

# Anvil Range Mining Complex Additional Borrow Studies 2005/06 Task 17a

Prepared for

Deloitte and Touche Inc.

On behalf of

Faro Mine Closure Planning Office

Prepared by



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## 2005/06 Task 17a

# **Deloitte & Touche Inc.**

On behalf of

# **Faro Mine Closure Planning Office**

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## **Executive Summary**

Amongst the various issues that require investigation in order to develop a final closure and reclamation plan is the availability of potential borrow materials that may be utilized for cover and earthwork construction during mine closure. Various technical studies of relevance to this issue have been completed over the past 25 or so years. Since 2002, the most recent studies that focus specifically on mine closure have been undertaken in areas which are largely accessible by road. Following the completion of various borrow studies from 2002 to 2004, it was apparent that, depending on the final closure plan, the available volume of fine-grained till deposits on the Faro side of the property in areas presently accessible by road may not be adequate. Therefore, if additional fine grained material is to be obtained on the Faro side of the property, it would have to be sourced from areas that are not presently accessible by road. SRK was contracted by Deloitte & Touche Inc. on behalf of the Faro Mine Closure Planning Office to undertake incremental borrow studies to address this issue. However, in accordance with the project's terms of reference, the additional studies would have to be undertaken without developing new road access.

YGS maps, which were based on a large suite of exploration borehole data dating back to the 1960's, were used to layout a field program that evaluated five areas that were judged to have the potential to provide significant additional quantities of borrow. The field program consisted of 23 exploration drill holes completed in two phases using a light-weight, manually-portable drill. Samples were collected from select bore holes and delivered to a laboratory in Whitehorse for routine classification testing.

The quantity of fine grained borrow material identified on the Faro side of the property has, as a result of the 2005/06 program, significantly increased the estimated reserves of fine grained material. However, due to their limited depth, most of the potential borrow areas would be relatively inefficient to develop and would leave a large developmental footprint. All of these areas would require new road access. Consideration to use any or all of these borrow areas for closure purposes will need to be balanced, therefore, against the impacts of incremental disturbance resulting from the development of a new borrow area.

\* \* \*

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# 1 Introduction

## 1.1 General

The Anvil Range Mining Complex (ARMC) is situated near the town of Faro in the central Yukon. The owner, Anvil Range Mining Corporation, is currently in receivership and Deloitte & Touche Inc. (Deloitte), in its capacity as "Interim Receiver", is overseeing management of the site. In 2002, as part of its mandate, the Interim Receiver initiated the process of developing a Final Closure and Reclamation Plan.

Amongst the various issues that require investigation in order to develop a final closure and reclamation plan is the availability of potential borrow materials that may be utilized for cover and earthwork construction during mine closure. Various technical studies of relevance to this issue have been completed over the past 25 or so years. Since 2002, the most recent studies that focus specifically on mine closure have been undertaken by SRK Consulting (SRK) on areas which are largely accessible by road. Following the completion of various SRK borrow studies from 2002 to 2004, it was apparent that additional studies were needed to assess the incremental availability of fine-grained till deposits at the Faro side of the property in areas that are not currently accessible by road. However, new road access would not be developed as part of these incremental studies. SRK was contracted by Deloitte & Touche Inc. on behalf of the Faro Mine Closure Planning Office to undertake these incremental borrow studies as Task 17a in 2005/2006.

General background on the ARMC and the significance of borrow materials to closure are provided in Section 1.2. Previous technical studies related to the availability of potential borrow materials are discussed in Section 1.3. Section 2 provides a summary of general site conditions in the context of potential borrow materials. Potential borrow source requirements, based on the current range of options from which a final closure plan may be developed, are reviewed in Section 3. The 2005/06 borrow assessment, which was undertaken in August and September 2005, is described in Section 4. The results of the borrow assessment, by area, and a discussion of their significance are provided in Section 5. Section 6 contains the key conclusions arising from the 2005/06 borrow assessment.

## 1.2 Background

The Anvil Range Mining Complex consists of two mine areas, Faro and Vangorda Plateau, which are approximately 15 km apart. Lead and zinc were the metals of economic importance, along with small quantities of silver and gold.

The original open pit mining and all milling and tailings deposition took place on the Faro mine site. Two additional open pits (Vangorda and Grum) are located on Vangorda Plateau, but no milling or tailings deposition took place there. The two mine areas are connected by a haul road that was used to truck ore from Vangorda Plateau to the Faro mill. Mining operations ceased in January 1998 when Anvil Range Mining Corporation filed for creditor protection. Deloitte & Touche Inc. was appointed Interim Receiver of Anvil Range in April 1998 and has overseen the management of the property under the terms of the water licenses since that time. Although the mandate has changed recently, in 2002 the Interim Receiver was responsible for:

- The identification and definition of remediation projects that can be proposed as part of the Water Licence renewal, i.e., to be completed in 2003 to 2008; and
- The identification of critical information needs for the Water Licence renewal and the Integrated Comprehensive Abandonment Plan (ICAP) that will need to be finalized by 2008.

ICAP activities may involve relatively large volumes of materials for purposes such as covers and channel protection. The development of closure plans and related cost estimations require an understanding of the available volume, quality and location of potential borrow sources. Borrow source surveys are often split into two or more phases, of which the first phase usually concentrates on a review of maps and aerial photos, followed by one or more phases of field verification. A description of the borrow studies completed to date is provided below.

## 1.3 Previous Work

## 1.3.1 Studies Prior to 2002

Studies undertaken prior to 2002 that are of direct relevance to potential borrow materials in the vicinity of the ARMC are as follows:

- Klohn Leonoff, 1981. Faro Tailings Abandonment Plan.
- Jackson, L.E., Jr. 1993. Surficial Geology, Magundy River, Yukon: Geological Survey of Canada, Map 1821A, scale 1:100,000.
- Bond, Jeffrey D., 2001. Quaternary Geology and Till Geochemistry of the Anvil District (parts 105K/2, 3, 5, 6 and 7) central Yukon.

The Klohn Leonoff report refers to previous surficial geology mapping studies by Tempelman-Kluit (1972, 1980), bedrock maps by CAMC and other reports by Golder Associates, including air photo studies and borehole drilling.

The surficial geological mapping by Jackson in 1993 was superceded by the Quaternary geological mapping by Bond in 2001. Maps produced by Bond form the basis of the surficial geology maps and prospective borrow area maps presented in several SRK borrow study reports completed since 2002.

## 1.3.2 Studies Since 2002

## Two-phase Borrow Investigation of 2002/03

In 2002 and 2003, SRK undertook a two-phase investigation to evaluate borrow materials on the ARMC.

The first phase of the investigation, undertaken in July and August 2002, comprised compilation of a database of existing geological information, preliminary sampling of seven potential borrow areas and laboratory testing of these samples for routine soil classification. The Phase 1 report, issued in August 2002, provided a preliminary assessment of the locations, available volumes and characteristics of potential borrow sources. The report also provided recommendations for the execution of the Phase 2 investigation.

Phase 2 of the investigation, undertaken in September through November 2002, comprised a detailed field reconnaissance, the excavation of 60 test pits in areas with existing road access and laboratory testing of representative samples to confirm soil classification and revegetation potential. The Phase 2 report, issued in April 2003, included a revised assessment of the locations, available volumes and characteristics of potential borrow sources (Figures 1 through 4).

The conclusions arising from this two-phase study were as follows. The quantities of granular soils and cohesive soils at the Anvil Range Mining Complex that are currently accessible by road access are likely to be adequate for most cover scenarios. However, granular soils are more common close to Faro and cohesive soils are more common at the Vangorda Plateau. Therefore, depending on the specific cover requirements at each mine area, haulage costs could be relatively high if material had to be hauled between Vangorda Plateau and the Faro mine site. In a scenario such as this, it may be more cost-effective to develop access to new borrow areas. Potential quarry sites capable of providing rock suitable for riprap are scarce in the immediate vicinity of the tailings containment area and waste dumps. The best source of riprap is processed calc-silicate waste rock from the Faro waste rock dumps or the rock drain at the North Fork of Rose Creek. Organic soils are not widely available and, where present, typically require the development of road access.

## Additional Borrow Studies in 2004/05

As part of a series of geophysical studies in October 2004, Aurora Geosciences Ltd. of Whitehorse completed ground penetrating radar and seismic refraction surveys at three potential borrow areas (Figure 5) identified following two-stage borrow studies undertaken in 2002 and 2003. The areas of study were situated on the Vangorda - Grum side of the ARMC. Two of the areas involved fine grained soils (till) and the third involved granular soils (sands and gravels of glaciofluvial origin).

SRK issued the final summary report in 2006. It summarized the program objectives, provided a brief overview of the field investigation and its results and provided recommendations related to further studies that may be appropriate, depending on the details of the final closure plan. The GPR survey failed to conclusively map bedrock at most sites because of signal attenuation and scattering. In general, the seismic refraction interpretation produced more definitive results, but the interpretations were complicated by a high velocity layer that could represent either dense till or weathered bedrock. In order to obtain more meaningful interpretations, the geophysical contractor recommended the completion of a drilling program to calibrate the geophysical data.

# 2 Site conditions

The following description of the conditions at the Anvil Range Mining Complex is taken primarily from Bond (2001).

## 2.1 Location and Physiography

Faro mine is located within the Anvil District, which is located within the Yukon Plateau physiographic subdivision. The Anvil Range lies at the core of the district, with summits rising above 1,800 m and intermediate surfaces, such as Vangorda Plateau, that flank the uplands.

## 2.2 Bedrock Geology

The stratigraphic sequence comprising the Anvil District extends from the Precambrian to the Ordovician and includes the Mount Mye, Vangorda and Menzie Creek Formations. The Mount Mye and Vangorda Formations comprise deep marine schist and phyllite sequences with other minor lithologies. The mid Cretaceous Anvil Range plutonic suite intrudes these rocks and is comprised of granite, granodiorite and quartz monzonite lithologies. Regional dips of the metasediments are to the southwest and northeast away from the batholith. Target materials for coarse and durable riprap material generally include the coarse-grained igneous rocks (granite, diorite and granodiorite), calc-silicates and more competent (weakly foliated) schists and phyllites.

## 2.3 Surficial Geology

The surficial geology of the Anvil Range Mining Complex is summarized on three maps that cover the areas shown by Figure 1. Figures 2, 3 and 4 show the surficial geology, according to Bond (2001), of the Faro mine site area, the Vangorda-Grum area and most of the area between the two mining complexes, respectively. The abbreviated material descriptions, which normally appear as two letters in brackets (one upper case and one lower case), are explained in the legends provided on Figures 2 through 4.

The Anvil District has been subject to repeated glaciation. The last glaciation occurred between 25,000 and 10,000 years ago late (Wisconsinan McConnell glaciation). Significant surficial materials were deposited during this period including morainal till veneers (<1 m thick) and till blankets (>1 m thick). Glaciofluvial and glaciolacustrine deposits are generally located on lower range slopes flanking active drainage channels. Recent alluvium and organic (sporadic) deposits are found throughout the area with veneers of colluvium blanketing upland slopes. Brief comments on the each of the main surficial deposits are provided below.

## 2.3.1 Alluvial Deposits

The alluvial materials comprise alluvial plain (Ap), terrace (At), fan (Af) and complex (Ax) deposits and generally consist of sand, silt, pebble, cobble and boulder mixtures. They may be up to 10 m thick and the fan deposits may be greater than 10 m thick. These deposits occur within the main drainages and are up to 600 m wide in the Rose Creek valley and 50 m wide in the North Fork Rose Creek and Next Creek valleys (Figure 2). The alluvial fan deposits consist of coarse sand, pebbles cobbles and mudflow deposits up to or greater than 10 m thick. The alluvial plain deposits consist of silt, sand and pebbles with reworked cobbles and boulders and are up to 10 m thick. These materials mostly consist of 'clean' granular materials (sand to boulder size) and form important existing and future target borrow materials.

## 2.3.2 Colluvial Deposits

The colluvial deposits generally consist of gravels with lenses of sand and silt and are found on slopes and at the base of slopes. They generally occur as thin veneers (Cv) less than 1m thick, or as aprons (Ca) which have coalesced at the base of slopes. Colluvial deposits most commonly overlie bedrock above the treeline, but also overlie older morainal till deposits on lower slopes.

## 2.3.3 Glaciofluvial Deposits

The glaciofluvial deposits consist of stratified to massive, poorly to well sorted, gravel and sand with minor silt and cobbles, deposited by meltwater originating from glacial ice. These deposits are common in Rose Creek and the major northeast tributaries. Important derivatives include the glaciofluvial plain (Gp) deposits from 3 m to 10 m thick and glaciofluvial complex (Gx) deposits up to 40 m thick.

## 2.3.4 Glacial Till

Till deposits generally consist of unsorted clay, silt, sand, pebbles and cobbles with minor boulders, deposited by or from glacial ice. Till is common as a veneer (Tv, <1 m thick) over much of the Faro and Vangorda-Grum areas and grades into blanket deposits (Tb, >1 m thick) on more gentle slopes and valley bottoms.

## 2.3.5 Organic Deposits

Organic deposits (O) mostly consist of peat and woody material and overlie lacustrine, till or poorly drained glaciofluvial and alluvial deposits, but rarely occur as a significant geologic deposit.

The general material types and the range in material volumes that may be required for future mine maintenance and closure activities were discussed in SRK (2003). A summary of those material type sand approximate volume requirements is provided below.

## 3.1 Material Types

Borrow materials that may be required for future mine maintenance and closure activities are described below:

- cohesive soils for construction of low permeability covers or vegetative covers,
- granular soils for use as filter or drain material, stabilizing fill, road fill, protective covers for geosynthetic materials, erosion protection and concrete aggregate,
- coarse rock fill for erosion protection in channels (riprap) and road ballast,
- general fills for covers, slope stabilization and potential needs, and
- organic soils for establishing vegetative covers.

Table 3.1 identifies the target geological units that, in their current form or as a result of processing, will be capable of providing the borrow materials listed above.

Borrow Material	Target Geological Units	
Cohesive Soils	Glacial till deposits (Tv, & Tb)	
Cronular Soila	Alluvial deposits (Af, Ap, At & Ax)	
Granulai Solis	Glaciofluvial deposits (Gp, Gx, Gc & Gt)	
	Screened material from alluvium & glaciofluvium	
Coarse Rock Fill	Bedrock (obtained from quarries by drilling and blasting)	
	Calc-silicate cobbles and boulders in the Faro waste rock dump & North Fork rock drain	
	Glacial till, glaciofluvium and alluvium	
General Fills	Calc-silicate gravels in the Faro waste rock dump & North Fork rock drain	
Organic Soils	Organics (O)	

Table 3.1: Required Borrow Materials and Target Geological Units

## 3.2 Material Quantities

The process of selecting the closure methods for the ARMC site is currently underway. Once selected, the closure methods will require detailed design. However, based on current concepts, the potential use of cover materials on waste dumps at the Faro, Grum and Vangorda areas, and on the Rose Creek tailings facility represent the largest volumes of borrow material and are, therefore, key "drivers" for the borrow source studies. Actual quantities will depend on the cover design of each element, but for preliminary planning purposes, the scoping studies (SRK, 2003a) considered the following cover designs:

- A "Basic Cover" was assumed to require a single 30-cm layer of soil. Such a cover would not restrict infiltration, but would provide a basis for re-vegetation.
- An "Intermediate Cover" was assumed to require a 40-cm compacted layer overlain by a 60cm uncompacted layer. It would provide some restriction of infiltration and oxidation.
- An "Excellent Cover" was assumed to require three layers of lightly compacted material, each 50-cm thick, overlain by a 50-cm thick uncompacted layer. It would provide further restriction of infiltration and oxidation.

Based on these design options, it is assumed the cover thickness could range from a minimum of 0.3 m to a maximum of 2.0 m. The order of magnitude requirement for the cover volume at each of the main areas is summarized in Table 3.2. The quantities of the other borrow materials are, compared to the cover quantities, likely to be relatively modest and have, therefore, been excluded from this summary.

Location	Plan Area (ha)	Surface Area <sup>1</sup> (ha)	Volume Range <sup>2</sup> (million m <sup>3</sup> )
Rose Creek Tailings Facility	196	196 234 0.7	
Faro Waste Dumps	334	407	1.2 to 8.1
Vangorda Waste Dumps	43	51	0.2 to 1.0
Grum Waste Dumps	128	153	0.5 to 3.1
Total for all four areas	701	845	2.5 to 16.9

Table 3.2: Range of Borrow Quantities for Assumed Cover Options

Note 1: The surface area has been conservatively estimated by increasing the plan area by 20%.

Note 2: Lower and upper limit of range correspond to cover thicknesses of 0.3 m and 2.0 m, respectively.

Considering solely the cover requirements on the Faro side of the property (i.e. Rose Creek Tailings Facility and Faro Waste Dumps in Table 3.2), the potential volume of borrow material ranges from a low of about 1.9 million m<sup>3</sup> to a high of about 12.8 million m<sup>3</sup>, depending on cover thickness.

The available reserves for the Faro side of the property, based on the estimates completed in 2002/03, are summarized in Table 3.3. The values in Table 3.3 suggest the approximate volumes of available materials are as follows: 3.2 million m<sup>3</sup> of low permeability material, 1.6 million m<sup>3</sup> of granular soils (excluding waste rock), at least 1.1 million m<sup>3</sup> of coarse rock fill and about 0.1 million m<sup>3</sup> of organic soils.

Material Type	Sites <sup>1</sup>	Inferred Volumes	Comments	
	Haul Road Borrow	720,000 m <sup>3</sup>	Till (brown), with the potential for	
Low Permeability Soils	Rose Creek Haul Road	800,000 m <sup>3</sup>	additional deposits (1) north and (2) south of the tailings impoundment and (3) unslope of the Faro-Vangorda baul	
00113	Tailings Borrow	1.7 Mm <sup>3</sup>	road	
	Haul Road Borrow	150,000 m <sup>3</sup>		
Granular		1.4 Mm <sup>3</sup>	Glaciofluvial and alluvial deposits, with potential for additional material across Rose Creek, below the tailings	
Soils	Rose Creek Borrow	(excluding		
		waste)	-	
	Waste Rock Dump	600,000 m <sup>3</sup>	Calc-silicate waste rock in select dump areas <sup>2</sup>	
Coarse Rock Fill	arse Rock North Fork Rock Drain Fill at Haul Road		Calc-silicate waste rock over a 70 m long section of road	
	Rose Creek Diversion	Unknown	Phyllite schist - variable quality	
Organic Soils	Faro West, i.e. north of the Rose Creek Haul Road	50,00 to 75,000 m <sup>3</sup>	Shallow organic deposits at two unexplored areas	

Note 1: This table excludes "off-site" quantities.

Note 2: Calc-silicate waste rock has been identified as being a suitable borrow material due to its physical durability and non-acid geochemical character. Most other waste rock is considered unsuitable due to its potential for acid generation.

In the event that the demand for cover materials on the Faro side of the property exceeds 4 to 5 million m<sup>3</sup>, there is a shortfall of confirmed borrow materials in close proximity to these areas. While ample cover materials are available at the Vangorda Plateau, there is a significant incremental cost to haul material from Vangorda Plateau to the Faro area.

# 4 2005 Borrow Source Studies

As indicated above, the potential exists for a significant shortfall of borrow materials on the Faro side of the ARMC. The focus of the 2005 borrow studies was, therefore, directed to the investigation of additional potential borrow areas on the Faro side of the property.

## 4.1 General Approach

## 4.1.1 Incremental Surficial Geology Mapping

Jeff Bond, a surficial geologist with the Yukon Geological Survey (YGS), completed a significant mapping study in the Faro area in 1999. As noted previously, his work formed, in part, the basis of the field studies undertaken by SRK from 2002 to 2004 in relation to borrow materials. However, the maps obtained from Bond covered only the most impacted parts of the ARMC.

In conjunction with the current study, Bond was contacted about doing incremental mapping of the surficial geology on specific portions of the Faro side of the ARMC. As it turned out, Bond had recently used a large suite of exploration borehole data dating back to the 1960's to complete an incremental assessment of the geology in the vicinity of the Faro mine site. This information was used to develop two new maps within the YGS Arcmap database that show surficial geology and drill hole locations around the Faro mine site. These maps, which were completed in approximately November 2004, are attached as Figures 6 and 7. The label attached to each drill hole on the map identifies the hole and the depth of overburden, as recorded by the driller and geologist. In general, the surficial material is not described in the drill logs, although some rotary drill holes in the overburden that were targeted for geochemistry have limited additional data.

Bond's maps highlight the locations of thick deposits, proximal to the Faro mine site, which may be overburden. In particular, the borehole logs from the area immediately west-northwest of the open pit suggest that overburden, likely till, reaches a depth of 46 m. Bond noted that there appears to be a small buried valley in this area. In addition, there is potential till deposit adjacent to the southeast side of the North Fork of Rose Creek. The logs indicate that overburden depths reach over 100 m in this area, however the stratigraphy is likely more variable with gravelly and glaciolacustrine deposits present. These areas were considered for further assessment as part of the 2005 field program.

## 4.1.2 Incremental Field Work

The general approach to the 2005 field program was to undertake additional borrow investigations in target areas identified by Bond and SRK as being higher priority, but without having to develop new road access. Based on this latter criterion, conventional truck, track or skid-mounted drills could not be used due to their requirement for road access. This led to the consideration of a light-weight, manually-portable drill that could be carried reasonable distances to potential borrow areas. The primary disadvantage of this type of drill is that it is cannot reach the depths that can be reached by conventional geotechnical drill rigs. However, based on the factors governing this program, a light-

weight, portable drill operated by Rocky Mountain Soil Sampling Inc. was used to undertake the field investigations during 2005. The objective of these investigations was to evaluate the likelihood that significant volumes of till material exist in these target areas.

## 4.2 Field investigation

Following a review of the SRK borrow studies in 2002/03 and the recent mapping from Bond (Figures 6 and 7), five target areas were identified for investigation. At each of these areas, the surficial geological mapping indicated that the material at surface consists of a till blanket (unit Tb, till greater than 1 m thick). The locations of these areas, which are shown on Figures 8 and 9, were as follows:

- The north slope above the Cross Valley Dam;
- Between the Faro waste rock dumps and the original tailings impoundment;
- East of the former Fresh Water Supply Reservoir, below the haul road;
- East of the North Fork of Rose Creek, above the haul road; and
- Northwest of the Faro waste rock dumps.

The field activities associated with the investigation of these areas comprised the following:

- Visual inspections, supported by available surficial geological mapping, aerial photographs and an electronic global positioning system (GPS) locator;
- Completion of 14 drill holes (B-AD-01(B) through B-AD-14) in an initial phase of drilling in August 2005; and
- Completion of nine additional drill holes (B-TE05-01 through B-TE05-03 and B-TW05-04 through B-TW05-09) in a second phase of drilling in September 2005.

Both phases of drilling were undertaken using a small, manually-portable drill operated by a two-man crew from Rocky Mountain Soil Sampling Inc. Drill holes ranged in depth from 0.3 to 6.5 m, with a mean depth of 2.8 m. The locations of the 23 drill holes are shown on Figures 8 and 9.

An inspector from SRK identified the proposed location of each drill hole using a GPS unit, supervised the drilling, collected soil samples from select drill holes and logged each drill hole. The drill hole logs are included in Appendix A.

## 4.3 Laboratory Testing Programs

Soil samples collected during the drilling program were delivered to EBA Engineering Consultants (EBA) in Whitehorse for routine classification testing. Specific laboratory test performed by EBA included gradation analyses and moisture content determinations. The results of these laboratory tests are provided in Appendix B.

# **5** Investigation Results

## 5.1 North Slope above the Cross Valley Dam

This area is located north of a potential borrow source identified in Phase 2 of the 2002/03 borrow investigation. The slope of this area decreases as the elevation increases. A total of six drill holes (B-AD-01(B) through B-AD-05, B-AD-14) were completed in this area, with a variation in depth from 1.7 to 3.1 m. All drill holes refused on what is assumed to be bedrock (confirmation normally requires that the hole penetrate about 3 to 5 m in order to demonstrate the rock is not a boulder).

In the northern part of the area (B-AD-01(B) and B-AD-02), the soil that was encountered consisted of glacial till with sand, silt, clay and a minor amount of gravel. The shallow soil encountered in the vicinity of drill holes B-AD-03, B-AD-04 and B-AD-14 consisted primarily of glacial till made up of equal amounts of sand and silt, with minor portions of gravel and clay (shown by Cross Section 1 on Figure 10). In the vicinity of the most southerly drill hole (B-AD-05), fine-grained glacial till, with reduced amounts of sand and gravel, was encountered.

Permafrost, with stratified horizontal ice lenses and local individual ice crystals and inclusions, was encountered in one drill hole (B-AD-02). According to the classification system developed by the National Research Council of Canada, this permafrost is classified as Vs and Vx.

## 5.2 Between the Faro Waste Rock Dumps and the Original Tailings Impoundment

This area, which is situated between potential borrow source areas identified in Phase 2 of the 2002/03 borrow investigation, coincides with a relatively flat hill. Three drill holes (B-AD-06 through B-AD-08), varying in depth from 0.3 to 2.3 m, were completed in the area. All drill holes refused on bedrock.

The upper part of the hill mainly consists of glacial till made up of silt and sand with minor amounts of clay and gravel. The lower part of the slope is mainly comprised of glacial till made up of clay and silt, with minor sand and gravel.

## 5.3 East of the Fresh Water Supply Reservoir

This area includes a long, thin, relatively flat area between the haul road and the former location of the Fresh Water Supply Reservoir and is approximately equidistant between the Faro and Vangorda Plateau sides of the property. Five drill holes (B-AD-09 through B-AD-13) were completed in this area. The depth of the drill holes varies from 2.5 to 6.1 m. With the exception of the deepest hole, all drill holes refused on bedrock.

The most northern part (B-AD-09) is comprised of glacial till made up of sand and silt, with smaller amounts of gravel and clay. The site covered by B-AD-10(A) and B-AD-11 consists of glacial till made up of silt and sand, with larger quantities of clay and gravel. The two drill holes in the south, B-AD-12 and B-AD-13 (shown by Cross Section 4 on Figure 11) encountered glacial till made up of sand, with smaller amounts of silt and gravel and only traces of clay.

## 5.4 East of the North Fork of Rose Creek

Situated southeast of Faro Pit is a relatively flat area. Three exploratory drill holes (B-TE05-01 through B-TE05-03) were completed, with a variation in depth from 3.0 to 6.5 m. None of the drill holes encountered bedrock.

The soil in this area showed some variability but consisted mainly of sand and silt, with larger quantities of gravel and traces of clay. Some of this material was identified as a till but, in some holes, the material may be glaciofluvial. A cross section through the area, including drill holes B-TE05-02 and B-TE05-01, is shown by Cross Section 3 on Figure 11.

## 5.5 Northwest of the Faro Waste Rock Dumps

This zone, located northwest of Faro Pit, is divided by a creek and is rather steep. Six drill holes (B-TW05-04 through B-TW05-09) were completed in this area, with a range in depth from 2.1 to 4.5 m. Except for one drill hole, most of these drill holes were terminated in weathered bedrock that was slow to penetrate.

The soil in this area consists typically of glacial till composed of sand and silt with a moderate quantity of fine gravel. A cross section through the area, including B-TW05-05 and B-TW05-06, is provided in Figure 10 (Cross Section 2).

# 6 Conclusions

The quantities of potential borrow materials that are present at the five areas investigated in 2005 are summarized below.

**North Slope above the Cross Valley Dam:** The typical stratigraphic profile in this area consists of about 2.1 m of glacial till overlying bedrock. The till is well graded and relatively fine grained, with occasional pockets of relict permafrost. Given an area that is about 1,000 m by 1,500 m, the quantity of till available for use as borrow is in the order of 3,000,000 m<sup>3</sup>. However, due to its limited thickness, the potential excavation of till from this area would not be very efficient and would leave a relatively large footprint.

**Between the Faro Waste Rock Dumps and the Original Tailings Impoundment:** The typical stratigraphic profile in this area consists of about 1.2 m of glacial till overlying bedrock. The till is well graded and relatively fine grained. Given an area that is about 1,000 m by 300 m, the quantity of till available for use as borrow is in the order of 400,000 m<sup>3</sup>. However, due to its limited thickness, the potential excavation of till from this area would be inefficient and would leave a relatively large footprint.

**East of the Fresh Water Supply Reservoir:** With the exception of a localized zone near its west limit, the typical stratigraphic profile in this area consists of about 2.9 m of glacial till overlying bedrock. The till is well graded and relatively fine grained. Given an area that is about 4,000 m by 500 m, the quantity of till available for use as borrow is in the order of 5,800,000 m<sup>3</sup>. Relative to other borrow sources on this side of the property, this is a relatively efficient borrow area. However, the potential excavation of till from this area would leave a relatively large footprint.

**East of the North Fork of Rose Creek:** Discounting the fact that bedrock was not encountered in any of the drill holes, the typical stratigraphic profile in this area consists of about 4.2 m of soil, either glacial till or glaciofluvial soil. Given an area that is about 1,000 m square, the quantity of soil available for use as borrow is in the order of 4,200,000 m<sup>3</sup>.

**Northwest of the Faro Waste Rock Dumps:** The typical stratigraphic profile in this area consists of about 1.8 m of glacial till overlying weathered bedrock. The till is well graded and dominated by sand. Given an area that is about 750 m by 1,500 m, the quantity of till available for use as borrow is in the order of 2,000,000 m<sup>3</sup>. However, due to its location and elevation, this deposit would be relatively expensive to develop.

Relative to Table 3.3, the quantity of fine grained borrow material identified on the Faro side of the property has, as a result of the 2005/06 program, significantly increased the estimated reserves of till (low permeability soil). However, due to their limited depth, most of the potential borrow areas would be relatively inefficient to develop and would leave a large developmental footprint. All of these areas would require new road access. Consideration to use any or all of these borrow areas for

This final report, **"Additional Borrow Studies - 2005/06 Task 17a"**, has been prepared by SRK Consulting (Canada) Inc.

Cam Scott, P.Eng.

# 7 References

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Figures





#### LEGEND (from Bond, 1999)

#### MINE DISTURBANCE

MD- mine disturbance; consisting of an open-pit and stripped till and bedrock accumulations. Bedrock and surficial sediments exposed in open-pit.

MT - mine tailings; consisting of sand, silt and some clay.

ORGANIC DEPOSITS

O - organics; consisting of woody sedge peat, variable thickness. White River ash accumulations are commonly associated with poorly drained peaty areas.

#### ALLUVIAL DEPOSITS

Ap - alluvial plain; silt, sand and pebbles with reworked cobbles and boulders occurring as bars, overbank floodplain deposits, 0 - 10 m thick; floodplain subject to periodic floods. Small valley alluvial plains may not be mapped at this scale.

Ap (active) - alluvial plain; area of Pelly River floodplain that has been recently active.

At - alluvial terrace; silt, sand, and pebbles with reworked cobbles and boulders occurring as low terrace deposits, 0 - 10 m thick

Af - alluvial fan; coarse sand, pebbles, cobbles and mudflow deposits, up to or >10 m thick. Appear as vegetated, often peat covered, landforms developed during post-glacial sedimentation.

Ax - complexes of Ap and Af undivided. Common when a stream is unconfined and also in narrow valleys where side-entry alluvial fans cannot be differentiated from an alluvial plain.

#### PLEISTOCENE AND HOLOCENE (UNDIVIDED)

#### COLLUVIAL DEPOSITS

Cv - colluvium veneer; conforms to bedrock topography, <1 m thick.

Ca - colluvium apron; coalescing colluvial fans at the base of a slope, >1 m thick.

Cz - mass wasting; includes slumping, debris slides and rockfalls. Slumping and rockfalls are Common on Mt. Mye.

LATE PLEISTOCENE (WISCONSINAN) - McCONNELL GLACIATION GLACIOLACUSTRINE DEPOSITS

Lb - glaciolacustrine blanket; 1- 40 m thick.

GLACIOFLUVIAL DEPOSITS Gp - glaciofluvial plain; 3 - 10 m thick.

Gt - glaciofluvial terrace; <10 m thick.

Gx - glaciofluvial complex; 1 - 30 m thick, composed of deposits of outwash, glaciolacustrine and minor till deposited in an ice contact environment. Hummocky topography is associated with this depositional setting. Crevasse fillings were mapped in the upper part of Vangorda Creek

#### GLACIAL DEPOSITS

Tv - till veneer; conforms to underlying topography, <1 m thick.

Tb - till blanket; gently to moderately sloping plain controlled by bedrock or underlying surficial

Tx - till complex; till blanket or veneer composed of meltout till and minor ice contact glaciofluvial deposits.

#### LOWER CAMBRIAN TO CRETACEOUS

R - bedrock; common on plateau summits and ridges on Mt. Mye and Sheep Mountain.

#### EXISTING QUARRY OR BORROW

#### POTENTIAL QUARRY OR BORROW

AREA IDENTIFIED IN PHASE 1 (TOO THIN OR UNTESTED)

MINE INFRASTRUCTURE

EXISTING ACCESS ROAD

PHASE 2 BORROW TEST PIT

## FIGURE 2

#### FARO MINE SITE Surficial Geology and Soil and Rock Borrow Locations



HOLOCENE

MINE TAILINGS

ORGANIC DEPOSITS O - organics; consisting of woody sedge peat, variable thickness. White River ash accumulations are commonly associated with poorly drained peaty areas.

ALLUVIAL DEPOSITS Ap - alluvial plain; silt, sand and pebbles with reworked cobbles and boulders occurring as bars, overbank floodplain deposits, 0 - 10 m thick; floodplain subject to periodic floods. Small valley alluvial plains may not be mapped at this scale.

Ap (active) - alluvial plain; area of Pelly River floodplain that has been recently active. At - alluvial terrace; silt, sand, and pebbles with reworked cobbles and boulders occurring as low terrace deposits, 0 - 10 m thick

Af - alluvial fan; coarse sand, pebbles, cobbles and mudflow deposits, up to or >10 m thick. Appear as vegetated, often peat covered, landforms developed during post-glacial sedimentation.

Ax - complexes of Ap and Af undivided. Common when a stream is unconfined and also in narrow valleys where side-entry alluvial fans cannot be differentiated from an alluvial plain.

Cz - mass wasting; includes slumping, debris slides and rockfalls. Slumping and rockfalls are Common on Mt Mve

LATE PLEISTOCENE (WISCONSINAN) - McCONNELL GLACIATION GLACIOLACUSTRINE DEPOSITS Lb - glaciolacustrine blanket; 1- 40 m thick.

GLACIOFLUVIAL DEPOSITS Gp - glaciofluvial plain; 3 - 10 m thick. Gt - glaciofluvial terrace; <10 m thick.

Gx - glaciofluvial complex; 1 - 30 m thick, composed of deposits of outwash, glaciolacustrine and minor till deposited in an ice contact environment. Hummocky topography is associated with this depositional setting. Crevasse fillings were mapped in the upper part of Vangorda Creek

Tb - till blanket; gently to moderately sloping plain controlled by bedrock or underlying surficial deposits. >1 m thick

Tx - till complex; till blanket or veneer composed of meltout till and minor ice contact glaciofluvial deposits.

BEDROCK R - bedrock; common on plateau summits and ridges on Mt. Mye and Sheep Mountain.

MINE INFRASTRUCTURE EXISTING ACCESS ROAD

### LEGEND (from Bond, 1999)

#### MINE DISTURBANCE

MD- mine disturbance; consisting of an open-pit and stripped till and bedrock accumulations. Bedrock and surficial sediments exposed in open-pit.

MT - mine tailings; consisting of sand, silt and some clay.

#### PLEISTOCENE AND HOLOCENE (UNDIVIDED)

#### COLLUVIAL DEPOSITS

Cv - colluvium veneer; conforms to bedrock topography, <1 m thick.

Ca - colluvium apron; coalescing colluvial fans at the base of a slope, >1 m thick.

#### GLACIAL DEPOSITS

Tv - till veneer; conforms to underlying topography, <1 m thick.

#### LOWER CAMBRIAN TO CRETACEOUS

EXISTING QUARRY OR BORROW

POTENTIAL QUARRY OR BORROW

AREA IDENTIFIED BY BOND, UNTESTED IN PHASE 2

#### PHASE 2 BORROW TEST PIT

## FIGURE 3

### **VANGORDA - GRUM AREA** Surficial Geology and Soil and Rock Borrow Locations



NG N DWG PHA

#### LEGEND (from Bond, 1999)

MD- mine disturbance; consisting of an open-pit and stripped till and bedrock accumulations. Bedrock and surficial sediments exposed in open-pit.

MT - mine tailings; consisting of sand, silt and some clay.

O - organics; consisting of woody sedge peat, variable thickness. White River ash accumulations are commonly associated with poorly drained peaty areas.

#### ALLUVIAL DEPOSITS

Ap - alluvial plain; silt, sand and pebbles with reworked cobbles and boulders occurring as bars, overbank floodplain deposits, 0 - 10 m thick; floodplain subject to periodic floods. Small valley alluvial plains may not be mapped at this scale.

Ap (active) - alluvial plain; area of Pelly River floodplain that has been recently active.

At - alluvial terrace; silt, sand, and pebbles with reworked cobbles and boulders occurring as low terrace deposits, 0 - 10 m thick.

Af - alluvial fan; coarse sand, pebbles, cobbles and mudflow deposits, up to or >10 m thick. Appear as vegetated, often peat covered, landforms developed during post-glacial sedimentation.

Ax - complexes of Ap and Af undivided. Common when a stream is unconfined and also in narrow valleys where side-entry alluvial fans cannot be differentiated from an alluvial plain.

#### PLEISTOCENE AND HOLOCENE (UNDIVIDED)

#### COLLUVIAL DEPOSITS

Cv - colluvium veneer; conforms to bedrock topography, <1 m thick.

Ca - colluvium apron; coalescing colluvial fans at the base of a slope, >1 m thick.

Cz - mass wasting; includes slumping, debris slides and rockfalls. Slumping and rockfalls are

LATE PLEISTOCENE (WISCONSINAN) - McCONNELL GLACIATION GLACIOLACUSTRINE DEPOSITS

Lb - glaciolacustrine blanket; 1- 40 m thick.

#### **GLACIOFLUVIAL DEPOSITS** Gp - glaciofluvial plain; 3 - 10 m thick.

Gt - glaciofluvial terrace; <10 m thick.

Gx - glaciofluvial complex; 1 - 30 m thick, composed of deposits of outwash, glaciolacustrine and minor till deposited in an ice contact environment. Hummocky topography is associated with this depositional setting. Crevasse fillings were mapped in the upper part of Vangorda Creek

Tv - till veneer; conforms to underlying topography, <1 m thick.

Tb - till blanket; gently to moderately sloping plain controlled by bedrock or underlying surficial

Tx - till complex; till blanket or veneer composed of meltout till and minor ice contact

#### LOWER CAMBRIAN TO CRETACEOUS

R - bedrock; common on plateau summits and ridges on Mt. Mye and Sheep Mountain.

#### EXISTING QUARRY OR BORROW

POTENTIAL QUARRY OR BORROW

AREA IDENTIFIED IN PHASE 1 (REJECTED IN PHASE 2)

MINE INFRASTRUCTURE

EXISTING ACCESS ROAD

#### PHASE 2 BORROW TEST PIT

## **FIGURE 4**

#### FARO-VANGORDA HAUL ROAD Surficial Geology and Soil and Rock Borrow Locations



#### LEGEND (from Bond, 1999)

#### QUATERNARY

#### HOLOCENE

#### MINE DISTURBANCE

MD- mine disturbance; consisting of an open-pit and stripped till and bedrock accumulations. Bedrock and surficial sediments exposed in open-pit.

#### MINE TAILINGS

MT - mine tailings; consisting of sand, silt and some clay

#### ORGANIC DEPOSITS

O - organics; consisting of woody sedge peat, variable thickness. White River ash accumulations are commonly associated with poorly drained peaty areas.

#### ALLUVIAL DEPOSITS

Ap - alluvial plain; silt, sand and pebbles with reworked cobbles and boulders occurring as bars, overbank floodplain deposits, 0 - 10 m thick; floodplain subject to periodic floods. Small valley alluvial plains may not be mapped at this scale.

Ap (active) - alluvial plain; area of Pelly River floodplain that has been recently active.

At - alluvial terrace, silt, sand, and pebbles with reworked cobbles and boulders occurring as low terrace deposits, 0 - 10 m thick.

Af - alluvial fan; coarse sand, pebbles, cobbles and mudflow deposits, up to or >10 m thick. Appear as vegetated, often peat covered, landforms developed during post-glacial sedimentation.

Ax - complexes of Ap and Af undivided. Common when a stream is unconfined and also in narrow valleys where side-entry alluvial fans cannot be differentiated from an alluvial plain.

#### PLEISTOCENE AND HOLOCENE (UNDIVIDED)

#### COLLUVIAL DEPOSITS

Cv - colluvium veneer; conforms to bedrock topography, <1 m thick.

Ca - colluvium apron; coalescing colluvial fans at the base of a slope, >1 m thick.

Cz - mass wasting; includes slumping, debris slides and rockfalls. Slumping and rockfalls are Common on Mt. Mye.

#### LATE PLEISTOCENE (WISCONSINAN) - McCONNELL GLACIATION GLACIOLACUSTRINE DEPOSITS

Lb - glaciolacustrine blanket; 1- 40 m thick.

#### GLACIOFLUVIAL DEPOSITS

Gp - glaciofluvial plain; 3 - 10 m thick.

Gt - glaciofluvial terrace; <10 m thick.

Gx - glaciofluvial complex, 1 - 30 m thick, composed of deposits of outwash, glaciolacustrine and minor till deposited in an ice contact environment. Hummocky topography is associated with this depositional setting. Crevasse fillings were mapped in the upper part of Vangorda Creek valley.

#### GLACIAL DEPOSITS

Tv - till veneer; conforms to underlying topography, <1 m thick.

Tb - till blanket; gently to moderately sloping plain controlled by bedrock or underlying surficial deposits, >1 m thick.

Tx - till complex; till blanket or veneer composed of meltout till and minor ice contact glaciofluvial deposits.

#### LOWER CAMBRIAN TO CRETACEOUS

#### **BEDROCK**

R - bedrock; common on plateau summits and ridges on Mt. Mye and Sheep Mountain.

 $\frown$ 

EXISTING QUARRY OR BORROW

 $\otimes$ POTENTIAL QUARRY OR BORROW IDENTIFIED IN PHASE 2 (2003)

AREA IDENTIFIED BY BOND, UNTESTED IN PHASE 2 (2003)

#### MINE INFRASTRUCTURE \_\_\_\_

EXISTING ACCESS ROAD

#### GPR SURVEY LINE (2004)

SEISMIC REFRACTION SURVEY LINE (2004)

## **GPR-Survey Lines and** Seismic Refraction Survey Lines from 2004/05 Program

Vangorda-Grum Area

PPROVED FIGURE: DATE 5 May 06









#### LEGEND (from Bond, 1999)

#### QUATERNARY

#### HOLOCENE

#### MINE DISTURBANCE

MD- mine disturbance; consisting of an open-pit and stripped till and bedrock accumulations. Bedrock and surficial sediments exposed in open-pit

#### MINE TAILINGS

MT - mine tailings, consisting of sand, silt and some clay.

#### ORGANIC DEPOSITS

O - organics; consisting of woody sedge peat, variable thickness. White River ash accumulations are commonly associated with poorly drained peaty areas.

#### ALLUVIAL DEPOSITS

Ap - alluvial plain, silt, sand and pebbles with reworked cobbles and boulders occurring as bars, overbank floodplain deposits, 0 - 10 m thick; floodplain subject to periodic floods. Small valley alluvial plains may not be mapped at this scale.

Ap (active) - alluvial plain; area of Pelly River floodplain that has been recently active.

At - alluvial terrace; silt, sand, and pebbles with reworked cobbles and boulders occurring as low terrace deposits, 0 - 10 m thick.

Af - alluvial fan; coarse sand, pebbles, cobbles and mudflow deposits, up to or >10 m thick. Appear as vegetated, often peat covered, landforms developed during post-glacial sedimentation. Ax - complexes of Ap and Af undivided. Common when a stream is unconfined and also in narrow valleys where side-entry alluvial fans cannot be differentiated from an alluvial plain

#### PLEISTOCENE AND HOLOCENE (UNDIVIDED)

#### COLLUVIAL DEPOSITS

Cv - colluvium veneer; conforms to bedrock topography, <1 m thick.

Ca - colluvium apron; coalescing colluvial fans at the base of a slope, >1 m thick.

Cz - mass wasting; includes slumping, debris slides and rockfalls. Slumping and rockfalls are Common on Mt. Mye.

#### LATE PLEISTOCENE (WISCONSINAN) - McCONNELL GLACIATION GLACIOLACUSTRINE DEPOSITS

Lb - glaciolacustrine blanket; 1-40 m thick.

#### GLACIOFLUVIAL DEPOSITS

Gp - glaciofluvial plain; 3 - 10 m thick.

Gt - glaciofluvial terrace; <10 m thick.

Gx - glaciofluvial complex, 1 - 30 m thick, composed of deposits of outwash, glaciolacustrine and minor till deposited in an ice contact environment. Hummocky topography is associated with this depositional setting. Crevasse fillings were mapped in the upper part of Vangorda Creek valley.

#### GLACIAL DEPOSITS

Tv - till veneer, conforms to underlying topography, <1 m thick.

Tb - till blanket; gently to moderately sloping plain controlled by bedrock or underlying surficial deposits, >1 m thick

Tx - till complex; till blanket or veneer composed of meltout till and minor ice contact glaciofluvial deposits.

### LOWER CAMBRIAN TO CRETACEOUS

 $\frac{\text{BEDROCK}}{\text{R}-\text{bedrock}}; \text{ common on plateau summits and ridges on Mt. Mye and Sheep Mountain.}$ 

LEGEND OF GEOLOGICAL MATERIAL SEE FIGURE 3



EXISTING QUARRY OR BORROW

POTENTIAL QUARRY OR BORROW AREA INVESTIGATED IN 2005

 $\otimes$ POTENTIAL QUARRY OR BORROW IDENTIFIED IN PHASE 2 (2003)

AREA IDENTIFIED IN PHASE 1 (TOO THIN OR UNTESTED) (2002)

\_\_\_\_ MINE INFRASTRUCTURE

EXISTING ACCESS ROAD

SRK 2005 BOREHOLES Ð

CROSS SECTION LOCATION

#### PREDOMINANT MATERIAL: SAND, MINOR MATERIALS: SILT, CLAY C - CLAY, G - GRAVEL, M - SILT, S - SAND Sмс

## Drill Hole Locations and **Cross Sections** from 2005/06 Program

ngorda	Haul	Road
ngorua	nau	rtoau

















loitte Iouche	Cross Sections 3 and 4 from 2005/06 Program		
ro Mine Site/			
ngorda Haul Road	May 06	APPROVED:	FIGURE: 11

Appendix A Drill Hole Logs

Appendix A-1 August 2005 Program

#### Drill Holes completed Aug. 2005

#### B-AD-01(B)

GPS (NAD27) readings			
E	N		
579,840	6,915,280		

Interv	ral (m)			
From	То	Soil type	Soil description	Notes
0.0	0.2	Peat	Top organic soil cover. Peat, black.	
0.2	3.1	Sandy-silty clay	Sandy-silty clay (fine to coarse sand), with fine to coarse, sub-angular to sub-rounded gravel, brown-gray, with low plasticity, damp.	Clayey till.

SAMPLES 0.2-3.1m



Borehole Log: B-AD-01

#### Drill Holes completed Aug. 2005

#### B-AD-02

GPS (NAD27) readings				
E	N			
580,120	6,915,320			

Interv	ral (m)			
From To		Soil type	Soil description	Notes
0.0	0.1	Peat	Top organic soil cover. Peat, black.	
0.1	0.5	Sandy-silty clay	Sandy-silty clay (fine to medium sand), gray, with low plasticity, wet.	
0.5	1.0	Sandy-silty clay	Permafrost. Sandy-silty clay (fine to coarse sand), with minor angular to sub-angular fine gravel, gray, with low plasticity, wet.	Ice features: Vs-Vx. stratified horizontal ice lenses, hair thin to 0.5mm thick, with local individual ice crystals/inclusions. Approx. 10-15% visible ice. Refusal at 1.0m (bedrock).
, <u> </u>	0.1-0.5m			· · · · · · · · · · · · · · · · · · ·

SAMPLES

0.5-1.0m

#### Drill Holes completed Aug. 2005

#### B-AD-03

GPS (NAD27) readings			
E N			
580,437	6,914,947		

Interval (m)

From	То	Soil type	Soil description	Notes
0.0	0.3	Peat	Top organic soil cover. Peat, black.	
0.3	0.8	Sand	Fine to coarse sand, with minor silt-clay, with minor fine, sub- angular to sub-rounded gravel, brown, loose, damp.	
0.8	3.0	Silty sand	Silty-clayey fine to coarse sand (or sandy silt), with fine to coarse, sub-angular to sub-rounded gravel, brown-gray, damp.	Minor sandy silt-clay levels, with low plasticity. Refusal at 3.0mbgl (bedrock).
	0.3-0.8m			

SAMPLES

0.8-3.0m

Bedrock outcrop nearby

E N

580,495 6,914,921

#### Drill Holes completed Aug. 2005

#### B-AD-04

GPS (NAD27) readings		
E N		
580,620	6,915,200	

Interval (m)

From	То	Soil type	Soil description	Notes
0.0	0.3	Peat	Top organic soil cover. Peat, black, loose, damp.	
0.3	0.4	Sandy-clayey silt	Clayey-sandy silt (fine sand), with fine to coarse sub-angular to sub-rounded gravel, dark gray, with organic matter, loose, damp.	
0.4	1.5	Silty-gravelly sand	Silty-gravelly fine to coarse sand (fine to coarse, angular to sub-angular gravel), minor clay, poorly sorted, brown, wet.	
1.5	1.7	Gravelly sand	Gravelly fine to coarse sand (predominantly fine gravel), minor silt, brown, loose, wet.	
1.7	1.9	Silty sand	Silty fine to coarse sand, poorly sorted, with fine to coarse sub-angular gravel, brown, wet.	

SAMPLES 0.4-1.5m

#### Drill Holes completed Aug. 2005

#### B-AD-05

GPS (NAD27) readings				
E N				
581,006	6,914,760			

Interv	val (m)			
From	То	Soil type	Soil description	Notes
0.0	0.2	Peat	Top organic soil cover. Peat, black.	
0.2	1.7	Sandy-silty clay	Sandy-silty clay or sandy-clayey silt (fine to coarse sand), with fine to coarse, sub-angular to sub-rounded gravel, brown-gray, with low plasticity, damp.	Clayey till. Refusal at 1.7m (bedrock).

SAMPLES 0.2-1.7m

#### Drill Holes completed Aug. 2005

#### B-AD-06

GPS (NAD27) readings			
E N			
583,280	6,913,400		

Interv	al (m)			
From	То	Soil type	Soil description	Notes
0.0	0.1	Peat	Top soil organic cover, with some fine sand. Dark brown, loose, damp.	
0.4	0.8	Clayey silt	Or silty clay, with minor fine to coarse sand and fine gravel, brown, with low plasticity, damp.	Sample collected.
0.8	0.9	Weathered bedrock	Transition to bedrock, increased amount of gravel.	Refusal at 0.9m.

SAMPLES 0.4-0.8m

#### Drill Holes completed Aug. 2005

#### B-AD-07

GPS (NAD27) readings			
E N			
583,440	6,913,540		

Interv	/al (m)			
From	То	Soil type	Soil description	Notes
0.0	0.3	Gravelly silt	Fine to coarse gravel in a clayey silt matrix, brown, loose, damp.	Drilled 4 holes, maximum depth reached 0.3m (refusal at bedrock). Bedrock (schist) outcrops observed nearby.

Nearby bedrock outcrop coords:

E	N
583,413	6,913,505
583,420	6,913,531

#### Drill Holes completed Aug. 2005

#### B-AD-08

GPS (NAD27) readings				
E N				
583,960	6,913,180			

Interval (m)				
From	То	Soil type	Soil description	Notes
0.0	0.15	Peat	Top organic soil cover. Peat, black, loose, damp.	
0.15	2.3	Sandy-clayey silt	Sandy-clayey silt (fine to coarse sand), with minor fine to coarse, sub-angular to sub-rounded gravel, gray, with low plasticity, wet.	High fines-content till. Refusal at 2.3m (bedrock).

SAMPLES 0.15-2.3m

#### Drill Holes completed Aug. 2005

#### B-AD-09

GPS (NAD27) readings			
E N			
586,640	6,910,330		

Interval (m)				
From	То	Soil type	Soil description	Notes
0.0	0.20	Peat+sand	Top organic soil cover. Peat, black. Fine to coarse sand from 0.15 to 0.2m.	
0.20	6.1	Sandy clayey silt	Sandy-clayey silt (fine to coarse sand), with minor fine to coarse, sub-angular to sub-rounded gravel, gray, damp, with low plasticity.	High fine-content till.

SAMPLES 0.2-6.1M



Borehole Log: B-AD-09

#### Drill Holes completed Aug. 2005

#### B-AD-10A

GPS (NAD27) readings			
E	N		
587,151	6,909,560		

Inter	rval (m)			
From	То	Soil type	Soil description	Notes
0.0	0.1	Peat	Top organic soil cover. Peat, black, loose, damp.	
0.1	0.2	Sand	Silty fine sand, gray, well sorted, with roots and organic matter, loose, damp.	
0.2	0.9	Sandy silt	Sandy silt (fine to coarse sand), trace clay, with fine sub- angular gravel, brown, loose, damp.	Rock fragments from 0.75 to 0.9mbgl.
0.9	2.4	Sandy-silty clay	Sandy-silty clay (fine to coarse sand), with minor fine to coarse, sub-angular to sub-rounded gravel, brown-gray, damp, with low plasticity.	Clayey till.
2.4	3.3	Sandy-silty clay	As above, with reduced amount of fines (clay). Sandy-clayey silt (fine to coarse sand), with minor fine to coarse, sub-angular to sub-rounded gravel, brown-gray, friable.	Sandy till.
3.3	5.3	Sand and gravel	Intercalation of rock fragments intervals (up to 10cm thick) with silty fine to coarse sand (with fine sub-angular to sub- rounded gravel), damp, loose.	
SAMPLES	0.9-2.4m			

2.4-3.3m 3.3-5.3m

PHOTO 88 bedrock outcrop near original location

#### Drill Holes completed Aug. 2005

#### B-AD-11

GPS (NAD27) readings			
E	Ν		
587,400	6,909,820		

Interval (m)				
From	То	Soil type	Soil description	Notes
0.0	2.0	Sand	Fine to coarse sand (predominantly fine-medium fractions), trace silt and clay, with fine to coarse, angular to sub-angular gravel, brown, damp, loose. Thin levels (<10cm) of clayey sand.	
2.0	2.5	Clayey silt	Clayey silt, with fine to medium sand and fine to coarse gravel.	Weathered bedrock (schist). Foliation well preserved, micaceous. Refusal at 2.5mbgl.
SAMPLES	0-2.0m			

2.0-2.5m

#### Drill Holes completed Aug. 2005

#### B-AD-12

GPS (NAD27) readings			
E	N		
588,180	6,908,680		

Interval (m)

From	То	Soil type	Soil description	Notes
0.0	0.2	Silty sand	Silty fine to coarse sand, poorly sorted, brown, loose, damp.	
0.2	0.9	Silty-clayey sand	Silty-clayey fine to coarse sand, poorly sorted, with minor fine, sub- angular gravel, brown loose,damp.	
0.9	3.0	Silty-clayey sand	Or sandy-clayey silt (?). As above, with increased amount of fine to coarse gravel, brown-gray, damp.	Sandy till. Locally higher fines (clay) content levels.

SAMPLES 0.9-3.0m



Log.B-AD-12.doc

#### Drill Holes completed Aug. 2005

#### B-AD-13

GPS (NAD27) readings			
E N			
588,380	6,908,820		

Interval (m)				
From	То	Soil type	Soil description	Notes
0.0	0.25	Peat	Top organic soil cover. Peat, black, loose, damp.	
0.25	1.4	Sand	Fine to coarse sand (poorly sorted), trace silt, with fine to coarse, angular to sub-angular gravel, brown, loose, damp.	
1.4	3.2	Silty sand	Fine to coarse sand (predominantly fine to medium fractions), or sandy silt with fine to coarse, sub-angular to sub-rounded gravel, brown, damp, with low plasticity.	Sandy till. Low fines content interval from 2.7-3.0m.
3.2	3.3	Sand	Fine to coarse sand (poorly sorted), trace silt/clay, with fine to coarse, sub-angular to sub-rounded, brown, loose, damp.	Fragments of weathered schist, dark gray, showing original foliation. Refusal at 3.3mbgl.

SAMPLES 0.25-1.4m 1.4-3.2m

3.2-3.3m

#### Drill Holes completed Aug. 2005

#### B-AD-14

GPS (NAD27) readings			
E	N		
580,088	6,914,916		

Interval (m)

From	То	Soil type	Soil description	Notes
0.0	0.2	Peat	Top organic soil cover. Peat, black, loose, damp.	
0.2	0.8	Sandy-clayey silt	Sandy-clayey silt (fine to coarse sand), brown to dark gray, with organic matter, loose, damp.	
0.8	1.5	Sandy-clayey silt	Sandy-clayey silt (fine to coarse sand), with fine to coarse, sub-angular to sub-rounded gravel, gray, wet.	Soil possibly frozen (no visible ice). Intercalated organic silt levels.
1.5	1.9	Sand	Gravelly fine to coarse sand (fine gravel), minor silt-clay, brown-gray, wet.	Refusal at 1.9m (bedrock).

No samples collected.

Appendix A-2 September 2005 Program

#### Drill Holes completed Sep. 2005

#### B-TE05-01

GPS (NAD27) readings			
Е	N		
586,588	6,913,124		

Interval (m)

From	То	Soil type	Soil description	Notes
0.0	0.7	Peat	Top organic soil cover. Peat.	No recovery.
0.7	1.9	Sand	Fine to coarse sand, minor silt, with fine to coarse angular to sub- angular gravel, brown, loose, damp.	
1.9	6.5	Sandy silt	Sandy silt (fine to coarse sand) with fine to coarse angular to sub- angular gravel, gray, with low plasticity, wet.	Sandy till.

SAMPLES 1.9-6.5m

#### Drill Holes completed Sep. 2005

#### B-TE05-02

GPS (NAD27) readings			
E N			
586,145	6,913,231		

Interval (m)

From	То	Soil type	Soil description	Notes
0.0	0.4	Peat	Top organic soil cover. Peat.	
0.4	0.6	Clayey silt	Clayey silt, brown, with organic matter, damp.	
0.6	0.8	Silty sand	Silty fine to coarse sand, with fine to coarse angular to sub-angular gravel, brown, loose, damp.	
0.8	2.2	Sandy silt	Sandy silt (fine to coarse sand), with fine to coarse angular to sub- angular gravel, greenish gray/brown, damp, compact.	Sandy till.
2.2	3.0	Sandy silt	As above, with increased amount of gravel, friable.	Sandy till. Refusal at 3.0mbgl (boulder?). Tried three more holes, could not advance below 3.0mbgl.

0.8-2.2m SAMPLES

2.2-3.0m

#### Drill Holes completed Sep. 2005

#### B-TE05-03

GPS (NAD27) readings			
E N			
586,279	6,913,631		

Interval (m)

From	То	Soil type	Soil description	Notes
0.0	0.4	Peat	Top organic soil cover. Peat, black.	
0.4	1.4	Sand	Fine to coarse sand, trace silt, with fine to coarse, angular to sub-angular gravel, brown, loose, damp.	
1.4	2.6	Sand	As above, wet.	
2.6	3.0	Sand	Silty fine sand, well sorted, brown, damp, compact.	Sample tool plus rods got stuck in the hole when advancing from 3.0m onwards. Rocky Mtn went back to location a few days later to recover their equipment and recovered a sample (clayey silt) from 3.1 to 3.3 m approximately. No till detected down to investigated depth.
3.0	3.3	Silt	Clayey silt.	

No samples collected.

#### Drill Holes completed Sep. 2005

#### B-TW05-04

GPS (NAD27) readings			
E N			
583.431	6.916.389		

Interval (m)

From	То	Soil type	Soil description	Notes
0.0	0.4	Peat	Top organic soil cover. Moss/peat.	No recovery.
0.4	1.9	Sandy silt	Sandy silt (fine to coarse sand) with minor fine angular to sub- angular gravel, orangey-brown, friable, damp.	Soil presents a structure similar to till, but very oxidised, friable (abundant sand), hard to drill.
1.9	2.1	Sandy silt	As above, wet.	
2.1	2.5	Bedrock	Weathered schist, gray.	

SAMPLES 0.4-1.9m

2.1-2.5m

#### Drill Holes completed Sep. 2005

#### B-TW05-05

GPS (NAD27) readings				
E N				
583,760	6,916,278			

Interval (m)

From	То	Soil type	Soil description	Notes
0.0	0.7	Peat	Top organic soil cover. Moss/peat.	No recovery from 0.0-0.6m.
0.7	1.7	Sandy silt	Sandy silt (fine to coarse sand) with fine to coarse angular to sub- angular gravel, brown, damp.	Sandy till.
1.7	1.8	Sandy silt	As above, increased amount of sand, orange staining.	
1.8	2.1	Bedrock	Weathered schist, gray.	

SAMPLES 0.7-1.7m

#### Drill Holes completed Sep. 2005

#### B-TW05-06

GPS (NAD27) readings			
E	N		
583,776	6,915,995		

Interval (m)

From	То	Soil type	Soil description	Notes		
0.0	0.5	Peat/moss	Top organic soil cover. Peat.	No recovery.		
0.5	0.7	Sandy silt	Sandy silt (fine sand), brown, with organic matter, friable, damp.			
0.7	1.1	Silty sand	Silty fine to medium sand, with abundant fine to coarse angular gravel, brown, loose, damp.			
1.1	2.4	Sandy silt	Sandy silt, gray, loose, dry.	Weathered bedrock. Hard, slow drilling.		

No samples collected.

#### Drill Holes completed Sep. 2005

#### B-TW05-07

GPS (NAD27) readings							
Or O (INADZI) readings							
E N							
583,140	6,916,087						

Interval (m)

From	То	Soil type	Soil description	Notes		
0.0	0.4	Peat	Top organic soil cover. Moss/peat.	No recovery.		
0.4	1.4	Sandy silt	Sandy silt (fine to coarse sand) with fine to coarse angular to sub- angular gravel, brown, friable, damp.	Weak, sandy till.		
1.4	2.0	Sandy silt	As above, increased amount of fines (sandy silt with clay).	Sandy till.		
2.0	4.3	Sandy silt	Sandy silt (fine to coarse sand) with fine to coarse angular gravel, brown, friable, slightly damp.	Weathered schist fragments intercalated with quartz and other rock fragments. Unclear, but possibly top of bedrock weathering profile. Very weak, friable soil.		

SAMPLES 1.4-2.0m

7 of 9

#### Drill Holes completed Sep. 2005

#### B-TW05-08

GPS (NAD2	PHOTO 95	
E	Ν	
582,885	6,915,371	

Interval (m)

From	То	Soil type	Soil description	Notes
0.0	0.8	Peat	Top organic soil cover. Peat/moss.	
0.8	2.1	Sandy silt	Sandy silt (fine to coarse sand), with fine to coarse angular to sub- angular gravel, brown-gray, compact, damp.	Refusal at 2.1m (bedrock).

SAMPLES 0.7-2.1m

#### Drill Holes completed Sep. 2005

#### B-TW05-09

GPS (NAD27) readings						
E N						
582,204	6,915,367					

Interval (m)

From	То	Soil type	Soil description	Notes
0.0	0.4	Peat	Top organic soil cover. Peat, moss.	
0.4	0.9	Silt	Silt with gravel, dark brown, with organic matter.	
0.9	9 4.5 Sandy silt		Sandy silt (fine to coarse sand), with fine to coarse angular to sub- angular gravel, brown, compact, wet.	Sandy till.

SAMPLES 0.9-4.5m

Appendix B Laboratory Testing Program

# SOIL SAMPLE INVENTORY AND LABORATORY INDEX TESTING SUMMARY

PROJECT NO: 1200091.029

SRK (Mauro Prado) - 2005 - Sample Summary

to .	ΡĒ	SAM INTE	1PLE RVAL	に (%)	F	PARTIC DISTRI	LE SIZ	E N	ATTERBERG LIMITS		ECT	
OREHOLE ESTPIT N	AMPLE TY	From/ At	То	MOISTUR	gravel	6 sand	% silt	% clay	LASTIC	LIQUID	ASTICITY INDEX	K PROJE NUMBEF
ă F	/S	(m)	(m)	- ŭ	~			-	<u>ц</u>		Ы	Ś
SRK05-DC-1	grab	0.4	3.3	7.4								1cd003.081
SRK05-DC-1	grab	3.3	4.0	7.7	24,81 B	:	1997 - 1997 -	an an an				1cd003.081
SRK05-DC-1	grab	4.0	5.3	8.6								1cd003.081
SRK05-DC-2A	grab	0.2	2.8	11.1			25					1cd003.081
SRK05-DC-2B	grab	3.0	5.3	10.0								1cd003.081
SRK05-DC-3	grab	0.0	3.0	11.3								1cd003.081
SRK05-DC-3	grab	3.0	5.3	12.1								1cd003.081
SRK05-DC-4	grab	0.0	0.5	11.1			11					1cd003.081
B-AD-01A	grab	0.2	2.3	13.6	13	42	31	14				1cd003.078
B-AD-03	grab	0.8	3.0	10.1	20	39	39	2				1cd003.078
B-AD-08A	grab	0.15	2.3	14.2	7	50	32	11				1cd003.078
B-AD-09	grab	0.2	6.1	11.8	13	40	36	11				1cd003.078
B-AD-12	grab	0.9	2.9	8.4	21	46	28	5				1cd003.078
B-AD-13	grab	1.4	3.2	8.9	23	44	29	4				1cd003.078



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Project: 0201-1200091.029

Date Tested: 05/08/31

BY: MB

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