet. Two borrow sources (Deposit nos. 1 and 3; see Figure 3 in **Appendix A**) will be developed and used for construction of the Access Road. The remaining borrow sources will be developed over time, as the Hamlet needs granular material for municipal projects.

Much of the Project area is covered by large bedrock outcrops and hills, interspersed by valleys and lowlands. Bedrock outcrops are unvegetated, except in depressions where soil has accumulated. Cobble, gravel and sandy substrates typically occur on the tops of small hills and on steeper slopes; these sites were dry with little to no standing water. Wet areas occur within valley bottoms, on flatlands and shallow slopes where standing and running water from snow melt and streams are present. These areas generally have greater soil development and cobbles and boulders were interspersed throughout the area.

Permafrost is continuous throughout the region and Project area, implying the area is underlain by 90 to 100% permafrost.). Very little site specific information related to permafrost conditions is available for the Repulse Bay area however depth to permafrost is estimated at 0.60 m (Collins 1991) or deeper (S. McCuaig, *pers.comm.)*, depending on the terrain and landform.

Six streams occur along the Project route and will be crossed by the Access Road. The tip of the tidal flat of Tariugaq Inlet is also crossed by the Access Road. Five small lakes are also present within the Project area and are located adjacent to the Access Road.

2.1 Potential Contaminants

Over the course of construction, the several contaminants may be used by equipment and crews working and travelling the Access Road route. These contaminants are listed below and may be involved in a spill:

- Gasoline
- Diesel
- Hydraulic oil
- Motor oil
- Lubricating oils and grease
- Antifreeze and other coolants

Contaminant spills may occur on land or in the water along the entire Project route. Spills may result from any of the following occurrences:

- Leaks or ruptures of fuel storage tanks
- Valve or line failure in systems, vehicles or heavy equipment
- Heat expansion due to overfilling or improper storage
- Improper storage of contaminants
- Vehicular accidents
- Spill during transfer of contaminant
- Vandalism

3 RESPONSE ORGANIZATION

A Qualified Professional with expertise in northern road building projects will be contracted to manage construction of the Access Road. This contractor has not yet been selected but will be responsible for initiating this SCP during Access Road construction, as well as the Hamlet's Senior Administrative Officer (SAO) and/or Hamlet Foreman. Development and operation of the Borrow Sources will be managed by the Hamlet of Repulse Bay.

Whenever a spill is identified, the Access Road contractor, Hamlet's SAO and/or Hamlet Foreman should be contacted as soon as possible. The Access Road contractor, SAO and Hamlet Foreman are responsible for initiating the SCP. Contact information for the SAO and Hamlet Foreman are in Table 3-1 below. The SCP should be updated with the contractor contact information once they are selected.

Table 3-1 Spill Contingency Contacts for Construction of the Access Road to Granular Resources, Repulse Bay, NU

Senior Administrative Officer	Hamlet Foreman
Steve Mapsalak Hamlet of Repulse Bay Office Phone: (867) 462 – 9952 Fax: (867) 462 – 4411 Email: saorepulse@qiniq.com	Hamlet of Repulse Bay Office Phone: (867) 462 - 9952 Fax: (867) 462 – 4411

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4 INITIAL ACTIONS

The following actions should be taken by the first person(s) who identifies a spill:

1. Be alert and considerate of your safety and of those around you. If possible, identify the spilled contaminant.
2. Assess the hazard to persons in the area of the spill.
3. If possible, without further assistance, control any danger to human life or the environment.
4. Assess whether the spill can be readily stopped or brought under control.
5. If safe to do so, and if possible, try to stop the spillage of contaminant.
6. Gather information about the status of the situation.
7. Report the spill immediately to the SAO and/or Hamlet Foreman who will report the spill to the 24-Hour Emergency Spill Report Line/
8. Resume any effective action to contain, clean up or stop the flow of spilled contaminant. See Section 6.1 for more information on spill response procedures.

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5 REPORTING PROCEDURE

All spills or potential spills of contaminants must be reported to the 24-hour Northwest Territories – Nunavut Emergency Spill Report Line to ensure that an investigation may be undertaken by the appropriate government authority. Reporting of any spills associated with construction of the Access Road or development of borrow sources should be completed by the hired contractor or SAO.

To report a spill:

1. Fill out the Nunavut Spill Report Form (found in **Appendix B** of this SCP) as completely as possible before calling in the spill report.
2. Contact the Government of Nunavut 24-hour Emergency Spill Report Line

   24-HOUR EMERGENCY SPILL REPORT LINE 867-920-8130
3. Where fax is available, fax the completed Nunavut Spill Report Form to **867-873-6924**. Alternatively, if email is available, email the completed Nunavut Spill Report Form to spills@gov.nt.ca

Any person reporting a spill is required to give as much information as possible, however reporting of a spill should not be delayed if all of the necessary information is not known. Additional information can be provided later. From the *Consolidation of Spill Contingency Planning and Reporting Regulations* (1998), as much of the following information should be reported during the initial spill report:

- Date and time of spill
- Location of spill
- Direction spill is moving
- Name and phone number of a contact person close to the location of the spill
- Type of contaminant spilled and quantity
- Cause of spill
- Whether spill is continuing or has stopped
- Description of existing contaminant
- Action taken to contain, recover, clean up, and dispose of spilled contaminant
- Name, address and phone number of person reporting the spill
- Name of owner or person in charge, management or control of contaminants at the time of the spill

In addition to reporting to the 24-hour Emergency Spill Report Line, an Indian and Northern Affairs (INAC) Water Resources Inspector must be notified of a spill immediately after occurrence. The INAC Water Resources Inspector should be contacted at (867) 975-4298. A copy of the completed Nunavut Spill Report Form should be forwarded to them.

6 ACTION PLANS

The most likely spill possibilities during construction and operation of the Access Road and Borrow Sources would be leakage or line failure from heavy equipment or other vehicles, spilling during fuel transfer, or vehicular accident. The likelihood of a major spill is negligible as no contaminants will be stored at construction sites along the Access Road route. All contaminants will be stored at a designated storage facility (e.g., Hamlet Garage, Naujaat Co-Op Fuel Centre). Further, a spill response kit will be kept at all construction sites.

The risk of spills will be further reduced through regular inspection and maintenance of all heavy equipment and vehicles associated with construction and operation activities along the Access Road and at Borrow Sources, as well as routine activities. These activities may include, but not be limited to:

- routine checks of fuel transfer hoses and equipment;
- inspection of fuel and oil lines on all equipment;
- completing on-site fuel transfer over spill pads and a minimum of 100 m from the high water mark of any waterbody;
- monitoring of tank volume during fuel transfer;
- cleaning up drips and minor spills immediately; and,
- ensuring quick repair of any identified deficiencies on heavy equipment or other vehicles.

6.1 Spill Response

The following steps outline the general spill response procedures for initial actions to be taken to contain and clean up a contaminant spill, as well as disposing of contaminated materials. Three procedures have been developed for handling contaminant spills, depending on where the spill has occurred (i.e., land, water or snow/ice).

6.1.1 Spills on Land

1. Once a spill is identified, all sources of ignition should be turned off (e.g., no smoking, shut off engines).
2. The spilled material (e.g., gasoline, diesel, antifreeze, etc) should be identified, if possible.
3. The affected area should be secured, ensuring the area is safe for entry and does not represent a threat to human health and safety of the spill responders. Public access of the area should be restricted.
4. If possible, identify where the spill is coming from (the source). Determine if the spill is still occurring (i.e., still leaking) or if the spillage has stopped. If the spill has not stopped, determine if it is safe to stop or control the spill (e.g., plug hole, close valve, upright

container), or contain the spill (e.g., place a container or tarp with built up edges under the spill source to contain the spill).

5. If the spill is too large to be controlled with the spill materials at hand, contact the SAO or Hamlet Foreman and report the spill immediately (see Section 3 for contact information).
6. If the spill is small enough to be controlled with the spill response materials at hand, prevent spilled contaminants from spreading or entering waterways by using sorbent (oil-absorbing) materials or a soil dyke down slope from the spill. This is especially the case with liquid contaminants (e.g., gasoline, diesel).

   If some contaminant has entered a waterway, follow procedures in the next section (***Spills in Water***) to contain and clean-up the contaminant in the water.
7. Once the spill has been controlled and further spreading prevented, contact the SAO or Hamlet Foreman and report the spill (see Section 3 for contact information). The SAO or Hamlet Foreman is responsible to report the spill to the 24-Hour Emergency Spill Report Line.
8. If possible with spill response materials at hand, clean up the remaining spilled contaminant and store contaminated materials in a secure container for proper disposal. Do not flush the affected area with water.
9. If possible, remove any contained liquid by pumping into secure drums.

6.1.2 Spills in Water

1. Once a spill is identified, all sources of ignition should be turned off (e.g., no smoking, shut off engines).
2. The spilled material (e.g., gasoline, diesel, antifreeze, etc) should be identified, if possible.
3. The affected area should be secured, ensuring the area is safe for entry and does not represent a threat to human health and safety of the spill responders. Public access of the area should be restricted.
4. If possible, identify where the spill is coming from (the source). Determine if the spill is still occurring (i.e., still leaking) or if the spillage has stopped. If the spill has not stopped, determine if it is safe to stop or control the spill (e.g., plug hole, close valve, upright container).
5. If the spill is too large to be controlled with the spill materials at hand, contact the SAO or Hamlet Foreman and report the spill immediately (see Section 3 for contact information).
6. If the spill is small enough to be controlled with the spill response materials at hand, use sorbent booms to contain the spill for recovery. Place sorbent sheets on the water within the boomed area to help contain the contaminant. For narrow waterways such as streams, place one or more sorbent booms across the waterway, downstream of the spill location, and anchor the booms on the each bank.

7. Once the spill has been controlled and further spreading prevented, contact the SAO or Hamlet Foreman and report the spill (see Section 3 for contact information). The SAO or Hamlet Foreman is responsible to report the spill to the 24-Hour Emergency Spill Report Line.
8. If possible with the spill response materials at hand, clean up the remaining spilled contaminant within the boomed area. Store contaminated materials in a secure container for proper disposal.

6.1.3 Spills on Snow/Ice

1. Once a spill is identified, all sources of ignition should be turned off (e.g., no smoking, shut off engines).
2. The spilled material (e.g., gasoline, diesel, antifreeze, etc) should be identified, if possible.
3. The affected area should be secured, ensuring the area is safe for entry and does not represent a threat to human health and safety of the spill responders. Public access of the area should be restricted.
4. If possible, identify where the spill is coming from (the source). Determine if the spill is still occurring (i.e., still leaking) or if the spillage has stopped. If the spill has not stopped, determine if it is safe to stop or control the spill (e.g., plug hole, close valve, upright container).
5. If the spill is too large to be controlled with the spill materials at hand, contact the SAO or Hamlet Foreman and report the spill immediately (see Section 3 above for contact information), particularly since a spill occurring on snow or ice presents the potential for immediate access of contaminants into waterways.
6. If the spill is small enough to be controlled with the spill response materials at hand, prevent spilled contaminants from spreading or entering waterways by using sorbent materials or a snow/soil dyke down slope from the spill. This is especially the case with liquid contaminants (e.g. gasoline, diesel).
7. Once the spill has been controlled and further spreading prevented, contact the SAO or Hamlet Foreman and report the spill (see Section 3 above for contact information). The SAO or Hamlet Foreman is responsible to report the spill to the 24-Hour Emergency Spill Report Line.
8. If possible with the spill response materials at hand, clean up the remaining spilled contaminant and store contaminated materials in a secure container for disposal. Impacted snow should also be stored in drums for proper disposal.

6.2 Additional Spill Delineation or Monitoring

In the event of a large spill or a spill in which not all of the spilled contaminant can be readily cleaned up with materials at hand (as described above), delineation of the affected area may be required. This would include subsurface investigation of the area (i.e., digging of test pits, soil sampling,

installation of monitoring wells) to determine how large and how deep the contaminant affected the subsurface soil and/or groundwater (horizontal and vertical extent of the spill). The delineation would result in the development of an appropriate remediation plan for the affected area. In this case, a qualified environmental consultant should be retained to provide advice on how to proceed with delineation and remediation of a large spill.

7 ENVIRONMENTAL MAPPING

As previously mentioned in Section 1 and indicated on Figures 1 to 3 in **Appendix A**, impacts from spills could occur all along the Project route as construction advances, and at all waterbodies adjacent to or crossed by the Access Road, or adjacent to Borrow Sources.

All six streams eventually flow into the marine environment of Repulse Bay and spills in water or on land adjacent to streams could impact this downstream environment. Additionally, some lakes along the Project route were confirmed to be fish-bearing while others are suspected. Spills in water or on land adjacent to these lakes could impact the fish and fish habitat.

Spill response equipment (e.g., spill kits) will be present at the construction site of the advancing road and at the excavation operations of the Borrow Sources. Spill response equipment is also kept in the Hamlet Garage and the Naujat Co-Op Bulk Fuel Storage Facility.

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8 RESOURCE INVENTORY

8.1 On-Site Resources

8.1.1 Personnel

All personnel hired to work on Access Road construction and/or borrow source development will be trained in on-site spill prevention, response and clean-up measures (see Section 9).

8.1.2 Equipment

The following is a list of equipment available to respond to possible spills.

- Two loaders
- Two haul/dump trucks
- One grader
- One pick-up truck (light vehicle)

8.1.3 Spill Kits

8.1.3.1 Spill Kit Locations

At least one spill kit should be clearly marked and present at each construction site along the Access Road route; this will include the along the advancing road front and at the borrow source excavation site(s). One spill kit should also be clearly marked and present at the Hamlet Garage or wherever equipment maintenance will be completed.

8.1.3.2 Spill Kit Contents

The following outlines the recommended minimum requirements for contents of spill kits to be used during construction of the Access Road. Each spill kit should be regularly inspected to ensure it always contains the following, at a minimum (in part from INAC [2007]):

- 1 – 205 L open top steel drum with lid, bolting ring and gasket (spill kit container)
- 10 disposable large 5 mil polyethylene bags (dimensions 65 cm x 100 cm) with ties
- 4 – 12.5 cm x 3 m (5 in. X 10 ft.) sorbent booms
- 10 kg bag of sorbent particulate
- 100 sheets (1 bail) of 50 cm x 50 cm sorbent sheets
- 2 large (5 m x 5 m) plastic tarps
- 1 roll duct tape
- 1 utility knife

- 1 field notebook and pencil
- 1 rake
- 1 pick-axe
- 3 spark-proof shovels
- 4 Tyvex® splash suits
- 4 pairs chemical resistant gloves
- 4 pairs of splash protective goggles
- Instruction binder, including Spill Contingency Plan.

The entire spill kit contents, with the exception of the spark-proof shovels, can be stored within the 205 L steel drum. The drum should be sealed securely to protect the spill kit contents though should always be accessible without the use of tools (i.e., finger tight bolt ring). The drum's bolt ring should be inspected regularly during facility inspections to ensure it turns freely and is lubricated.

Extra spill response materials should also be available for use, in addition to the spill kit contents. These include:

- 10 – 205 L open top steel drum with lid, bolting ring and gasket
- 2 spark-proof shovels
- 50 disposable large 5 mil polyethylene bags (dimensions 65 cm x 100 cm)
- 10 – 12.5 cm x 3 m (5 in. X 10 ft) sorbent booms
- 5 – 10 kg bags of sorbent particulate
- 500 sheets (5 bails) of 50 cm x 50 cm sorbent sheets
- 2 Tyvex® splash suits
- 2 pairs of chemical resistant gloves
- 2 pairs of splash protective goggles.

8.2 Off-Site Resources

The following agencies can be contacted for assistance in spill reporting, response and/or clean-up and remediation.

Table 8-1 Regulatory agency contact information for spill contingency planning.

Agency	Legislation	Contact Information
Nunavut Water Board	*Nunavut Waters and Surface Right Tribunal Act*	Phone: (867) 360-6338 Fax: (867) 360-6369
Nunavut Impact Review Board	*Nunavut Land Claims Agreement Act*	Phone: (867) 983-2593
Government of Nunavut Department of Environment	*Nunavut Environmental Protection Act*	Phone: (867) 975-7700 Fax: (867) 975-7740

Agency	Legislation	Contact Information
Environment Canada	*Canadian Environmental Protection Act,* 1999	Phone: (867) 975-4464 Fax: (867) 975-4645
Fisheries and Oceans Canada	*Fisheries Act*	Phone: (867) 979-8000 Fax: (867) 979-8039
Transport Canada (Coast Guard)	*Transportation of Dangerous Goods Act*	Phone: (867) 979-5269 Fax: (867) 979-4260

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9 TRAINING & EXERCISES

9.1 Outline

All individuals hired to work on Access Road construction and/or borrow source development should have their basic first aid and WHMIS (Workplace Hazardous Materials and Information System) training before working on site. A training session on spill prevention and response should also be held for all individuals prior to the start of Access Road construction or borrow source development. The training session should review this SCP and include information on:

- Individuals roles and responsibilities in regards to spill prevention, detection, response and clean-up;
- Location(s) of hard copies of the SCP, maps and spill kits;
- Equipment available for spill response;
- Content of spill kits;
- Initial actions and spill reporting procedures; and,
- Spill response and clean-up actions.

Training exercises, including mock spills and proper use of spill kits, should also be held prior to the start construction to provide hands-on training for individuals on spill response procedures and equipment. Training exercises can be held during the training session for all individuals or at another time for individuals directly involved with handling of hazardous materials.

9.2 Schedule

The training session and exercises should be held prior to the start of construction and borrow source excavation each year. This will ensure all returning individuals receive a refresher while any new individuals become familiar with on-site spill prevention and response measures.

The Hamlet will keep records of all individuals who attend the training session and exercises, as well as copies of their training certificates (e.g., first aid, WHMIS).

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10 REFERENCES

10.1 Literature Cited

Indian and Northern Affairs Canada (INAC). Guidelines for Spill Contingency Planning. Yellowknife, NT: Water Resources Division, INAC, 2007. Retrieved 7 February 2011: http://www.ainc-inac.gc.ca/ai/scr/nt/pdf/SCP-EUD-eng.pdf

Northwest Territories Water Board (NWTWB). Guidelines for Contingency Planning. Yellowknife, NT: NWTWB, 1987.

10.2 Personal Communications

McCuaig, S. Senior Terrain Scientist, Stantec Consulting Ltd. Conversations. 10 – 14 January 2011.

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APPENDIX A

Figures

Construction and Operation of an Access Road and Borrow Sources at Repulse Bay, NU

Repulse Bay Final Road Design

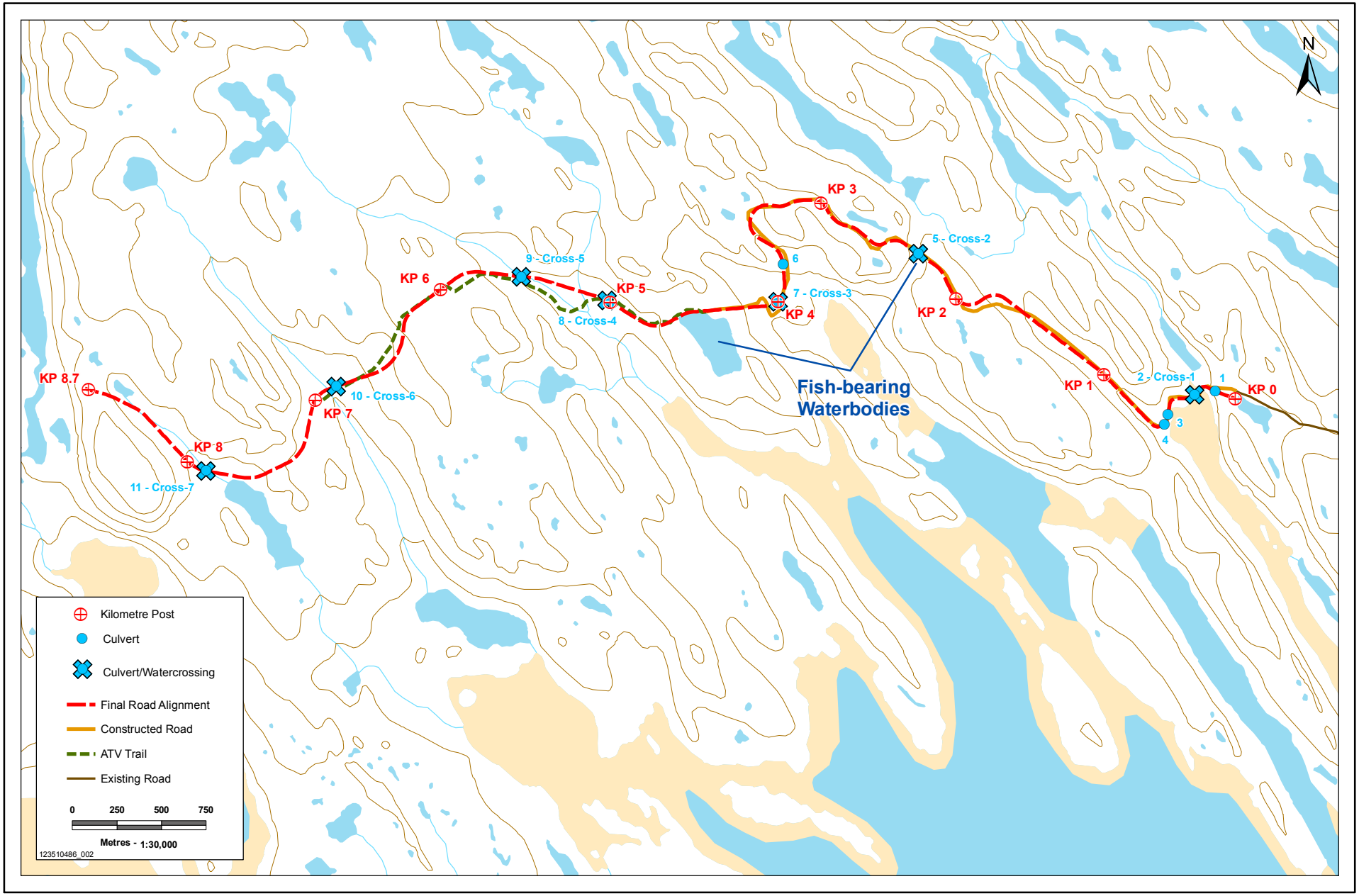
Acknowledgements: Original Drawing by Nunami Stantec; NTS Data: Sheet 046L09, 1:50,000 provided by Government of Canada, Natural Resources Canada, Centre for Topographic Information

PREPARED FOR
NUNAMI STANTEC

PREPARED FOR

FIGURE NO.
1

Last Modified: March 8, 2011 by pselmo



Construction and Operation of an Access Road and Borrow Sources at Repulse Bay, NU

Repulse Bay Final Road Design and Watercrossings

Acknowledgements: Original Drawing by Nunami Stantec; NTS Data: Sheet 046L09, 1:50,000 provided by Government of Canada, Natural Resources Canada, Centre for Topographic Information

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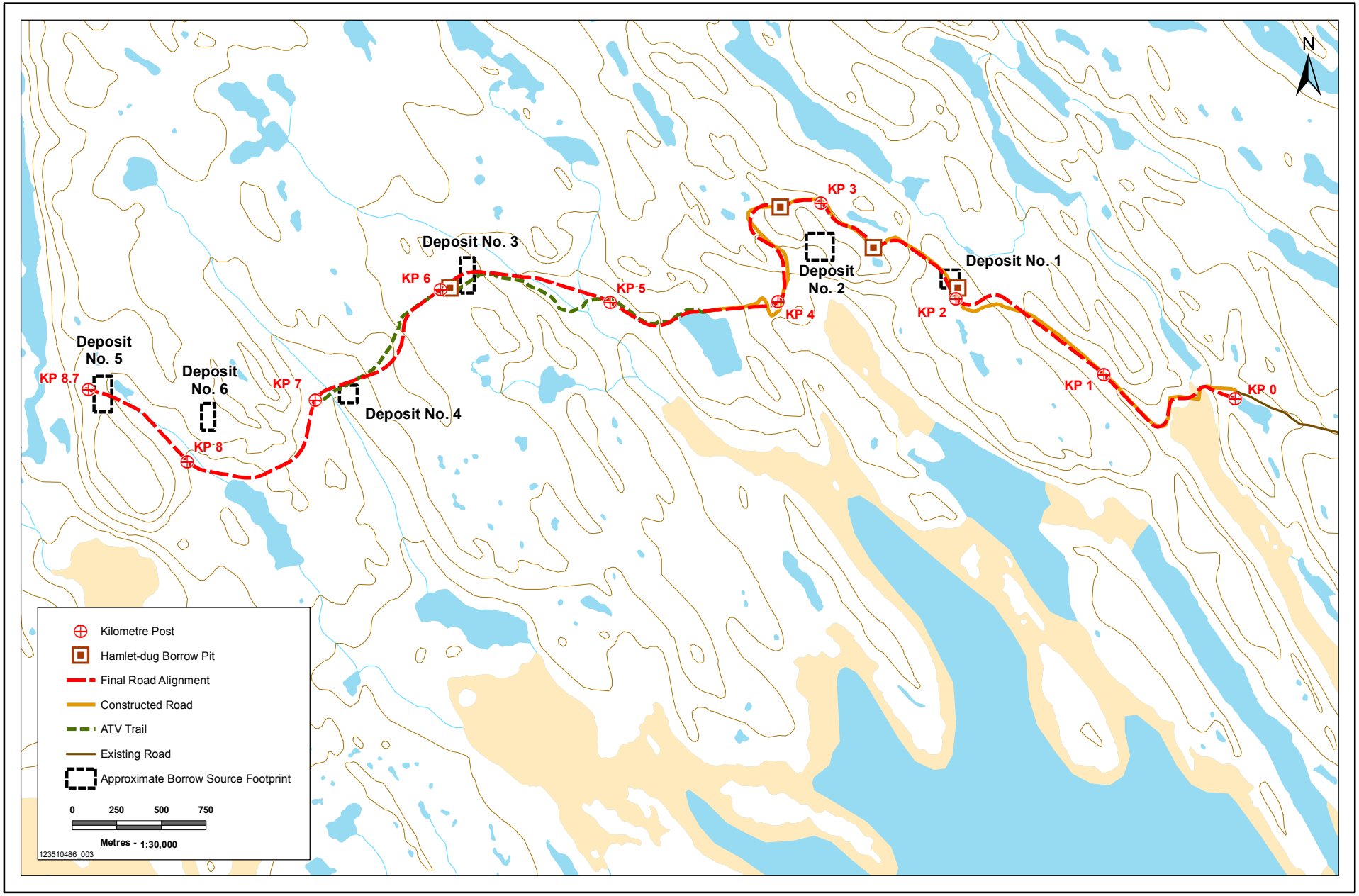
PREPARED FOR

FIGURE NO. **2**

Last Modified: March 8, 2011 by pselmo



Construction and Operation of an Access Road and Borrow Sources at Repulse Bay, NU

Repulse Bay Final Road Design and Borrow Source Locations

Acknowledgements: Original Drawing by Nunami Stantec; NTS Data: Sheet 046L09, 1:50,000 provided by Government of Canada, Natural Resources Canada, Centre for Topographic Information

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NUNAMI STANTEC

PREPARED FOR

FIGURE NO.
3

Last Modified: March 8, 2011 by pselmo

APPENDIX B

Nunavut Spill Report Form

NT-NU SPILL REPORT

OIL, GASOLINE, CHEMICALS AND OTHER HAZARDOUS MATERIALS

NT-NU 24-HOUR SPILL REPORT LINE
TEL: (867) 920-8130
FAX: (867) 873-6924
EMAIL: spills@gov.nt.ca

REPORT LINE USE ONLY

A	REPORT DATE: MONTH – DAY – YEAR	REPORT TIME	☐ ORIGINAL SPILL REPORT, OR ☐ UPDATE # _____ TO THE ORIGINAL SPILL REPORT	REPORT NUMBER ____-_____
B	OCCURRENCE DATE: MONTH – DAY – YEAR	OCCURRENCE TIME		

C	LAND USE PERMIT NUMBER (IF APPLICABLE)	WATER LICENCE NUMBER (IF APPLICABLE)
D	GEOGRAPHIC PLACE NAME OR DISTANCE AND DIRECTION FROM NAMED LOCATION	REGION ☐ NWT ☐ NUNAVUT ☐ ADJACENT JURISDICTION OR OCEAN
E	LATITUDE DEGREES MINUTES SECONDS	LONGITUDE DEGREES MINUTES SECONDS

F	RESPONSIBLE PARTY OR VESSEL NAME	RESPONSIBLE PARTY ADDRESS OR OFFICE LOCATION	
G	ANY CONTRACTOR INVOLVED	CONTRACTOR ADDRESS OR OFFICE LOCATION	
H	PRODUCT SPILLED	QUANTITY IN LITRES, KILOGRAMS OR CUBIC METRES	U.N. NUMBER
	SECOND PRODUCT SPILLED (IF APPLICABLE)	QUANTITY IN LITRES, KILOGRAMS OR CUBIC METRES	U.N. NUMBER
I	SPILL SOURCE	SPILL CAUSE	AREA OF CONTAMINATION IN SQUARE METRES
J	FACTORS AFFECTING SPILL OR RECOVERY	DESCRIBE ANY ASSISTANCE REQUIRED	HAZARDS TO PERSONS, PROPERTY OR ENVIRONMENT
K	ADDITIONAL INFORMATION, COMMENTS, ACTIONS PROPOSED OR TAKEN TO CONTAIN, RECOVER OR DISPOSE OF SPILLED PRODUCT AND CONTAMINATED MATERIALS		

L	REPORTED TO SPILL LINE BY	POSITION	EMPLOYER	LOCATION CALLING FROM	TELEPHONE
M	ANY ALTERNATE CONTACT	POSITION	EMPLOYER	ALTERNATE CONTACT LOCATION	ALTERNATE TELEPHONE

REPORT LINE USE ONLY

N	RECEIVED AT SPILL LINE BY	POSITION STATION OPERATOR	EMPLOYER	LOCATION CALLED YELLOWKNIFE, NT	REPORT LINE NUMBER (867) 920-8130

LEAD AGENCY ☐ EC ☐ CCG ☐ GNWT ☐ GN ☐ ILA ☐ INAC ☐ NEB ☐ TC

SIGNIFICANCE ☐ MINOR ☐ MAJOR ☐ UNKNOWN

FILE STATUS ☐ OPEN ☐ CLOSED

AGENCY	CONTACT NAME	CONTACT TIME	REMARKS
LEAD AGENCY			
FIRST SUPPORT AGENCY			
SECOND SUPPORT AGENCY			
THIRD SUPPORT AGENCY			

APPENDIX E

Photographs

Photo 1: Constructed Cross-1 at km 0+258 across the tidal flat of Tariugaq Inlet in June 2008; west aspect.

Photo 2: Tariugaq Inlet tidal flat from the constructed Cross-1 in June 2008; south aspect.

Photo 3: Tariugaq Inlet tidal flat from the constructed Cross-1 in June 2008; north aspect.

Photo 4: Constructed Cross-1 across the tidal flat of Tariugaq Inlet in June 2008; south aspect.

Photo 5: Tariugaq Inlet substrate and large riprap on south shore of Cross-1 in June 2008; south aspect

Photo 6: Tariugaq Inlet substrate and large riprap on north shore of Cross-1 in June 2008; west aspect

Photo 7: Constructed Cross-1 across Tariugaq Inlet in August 2010; west aspect (FSC 2010).

Photo 8: Constructed Cross-1 across Tariugaq Inlet in August 2010; southwest aspect (FSC 2010).

Photo 9: Constructed access road at km 0+980 with typical terrain in June 2008; north aspect.

Photo 10: Constructed access road at km 1+720 with typical terrain in June 2008; southeast aspect.

Photo 11: Constructed Cross-2 at km 2+330 in August 2010; northwest aspect (FSC 2010).

Photo 12: Downstream environment of constructed Cross-2 in June 2008; north aspect.

Photo 13: Upstream environment of constructed Cross-2 in June 2008 and location where a ninespine stickleback was observed; west aspect.

Photo 14: Cross-2 culvert and upstream substrate on south side of road in June 2008; west aspect.

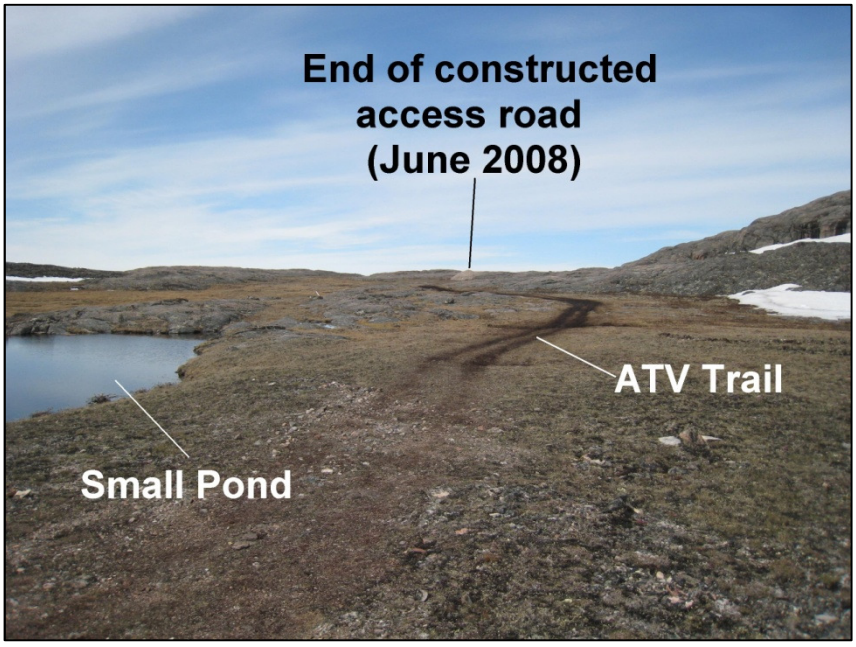

Photo 15: End of constructed access road at approximately km 3+500, ATV trail and small pond in June 2008; north aspect.

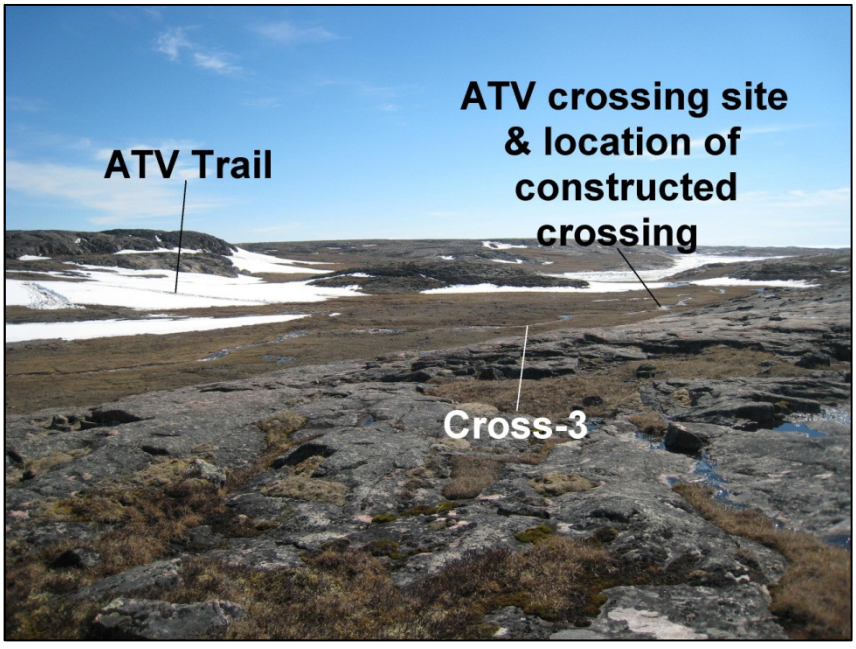

Photo 16: Overview of Stream #2 with ATV trail in June 2008; southeast aspect

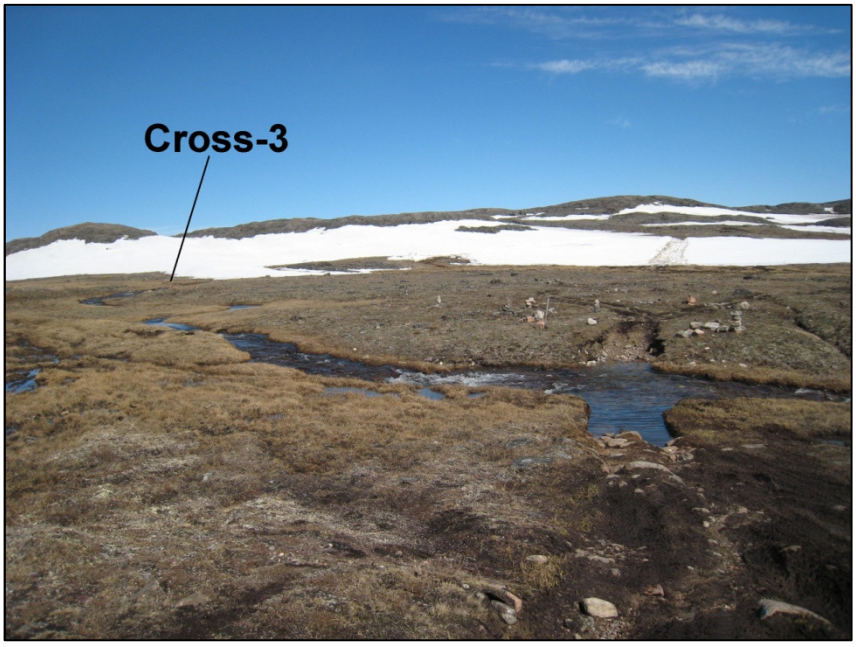

Photo 17: ATV crossing site at Stream #2 in June 2008 with Cross-3 at km 4+050 in background; east aspect.

Photo 18: Constructed crossing at Stream #2 and laydown area in September 2010; east aspect (FMA 2010).

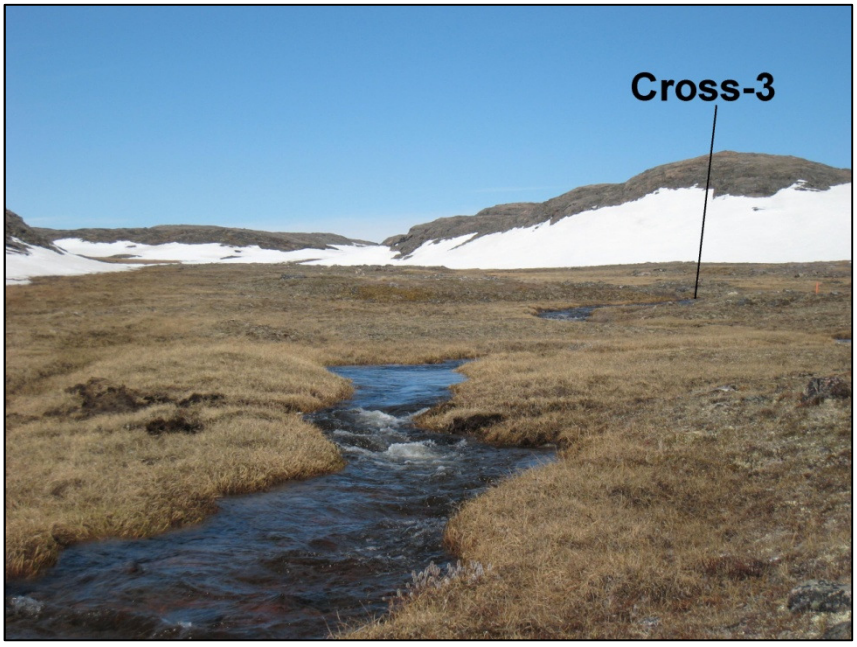

Photo 19: Stream #2 downstream of Cross-3 in June 2008, upstream of the currently constructed crossing; northwest aspect.

Photo 20: Natural bank and substrate of Stream #2 downstream of Cross-3 in June 2008; upstream of the currently constructed crossing.

Photo 21: Stream #2 downstream of currently constructed crossing in June 2008; southeast aspect.

Photo 22: Terrain near current end of constructed access road at km 4+400 in June 2008; east aspect.

Photo 23: Small lake at km 4+460 where ninespine stickleback were observed in June 2008; east aspect.

Photo 24: Stream #3 downstream of Cross-4 at km 5+020 in June 2008; north aspect.

Photo 25: Terrain upstream of Cross-4 with snowpack and boulders in June 2008; south aspect.

Photo 26: Substrate and snowpack of Stream #3 downstream of Cross-4 in June 2008; southeast aspect.

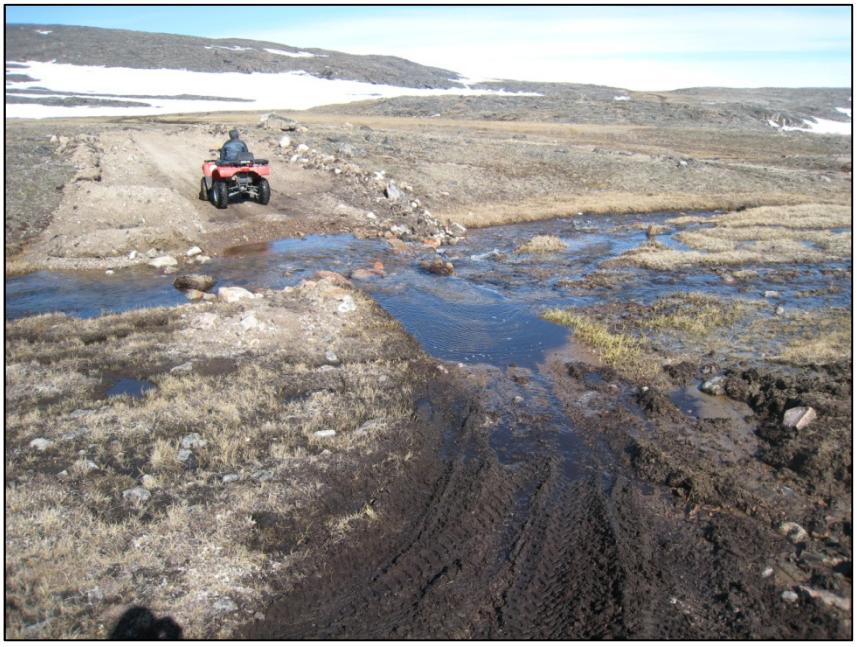

Photo 27: ATV crossing of Stream #4 in June 2008, located approximately 370 m downstream of Cross-5; east aspect.

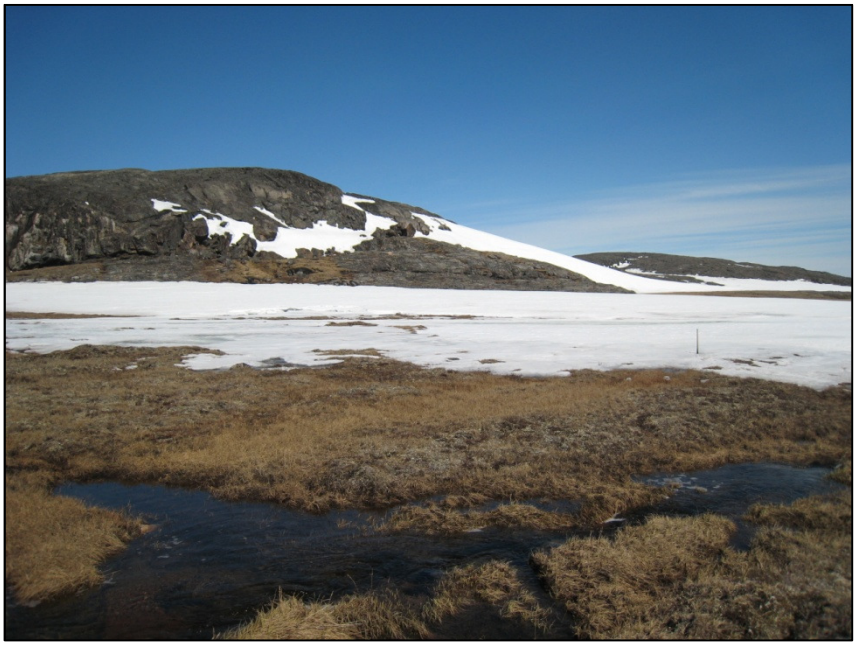

Photo 28: Stream #4 at Cross-5 at km 5+520 in June 2008; southeast aspect.

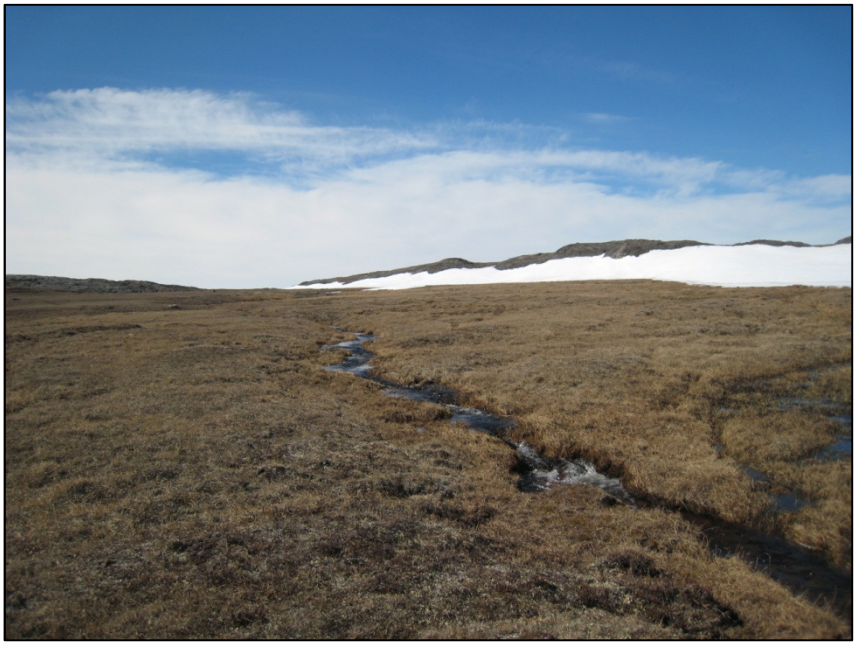

Photo 29: Stream #4 upstream of Cross-5 June 2008; north aspect.

Photo 30: Stream #4 downstream of Cross-5; south aspect.

Photo 31: ATV trail across terrain at km 6+300 in June 2008; south aspect.

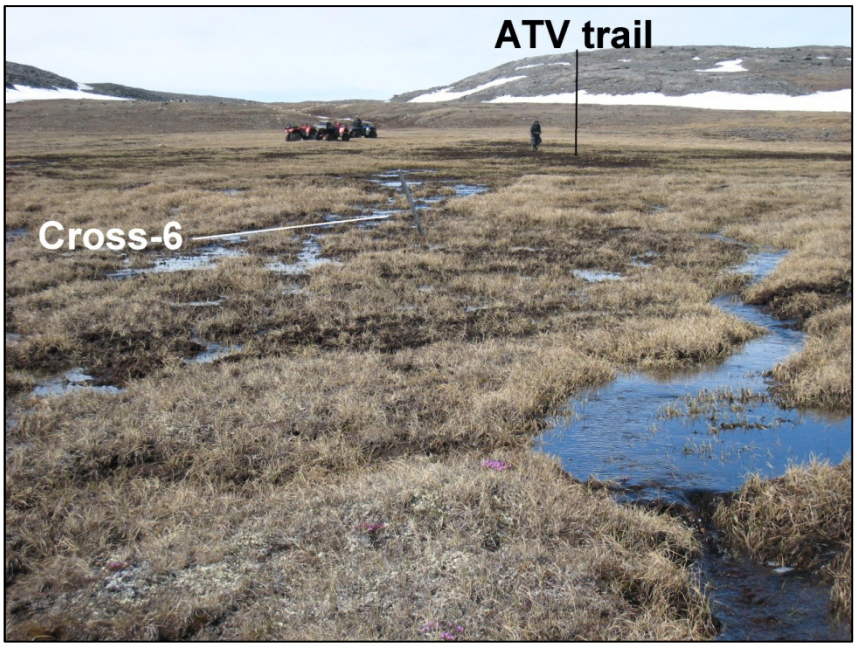

Photo 32: Stream #5 at Cross-6 at km 6+863 in June 2008, ATV trail in background; north aspect.

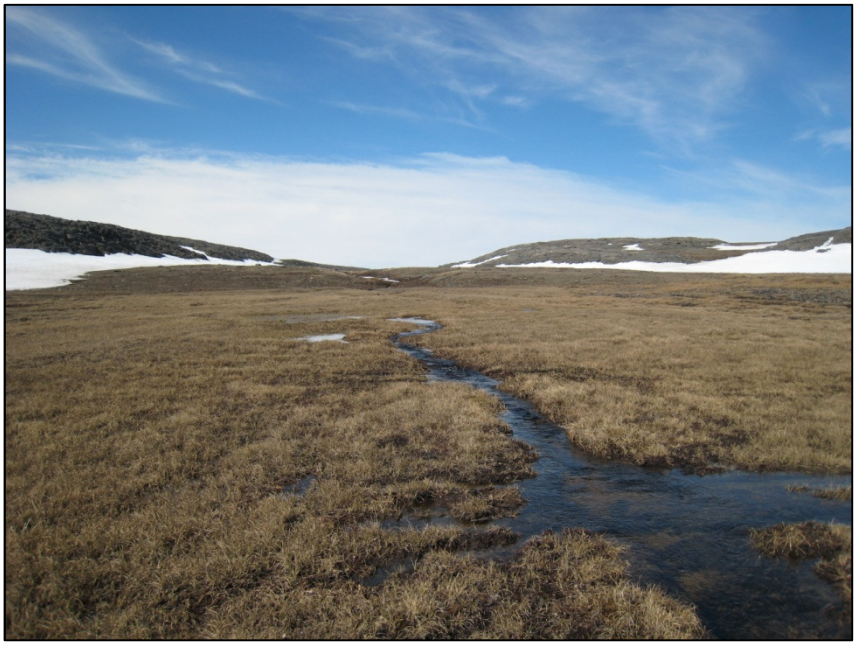

Photo 33: Stream #5 upstream of Cross-6 and the ATV trail in June 2008; north aspect.

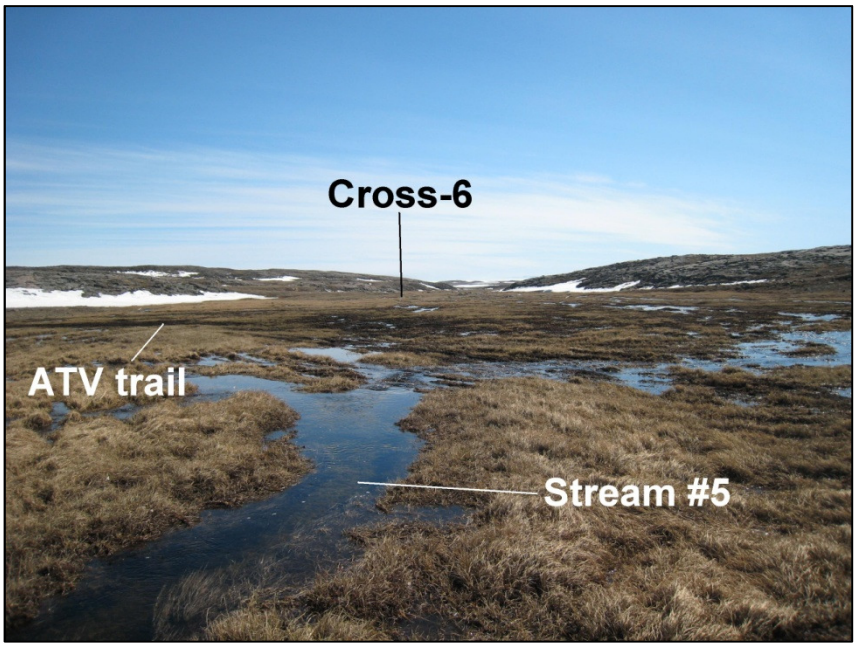

Photo 34: Saturated terrain and ATV trail across Stream #5, upstream of Cross-6, in June 2008; south aspect.

Photo 35: Stream #5 downstream of Cross-6; south aspect.

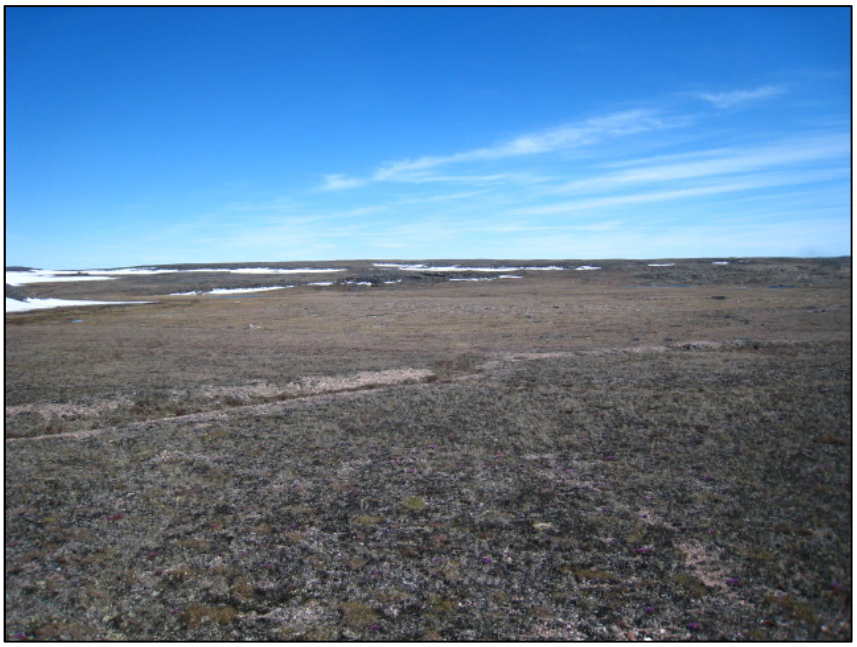

Photo 36: Terrain at km 7+500 of the access road; east aspect.

Photo 37: Stream #6 at Cross-7 at km 7+860 in June 2008, downstream lake in background; south aspect

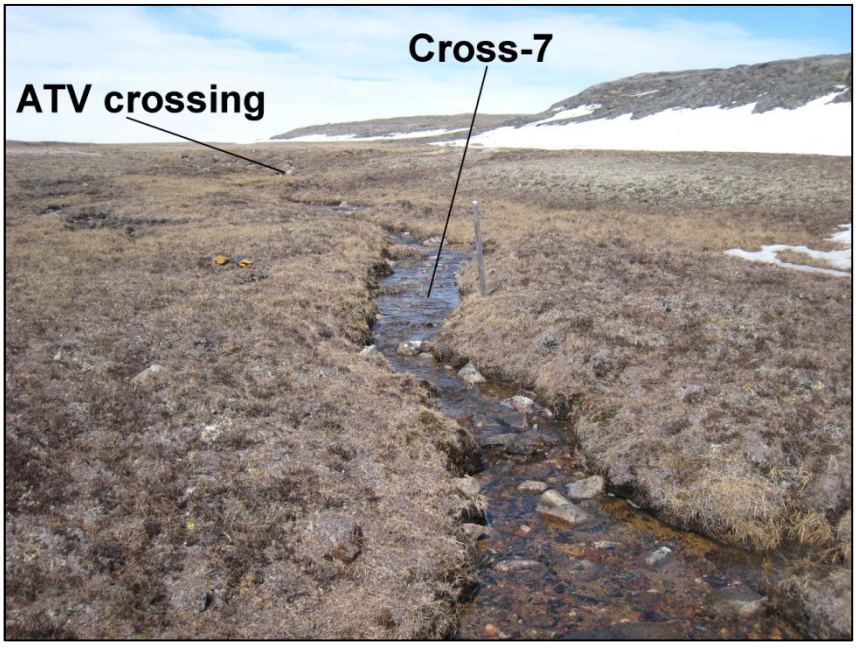

Photo 38: Stream #6 at Cross-7 with ATV crossing site upstream in June 2008; north aspect.

Photo 39: ATV crossing site on Stream #6, upstream of Cross-7; north aspect.

Photo 40: Stream #6 downstream of Cross-7, downstream lake (at km 7+700) in background; south aspect.

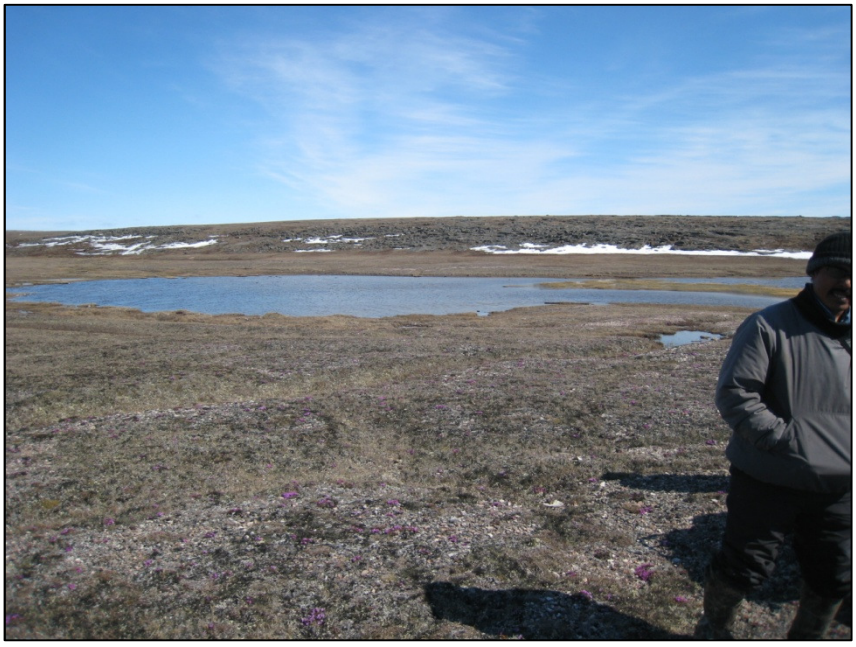

Photo 41: Headwater pond of Stream #6 at km 8+540 in June 2008, near the termination of the access road; east aspect.

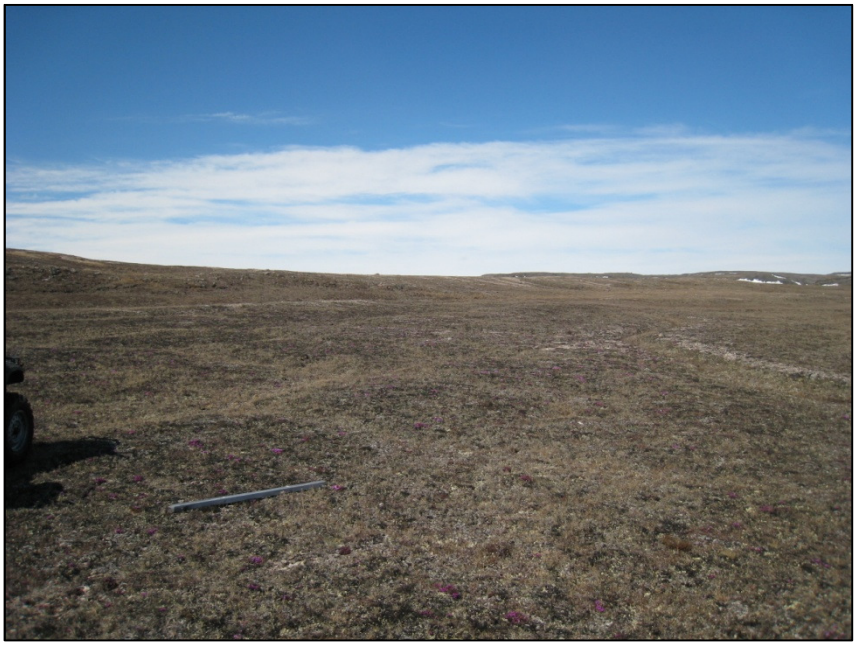

Photo 42: Terrain at km 8+540 in June 2008, near the termination of the access road; north aspect

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APPENDIX F

Dust Management Plan

Dust Management Plan

for the

Access Road and Borrow Sources

Hamlet of Repulse Bay

February 2011

Introduction

The following report details the dust management plan prepared for the operation of the access road and borrow sources situated northwest of the Hamlet of Repulse Bay, NU (the Hamlet). The access road is located within the municipal boundaries of Repulse Bay and the Hamlet will undertake all maintenance, including dust management, for the access road. The purpose of this dust management plan is to provide details about the procedures used to manage potential dust emissions arising from use of the access road and development of borrow sources.

Background

The Hamlet needs to develop granular resource sites (borrow sources) to allow for municipal road construction and other community projects. Six granular deposits were identified northwest of the Hamlet in 2002 and final design for a road to access these sites was completed by FSC Architects and Engineers in 2010. The construction of the access road is planned over two summers, beginning in July 2011, with completion expected in the fall of 2012. The 8.729 km long access road will be constructed of granular materials and measure a minimum of 11 metres wide at its base, with additional shoulder and culvert space in some areas.

The access road will be used by off-road (ATVs) and light vehicles, as well as heavy equipment when accessing the borrow sources. Dust, arising from road construction and operation (i.e., traffic) and borrow source development, was identified as having a potential adverse effect on vegetation, water quality and fish habitat within and adjacent to the access road and borrow source footprints. Increased dust will only be a concern during the summer months (primarily June to September) when the road surface will be dry and snow free. A dust management plan is required to effectively mitigate the potential effects of increased dust in the area and safeguard the aforementioned valued environmental components.

Procedure

Access Road

In the dry summer months, dust arising from the access road surface will be primarily controlled by road watering. Recommended vehicle speeds will also posted along the access road and enforced to limit speed and reduce fugitive dust by vehicle traffic. Lower speed limits could also be imposed on heavy traffic using the access road to further reduce dust emissions.

Road watering will be carried out by the Hamlet's Public Works division. Water will be obtained from the community's potable water supply and be applied with the use of a water truck and attached spray bar. The application rate will be monitored to ensure adequate coverage of the road surface without causing pooling or runoff. The access road will typically be watered once per week during the summer months. This frequency may be increased or decreased depending on the road surface and weather conditions (e.g., temperature, precipitation), at the discretion of the Hamlet foreman.

Other dust suppression techniques, including the use of saltwater and dust suppression products, will be further investigated if the present road watering technique proves ineffective or impractical. In Iqaluit, NU, saltwater is used for dust suppression on community roads as it has been observed to adhere to the road surface better and requires less frequent watering (R. Eno, *pers. comm.*). Only dust suppression products

approved for use in Nunavut (i.e., calcium chloride, Bunker C or DL 10) will be considered if this option is explored for future use on the access road. Application of any of these products will follow those procedures outlined in the Government of Nunavut's *Environmental Guideline for Dust Suppression* (2002).

Borrow Sources

Unpaved roads within quarries or borrow pits can be the largest source of dust emissions (SOURCE). The above procedures described for the access road will also be employed on the small access roads to the borrow sources to control fugitive dust.

Dust emissions from within the borrow sources are expected to be minimal as no blasting, crushing or screening activities will be occurring. However to further reduce the potential for fugitive dust from within the borrow sources, the following practices will be implemented:

- all material piles will be sloped with a minimum 2:1 horizontal to vertical ratio to reduce wind erosion;
- pit faces will be oriented with consideration to prevailing winds to direct any generated dust away from the community;
- borrow source excavation activities will be halted on high-wind days; and,
- limiting speeds of heavy equipment and/or haul/dump trucks to reduce fugitive dust generated during material transport.

If the above mitigation measures prove to be inadequate to control dust generation from the borrow sources, watering of the pit floor can also be employed to control fugitive dust. Similar to the access road, the application rate will be monitored to ensure adequate coverage of the floor without causing pooling or runoff. Watering of the pit floor is not expected to be routinely required and will only occur on an as-needed basis based on local conditions.

References & Personal Communications

Government of Nunavut. Environmental Guidelines for Dust Suppression. Environmental Protection Service, Government of Nunavut, January 2002. Available at <http://www.gov.nu.ca/env/suppression.pdf>.

Eno, R. Manager, Pollution Control. Government of Nunavut, Department of Environment, Environmental Protection Service. Telephone conversation. 22 January 2009.