Yukon
Energy, Mines and Resources
Assessment and Abandoned Mines
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December 19, 2012

MEMORANDUM

Re: EBA Engineering Report "Brown-McDade Pit Assessment at the Mount Nansen Site" (November 2012)

This memorandum is to preface the "Brown-McDade Pit Assessment at the Mount Nansen Site" (November 2012) written by EBA Engineering (EBA) for Yukon Government Assessment and Abandoned Mines (AAM).

Introduction

EBA was retained to complete an assessment of the geotechnical stability of the Mount Nansen Brown-McDade Pit (the pit) in Fall 2012. Work to assess the geotechnical stability of the pit has been completed over the years by several different contractors, and was reviewed by EBA. In addition, a site inspection was undertaken.

AAM requested an updated status of the pit by EBA of which the following was to be included in the report:

1) Identifying areas of the pit that may be unstable;
2) Identifying areas that may be prone to rock fall; and
3) Devising mitigation recommendations to reduce and control risk to personnel and equipment to a level that is as low as reasonably practicable.

This memo summarizes the recommendations outlined by EBA in the report.

Contractor Recommendations for Risk Mitigation and Remediation of the Pit

EBA proposed many recommendations for risk mitigation and remediation to stabilize the pit walls following their site investigation and assessment. The following is a summary of those recommendations; for more specific details on the recommendations, please see the full report.

Key procedural work methods to be adopted during backfilling work (to mitigate rock fall and slope failure risk):

1) Area in working pit should be vehicle access only

2) Rock truck to dump waste rock into the pit base which will be bull-dozed and spread out. Create working faces adjacent to the western and eastern walls, so that in the event of a slope failure the working faces will catch the slide.

*AAM and its contractors should review the constructability of these two options.

Safety precautions to be adopted during pit water sampling:

1) Workers walk to the sampling site via a route that is as far away from the rock slopes as practicable
2) Two workers should be present at all times while conducting work in the pit
3) Workers must carry a radio communication device and use it to communicate with the mine safety coordinator prior to entering and leaving the pit
4) Sampling work should be delayed if a heavy rain event occurs 24 hours before scheduled sampling, or if heavy persistent rain occurs just before scheduled sampling
5) Working in the pit should be avoided if possible during spring freshet or spring thaw
6) The sampling company should prepare a risk assessment with the above mitigation measures included in the risk assessment

Remediation work tasks to provide a temporary measure to stabilize the pit walls (to allow for other work to be done in the pit; e.g. water quality monitoring):

1) Scaling the pit walls from the top down (to avoid working below loose or undercut sections of rock) to remove loose soil, rock and overburden from the crest of the slope, the slope face and benches in the slope. A banksman should have the capacity for radio contact with the scaler/foreman at all times. Rock 0.25m diameter or greater will be removed.

    a. Hand Scaling

       Hand scaling should be conducted from a fall restraint or work positioning system, using suitable hand tools and power equipment. Personnel must be experienced, and crews will consist of 4 people and a site supervisor with two-way radio communication.

    b. Machine Scaling

       Machine scaling should be completed utilizing an excavator and carried out by a skilled operator experienced in machine scaling rock faces. The excavator should be able to reach 25 feet at the toe of the cut.

2) Blasting to trim back slope crests or break up large boulders for tasks that cannot be accomplished by scaling. Recommended for large boulders on east pit wall and tension cracks on the west pit wall.

Portal and Mine Entrance Remediation:

1) EBA's observations of the Pony Creek adit concludes that there does not appear to indicate any significant changes since 2006, and therefore, there is no reason to question the adequacy of SRK's bulkhead design from 2006. It is however, outside of the current scope of work to review this.

2) The other excavations have no backfilling method recommended; it is outside the current scope of work to review this. Blocking off the excavations and sealing them should be considered further.

3) In addition to the SRK bulkhead design, the rock slope above the five portals should undergo more intensive scaling treatment than other areas in the pit. A temporary catch fence or rock fall mesh may be required in addition to scaling.

4) The adit entrances should be excavated properly to expose the entrance and in-situ rock within the adit.

5) A shotcrete fence should be constructed within the adit. Shotcrete should be sprayed to form a wall and tie in dowels and mesh. A sand slurry should be pumped behind the shotcrete wall. Tubes through the wall used to pump the slurry should be sealed with shotcrete once finished.

Construction Methodology:

1) Contractors must complete a Site Safety Orientation and a Contractor Review prior to the start of any work. The Contractor Review should include such things as: anchor requirements for scaling, emergency plans, rope rescue plans, schedules for blasting and scaling, hazard identification.

2) The scaling crew will be notified of blast times and locations 1 hour prior to the start of blasting, and every 15 minutes thereafter.

3) Scaling records will be kept and filled out daily.

4) The entrance to the pit will be closed during all rocks scaling operations, signs will be posted (listing contact names and radio channels), and a guard will be positioned at the entrance to the pit. Access to the top of the pit will also be restricted.

5) There will be primary and secondary tie off locations located at the top of the pit wall. There will be specifications depending on the number of scalers, the location, and if vehicles are involved.

6) The brow of the pit should be cleared back of loose debris prior to any scaling work below.

7) At the end of each shift the scalers will notify the engineers of any unforeseen slope instabilities.

8) All sectors requiring trim blasting will be completed in conjunction with scaling by a licenced blaster (registered in the Yukon).

9) Blast plans, locations and times will be submitted for approval to the engineer prior to blasting.

10) The trim blasting crew will consist of one blaster and two scalers.

11) Blasting work safe procedures will be discussed prior to each shift.

12) A pre and post blast inspection will be performed of the pit wall directly above each blast location.

13) During blasting operations, the blaster will designate spotters at key locations prior to initiating a blast warning.

14) The site will have muster points and scalers that are certified in First Aid. First Aid equipment will be near the work areas. Emergency information will be provided to all crew members.

15) Wildlife sightings will be reported and garbage will be contained to closed vehicles.

Work to be Completed

Recommendations for risk mitigation and remediation of the pit should be implemented in the remediation phase of the Mount Nansen Remediation Project. If the timeline to implement the recommendations exceeds 3 years, then the recommendations and assessment should be revised to ensure the accuracy and pertinence of the recommendations. A new assessment may be required.

Sincerely,

Adrienne Turcotte
Project Officer – Environmental Monitoring
Assessment and Abandoned Mines

GOVERNMENT OF YUKON – ENERGY, MINES AND RESOURCES

BROWN - McDADE PIT ASSESSMENT AT THE MOUNT NANSEN SITE

REPORT

NOVEMBER 2012
ISSUED FOR USE
EBA FILE: V13401062

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1.0 EXECUTIVE SUMMARY

EBA Engineering Consultants Ltd., operating as EBA, A Tetra Tech Company (EBA) undertook a site inspection and assessment of the Brown-McDade open pit at the Mount Nansen Site, during the last week of July, to determine the remediation work tasks required to temporarily stabilize the pit walls to reduce the potential risks to ALARP levels. In addition to reducing the risk to ALARP levels, procedures are presented to further reduce risks during backfilling should this option be adopted. Based on the assessment, 21 sectors were identified, where similar failure mechanisms causing rock fall or slope failure were present. Within each of these sectors, rock fall risk assessments were undertaken and the results were used to determine the quantity or type of remediation work required. Although outside of EBA's current scope of work, additional recommendations are made with regard to the closure and backfilling of five adits, located throughout the Brown-McDade pit.

Based on the information gathered, it is EBA's opinion that the Target Budgetary Number to perform the stabilization of the pit walls is estimated at $198,000.00, in addition to the costs associated with the construction of an adit bulkhead designed by SRK.

2.0 INTRODUCTION

EBA Engineering Consultants Ltd., operating as EBA, A Tetra Tech Company (EBA) were commissioned by the branch of Assessment and Abandoned Mines (AAM) of the Department of Energy, Mines and Resources, Yukon Government to assess the pit wall slopes of the Brown-McDade open pit at the Mount Nansen Site situated 60 km west of Carmacks, Yukon Territory. Figure 1 shows the location of the open pit.

This report has been conducted following an inspection and assessment of the pit by Mr. Charles Hunt, P.Eng. (BC) and Abott Shoring and Stabilization representative, Mr. Peter Louvros. The report initially presents a qualitative risk assessment of the open pit walls and describes the mechanisms of failure that are prevalent within the pit. The report then presents the risk control and mitigation measures that are considered appropriate to reduce the risk from potential rock fall and slope failure. Backfilling procedural methods are also discussed to reduce the risk further. Finally, the report details and summarizes the remediation work tasks that are required and provides specifications and a cost estimate for undertaking this work.

3.0 SCOPE OF WORK

To carry out this study, the following scope of work was completed:

- Review of the existing information.
- Development of a safety plan which EBA representatives adhered to during the inspection.
- Inspection of the pit.
- Engineering evaluation.
- Reporting on findings from inspection.

- Cost estimate of proposed remediation work.

The purpose of the inspection consists of; (i) identifying areas of the pit that may present unstable conditions (at bench or larger scale), ii) identification of areas prone to rock fall, and, (iii) devising mitigation recommendations to reduce and control both risk to personnel and equipment to a level of "as low as reasonably practicable" or ALARP. This report also includes recommendations for implementation of construction management to reduce and offset the costs associated with pit wall stabilization.

4.0 BACKGROUND REVIEW

4.1 Previous Reports

EBA was provided reports and background material by AAM. The information and data that was provided is listed below:

- A Review of the Mount Nansen Property - Strathcona Mineral Services Ltd (2001).
  - The purpose of Strathcona's site visit in March of 2000 was to determine if further development of the Mount Nansen deposit was feasible while considering the foreseeable conditions in the precious metal market. This report suggests three recommendations for the property: 1) be permanently close and deactivate with all equipment being sold off; 2) have the existing tailings stabilized; and 3) have all geological information stored in an organized manner as preparation for future further mineral exploration.
- Mount Nansen Risk Assessment, Conceptual Closure Plan and Cost Estimation - EBA Engineering (2004).
  - This risk assessment was conducted to consider the condition and physical stability (e.g. under extreme events) of the earthfill tailings dam, its stability under extreme events, alternative scenarios for closure and cost estimations for each scenario. This assessment considered the current state of the facility (in 2004), the projected 2008 condition and long term facility closure.
- Mount Nansen Mine Site, Brown McDade Pit Summer Monitoring, Data Summary Report - Gartner Lee (2005).
  - The report provided by Gartner Lee summarized the results of water quality monitoring which took place in 2004. After studying various seepage and surface water samples from numerous locations over three months, Gartner Lee made recommendations based on pit water quality and pit water balance. More data collection and water monitoring was suggested with particular attention to the exact timing of snowmelt, seepage rates and locations in the pit, and surface runoff patterns. Review of 2004 data was also recommended to identify gaps and refine the monitoring program for future years.
- Specifications, Pony Creek Adit Bulkhead - SRK (2006-7)
  - The objective of this report was to provide a bulkhead design to prevent water flow through the Pony Creek Adit. This included: carrying out a site investigation; providing a design, specifications, construction procedures and an estimate of the materials required by contractors; indicating what

level of engineering and inspections were required during the installation of the bulkhead; and specifying post construction requirements and inspections that may be necessary. The design considerations are noted within, along with four different bulkhead designs.

- Mount Nansen Options for Closure - Lorax (2010)
  - This report provides the technical information necessary to evaluate and select the most appropriate closure option for the Mount Nansen site. This report was designed to be provided to the Government of Yukon as well as local stakeholders. The designs were assessed with respect to their geotechnical stability, water management, geochemistry, water quality and cost; however a specific recommendation was not suggested.
- Mount Nansen Closure Synopsis of Remediation Field Work - Sept 30th –Oct 28, 2011 - Altura (2012)
  - This memo summarizes a site visit, where Altura spent two days on site conducting a preliminary reconnaissance, a field investigation of the mill area adit, and to collect seeds of fall species. During this investigation, Altura also established a trial revegetation and checked vault and office area for geological maps. Recommendations were made to compile information collected from the site visit and to continue research of the species collected.

These reports were used as a basis for some key assumptions prior to analyses.

4.2 Review of Mine remediation

The environmental management of the Mount Nansen site has not been continuously maintained by the same company, which leads to many high priority issues that should be dealt with immediately.

4.2.1 Lorax Environmental Services Ltd. - Mount Nansen Options for Closure, November 2010

The report included many options for the tailings storage facility (TSF), waste rock piles, and the open pit. Some possibilities presented and discussed amongst stake holders resulted in the following list:

1. Tailings dam upgrade with water cover where the waste rock either stays in place or is moved to fill the pit;
2. Tailings dam upgrade with saturated soil cover where the waste rock either stays in place or is moved to fill the pit;
3. Wet tailings backfill into the Pit with high infiltration cover while keeping the waste rock as is; and
4. Dry tailings and the waste rock are put as backfill into the pit with low infiltration cover.

No recommendations were made in this report as it was not within the scope of work.

4.2.2 Strathcona Mineral Services Ltd. – A Review of the Mount Nansen Property , January 2001

Long-term environmental reclamation suggestions from the Strathcona Mineral Services Limited 2001 report consist of the following:

1. Redistribute the tailings within the impoundment and construct a low permeability cover;
2. Relocate enough tailings to the open pit such that the pit are flooded behind a new dam and the existing tailings dam is required to impound water over the long term; and
3. Remove all tailings from the current TSF and relocate them to the Brown-McDade open pit such that the pit is flooded behind a new pit dam and the existing tailings dam is removed.

In the Strathcona Mineral Services Ltd report, option number one is the preferred plan in part as there are uncertainties regarding the ability to flood tailings in the open pit.

4.2.3 EBA Engineering Consultants Ltd. - Risk Assessment, Conceptual Closure Plan and Cost Estimation, May 2004

In this report, EBA suggests a new tailings impoundment which would require the transfer of tailings from the current facility into a nearby new facility. The old facility would then need to be closed, and the surface of both facilities would be capped with an impervious material to control wind and water erosion while providing a base for vegetation. This option is considered to have a low risk to health and safety.

The other suggestion consists of the removal of tailings from the current TSF into the open pit. This will require a groundwater evaluation and monitoring system for the open pit. This option was considered to be of moderate risk.

4.3 Geology

The following summary of the geological history of the Mount Nansen area was compiled from report 'A review of the Mount Nansen Property' prepared by Strathcona Mineral Services Ltd, 2001, which in turn, relies upon prior work undertaken by BYG Natural Resources, Archer Cathro and Associates, and the Geological Survey of Canada.

The Mount Nansen property is located between the Coast Plutonic Complex to the southwest and the Yukon Terrane to the northeast, and is within the eastern part of the Yukon Crystalline Terrane. Strongly metamorphosed meta-sedimentary schists and gneisses are of Paleozoic age and are the oldest rocks in the area. An early Cretaceous felsic plutonic rock consisting of diorites, monzonites and syenites then intruded, followed by a mafic to intermediate mid-Cretaceous volcanic rock of the Mount Nansen Volcanic Suite.

The metamorphosed meta-sedimentary schists and gneissic rock cover the lower third of the mineral claim group, and are dominated by interbedded augen gneiss, amphibole, quartzite, and quartz feldspar-chlorite gneiss. Three of the main mineralization zones, identified as the Huestis, Flex, and Webber, can be seen in these rocks and have strong, foliations which dip steeply towards the northwest.

The northeast area of the Mount Nansen property shows locally foliated mid-Cretaceous granodiorite, quartz diorite and quartz monzonite rocks. This region is considered the Brown-McDade mineralized zone and is where the deposits were found. In the north of the Mount Nansen claim group, a large quartz-feldspar porphyry intrusive complex which consists of extrusive andesitic flow and tuff units which cuts earlier units unconformably. Small silicified breccia pipe zones with relatively high amounts of gold can be found within this complex. Copper, molybdenum, and bismuth geochemical signature can also be seen in this intrusive complex which suggests porphyry style mineralization.

Propylitic alteration consisting of epidote, calcite, pyrite and magnetite replacement of hornblende is widespread. Argilic alteration of the host rock can be seen along vein contacts near surface, which has resulted in an accumulation of clay which caused serious problems when mining the upper level of the Brown-McDade deposit.

Two major fault sets can be seen throughout the property, with one dipping from 50 to 70 degrees towards the south west while the other trends southeast and is subvertical. The first fault runs parallel to the main vein and is locally mineralized while the second fault locally cuts some mineralized zones. These faults are included in the larger regional structural corridor known as the Mount Nansen Trend.

No recent glacial activity affected the property so weathering and overburden can reach depths in excess of 70 meters from the topographic surface. In these 70 meters, sulphides in mineralized zones have been altered to limonite.

4.3.1 Mineralization

Two forms of mineralization can be found on the property and both are younger than the enclosing host rock according to cross cutting relationships.

The most common form of mineralization consists of quartz, carbonate and fluctuating amounts of sulphide veins. These veins are confined within a planar structurally controlled system. The vein systems can be simple quartz veins, such as the Huestis and Webber, or as complex as the anastomosing series corresponding to the Brown-McDade claim. The vein system varies from two to eight meters wide and can range up to 600 meters in length and is open to depth. Higher gold values are restricted to steeply plunging features with strong vertical continuity.

Less common mineralization is observed in siliceous pipe-like breccia zones which show variable sulphide concentrations (e.g. sulphide rich, as observed at the northern end of the Brown-McDade open pit). Both types are narrow, steeply plunging pipes with complex, poorly understood structural controls.

Pyrite, arsenopyrite with lesser amounts of galena, sphalerite, chalcopyrite, stibnite and various sulphosalts are the main sulphides present on the property. The depth of oxidation is variable as proven material was processed from the Brown-McDade pit, where the oxide tonnage was found to be less than anticipated.

Gold can be observed as fine grained (5 to 40 microns) inclusions in pyrite and arsenopyrite, as peripheral infiltrations in most sulphide materials and as free “gold” intergrowths with galena, freibergite and sulphosalts. The “free gold” is easy to recover by cyanide leaching or gravity, however the inclusions in the sulphide materials presents a challenge in processing. Conventionally, the sulphide ores would be treated with fine grinding, floatation, roasting and cyanidation whereas currently the pressure-oxidation treatment of a flotation concentrate would be used for deposits with large enough tonnage to justify the high capital expenses.

Silver occurs as inclusions within galena and sphalerite. Silver to gold ratios vary from 7 to 1 in planar vein mineralization zones to 3 to 1 in breccia pipe mineralization. The difference between base metal values is the reason for differentiation between the two types of mineralization.

5.0 MONITORING ACTIVITIES WITHIN THE PIT

Gartner Lee Ltd. began monitoring the Mount Nansen site in 2004 which focused on developing an understanding of the pit water elevation behaviour and its water quality. Field monitoring was conducted in three periods (July, August and September). Hydrogeological and hydrological conditions were monitored by:

- Surveying relevant locations of monitors and establishing depth profiles of water parameters at multiple locations.
- Collecting water samples for chemical analysis at several locations within the pit.
- Collecting seepage and surface water samples upstream and downstream of the pit.
- Collecting flow measurements to estimate water balance components.

5.1 Water Quality

- Water quality in Pony creek seems to degrade as it flows downstream from above to below the pit but does not vary drastically according to season.
- Water flowing through the seep in the East adit has higher concentrations of As, Cd, Ca, Cu, Mg, Na, Sr, S, Ti and Zn than Pony Creek upstream or downstream of the adit.
- The water column of the Brown-McDade pit is stratified but homogeneous throughout the length of the pit, however it could undergo inversion.
- The seep water has similar alkalinity values to those in the lake however the seep water has slightly higher concentrations of bicarbonate.
- Detailed conductivity, temperature, and dissolved oxygen with depth profiles should be examined over the winter season to determine if inversion occurs.
- Collect water quality measurements during the winter season to determine water quality beneath the ice cover.
- Perform spring and fall seep surveys to delineate other discrete loadings to the pit during spring melt and fall rain events.
- Continue Conductivity, Temperature, Depth (CTD) profiling of the pit once every two months to examine the behavious of the pit over a full year cycle.

6.0 GEOTECHNICAL CONDITIONS WITHIN THE PIT

The open pit at Mount Nansen is an elongated (North to South) pit approximately 400 m long and at the base up to 30 m wide at the base. The magnetic declination at the site is 21° 54' East. The base of the pit is flooded and has formed two ponded areas. The first flooded area to the south is approximately 3 to 4 m deep and can be walked around on the western side. The second flooded area is 6 to 8 m deep (we understand) and essentially obstructs access to the northern part of the pit base. There are two benches and three bench faces that have been formed within the pit from excavation. A fourth bench face may exist beneath the surface of the submerged northern flooded area. At this stage its existence is not known for certain, and bathymetric techniques could be used to establish the extent of the pit below the submerged level.

The eastern pit wall is approximately 400 m long and have generally been excavated in more competent granitic rock within which the major discontinuity set is steeply included at 70 to 80 degrees towards the west. The angles of the bench faces and overall pit wall follows this inclination which has led to generally kinematically stable bench faces. Other discontinuities are present within the rock mass (a sub-vertical set striking east-west and a sub-horizontal set can be distinguished, see Photo 17 and 32) and have created locally kinematically unstable blocks of rock. The overall rock mass quality of the eastern pit wall from the south to approximately 100 m from the northern end is fair to good. Several rock falls have occurred within this area and at some locations rock fall has almost filled a bench and spiraled down the bench face beneath. Large boulder and cobble sized fragments of rock are strewn on most of the benches, access is difficult but possible on foot. Frost and freeze thaw (macrogelivation) processes have created numerous potentially unstable blocks which require remediation (through scaling). At three locations the size of the unstable blocks of rock warrant trim blasting (see Photos 17, 20 and 32).

The northern 100 m of the east wall is composed of less competent, fractured, and heavily jointed weathered rock (thought to be weathered/altered massive sulphide and weathered granodiorite rock). A ravelling type of failure has occurred from the bench faces of this rock, with the result that some benches are completely full of a sand and gravel material, within which occasionally larger cobble sized blocks of rock exist.

The northern end of the pit is formed of the weathered massive sulphide and granodiorite rock. A talus slope and fractured rock slope has formed up from the ponded area in the base of the pit. The western side of the pit is generally composed of weathered and altered rock. The rock on the west wall is less competent than that found on the eastern side. The rock mass is heavily jointed, fractured, with a complex joint pattern. Overall the rock mass quality is poor and locally very poor. Towards the southern end of the pit, weathered massive sulphide and occasional exposures of granitic rock exist. The north-western benches are completely full of rock fall material and access to these benches was deemed unsafe. These were the only benches that were not accessible during the inspection. Other benches on the western side of the pit also have rock fall debris, but to a lesser extent. The fractured, weathered and heavily jointed nature of the west pit walls has created a ravelling type of failure mostly composed of gravel sized rock fragments.

The main joint set that can be distinguished on the west wall dips steeply towards the west (the same main set as found on the east wall). On the west wall this set has created the potential for a toppling style of kinematic failure. Since the rock mass is weathered, fractured and locally weak (in strength), through rock failure occurs in combination with potentially toppling blocks. At the crest of the first bench down from the pit crest, on the north-western wall, a series of tension cracks can be seen created by toppling and through-rock failure. The rock mass on the bench face below can often be seen to be distressed (with open fractures between joints) and disturbed (probably as a result of blasting and freeze thaw). There is therefore the potential for a large mass of rock to be mobilized in the event that one of the benches should fail. Given the benches beneath are full of material, any significant failure from these potential bench-scale failures would result in material falling to the pit base.

There are five adits that can be seen exposed within the base of the pit. On the east wall just above the submerged area an adit connects within the Pony Creek adit to the east of the pit. At the northern end of the pit two underground entrances can be seen. The western entrance terminates after 5 m, the eastern entrance is partially collapsed after a few metres and the extent could not be determined. On the western wall above the submerged area opposite from the adit connection with Pony Creek another adit exists. This excavation is considered to be a continuation of the Pony Creek adit, the extent is unknown. At the southern end, of the northern or second submerged area, an adit entrance can be seen trending south west into the western pit wall. The extent of this adit could not be determined.

Should the extent of these adits need to be known, Sonic Probing could be used and pushed beyond the collapsed zone. Alternatively, the portals could be stabilized with support at significant cost.

6.1 Seismicity

The southwest Yukon is one of the most seismically active areas in Canada. Here, the plate boundary between the giant Pacific and North American plates is changing from one of transform (sliding past one another), to subduction (where the Pacific plate is being forced beneath the Aleutian Islands to the northwest). This results in very rapid uplift rates (mountain building) of up to 30 mm/year. The area of the plate margin has experienced many large earthquakes. The most significant inland zone of seismicity follows the Dalton and Duke River segments of the Denali Fault Zone through the southwest Yukon. Farther inland, there is minor seismicity between the Denali and Tintina fault systems. Proximal to the Tintina Fault the greatest preferred magnitude recorded is within the >3.0 to <4.0 magnitude range, and the others fall within the >2.0 to <3.0 magnitude range.

The seismic risk at the site was evaluated based on the 2005 National Building Code Seismic Hazard Calculations. This evaluation is presented in Appendix A. The Peak Ground Acceleration (PGA) based on the 2005 building code is 0.11g for an event having a 2% probability of being exceeded in 50 years (i.e. return period of 2475 years) and 0.056 for 10% probability in 50 years (i.e. return period of 475 years). The site class is selected using the 2005 National Building Code considering the properties in the upper 100 feet of the soil/rock profile at the site. Information from current borings indicates that a Site Class B (rock) is the most appropriate for the pits.

It is evident that in the event of an earthquake, rock fall or bench-scale instability (from the toppling-through rock failure in the north-western part of the pit) could occur. Remediation of these features will significantly reduce the risk to personnel and equipment in the event that there is an earthquake concurrent with people in the pit. The long term integrity of any barriers or plugs within the adits should consider seismic events.

It should be noted that the length of time to fill up the pit is estimated to be within 5 years, therefore the probability that a seismic event in combination with remediation work in the pit is low.

7.0 SITE INSPECTION

7.1 Methodology and Sectorization

In order to assess the open pit a series of photographs were taken of the pit walls from the opposite side. On the majority of these photos a 5 m high levelling staff can be seen in the photos for scale. This set of photographs is presented in Appendix B. To assess the conditions of the pit walls, almost all benches were walked on both sides of the pit. Only the second bench down from the crest of the west wall was not walked over due to safety and access constraints. These inspections allowed the pit to be split into 21 sectors. A sector was defined as an area where the failure mechanism causing rock fall or slope failure was similar and the quantity or type of remediation work could be grouped into a defined area. Figure 2 shows the location of the sectors around the pit. The pit base has not been sectorized, both because it does not create a hazard, and because the level is submerged in the northern end of the pit.

8.0 ROCK FALL RISK

8.1 Risk Assessment

One definition of risk is that it is the sum of the consequences of an event multiplied by the probability of the event occurring. In considering the risk to workers remediating the Mount Nansen Open Pit from rock fall hazards (as well as undertaking water sampling), we have undertaken a basic qualitative risk assessment, which is described in the proceeding sections.

Within this report, risk has been qualitatively assessed on a scale of 1 (low) to 9 (high) based on a simple matrix defined by a range of low to high consequence and low to high probability, as shown in the table below.

Table 1: Risk Matrix

Risk Rating		Consequence		
		Low	Moderate	High
Probability	Low	1	2	3
	Moderate	2	4	6
	High	3	6	9

To assign a risk level the qualitative level of probability is combined with a level of consequence. Level of probability refers to the likelihood that a rock fall event could occur. The consequence of a rock fall depends on the potential for loss of life, injury, and / or severity of the damage in this case to equipment.

8.1.1 Probability:

This report details the current condition of the rock slopes based on observed rock characteristics and failure mechanisms. In estimating the probability of rock fall, the observed conditions were assessed in combination with the following factors; (i) freeze-thaw effects, (ii) fractured rock, (iii) kinematic stability, and (iv) the observed rock fall history.

8.1.2 Consequence:

The rock fall hazard has the potential to cause harm either in damaging vehicles/equipment or through injury to people, these are the "elements at risk". Consequence itself depends on various factors, including; (1) whether a rock fall event will reach the working area, (2) whether the elements at risk are present during rock fall event, (3) how vulnerable the elements at risk are to the rock fall event, magnitude (in terms of size of rock fall event and how high up the pit the event may occur/travel from) and (4) the value of the element at risk, or the number of people exposed.

8.1.3 Risk Assessment:

For each of the 21 sectors described in Section 6.1, the risk assessment detailed above has been undertaken. A risk rating has been qualitatively assessed to assist with the development and implementation of appropriate remedial measures.

Table 2: Risk Assessment of Different Pit Sectors

Sector	Probability Rating	Consequence Rating	Risk Rating
1	1 (low)	2 (moderate)	2
2	1 (low)	2 (moderate)	2
3	2 (moderate)	2 (moderate)	4
4	2 (moderate)	3 (high)	6
5	3 (high)	3 (high)	9
6	3 (high)	3 (high)	9
7	3 (high)	3 (high)	9
8	3 (high)	3 (high)	9
9	3 (high)	2 (moderate)	6
10	3 (high)	2 (moderate)	6
11	2 (moderate)	3 (high)	6
12	2 (moderate)	2 (moderate)	4
13	1 (low)	2 (moderate)	2
14	2 (moderate)	2 (moderate)	4
15	3 (high)	3 (high)	9
16	2 (moderate)	2 (moderate)	4
17	1 (low)	2 (moderate)	2
18	3 (high)	3 (high)	9
18A	3 (high)	3 (high)	9
18B	3 (high)	3 (high)	9
18C	3 (high)	3 (high)	9
18D	3 (high)	3 (high)	9
19	3 (high)	3 (high)	9
20	2 (moderate)	2 (moderate)	4
21	2 (moderate)	2 (moderate)	4

9.0 RISK MITIGATION & REMEDIATION

Based on the risk assessment carried out above and our observations of the pit wall, risk mitigation of the rock fall hazard is required.

9.1 Procedural Elimination of Risk

The hierarchy of risk mitigation and control should ideally be elimination, substitution, isolation, procedural (i.e. engineering and administration), and protective personal equipment (P.P.E.). In this particular case the proposed remediation is to eliminate the risk through rock scaling, trim blasting and other methods. However, we recommend two key procedural work methods be adopted during the backfilling work to mitigate rock fall and slope failure risk. The purpose of the key procedural methods is to implement strategies for the management of rock falls. This helps to highly reduce the required level of stabilization (through scaling, trim blasting and other methods), as well as substantially reducing the risks associated with rock falls.

Firstly, the area within the pit should become a vehicular access only area. Where man-access is unavoidable a safety strip 10 m wide along the centreline of the pit base should be created. This means that scaling work will focus on blocks larger than cobble size (greater than 250 mm in length) rather than attempt to remove every single gravel and cobble sized rock that could cause a rock fall hazard. These smaller blocks which may fall during remediation are unlikely to cause harm to personnel (who are in vehicles) and may only cause minor damage to vehicles.

The second working practice to mitigate the risk of rock fall and slope failure is the backfill methodology and sequence of work. We envisage that a rock truck will dump waste rock into the pit base which will then be bull-dozed and spread out. Adjacent to the western wall the work should be undertaken so as to create a 4 m high working face at the angle of repose of the material. In the event that a rock or minor slope failure occurs this will be caught by the 4 m high working face (refer to Figure 3). On the eastern side a 1 m high working face should be created, in recognition that generally the size of ravelling failure is smaller.

EBA recommends that AAM and its contractors review the implementation (constructability) of these two proposed key procedural methods. It should be noted that the purpose is to eliminate the need of implementation of expensive catchment structures such as rock fall fences or rock fall mesh.

9.2 Water Sampling

One of the ongoing work tasks within the pit is the water sampling operations. These are undertaken at stand pipe sampling points, and occasionally from a boat used to access the flooded area. Sampling is in-frequent, but nevertheless does involve accessing the pit and walking along the pit base. The risk to personnel undertaking this work is that they could potentially be struck by rock fall. However, based on our observations of rock fall, very little rock fall rolls or falls in the centre of the access road in the base of the pit. As a consequence given the frequency of rock fall, and the relatively short exposure time during sampling, we do not believe that the risk to personnel undertaking the sampling is above the ALARP level (as low as reasonably practicable), assuming the following precautions are followed:

- Workers walk to the sampling site on a route that is as far from the rock slopes as practicable.

- Whilst working in the pit, two people should be present at all times(i.e. one as a spotter and one completing the work).
- A radio communication device is carried with the workers and used to communicate with mine safety coordinator prior to entering and upon leaving the pit.
- Should a heavy rain event be experienced (typically assumed to be greater than 50 mm of rainfall over a 24 hour period) the sampling work should be delayed. If heavy persistent rain occurs just prior to the sampling (not necessarily an event as defined above) then the sampling should be delayed.
- During freshet or spring thaw, the pit should be avoided if possible.
- A risk assessment should be prepared by the sampling company. The hazard mitigation procedures detailed above should be included in the risk assessment.

9.3 Remediation Work Tasks

An overview of the work tasks proposed to mitigate the rock fall and potential slope instabilities is given below. Detailed draft specifications are contained within Appendix C. The specifications have been based on the currently proposed remediation work, they will require finalization once the remediation details have been agreed with AAM.

9.3.1 Scaling

Scaling consists of the removal of loose soil, rock, and overburden from the crest of the slope, the slope face, and benches on the slope. Scaling should be undertaken from the top of the rock face down to avoid working below loose or undercut sections of rock. A 'banksman' should have the capacity for radio contact with the scaler / foreman at all times to effectively convey orders to ensure safe working conditions.

9.3.1.1 Hand Scaling

Hand scaling should be conducted from a fall restraint or work positioning system and using suitable hand tools (scaling bars and compressed air pipes) and powered equipment.

9.3.1.2 Machine Scaling

Machine scaling should be completed utilizing an excavator and carried out by a skilled operator experienced in machine scaling rock faces. The excavator would preferably be equipped with a narrow scaling/ditching thumb or a tractor-mounted hoe-ram including a 550 kg rock impact hammer.

The excavator should be capable of operating up to a height of the maximum bench face, or if necessary, with the aid of a ramp to attain the required height.

9.3.2 Trimming

It will be necessary to utilize blasting for trimming back slope crests, or breaking up large boulders. Trimming consists of, i) rock excavation to remove unstable rock masses on a slope that are too large or solid to be removed by scaling, ii) rock excavation to improve slope and bench geometry, and iii) breaking up rock boulders larger than 1.5 m^3 in volume to facilitate loading to trucks for disposal.

9.4 Remediation by Pit Sector

The table below presents the sectors, the type of remediation work required, a summary of work task quantities with associated time required to complete the task, and reference to photographs (i.e. presented in Appendix B).

Table 3: Anticipated remediation required at each sector

Sector	Location	Anticipated Remediation Work	Time and/or Quantities per Task	Reference Overview Photo	Reference Detail Photo
1	▪ 60 m long bench at south east corner of pit.	▪ Light scaling.	▪ 1 day machine scaling.	1, 2	11
2	▪ Southern end of pit, adjacent to access road.	▪ Scaling to pull back crest of slope. ▪ Scaling of loose rocks.	▪ 1 day machine scaling.	8	12
3	▪ 55 m long bench by approximately 8 m high. ▪ Southeastern pit wall.	▪ Light scaling at the crest. ▪ Minor scaling on the slope.	▪ 16 hours hand scaling.	2, 3, 4	13
4	▪ 30 m long bench. ▪ Southeastern pit wall.	▪ Light scaling of fairly tight rock mass.	▪ 8 hours hand scaling.	3, 4	14
5	▪ 35 m long bench. ▪ Southeastern pit wall.	▪ Moderate scaling of blocky rock mass.	▪ 24 hours hand scaling.	3, 4, 5	15
6	▪ 110 m long lower bench above 1st southern ponded area.	▪ Scaling of lower bench.	▪ 8 hours hand scaling.	4, 5, 6	16
7	▪ Eastern pit wall central bench.	▪ Trim blast. ▪ 14 holes at 2m with 30kg of explosive.	▪ 120 m^3 of trim blasting.	4, 5	17, 18
7	▪ Eastern pit wall central bench.	▪ Removal of blast induced debris from face.	▪ 8 hours hand scaling	4,5	17, 18
7	▪ Eastern pit wall central bench.	▪ Rock removal from bench.	(Included in scaling time above)	4,5	17, 18
8	▪ Eastern pit wall central bench.	▪ Heavy scaling of numerous blocks in pit wall. ▪ Rock removal from bench.	▪ 84 hours hand scaling.	4, 5, 6	19
8A	▪ Eastern pit wall central bench.	▪ Allowance for trim blast.	▪ 60 m^3 of trim blasting. (not included in current total)	4, 5, 6	20, 21
9	▪ West bench eastside.	▪ Light scaling.	▪ 12 hours hand scaling.	5, 6	22
9	▪ West bench eastside.	▪ Rock removal from bench.	(Included in scaling time above)	5, 6	22

Table 3: Anticipated remediation required at each sector

Sector	Location	Anticipated Remediation Work	Time and/or Quantities per Task	Reference Overview Photo	Reference Detail Photo
9A	▪ Northern end of pit forming central bench.	▪ Remove blocks 1 m back from crest. ▪ Scale, especially on northern side of adit.	▪ 12 hours hand scaling.	5, 6	23
10	▪ 2nd bench up on eastern side above northern ponded area.	▪ Light scaling of overburden at northern end. ▪ Clean brow, 1 m to 45°	▪ 40 hours hand scaling.	5, 6	24, 25
11	▪ 110 m lowest bench in southern end on western side.	▪ Light scaling	▪ 16 hours hand scaling.	9, 10	26
11A	▪ Lowest bench in southern end on western side.	▪ Intense scaling localized to adit.	▪ 1 day machine scaling.	9, 10	27
12	▪ South western pit wall, central bench.	▪ Machine scaling from crest. ▪ Construction of small access ramp to south.	▪ 1 day machine scaling.	9, 10	28
13	▪ South western pit wall, upper bench.	▪ Machine scaling.	▪ 1 day machine scaling.	9, 10	29
14	▪ 80 m long, top bench on east side towards south end.	▪ Light scaling.	▪ 40 hours hand scaling.	2, 3, 4, 5	30
15	▪ 140 m long top bench east side.	▪ Light scaling.	▪ 40 hours hand scaling.	3, 4, 5, 6	31
15A	▪ Top bench east side.	▪ Trim blast - 3 x 3 x 2 m	▪ 18 m^3 of trim blasting.	3, 4, 5, 6	32
15B	▪ Top bench east side.	▪ Boulder busts 4 boulders.	▪ 10 m^3 of boulders.	3, 4, 5, 6	33
16	▪ Top and middle bench to southern end of west side of pit.	▪ Focus on cleaning gullies. ▪ Light scaling.	▪ 64 hours hand scaling.	9, 10	34
17	▪ Top bench good access.	▪ Light scale.	▪ 24 hours hand scaling.	7, 10	-
18	▪ Top bench on western pit wall.	▪ Trims of tension cracks.	-	7, 10	-
18A	▪ 30 m long section. ▪ Top bench on western pit wall.	▪ Series of tension cracks. ▪ Trim blast - 10 x 3 x 2 m. ▪ 1 to 1.5 m spacing, 3 m deep explosive. or ▪ Machine scaling.	▪ 60 m^3 of trim blasting. or ▪ 2 days machine scaling. (assumed trim blasting in current total)	7, 10	35

Table 3: Anticipated remediation required at each sector

Sector	Location	Anticipated Remediation Work	Time and/or Quantities per Task	Reference Overview Photo	Reference Detail Photo
18B	▪ 25 m long section. ▪ Top bench on western pit wall.	▪ Check scaling ▪ Overburden slips.	▪ 8 hours hand scaling.	7, 10	36
18C	▪ 55 m long section. ▪ Top bench on western pit wall.	▪ Trim blasting – 55 x 2 x 3 m. ▪ 1.5 m spacing, 2.5 m deep decked hole 500 g.	▪ 330 m^3 of trim blasting.	7, 10	37, 38
18D	▪ 2 locations, 20 m long. ▪ Top bench on western pit wall.	▪ Trim blasting.- 40 x 2 x 3	▪ 240 m^3 of trim blasting.	7, 10	39, 40
19	▪ At crest 1st bench up from ponded area northern end western side.	▪ Crest trimming. (by hand)	▪ 40 hours hand scaling.	7, 10	-
19	▪ At crest 1st bench up from ponded area northern end western side.	▪ Scale talus after trimming.	(Included in scaling time above)	7, 10	-
19A	▪ Base of pit at northern end.	▪ Adit location.	-	7, 10	41
20	▪ North eastern pit wall, upper bench	▪ Light scaling. ▪ 5 m high slope.	▪ 8 hours hand scaling.	5, 6	42
21	▪ Northern end and adits.	▪ Light scaling.	▪ 16 hours hand scaling.	7, 10	43
18/19/20	▪ As above	▪ If option of backfill is not used then additional scaling.	▪ 120 hours hand scaling. (not included in current total)	-	-

9.5 Remediation Work Summary

The following quantities summarize the main proposed work tasks described in the table above to remediate the rock fall and slope instability risk:

- Machine scaling (with CAT 345 Excavator or similar machine) = 5 days.
- Quantity of hand scaling = 468 hours.
- Trim blasting = 778 m^3.

10.0 PORTAL & MINE ENTRANCE REMEDIATION

EBA was asked by AAM to comment on the stability of the portals to the underground excavations and the potential remediation that might be needed on the surface to create a safe working environment for any backfilling work of the portals. It is in this context that we make the following comments with regard to the significance of the underground excavation entrances intersected by the pit.

There are five portal locations within the pit. At the present time one of these portal locations connecting to the Pony Creek Adit, has a bulkhead design (prepared by SRK in May 2006). EBA's observations of the adit do not appear to indicate any significant changes since 2006, and therefore, EBA have no reason to question the adequacy of SRK's design. It is however, outside of the current scope of work to review this.

The other adit excavations do not have any proposed backfilling method. Although out of the scope of this report, it is recognized that some of these excavations could provide a conduit for groundwater flow. In the event the excavations self-collapse in a number of years, the fractured nature of the collapsed material would probably have a greater hydraulic conductivity than the surrounding rock, and therefore potentially concentrate localized groundwater flow near the pit walls. Given that the pit will be filled with potentially contaminated material (such as tailings and other waste rock), it is conceivable that if the excavations are not blocked off locally near and adjacent to the pit walls, that these contaminants could be more easily transported into the regional groundwater system, than if the excavations were blocked off and sealed in a more controlled manner. This is clearly an aspect that requires further environmental consideration.

In terms of the stability of the portals and backfilling work, we have prepared in overview the following notes that outline one conceptual method of sealing the adit portals, in a safe manner. This would be in addition to the SRK bulkhead design.

- The rock slope above the five portals or underground entrances should undergo a more intensive scaling treatment than other areas within the pit. Given that workers will be directly below the slope, we envision that a combination of a temporary catch fence or rock fall mesh might be needed to further protect workers rather than just scaling alone.
- The adit entrances should be excavated to properly expose the entrance and in-situ rock within the adit.
- A shotcrete fence should be constructed approximately 1 to 2 m within the adit. This could be undertaken by installing dowels into the rock within the adit walls (perpendicular to the orientation of a particular adit), these should be resin grouted in place. Welded wire mesh should then be installed across the adit between the dowels with a layer of geotextile. Two larger diameter tubes should be fixed at the top of the welded wire mesh / geotextile wall, and sealed temporarily to prevent shotcrete from permanently sealing them.
- Shotcrete should then be sprayed to a designed thickness to form a wall and tie-in the dowels and mesh.
- Within one of the tubes formed in the shotcrete wall, a sand slurry (conceptually either a bentonite sand mix or a cement sand mix) should be pumped to backfill behind the wall. In this case the second tube acts as a breather tube to facilitate emplacement of the sand.
- Once the backfilling is complete both of the tubes through the wall should be sealed up by spraying further shotcrete.

Given that this proposed work requires discussion with AAM and further more detailed design, we have not estimated the cost of this work. Only one of the five adits is accessible from the base of the pit (due to flooding) and consequently at this stage we envisage that this work might form part of the backfill work contract. During backfilling all adits and entrances should be accessible.

With respect to the construction of the bulkhead design, in 2006 SRK made recommendations for the design of an adit bulkhead located within the Pony Creek Adit (Pony Creek Adit Bulkhead, Mt Nansen, Yukon, 2006). The SRK bulkhead was a formal structure to be constructed out of concrete with reinforcement.

Within the 2010 Lorax report is a list of 'Remediation Measures Completed to Date' which includes the installation of a 'hydraulic plug' in 2006 (Mount Nansen Options for Closure, 2010).

The SRK designed bulkhead was to be constructed some 30 m into the adit. EBA's site inspection earlier this year was for surface work and we were therefore unequipped to go underground and verify the presence of this structure. A review of the documentation provided to EBA does not indicate with any authority, the construction of the SRK designed bulkhead.

It is our opinion that the SRK bulkhead has not been constructed, and that what may have been put in place is a "hydraulic plug". We anticipate that this consisted of the placement of clay and fine grained materials at the adit portal exposure within the pit to form a dam to water. During the site inspection, EBA noted that the adit appeared to be partially open to the pit, this could be a result of erosion of the 'hydraulic plug' over the last few years. As such, EBA cannot categorically state what construction work has been completed within the Pony Creek Adit to date (SRK bulkhead or hydraulic fill).

If it is found that the SRK bulkhead has not been constructed, it would be beneficial to include this work as part of the overall scaling contract. We note that the cost estimate provided by SRK in 2006 was $39,010, assuming compound interest at 5 %, the cost of these works in 2013 would be approximately $55,000. Cost estimation and constructability issues are commented upon in the following section.

11.0 CONSTRUCTION METHODOLOGY

The remedial measures required to stabilize the existing pit walls within the Brown-McDade Pit consist of:

- Check Scale (Safety Scale) of the West and East sides of the pit,
- Machine Scaling of sections of the West and East sides of the pit,
- Trim Blasting of some large unstable rock masses on the East pit wall,
- Trim Blasting of several tension cracks on the West pit wall.

The work tasks associated with the remediation tasks are discussed in the following sections.

11.1 Mobilization

Crews will be required to be mobilized to site one day prior to beginning any work within the pit. The contractor will complete the Mount Nansen Site Safety Orientation along with a contractor review and a safety orientation which must be site specific to the Mount Nansen Site conditions. All members of the contractors team who perform the work must be present for the orientation. During the site review with the contractor's crew, the crew must acknowledge the following in the orientation:

- Description of Work to be performed.
- Site Access.
- Anchor Requirements for Scaling (rope access work).
- Emergency Evacuation Muster Points (including first aid locations).
- Emergency Heli Evacuation Locations (to include Latitude & Longitude).
- Rope Rescue Plan (must include helivac).
- Schedule and Work Safe Procedures for Scaling and Blasting.
- Potential onsite Environmental Hazards.
- Wildlife Hazards.

Equipment setup and staging area preparation must not be completed until the orientations have been completed.

11.2 Machine Scaling & Hand Scaling (Safety Scale)

11.2.1 Machine Scaling

Machine scaling requires the use of a 345 Excavator or equivalent that is able to reach at least 25 feet when based at the toe of the cut. During machine scaling, a spotter must work with the excavator operator at all times to ensure the safety of the operator and equipment and to prevent the operator from over scaling the existing pit wall.

There are three areas that machine scaling is required, with one of the locations accessible from the toe of the pit wall and two that are accessible from the top of the pit wall. These areas are sector #1, #2, and #18(a).

Sector #1 is only accessible from the toe of the pit wall. Sector #2 is accessible from the toe and from the top of the pit wall. Sector #18(a) is only accessible from the top of the pit wall and only requires scaling along an existing tension crack. (see Photo 35)

During the machine scaling, a spotter will work with the machine operator and monitor the scaling to ensure minimal impact to the pit wall is achieved. The excavator is to only focus on the rock mass that can potentially harm workers accessing the pit upon completion of the scaling. Light machine scaling is only required in Sector #1 & 2.

When the excavator moves to Sector #18(a), the machine will be required to base itself at the top of the cut (pit wall). This area requires the excavator to remove large unstable rock mass at the tension crack featured at the top of the cut. The excavator will be required to reach over the brow (edge of cut) to ensure the removal of the unstable material.

With limited reach, there will be a requirement for hand scaling upon completion of the machine scaling to remove unstable rock that was not removed by the excavator.

A spotter will be required for the machine scaling at Sector #18(a) to monitor any potential ground movement and to ensure the excavator covers the appropriate area when reaching over the brow. The scaled rock is not required to be removed to the top of the cut by the excavator. The scaled rock can be released into the pit.

11.2.2 Hand Scaling

Rope access work (rock scaling) will be performed on the designated pit walls specified within the contract documents. Rock scalers involved with the rope access work will have a minimum of five (5) years experience performing rock scaling operations. The scaling crew will consist of four (4) scalers and a site supervisor, with two way radio communication. At the beginning of each work day the scaling crew will review their work safe procedures and the area to be scaled will be inspected to identify work zones for the shift, potential hazards and injured worker extraction methods. In addition, a review of any trim blasting operations that may be taking place during scaling operations will be identified. If trim blasting is to be performed in the pit while scaling operations are in progress, work safe procedures for the trim blasting operations must be reviewed by the scaling crew prior to commencing work. Notification of blast times and location will be discussed and the blaster will notify the scaling crew 1 hour prior to the blast and every 15 minutes thereafter.

Scaling will commence on the East pit wall, starting at Sector #14 and continuing to Sector #9. Scaling will cover all designated area numbers on the east cut as specified in the contract drawings. Scaling records are to be kept and filled out daily. The scaling record will identify the:

1. Date of work performed.
2. The Sector Number scaled.
3. Number of Scalers.
4. Number of Man Hours.
5. Start and Completion time for each numbered sector.
6. Sector for Notes and Comments by sector.
7. Signoff for crew supervisor and field engineer.

Upon completion, and final approval from the field engineer, the scaling crew will move to the West pit wall and commence scaling from Sector #12/13 to Sector #21.

During all rock scaling operations, the entrance into the pit from the south will be closed to all personnel attempting to enter the pit and/or above the rock scalers. Signs will be posted at the entrance to the pit stating “Rock Scaling In Progress”. The signs will list a contact name and radio channel for personnel working at the site to contact in the event access to the pit or access above the scalers is required. A guard will also be posted at the entrance or near the scaling crew to monitor the scaling operations and site access. Due to the man hours allotted for scaling, there will be limited access to the pit during the scaling operations. Any unauthorized personnel that may require access to the pit will be required to review the work safe procedures with the scaling crew site supervisor and sign off prior to entering the pit. The work safe procedures must be located at the entrance into the pit for unauthorized personnel to review and sign.

Tie off locations for scaling will consist of a primary and secondary anchor points located at the top of the pit wall. Scalers will not be permitted to use one anchor point for rope access work or use anchor points for two scalers to tie off too. Anchors to be used will consist of a 43 mm anchor drilled into competent rock to a depth of no less than 1.2 meters and must be set back a minimum of 4 meters from the brow (edge of cut). The use of vehicles may be used as anchor points. If vehicles are to be used to tie off too, only two scalers may tie off to a single vehicle. The vehicle must have the emergency brake engaged, the keys removed from the ignition, doors locked and a spotter posted by the vehicles. Safety lines may not be attached to any fences or other existing built features. The area of the anchor points at the top of the pit wall must have a safety perimeter 6 meters beyond the furthest anchor located from the edge of cut and cordoned off with Caution Tape with a sign posted stating “Rock Scaling In Progress”.

Rock scaling of the pit wall will consist of the removal of rock 0.25 meter diameter or greater. The pit wall will be scaled from the top down, beginning on the highest point of the pit wall and working down to the lowest point, past the final bench. When scaling the pit wall, scalers will ensure the brow is cleaned thoroughly prior to descending the cut to ensure no material impacts the scaler working below. The brow will be cleared of all loose debris up to 3 meters back from the brow. Prior to descending the cut, scalers will communicate with the spotter within the pit via hand held radio and announce that scaling will be commencing.

During the scaling operation and at the end of each shift, the scaling crew supervisor will notify the engineer representing the owner of any unforeseen slope instabilities to allow the engineer to inspect the area of concern. If the engineer is not at the pit during scaling, the scaling crew supervisor will notify the engineer two (2) hours prior to the completion of each shift to allow the engineer ample time to inspect the scaled area for signoff.

11.3 Trim Blasting Operations

Trim blasting will be performed at locations specified within the contract documents and as required by the field engineer. The sectors that require trim blasting, on the west and east pit walls will be performed in conjunction with the rock scaling. All blasting will be performed by a certified licensed blaster, registered in the Yukon Territory.

One (1) week prior to any trim blasting, the blaster will submit blast plans, locations and approximate times of each trim blast to be performed for approval by the engineer. No blasting will take place until approvals are submitted.

The trim blasting operation will consist of the blaster and 2 scalers/drillers. Trim blasting will commence on the east pit wall, at two locations in Sector #7, #15(a) & 15(b), and a potential trim blast in Sector #8. Sector 15(b) consists of four (4) boulders positioned on the bench below cut Sector #15(a)(see Photo 33). All remaining trim blasts are located on the pit wall.

Drilling and trim blasting will commence in conjunction to the start-up of machine scaling in Sector #1 and hand scaling in Sector #14. All trim blasts on the pit wall will be completed prior to the drilling and blasting of the four (4) boulders positioned on the bench in Sector #15(b).

The scaling crew and machine operators will meet prior to shift to review the blasting work safe procedures. The blaster will discuss with both scaling operations the location of the blasts, times and potential hazards. The blaster will notify the scaling crews 1 hour prior to the blast time and every 15 minutes thereafter. The blaster and the scaling crew supervisor will ensure that the pit is evacuated and all personnel are clear of the pit and clear from the top of the pit, prior to initiating the twelve (12) horn signal. No scaling or entrance into the pit will be permitted until the blaster has initiated the "All Clear" signal after the blast. During the blasting operations, the blaster will have authority over all supervisors.

Upon completion of the trim blasting in Sector #15(a), the blasting crew will check scale the blast area to secure the area. The blasting crew will move to Sector #7 and commence the drilling and trim blasting at that location. Check scaling of the trim blast at Sector #7 will not be required until the scaling crew reaches the area, unless significant hazards exist. Upon completion of Sector #7, the blasting crew will move to the final location, Sector #15(b) and drill and blast the four boulders on the bench below Sector #15(a).

A pre and post blast inspection will be performed of the pit wall directly above each blast location to ensure the pit wall is stable enough for the blasting crew to enter and complete their trim blasts and post blast "all clear" signal. If the supervisor or field engineer determines the pit wall above the blast area is too unstable, the scaling supervisor must have the scalers perform a check scale prior to the blasting crew entering the location.

Upon completion of the trim blasting, on the east pit wall, the blasting crew will relocate to the west pit wall and commence trim blasting of all identified trim blast locations on the west pit wall.

The blasting crew will commence drilling and blasting at Sector #18(b) and continue through Sectors 18(c) and 18(d). These locations are identified as tension cracks along the brow of the pit wall. Sector #18(a) also has tension cracks and will be removed by use of an excavator. In the event the excavators efforts to machine scale the tension cracks is unsuccessful, the blasting crew may be required to trim blast along the tension crack in Sector #18(a).

Drilling and blasting of the tension crack locations will consist of drilling 38 mm holes to a depth of 2 meters. The spacing of the holes will be 1.5 meters and set back 0.3 meters from the tension crack, or as specified by the field engineer.

A pre and post blast inspection will be performed of the pit wall directly above each blast location to ensure the pit wall is stable enough for the blasting crew to enter and complete their trim blasts and post blast "all clear" signal. If the supervisor or field engineer determines the pit wall above the blast area is too unstable, the scaling supervisor must have the scalers perform a check scale prior to the blasting crew entering the location.

The scaling crew and machine operator will meet prior to shift to review the blasting work safe procedures. The blaster will discuss with both scaling operations the location of the blasts, times and potential hazards. The blaster will notify the scaling crews 1 hour prior to the blast time and every 15 minutes thereafter. The blaster and the scaling crew supervisor will ensure that the pit is evacuated and all personnel are clear of the pit and clear from the top of the pit, prior to initiating the twelve (12) horn signal. No scaling or entrance into the pit will be permitted until the blaster has initiated the "All Clear" signal after the blast. During the blasting operations, the blaster will have authority over all supervisors.

11.4 Site Safety

The following is an overview of the safety procedures which should be implemented during the stabilization construction activities. The work safety plan to be provided by the Contractor should address as a minimum the safety procedures listed below.

1. Access to all entrances to the pit and along the top of the pit will be limited during scaling and trim blasting operations.
2. Signs at the pit entrance will be posted and guarded and signs will be posted at four (4) potential entrance locations above the pit (two on the west, one at the north and one on the east side of the pit). All signs will indicate "Scaling in Progress" with a contact name and radio channel. All pertinent blast signs will also be posted at the same location. Air horns will be posted at each location to signal evacuation of the pit.
3. During blasting operations, the blaster will designate spotters at key locations prior to initiating a blast warning.
4. The site will have four (4) muster points for site evacuation. There will be one muster point on each side of the pit, including the north and south locations.
5. The scaling crew will consist of two Level 3 First Aid attendants.
6. First Aid equipment must consist of two Level 3 Trauma Packs and two Litters and must be posted within 200 feet of any work area.
7. Emergency & Medical Evacuation cards, listing contact numbers, names and radio channels will be provided to each crew member.
8. Heli Evacuation plan will be established and reviewed with all personnel onsite.
9. Due to potential wild life encounters, all crew members must ensure to secure any food within the trucks, do not leave garbage on the site and report any sightings within the job site.

11.5 Summary of Construction Methodology

Due to the unknown factors and potential hazards, the scaling and trim blasting work safe procedures may require modification on a daily or weekly basis so to adapt to changes in site conditions. Ongoing review of the schedule will also be needed to ensure the target deadline will be achieved. Prior to each shift, the scaling supervisor, blaster and field engineer will meet one hour prior to the beginning of shift to review the day's work. This will allow the team to ensure that the schedule and safety plan is not being compromised and to address any concerns the field engineer, blaster or supervisor may have.

All members of the stabilization crew will abide by the rules and regulations set forth by the Yukon Government Authorities for the Health & Safety of all work performed within the Mount Nansen Pit.

12.0 COST ESTIMATION

12.1 Bill of Quantities

In order to provide an estimate of the cost of carrying out the work detailed in this report, the following work tasks are envisaged and should be presented to contractors as part of a request for proposals:

- Mobilization / demobilization $________(lump sum)
- Machine scaling (with CAT 345 Excavator or similar machine) 5 days $________(day rate)
- Hand scaling hours (estimated as 468 hours) $________(hourly rate)
- Trim blasting (estimated at 778 m^3) $________(per cubic metre)
- Adherence with Environmental Management Plans (EMP) $________(lump sum)

Contingency items:

1. Sealing up and backfill of adits in pit using (shotcrete fence approach) $________(lump sum)
2. Construction of bulkhead in the Pony Creek adit $________(lump sum)
3. Additional scaling and stabilization of the rock above the adits $________(lump sum)

12.2 Cost Estimate

In order to estimate the overall cost of undertaking the work, the work methodology proposed in Section 10 has been used as well as the bill of quantities detailed above. A schedule has been prepared for the construction that is shown in Figure 4. It is expected to take approximately 12 to 14 days to complete the work.

Upon review of the pit and completion of the assessment, it has been determined that scaling and trim blasting will provide an effective measure to temporarily stabilizing the pit walls to allow for other work to be performed within the pit. Based on the information gathered, the Target Budgetary Number to perform the stabilization of the pit walls is estimated at $198,000.00 as detailed below.

- Mobilization / Demobilization $50,000
- Hand scaling $36,180
- Trim blasting $77,200
- Cat, 5 days $25,000
- Adherence with EMP $10,000

13.0 SUMMARY

This report has assessed the risk to personnel and equipment carrying out backfilling work at the Brown-McDade open pit at the Mount Nansen site. It has been determined that the risk level to workers carrying out water sampling is tolerable assuming the procedures noted in this report are in place during the water sampling activities. Recommendations have been made to stabilize the pit so as to mitigate the rock fall hazard to workers undertaking the backfilling operations. These remedial measures should decrease the risk to an ALARP level. We have also recommended procedural measures to be undertaken whilst backfilling the open pit. These measures on how the contractor forms a working face and catch ditch will reduce the intensity of the remediation work on some of the pit walls (and therefore the cost).

A cost estimate has been prepared for the remediation work to the plus / minus 20% level. This estimate was prepared by a contractor experienced in rock slope remediation work.

It is anticipated that the remediation work to stabilize the open pit slopes, will occur within the next two years. Following the remediation of the pit walls, backfilling of the pit should be carried out again within two years. Should the remediation or subsequent back filling work be delayed then the rock walls will undergo more than two cycles of freeze thaw weathering during the winter. As a result of such cycles and the process of macro-gelivation, the rock mass forming the pit walls will become more disturbed and may require further scaling or assessment.

14.0 LIMITATIONS & CLOSURE

This report and its contents are intended for the sole use of Government of Yukon – Energy, Mines and Resources and their agents. EBA, A Tetra Tech Company, does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than of Government of Yukon – Energy, Mines and Resources, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in EBA's Services Agreement. EBA's General Conditions are provided in Appendix D of this report.

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Sincerely,
EBA Engineering Consultants Ltd.

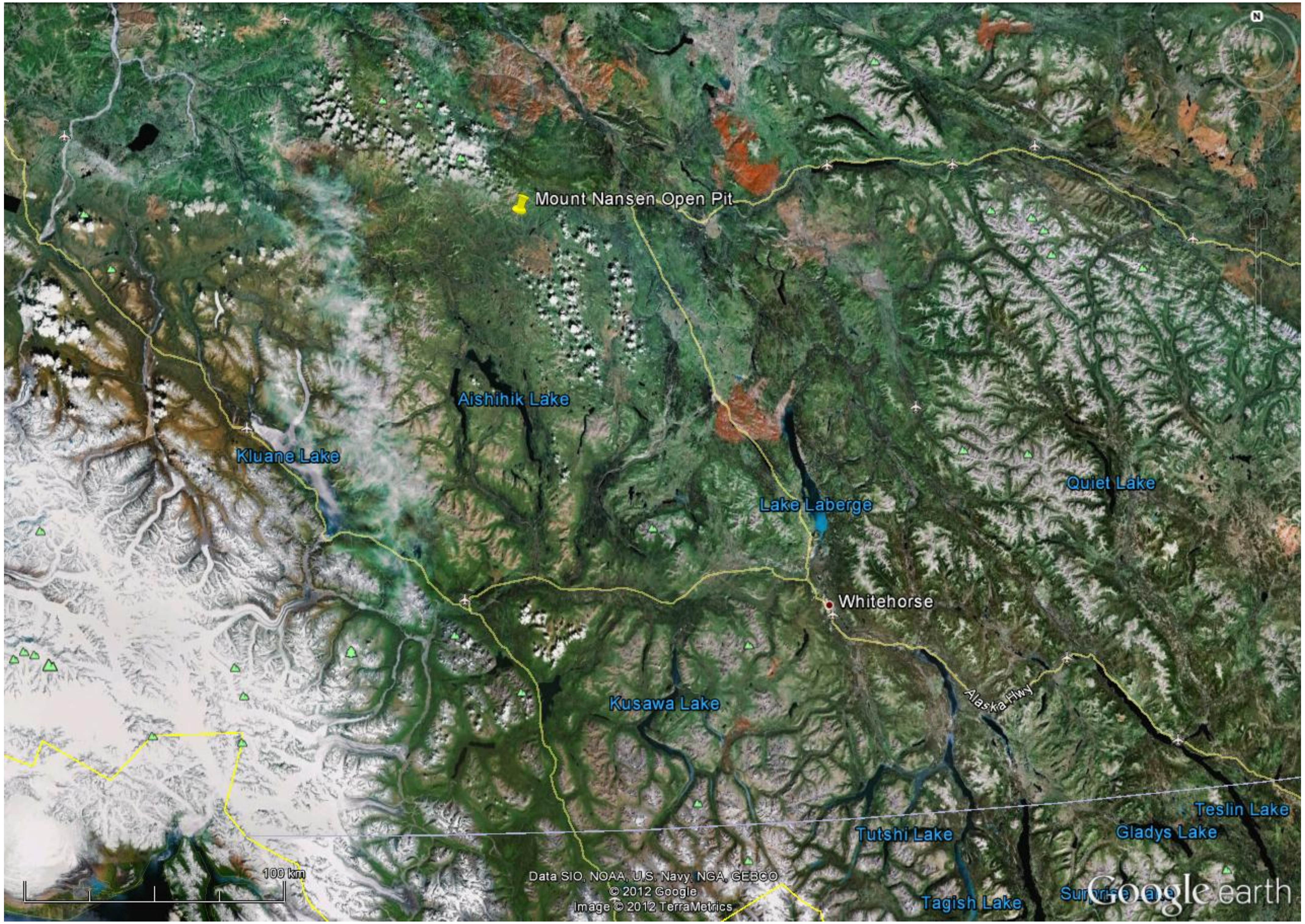
Prepared by:

Charles Hunt, P.Eng. (BC)
Project Director – Rock Engineering

Reviewed by:

Carlos Chaparro, P.Eng. (YK)
Senior Geotechnical Engineer

FIGURES



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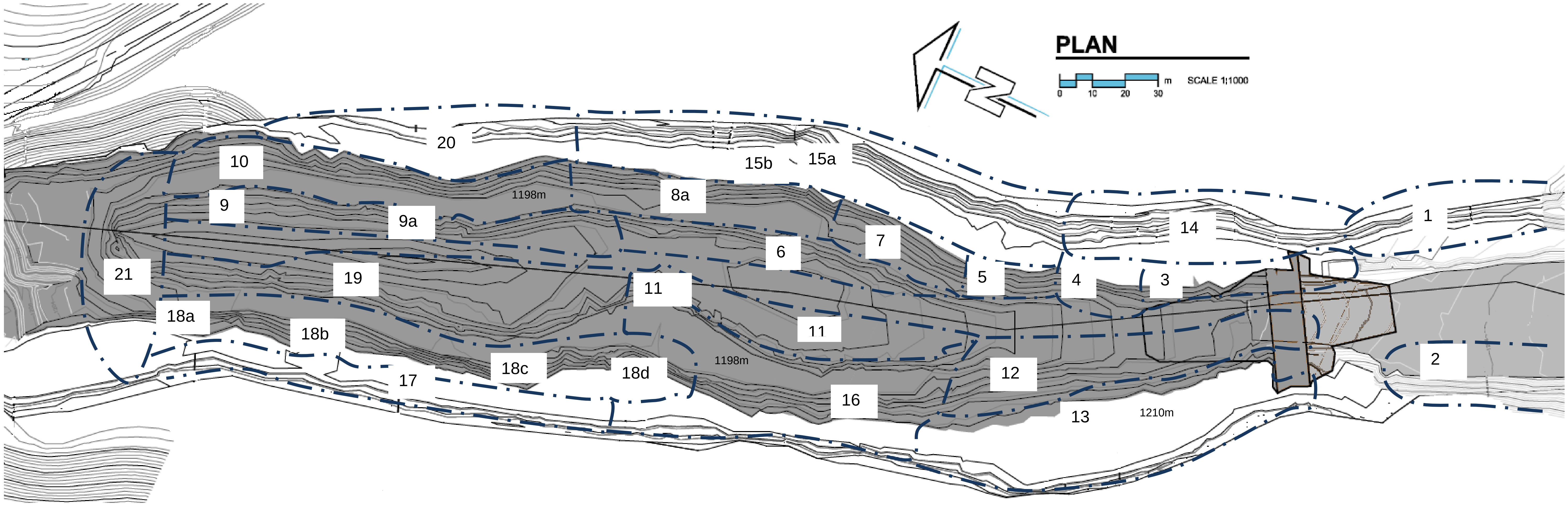
BROWN-MCDADE PIT REMEDIATION MOUNT NANSEN PROPERTY, YT

LOCATION MAP OF MOUNT NANSEN OPEN PIT

PROJECT NO.	DWN	CKD	APVD	REV	
V13401062	SM	CC	CH	0	**Figure 1**
OFFICE	DATE				
EBA-VANC	NOVEMBER 2012				

STATUS
ISSUED FOR USE

Q:\Vancouver\Engineering\V134\Project\V13401062 Nansen Mine\Figures and Photos\Figure 1 - Location Map.doc



LEGEND

Boundary of open pit sectors

NOTES

STATUS
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BROWN-MCDADE PIT REMEDIATION
MOUNT NANSEN, YT

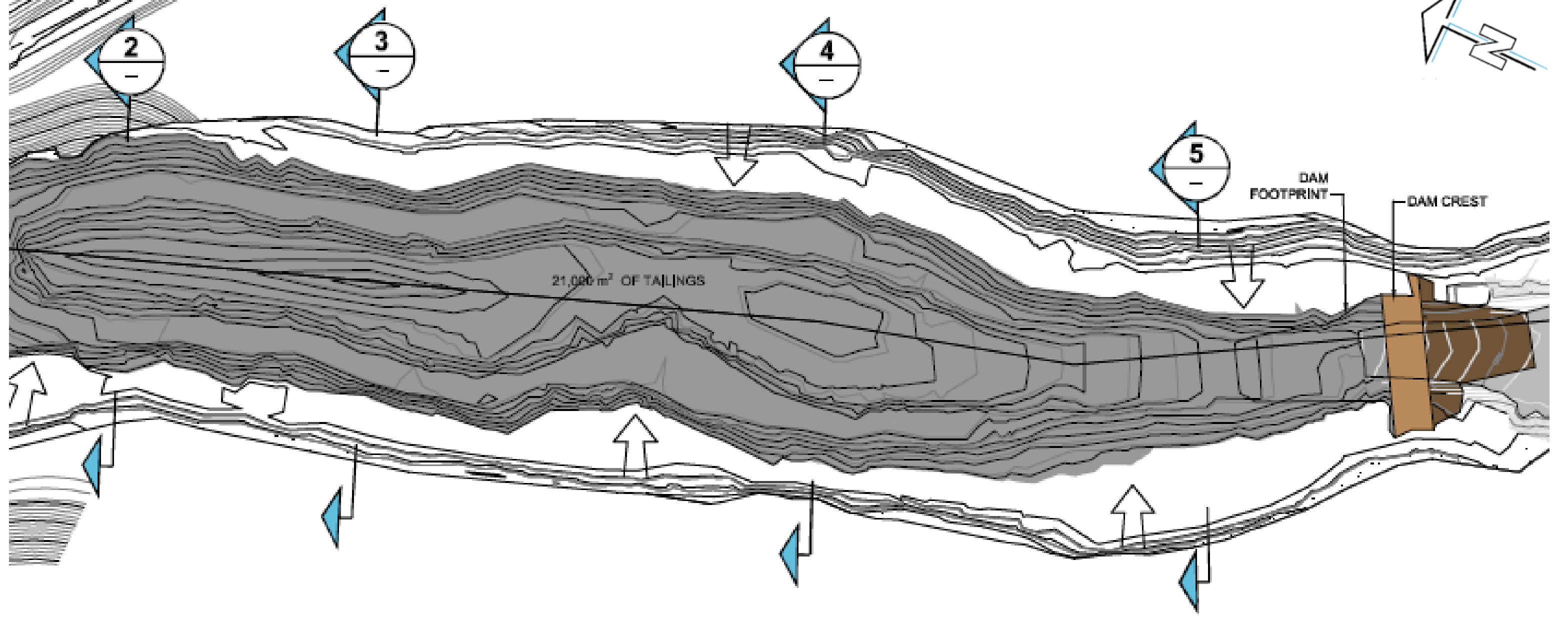
OPEN PIT SECTORS

PROJECT NO.	DWN	APVD	REV
V13401062	SM	CH	0

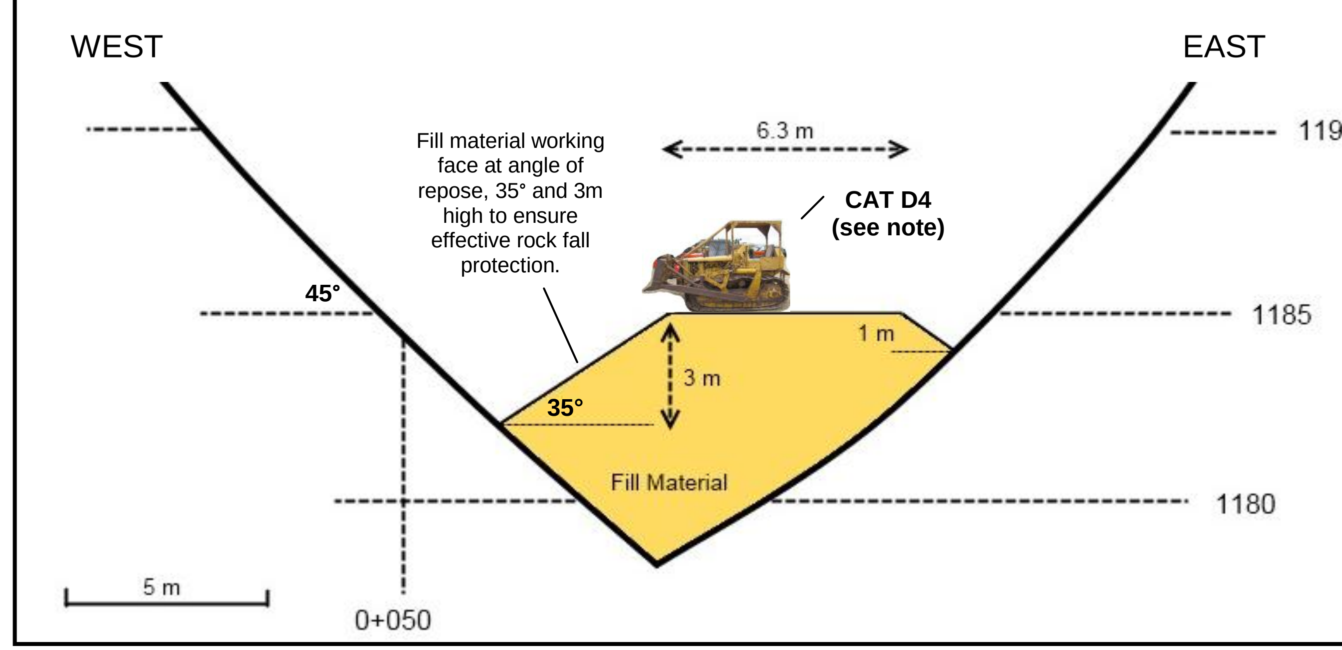
OFFICE	DATE
EBA-VANC	NOVEMBER 2012

Figure 2

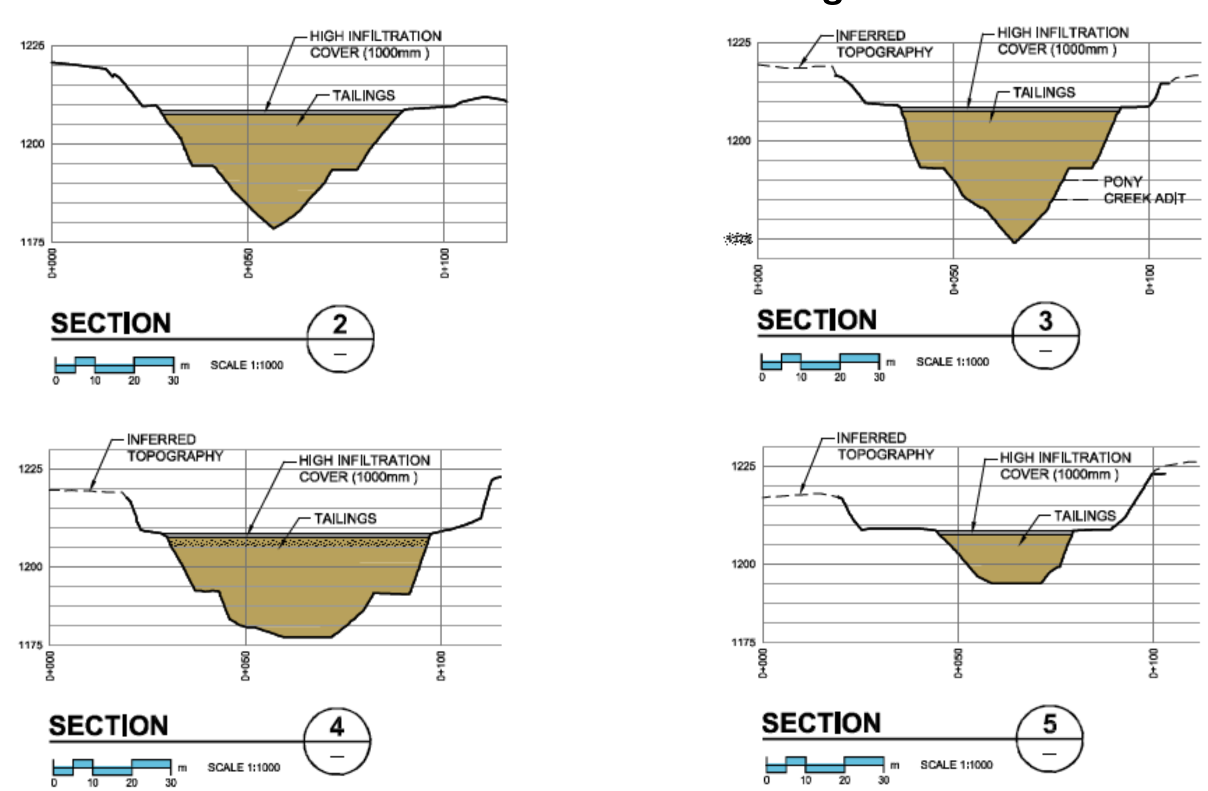
A – Plan of Nansen Site



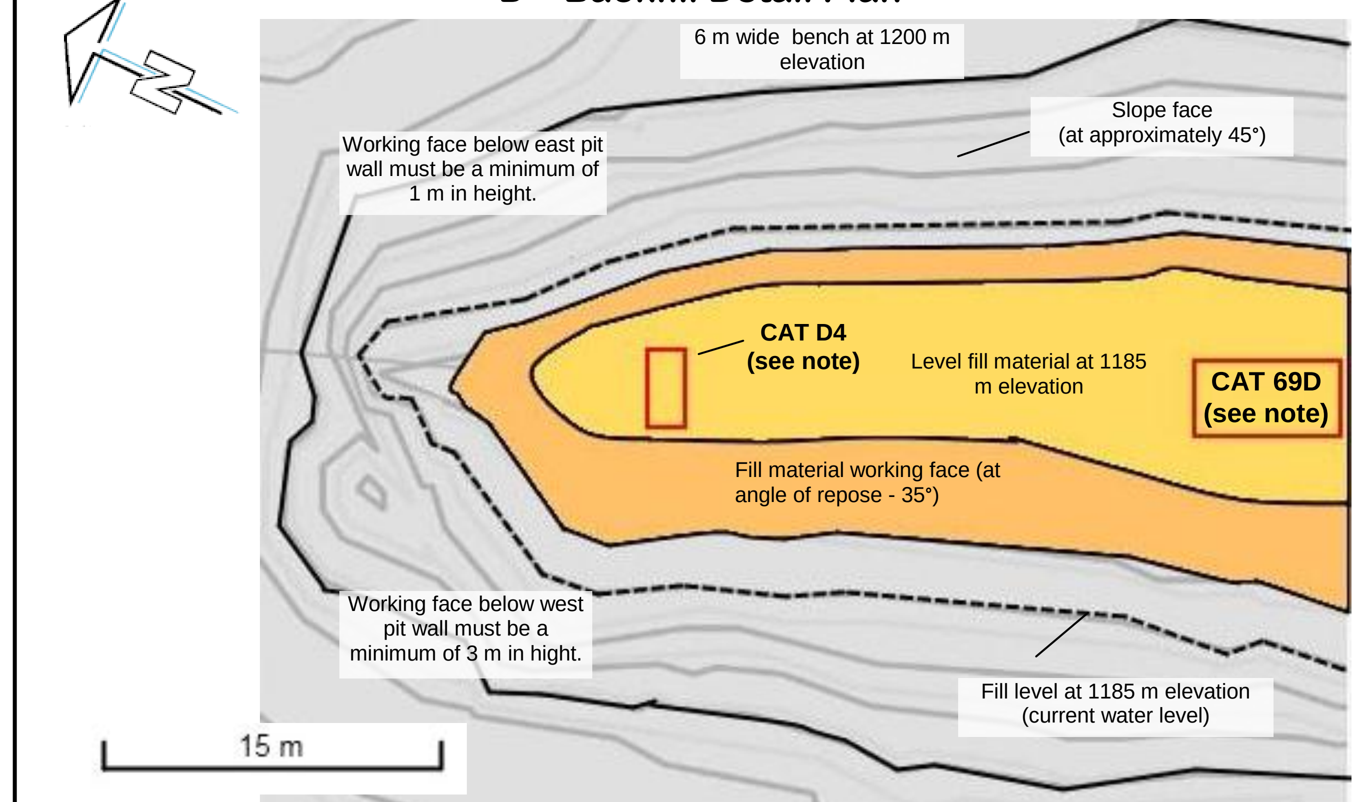
C – Backfill Detail Cross Section



B – Cross Sections Through Pit



D – Backfill Detail Plan



LEGEND

1. The current water lever is an approximate 1985 m elevation. This is the level at which the fill platform used for calculations has been assumed to be built up to.
2. The working face must be 3 m high below the western pit slope in order to sustain a sufficient rock trap. Below the eastern pit slope a 1 m high working face must be sustained.
3. The minimum width of fill platform is approximately 6 m wide at the 1185 level, then increases as the pit is progressively backfilled.
4. Cross section C cuts the pit at the location of ‘section 2’ on the overall pit plan.
5. CAT D4 – The dimensions of this are approximately 5.3 m x 3.2 m without the blade.
6. CAT 69D – The dimensions of this rock truck are approximately 8 m by 3.5 m.
7. A concervative 35° working face has been assumed, however, in practice a 45° slope may be attainable.

NOTES
Text

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BROWN-MCDADE PIT REMEDIATION MOUNT NANSEN PROPERTY, YT

INITIAL DETAIL FOR BACKFILL PROCEDURE

PROJECT NO.	DWN	CKD	APVD	REV
V13401062	JP	CC	CH	0

OFFICE	DATE
EBA-VANC	NOVEMBER 2012

Figure 3

Mount Nansen Mine Pit Wall Stabilization

Period From:
Period To:

Activity	DAY		QUANTITY	UNIT	PRODUCTION PER DAY	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14	Day 15	Day 16	Day 17	Day 18	Day 19
Mobilization																								
Mobilization	1	3																						
Site Safety Orientation	4	4																						
De-Mobilization																								
Check Scaling																								
Check Scale East Cut	5	13																						
Check Scale West Cut	13	18																						
Trim Blasting																								
Trim Blast East Cut	7	12																						
Trim Blast West Cut	13	17																						
Machine Scaling																								
Machine Scale East Cut	6	10																						
Machine Scale West Cut	12	17																						
Site Safety Meetings																								
Crew Safety Meeting (7:30am to 7:45am)																								

STATUS
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BROWN-MCDADE PIT REMEDIATION
MOUNT NANSEN PROPERTY, YT

CONSTRUCTIONSCHEDULE

PROJECT NO.	DWN	CKD	APVD	REV
V13401062	SM	CC	CH	0

OFFICE	DATE
EBA-VANC	NOVEMBER 2012

Figure 4

APPENDIX A

NATIONAL BUILDING CODE SEISMIC HAZARD CALCULATIONS

2010 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Requested by: , EBA July 26, 2012

Site Coordinates: 62.0426 North 137.0894 West

User File Reference: Mt. Nansen property

National Building Code ground motions:
2% probability of exceedance in 50 years (0.000404 per annum)

Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA (g)
0.213	**0.137**	**0.093**	**0.056**	**0.110**

Notes. Spectral and peak hazard values are determined for firm ground (NBCC 2010 soil class C - average shear wave velocity 360-750 m/s). Median (50th percentile) values are given in units of g. 5% damped spectral acceleration (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are tabulated. Only 2 significant figures are to be used. ***These values have been interpolated from a 10 km spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the calculated values.***

Ground motions for other probabilities:

Probability of exceedance per annum	0.010	0.0021	0.001
Probability of exceedance in 50 years	40%	10%	5%
Sa(0.2)	0.060	0.109	0.146
Sa(0.5)	0.044	0.079	0.101
Sa(1.0)	0.028	0.052	0.069
Sa(2.0)	0.017	0.032	0.042
PGA	0.033	0.060	0.078

References

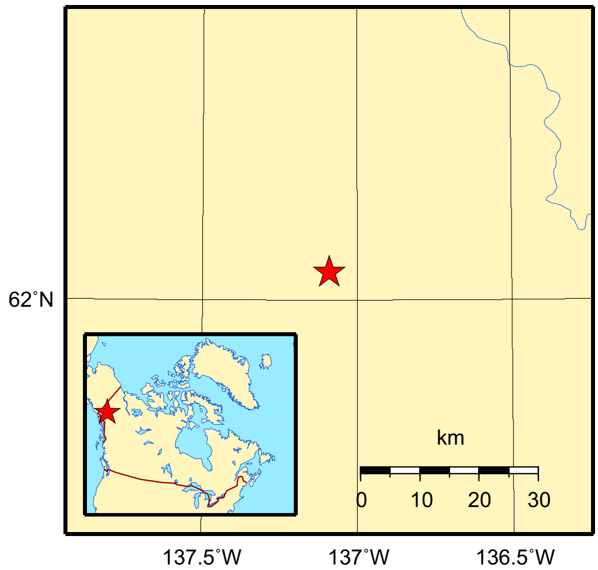
National Building Code of Canada 2010 NRCC no. 53301; sections 4.1.8, 9.20.1.2, 9.23.10.2, 9.31.6.2, and 6.2.1.3
Appendix C: Climatic Information for Building Design in Canada - table in Appendix C starting on page C-11 of Division B, volume 2

User's Guide - NBC 2010, Structural Commentaries NRCC no. 53543 (in preparation)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File xxxx
Fourth generation seismic hazard maps of Canada: Maps and grid values to be used with the 2010 National Building Code of Canada (in preparation)

See the websites *www.EarthquakesCanada.ca* and *www.nationalcodes.ca* for more information

Aussi disponible en français



APPENDIX B
PHOTOGRAPHS

Photo 1: Overview of sector 1.

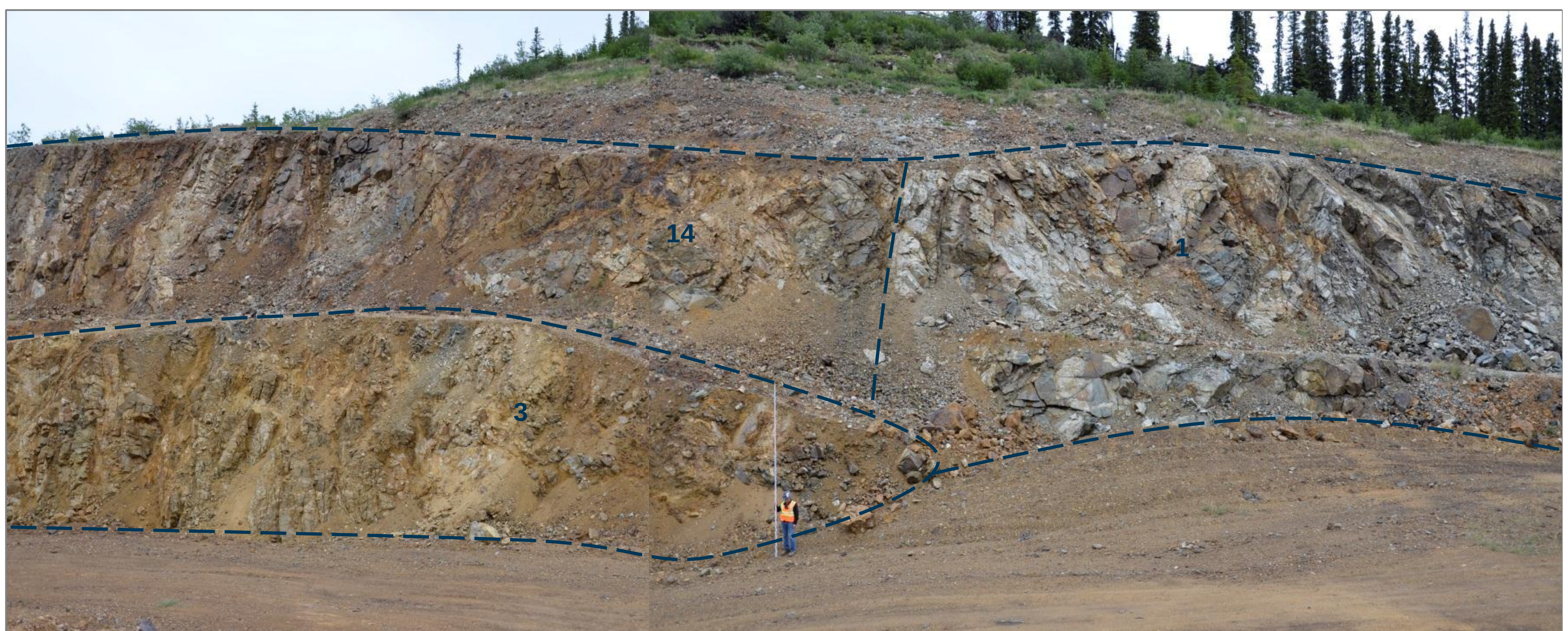


Photo 2: Overview of sector 1, 3, and 14.

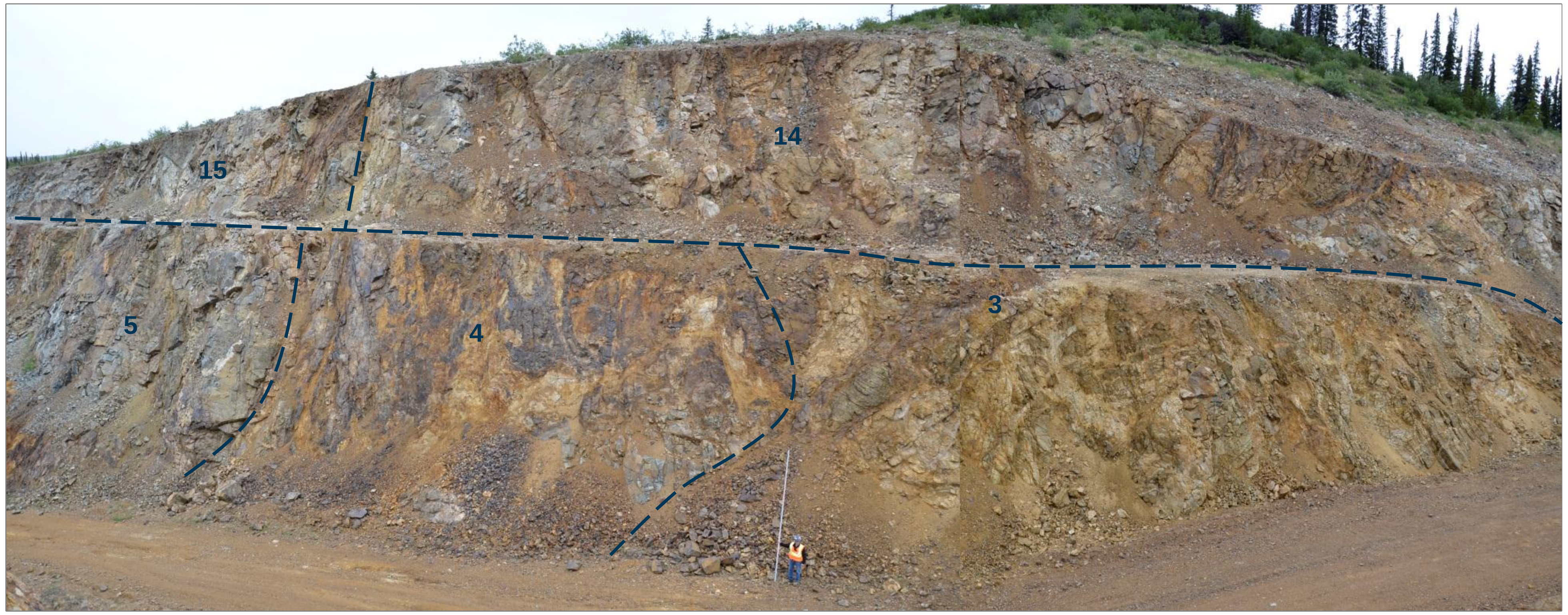


Photo 3: Overview of sector 3, 4, 5, 14 and 15.

Photo 4: Overview of sector 3, 4, 5, 6, 7, 8, 14 and 15.

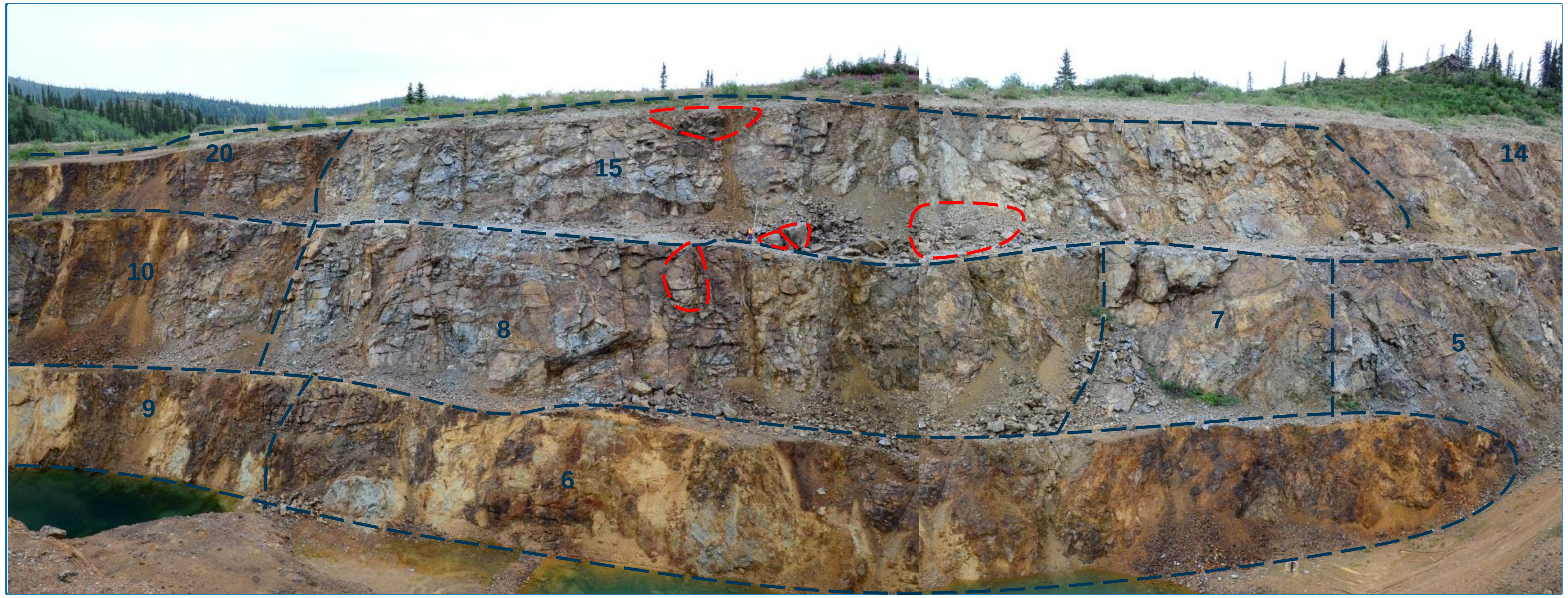


Photo 5: Overview of sector 5, 6, 7, 8, 9, 10, 14, 15 and 20.

Photo 6: Overview of sector 6, 8, 9, 10, 15 and 20.

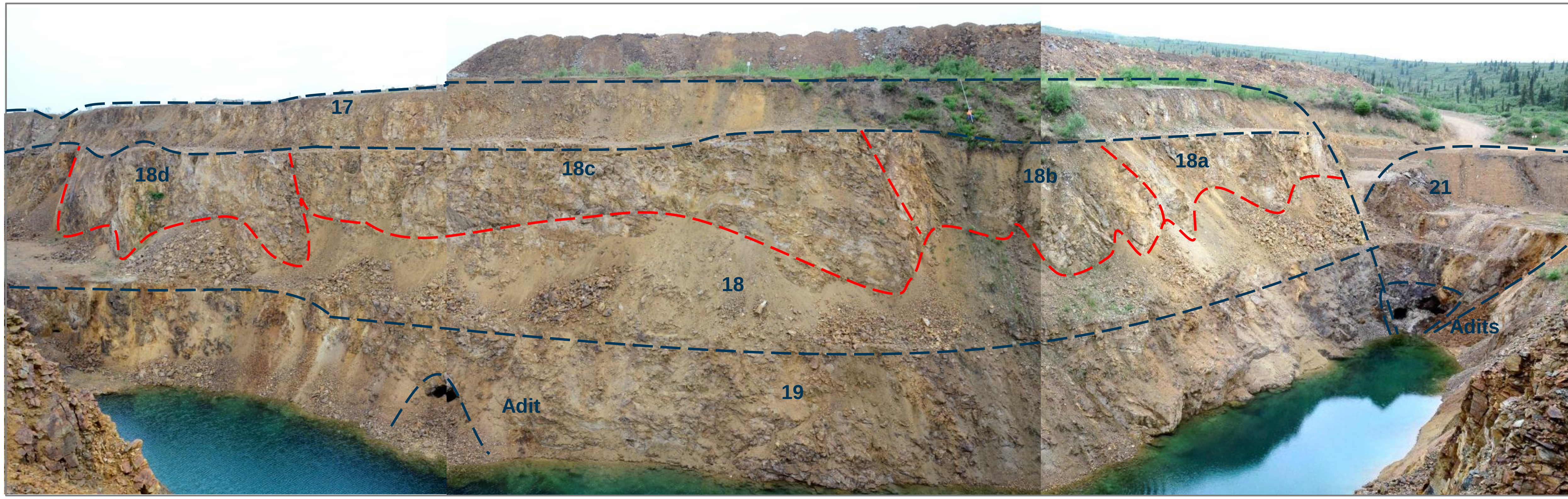


Photo 7: Overview of sector 17, 18, 19, and 21.

Photo 8: Overview of sector 2.

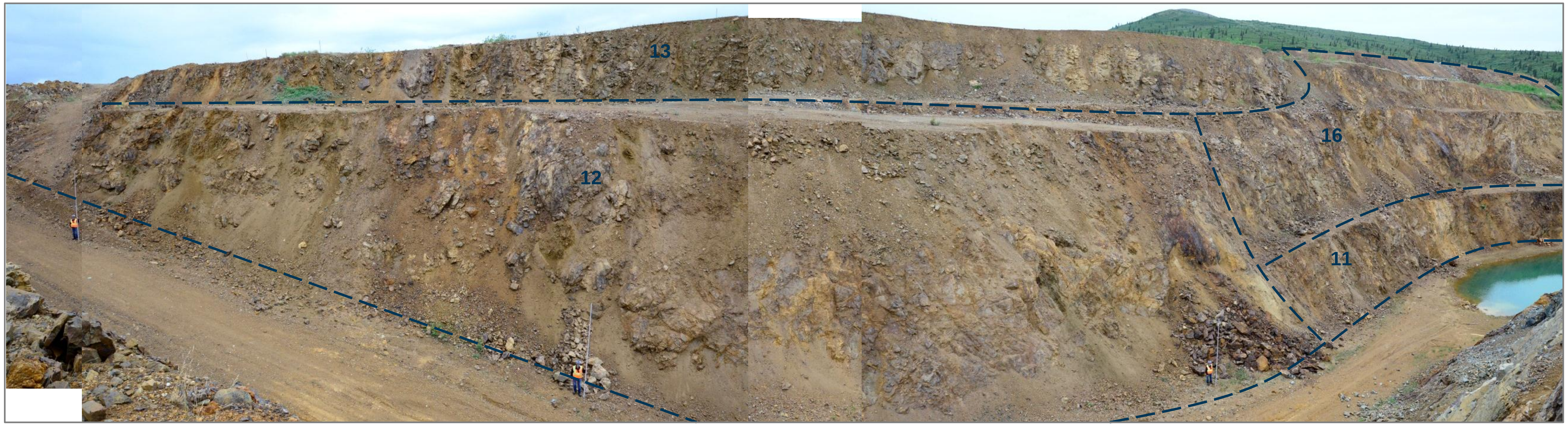


Photo 9: Overview of sector 11, 12, 13 and 16.

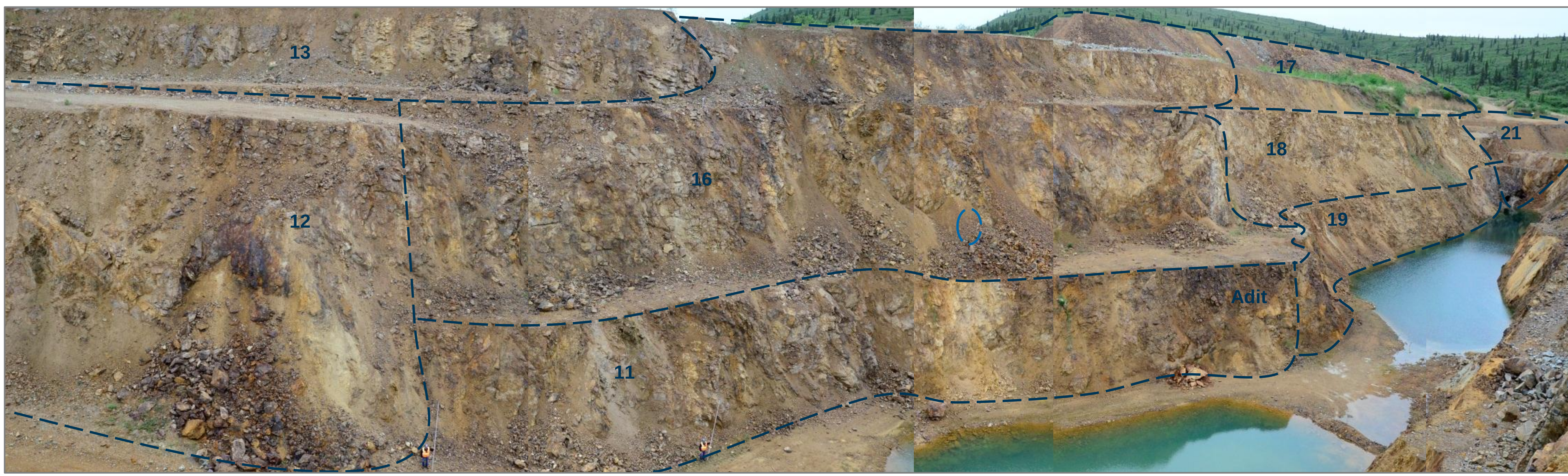


Photo 10: Overview of sector 11, 12, 13, 16, 17, 18, 19 and 21.

Photo 11: Sector 1 requires one day of light machine scaling.

Photo 12: Sector 2 requires scaling to pull back crest of slope. This is approximately one day of machine scaling.

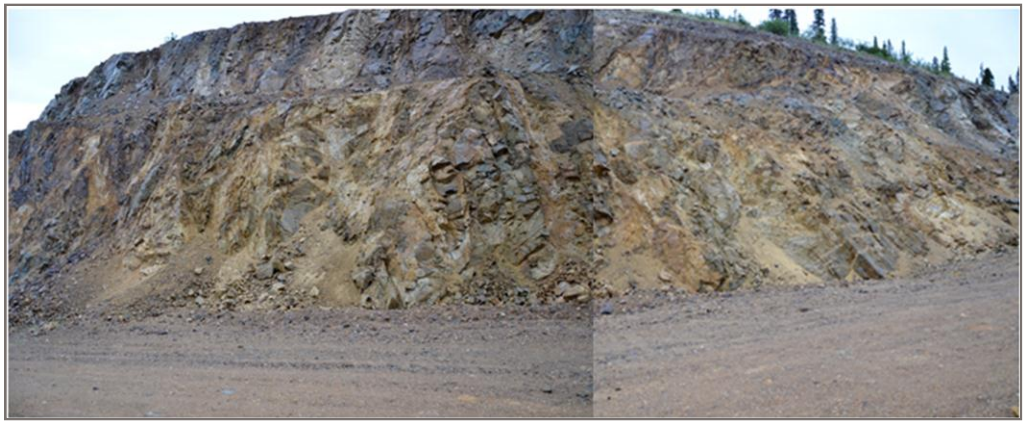


Photo 13: Sector 3 requires light scaling at the crest and minor scaling on the slope. 16 hours of hand scaling is expected.

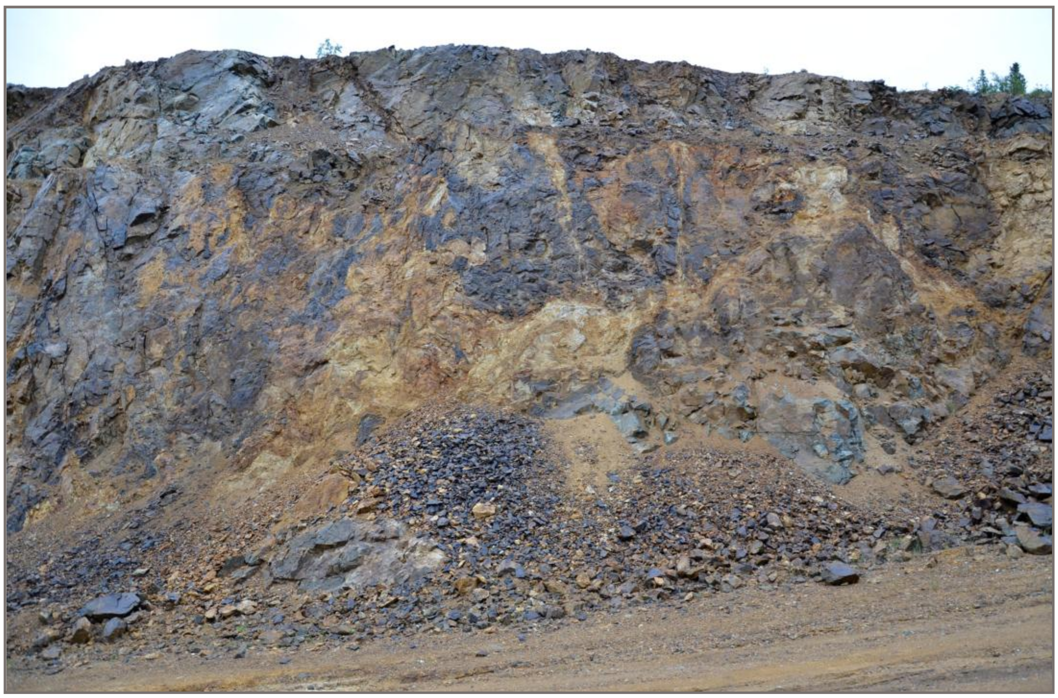


Photo 14: Sector 4 requires light scaling of fairly tight rock mass. Eight hours of hand scaling is expected.

Photo 15: Sector 5 requires moderate scaling of blocky rock mass which is expected to take 24 hours.

Photo 16: Sector 6 requires eight hours of hand scaling of the lower bench.

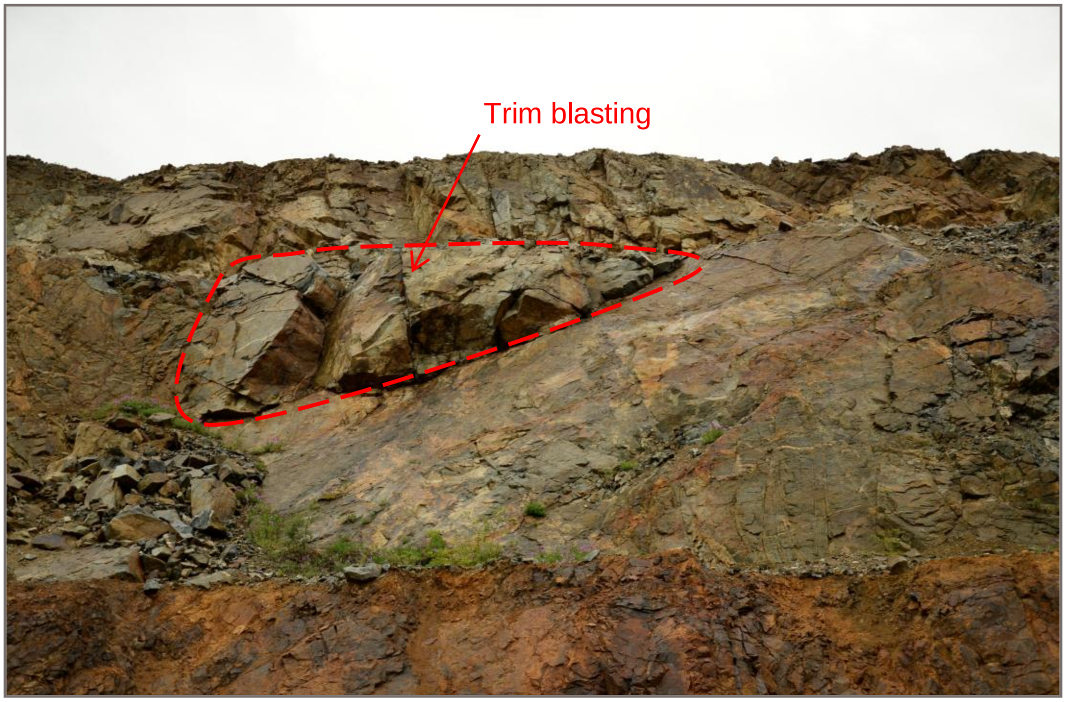


Photo 17: Sector 7 requires trim blasting with 14 holes at 2m with 30 kg of explosive totalling 120 m^3, eight hours of check scaling and rock removal from bench.

Photo 18: Detail of sector 7.

Photo 19: Sector 8 requires heavy scaling of numerous blocks in the pit wall. This is expected to require 24 hours of hand scaling.

Photo 20: Sector 8a - allowance for trim blast.

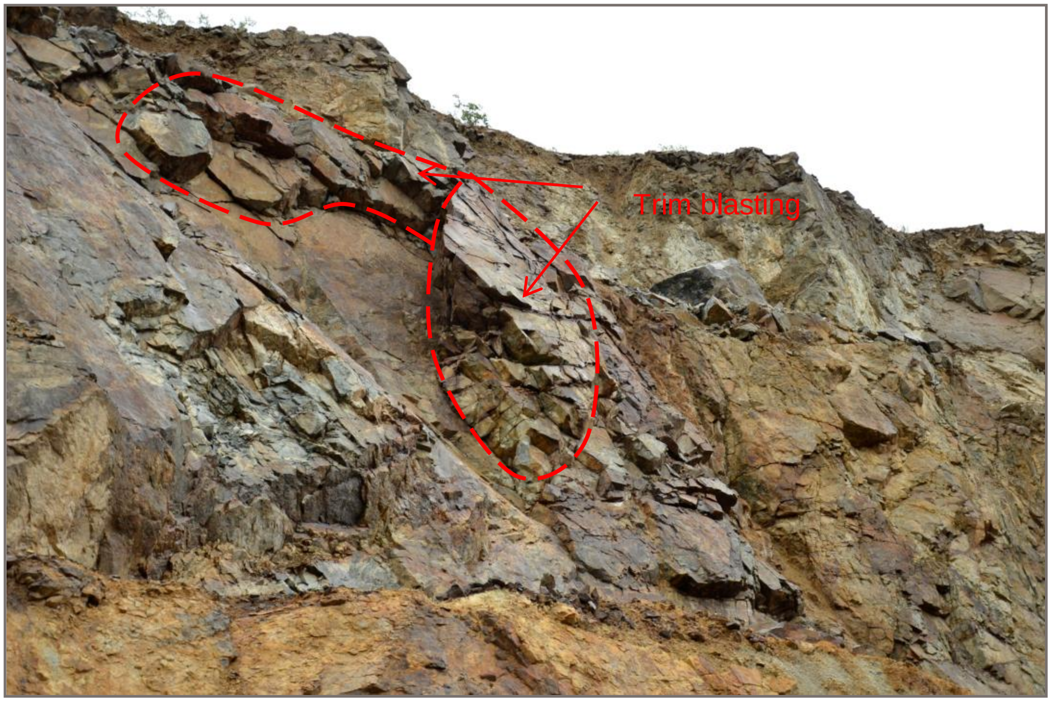


Photo 21: Sector 8a requires trim blasting.

Photo 22: Sector 9 requires light scaling which is estimated to take 24 hours of hand scaling.

Photo 23: Sector 9a requires block removal 1m back from crest. Scaling should also be done on the north side of the adit.

Photo 24: Sector 10 requires the brow to be cleaned 1m to 45^0 as well as light scaling of overburden at northern end. 40 hours of hand scaling is anticipated.

Photo 25: Detail of Sector 10.

Photo 26: Sector 11 requires light scaling. 16 hours of hand scaling and one day of machine scaling is expected.

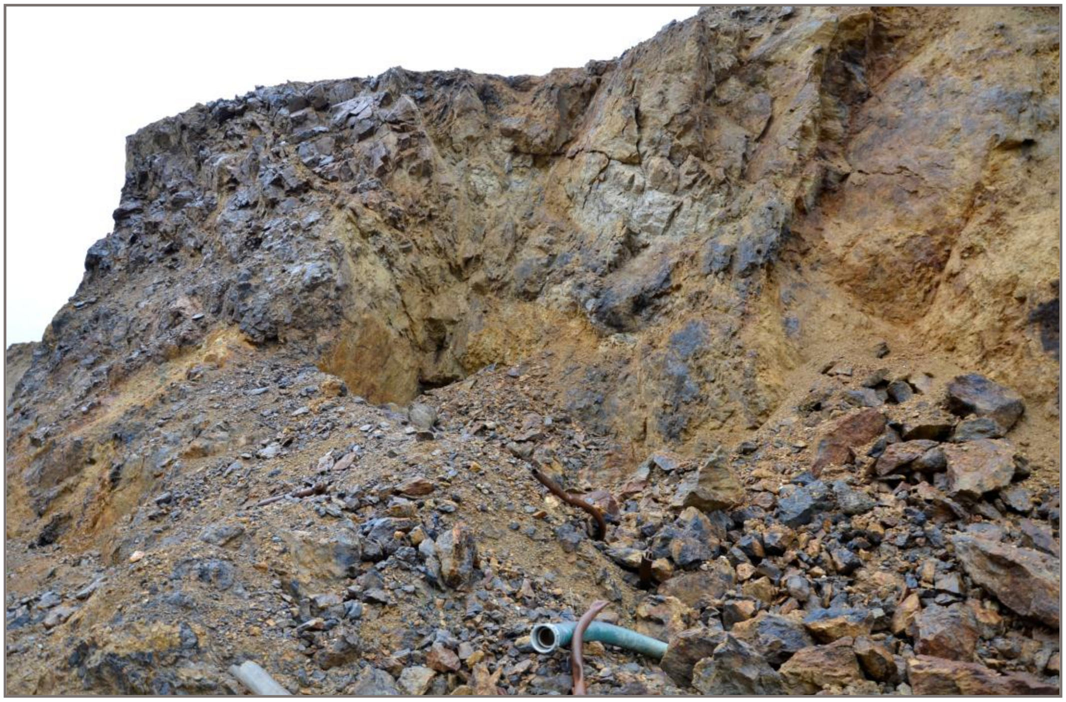


Photo 27: Sector 11a requires intense scaling localized to the adit.

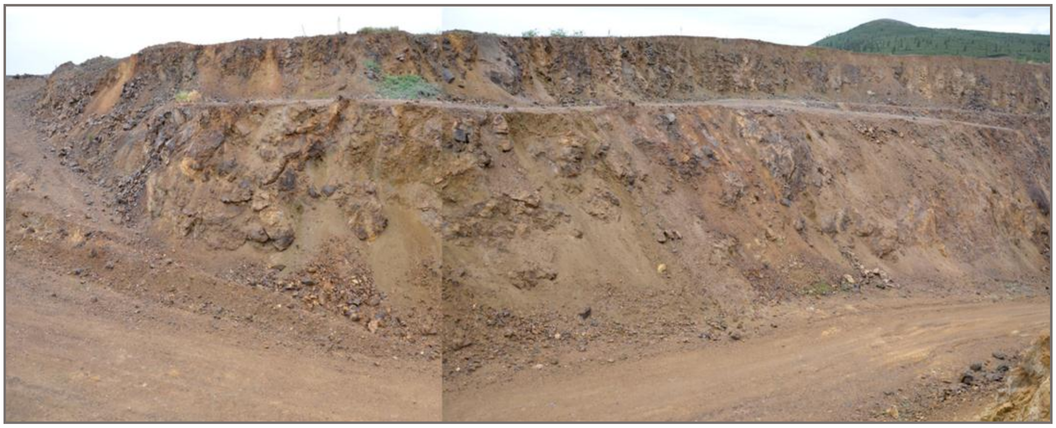


Photo 28: Sector 12 requires one day of machine scaling from crest.

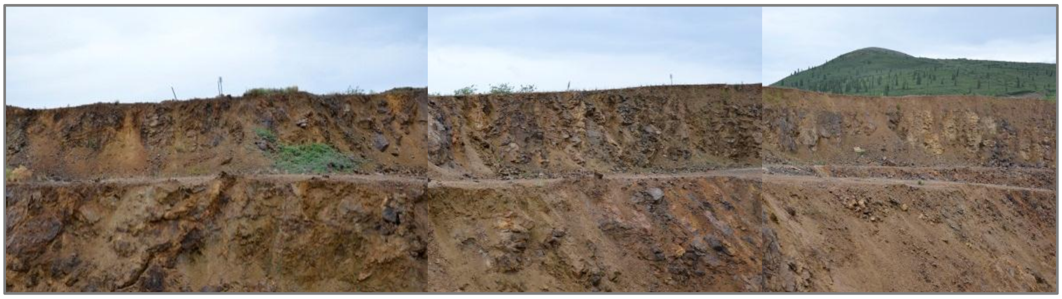


Photo 29: Sector 13 requires one day of machine scaling.

Photo 30: Sector 14 requires about 40 hours of light scaling.

Photo 31: Sector 15 requires 40 hours of hand scaling.

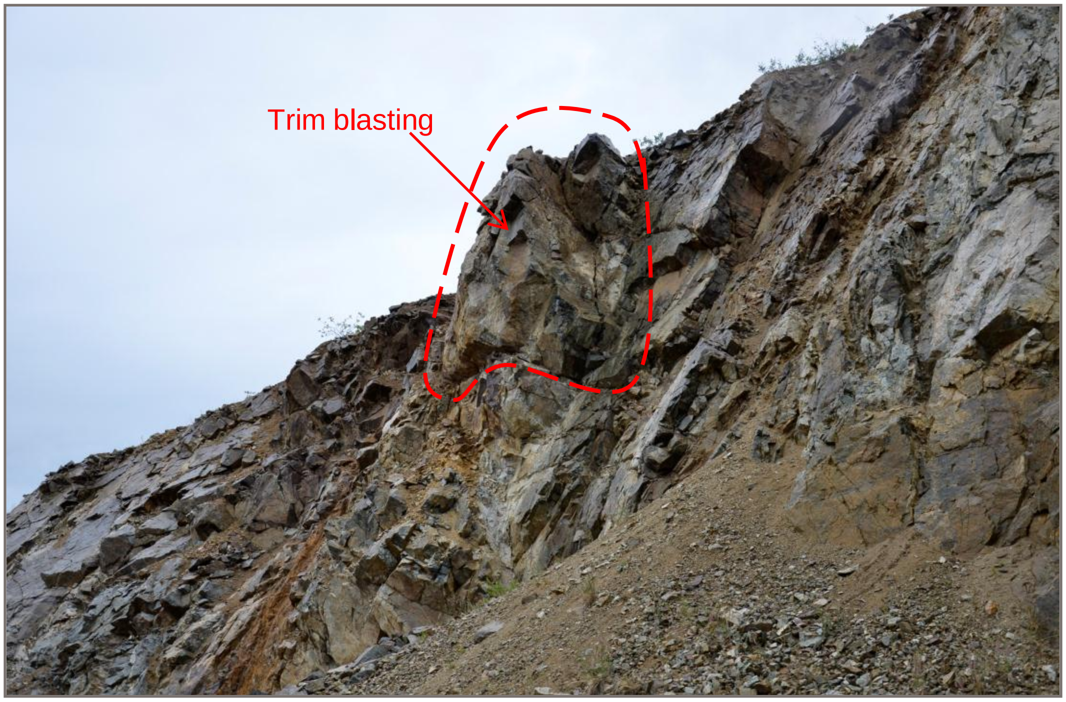


Photo 32: Sector 15a requires trim blasting of 3 x 3 x 2 m (12 m^3).

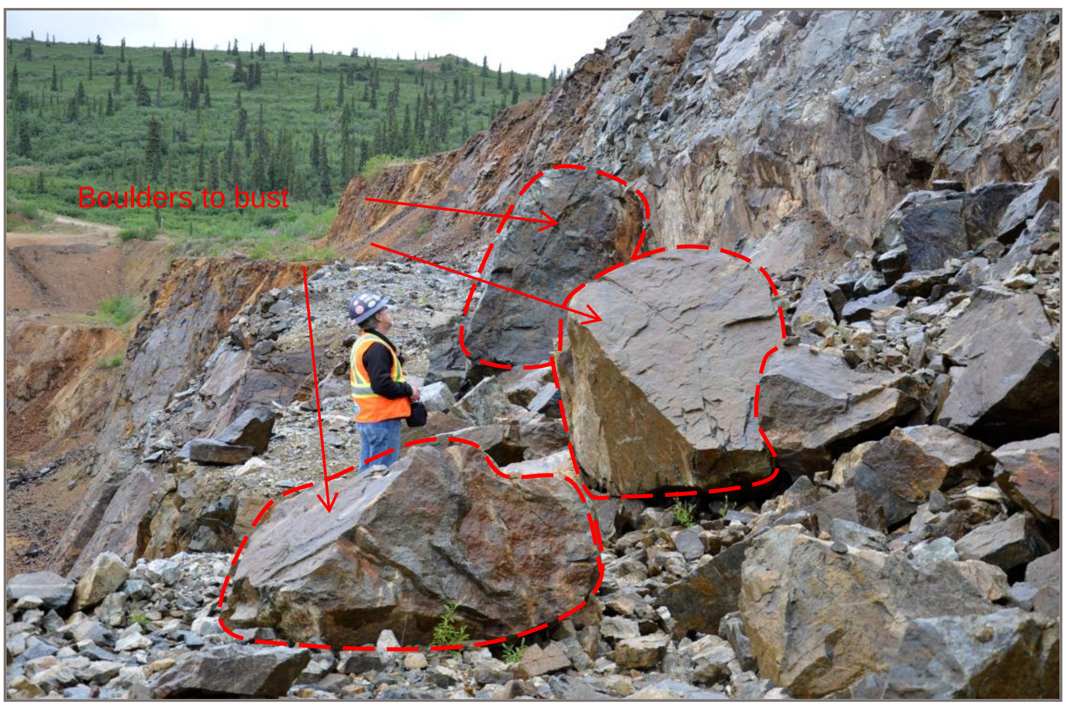


Photo 33: Sector 15b contains four boulders (about 10m^3) for busting.

Photo 34: Sector 16 requires gullies to be cleaned as well as light scaling. 64 hours of hand scaling is anticipated

Photo 35: Sector 18a shows a series of tension cracks that need 60 m^3 of trim blasting or two days of machine scaling.

Photo 36: Sector 18b requires about eight hours of check scaling and overburden slips.

Photo 37: Sector 18c requires trim blasting of 20 x 2 x 3 m.

Photo 38: Sector 18c requires trim blasting of 20 x 2 x 3 m totalling 220 m^3.

Photo 39: Sector 18d requires trim blasting of 40 x 2 x 3 m totalling 240 m^3.

Photo 40: Sector 18d requires trim blasting of 40 x 2 x 3 m totalling 240 m^3.

Photo 41: Sector 19a shows the adit. Site 19 requires about 40 hours of hand scaling to trim the crest. The talus must also be scaled after trimming

Photo 42: Sector 20 requires light scaling that is expected to take eight hours of hand scaling.

Photo 43: Sector 21 will require 16 hours of hand scaling.

APPENDIX C
SPECIFICATIONS

SPECIFICATIONS

MOBILIZATION / DEMOBILIZATION

Scope:

Consists of preparatory work and operations including but not limited to, those necessary for the movement of personnel, equipment, supplies and incidentals to and from the project site.

Measurement Procedures

.1 50% of the Mobilization and Demobilization Lump Sum Contract Price, to a maximum of 5% of total bid price, will be paid when mobilization to site is complete.

.2 Remainder of Lump Sum Contract Price for Mobilization and Demobilization to be paid when work is complete and all materials, equipment, and other facilities have been removed from site and site cleaned and left in a condition to the satisfaction of the Mount Nansen Representative and all other Agencies having Jurisdiction.

END OF SECTION

SCALING

Scope:

Scaling consists of the removal of loose soil, rock, and overburden from the crest of the slope, the slope face, and benches on the slope. Scaling also includes felling and removal of trees and brush, and pulling down larger rocks with wire rope attached to an excavator.

Definitions

.1 Scaling: Scaling consists of the removal of loose soil, rock, and overburden from the crest of the slope, the slope face, and benches on the slope. Scaling shall be done by hand working from a fall restraint or work positioning system and using suitable hand tools and powered equipment. Scaling also includes felling and removal of trees and brush, and pulling down larger rocks with wire rope attached to equipment on the highway.

.2 Manlift Scaling: Manlift Scaling consists of the removal of loose soil, rock, and overburden from the slope face beneath overhanging areas that are not easily accessible using rope access techniques. Manlift Scaling shall be done by a single scaler working from a mobile powered manlift or telescopic crane with man-basket using suitable hand tools and powered equipment.

.3 Machine Scaling: Machine Scaling consists of the removal of loose soil, rock, and overburden from the slope face with the use of an excavator where hand scaling is not sufficient. Machine Scaling shall be done by a single Skilled Operator controlling a suitable excavator utilizing suitable excavator attachments.

Measurement Procedures

.1 Scaling will be measured as the hours of time spent by each scaler actively working on the slope, beginning at the top of rope decent to the scaling area, and ending at the time the scaler reaches the bottom of that particular rope decent, including standby for passing traffic. Time spent accessing scaling areas, maintaining equipment, or carrying out work using tools or methods which are not the most appropriate or best suited to a particular situation will not be measured for payment.

.2 Manlift Scaling will be measured as the hours of time spent by a single scaler actively scaling the slope in designated areas while working from a manlift, commencing when the scaler ascends from ground level, and ending at the time the scaler returns to ground level, including standby for passing traffic. Time spent repositioning the manlift will be measured for payment. Time spent by a second crew member responsible for operating the manlift or telescopic crane will be considered incidental to Manlift Scaling and will not be measured for payment. Time spent, maintaining equipment, or carrying out work using tools or methods which are not the most appropriate or best suited to a particular situation will not be measured for payment.

.3 Machine Scaling will be measured as the number of days an excavator is actively working on the slope. Time spent travelling to the site, accessing scaling areas, maintaining equipment, or carrying out work using tools or methods which are not the most appropriate or best suited to a particular situation will not be measured for payment.

.4 Payment for Scaling will be made at the Contract Unit Price per hour for Scaling, which shall be full compensation for supplying all material, labour and equipment to execute the work as specified, including timber and brush disposal, and other overhead costs.

.5 Disposal and clean-up of materials from rock scaling, trimming, and excavation of existing fallen materials in ditches in the work areas, will be paid separately under the Common Excavation bid item.

.6 Protection of infrastructure shall be considered incidental to scaling and all other unit price work items. Clean up and removal of scaled material from adjacent areas is incidental to scaling.

.7 Repair or replacement of all infrastructure damaged by scaling operations, to the satisfaction of the Mount Nansen Representative, shall be at the Contractors cost.

Submittals

.1 Pre-Construction Condition Survey: The Contractor shall submit to the Mount Nansen Representative, not less than one day before the commencement of Work at each work area, a Pre-Construction Condition Survey of all infrastructure in the work area that may be subject to damage as a result of the work. The format of the survey shall be acceptable to the Mount Nansen Representative.

.2 Prior to the commencement of Scaling, the Contractor shall provide the Mount Nansen Representative with a Work Plan/Procedure which details measures the Contractor shall implement to protect any existing utilities and infrastructure which may be impacted by scaling or other construction activities.

Requirements

.1 The Contractor shall provide an experienced scaling crew that consists of a supervising scaling foreman with at least eight (8) years experience and a minimum of five (5) rock scalers with an average of at least four (4) years experience each scaling and working from ropes at heights. The scaling crew shall not have more than one (1) scaler with less than one (1) year experience at any time. The scaling crew size shall be maintained at all times until the completion of all work above the highway grade.

.2 Where scaling activities may impact upon any existing infrastructure the Contractor shall provide protective measures as detailed in the Contractor's Work Plan/Procedure, prior to commencing scaling. The Contractor shall be completely responsible for all damage that is a result of its scaling or other operations.

.3 The Contractor shall have scaling bars, mattocks / pulaskis, shovels, hydraulic jacks or wedge jacks, compressed air “blow pipes”, air bags, chainsaws, wire rope for pulling down large rock using a front end loader, and other hand tools and equipment available on site such that scaling can be carried out using the most appropriate and effective tools and methods for any given situation.

.4 The Contractor shall supply a front end wheel loader (CAT 966 or equivalent) equipped with a flat blade for removal of rock and debris from the pavement surface.

.5 The Contractor shall supply a telescopic boom manlift or telescopic boom crane with man-basket for Manlift Scaling. The manlift or crane shall have sufficient reach to safely position the scaler at a height of up to 27 m while maintaining sufficient horizontal reach to allow scaling without risk of damage to the manlift.

.6 The Contractor shall supply an excavator equipped with a narrow scaling/ditching thumb or a tractor-mounted hoe-ram including a 550 kg rock impact hammer. The excavator shall be capable of operating up to a height of the maximum bench face, or where necessary, utilize the construction of a temporary ramp to attain the required height.

.7 The scaling foreman and at least one other scaler on the slope shall have a 2-way radio for communication with supervisory/traffic control personnel at the highway grade.

Execution

.1 For each slope section, scale areas shown on the photographs and as directed by the Mount Nansen Representative.

.2 Trees and brush shall only be removed as directed and approved by the Mount Nansen Representative.

.3 Scaling shall be carried out using the most appropriate and effective tools and methods for any given situation as directed by the Mount Nansen Representative.

.4 Any construction access on the slope including but not limited to trail building, installing access ropes, ladders, and tree and brush removal to facilitate access to the designated scaling areas shall be considered incidental to work and all shall be removed upon completion of the work.

.5 All rope work shall comply with best practices detailed in the BC Construction Safety Network scaling operations guidelines and applicable WorkSafe BC regulations.

END OF SECTION

TRIMMING

Scope:

Trimming consists of rock excavation to remove unstable rock masses on a slope that are too large or solid to remove by scaling, rock excavation to improve slope and ditch geometry, and breaking up rock boulders larger than 1.5 m^3 in volume from sources other than Trimming to facilitate loading to trucks for off-site disposal.

Definitions

.1 Limits of Excavation: Surfaces forming the required extent of excavation by Trimming as shown on the photographs or as directed by the Mount Nansen Representative.

.2 Blasting Consultant: A consultant with expertise in blasting and non-explosive rock excavation who is independent of the Contractor and retained by the Contractor to provide blasting design and quality control functions as specified herein.

.3 Controlled Blasting: The use of blasting methods designed to prevent rock damage or overbreak beyond the Limits of Excavation, provide adequate fragmentation, and prevent damage to infrastructure from vibrations, flyrock, or falling rock. Unless otherwise authorized by the Mount Nansen Representative, Controlled Blasting requires that:

.1 Blast holes shall not exceed 8 m depth.

.2 The spacing of blast holes situated along the backline or Limit of Excavation shall not exceed 0.75 m.

.3 "Buffer Blasting" shall be used with appropriate delays between successive rows of blast holes where there are more than two rows of holes.

Measurement Procedures

.1 Trimming will be measured as the in-situ "bank" volume of rock excavated, based on measurements agreed upon by the Mount Nansen Representative and the Contractor before and after each trim. Over excavation and over break beyond the Limits of Excavation, and secondary breaking of oversize material resulting from Trimming will not be measured for payment.

.2 Payment for Trimming will be made at the Contract Unit Price per cubic meter of rock trimmed. The tendered unit price shall be full compensation for supplying all material, labour and equipment to execute the work as specified.

.3 Payment for Trimming will not be made until all related submittals have been received and approved by the Mount Nansen Representative.

.4 Each Blasting Consultant Site Visit of minimum 8 hours duration on site will be measured as one (1) Site Visit. Payment for each Site Visit will be made at the Contract Unit Price which shall include all hourly and disbursement costs associated with travel, costs incurred on site, reporting and administration. Only Site Visits requested by and approved in advance by the Mount Nansen Representative will be measured for payment.

.5 Disposal and clean-up of materials produced by rock scaling and trimming will be paid separately.

.6 Rock Scaling to facilitate access to trim locations and performance of Trimming, and Scaling of the trim area and the slope below the trim area to remove all loose rock produced by Trimming shall be incidental to Trimming.

.7 Preparation of submittals and engaging a Blast Consultant to prepare and/or certify Proposed Blasting Plans is considered incidental to Trimming.

.8 Protection of infrastructure and removal of trimmed material from the roadway and adjacent areas is considered incidental to Trimming.

.9 If the Contractor fails to follow the Blast Design and the slope remains in an undesirable condition following Trimming, all remedial measures necessitated by improper blasting as determined by the Mount Nansen Representative shall be at the Contractors expense.

Types Of Explosives And Accessories

.1 Bulk ammonium nitrate and fuel oil (ANFO) type explosives shall not be used.

.2 Where there is a danger of initiation system cut-offs, detonators and delay elements must be of a type that includes down-hole delays (e.g. Handidet) to prevent cut-offs.

.3 Non-explosive rock excavation products shall be produced by a recognized manufacturer.

Submittals

.1 Pre-Construction Condition Survey: The Contractor shall submit to the Mount Nansen Representative, not less than two (2) days before Trimming, a Pre-Construction Condition Survey of all infrastructure in the area that might be subject to damage. The format of the survey shall be acceptable to the Mount Nansen Representative.

.2 Proposed Blast Design: Not less than two (2) days prior to commencing work for each trim location, submit a Proposed Blast Design for that trim location to the Mount Nansen Representative for review. The Proposed Blast Design shall be in a format acceptable to the Mount Nansen Representative and include as a minimum the following information:

  .1 Site kilometer location and Station limits of proposed Trimming.

  .2 Plan and cross section sketch drawings of proposed trim showing the free face, drill pattern (burden and spacing), dimensions, and estimated volume.

  .3 Diameter, inclination, orientation, depth, and number of drilled holes.

.4 Loading diagram showing type and amount of high explosive or non-explosive products, initiators, and depth of stemming for each type of blast hole.

.5 Initiation sequence for blast holes including delay pattern and delay times.

.6 Manufacturer's data sheets for all explosive and non-explosive products, delays and initiation systems to be used.

.7 Make and model of non-explosive rock excavation equipment (e.g. hydraulic splitters, excavator mounted Hydraulic Breaker, etc.).

.8 Methods of protecting existing infrastructure that shall be employed.

.3 As-Built Blasting Record: Not more than one (1) working day after completing work at each trim location, submit an As-built Blasting Record to the Mount Nansen Representative. The As-built Blasting Record shall indicate all deviations from the Proposed Blast Design, the actual date, time, and duration of Trimming, and identify any known or suspected damage, traffic delays, or other problems which may have resulted from Trimming.

.4 Blasting Consultant Field Report: Within three (3) days following each Site Visit, the Contractor shall submit a Field Report prepared by the Blasting Consultant. The Field Report shall document observations and recommendations made by the Blasting Consultant and consist of 2 to 4 typed pages plus relevant photographs and drawings.

.5 Blasting plan submittals are for quality assurance and record keeping purposes. Review of the Proposed Blast Designs by Mount Nansen Representative shall not relieve Contractor from responsibility for accuracy and adequacy of the designs when implemented.

Quality Control

.1 Proposed Blast Designs for Trimming shall be prepared by the licensed Blaster who will directly oversee the Trimming, or by the Blasting Consultant.

.2 The Blasting Consultant shall have designed controlled blasts for at least three (3) similar projects over the past five (5) years and have at least ten (10) years relevant experience, including experience with non-explosive rock excavation methods. Qualifications of the Blasting Consultant shall be subject to approval by the Mount Nansen Representative.

.3 The Blasting Consultant shall make an initial Site Visit prior to any Trimming to inspect the Trimming areas and advise on Trimming methods and measures necessary to protect infrastructure and the environment. The Mount Nansen Representative may require the Blasting Consultant to make subsequent Site Visits during the course of the work.

.4 The Blaster shall be licensed with WorkSafeBC, and shall have designed and carried out trim blasts for at least four (4) similar projects in the last five (5) years.

.5 The Blaster shall directly oversee the drilling, loading, and detonation of all blasts.

.6 The Contractor shall not commence drilling or other work on a trim blast until the Blast Design has been submitted to and reviewed by the Mount Nansen Representative.

.7 The Contractor shall provide at least four (4) hours between the completion of drilling and start of loading to permit the Mount Nansen Representative to measure the length of holes, dimensions of the blast, and perform other quality assurance tasks.

General Requirements

.1 The Contractor shall provide a hydraulic excavator with minimum 8 m reach equipped with a hydraulic impact breaker of maximum 2,000 ft-lb (2,710 Joules) impact energy for Type C Trimming and for removing drill hole traces in trim areas.

.2 The Contractor shall provide a front end wheel loader (CAT 966 or equivalent) equipped with a flat blade for removal of rock and debris from the pavement surface.

.3 The Contractor shall provide blasting mats and all other supplies, labour, and equipment necessary to control flyrock and protect existing infrastructure during the work.

Execution

.1 Trimming shall be performed prior to other specified work such as scaling or rock bolting where this work may be adversely impacted by Trimming.

.2 Supply, place and remove protective measures for roadways and all other infrastructure that might be damaged by Trimming. Protective measures shall include but not be limited to; granular padding material to protect roadways, timbers or blasting mats to prevent flyrock or protect structures, and temporary removal of infrastructure at risk. The Contractor shall repair or replace any and all damage caused by Trimming at its own cost.

.3 Trimming shall be scheduled and coordinated with all stakeholders in compliance with blasting related provisions of the specifications.

.4 Following Trimming, the slope shall be scaled to provide a sound rock surface in the trim area and to remove all loose rock and debris caused by Trimming.

END OF SECTION

APPENDIX D

EBA'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOTECHNICAL REPORT

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

1.0 USE OF REPORT AND OWNERSHIP

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

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

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

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

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

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

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

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

4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

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

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

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

5.0 LOGS OF TESTHOLES

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

6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

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

7.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

8.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

9.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

10.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

11.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

12.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

13.0 SAMPLES

EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

14.0 INFORMATION PROVIDED TO EBA BY OTHERS

During the performance of the work and the preparation of the report, EBA may rely on information provided by persons other than the Client. While EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.