MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

ENVIRONMENTAL MONITORING PLAN

June 2011

TABLE OF CONTENTS

List of Appendices:

1.0 INTRODUCTION

The Environmental Monitoring Plan (EMP) encompasses a range of monitoring activities that includes data collection, interpretation, and identification of triggers when there is a potential for an environmental effect, and responsive contingency plans to address potential risks. To the extent possible, a response is anticipated and planned for with an adaptive management strategy. In addition, the EMP includes ongoing monitoring of various environmental conditions such as meteorological conditions which may or may not require an adaptive management approach.

1.1 Regulatory Context

Minto Explorations Ltd. (MintoEx) operates under two main regulatory licenses:

- Water Use Licence (WUL) QZ96-006 Amendment #7, issued on March 31, 2011; and
- Quartz Mining Licence QML-0001 issued on May 19, 2011.

With guidance from external expertise, Minto Ex on-site technical staff and geotechnical consultants have adjusted the monitoring program requirements outlined in the WUL QZ96-006 Amendment #7, to reflect the dynamic and unresolved nature of various engineered structures on site and to accommodate new features required of the Environmental Monitoring Plans requested in Schedule B of QML-0001.

Included in the plan requirements is an adaptive management strategy that allows for flexibility in response to changing conditions. This strategy will be employed for all monitoring plans where applicable allowing for best management practices to adjust to changes in the performance of engineered structures and minimize any possible impacts to these structures. Minto Ex and the Minto Mine Site has structures and features that can be susceptible to environmental conditions and whose performance is measured by a number of operational monitoring programs, including but not limited to:

- Physical Stability Monitoring of various site structures including;
    - ➢ Tailings Stability Monitoring
    - ➢ SW Dump and South Wall Monitoring
    - ➢ Geotechnical Inspections for Reclamation Overburden Dump and Main Waste Dump
- Geochemical monitoring of waste rock storage facilities;
    - ➢ Metals Leachate/Acid Rock Drainage Issues (ML/ARD)
- Water Quality Surveillance for site and receiving waters;
    - ➢ Adaptive Management and Monitoring Plan
- Meteorological Monitoring
- Biological Monitoring

- Reclamation Effectiveness Monitoring Program

2.0 PHYSICAL MONITORING PROGRAM

A Physical Monitoring Program (PMP) is conducted at Minto Mine in accordance with Part F sections 60 through 62 and Appendix 2 of Water Use Licence QZ96-006 and additional clauses recently added as described in Parts E and G of WUL QZ96-006 Amendment #7. It entails regular geotechnical stability monitoring of key site structures (Water Storage Pond Dam, the Mill Water Pond, Waste Rock and Overburden Dumps, Tailings Facility and Water Diversion Ditches and Conveyance Structures) and annual physical inspection of these facilities by a registered professional engineer. Minto Mine staff regularly liaises with the engineer of record for these mine components. Occasionally, additional monitoring is recommended through regular inspections. As such, the scope of physical monitoring conducted is continually adapted in accordance with observations in the field.

Slope stability monitoring was introduced as the pit depth increased, primarily for safety reasons. Instrumentation was installed on the south wall of Area 1 Open Pit, the Dry Stack Tailings Storage Facility, and Southwest Waste Dump. These areas are monitored for ground movement from deep seated and shallow failures and include data from survey hubs, ground temperature cables and DSI slope inclinometers. Minto staff, in conjunction with the engineers of record, also monitors surficial cracks as they appear. Additional visual monitoring for stability of the side slopes on all dump sites are performed on a regular basis, and in depth annual inspections are performed by a professional engineer on all engineered dumps, the tailings facility and water storage pond dam at least annually and in practice more frequently on an as-required basis. Safety factors are the primary considerations driving physical monitoring frequency and instrumentation requirements. As-built designs and monitoring coverage are adapted accordingly.

2.1 Tailings Stability Monitoring

An operational adaptive management program (AMP) has been proposed for the Tailings Storage Facility in the Operation Maintenance and Surveillance Manual (OMS), and is based on data collected through the monitoring initiatives proposed in the same document. The AMP for this facility focuses on the physical and chemical stability of the tailings materials. Current monitoring of the DSTSF indicates that the facility is subject to movement and the Mill Valley Fill (MVF) has been designed as a buttress to address this movement. Additional instrumentation is being installed to monitor this movement along with the new instrumentation already added in 2010. A monitoring program to track the movement rates following construction of the MVF will assess and substantiate the need for further contingency measures which may include adding additional material to the MVF.

Instrumentation currently installed at the DSTSF includes:

- 10 survey hubs at the toe key structure

- 5 inclinometers
- 7 ground temperature cables
- 2 vibrating wire piezometers

Monitoring frequency, and triggers and thresholds for response actions are described in detail in the OMS for the DSTSF. It includes, but is not limited to; ground temperature triggers, lateral movement triggers, tailings core characteristics, moisture contents and ML/ARD triggers. An annual inspection is performed by a registered professional engineer. Specific details of the monitoring plan are available in Appendix A, "Operation, Maintenance, and Surveillance Manual, Dry Stack Tailings Storage Facility, Minto Mine, YT", January 2011.

2.2 South Wall Monitoring

Any mandated monitoring requirements regarding the South Wall failure are now obsolete as the wall has failed and the South Wall Buttress is obsolete as it was intended to buttress the area that has already failed. We are however monitoring the road and survey hubs along the 810 bench once a day. As well, we are monitoring the inclinometers to the South of the haul road every two weeks.

There are 3 slope indicators on the south wall at the contact to the bedrock and a total of 9 survey hubs; 5 surrounding the haul road and 4 on the 810 bench of the Area 1 Pith. Minto Ex is currently investigating a number of contingency measures based on this failure in accordance with EBA recommendations. The tracking of the south wall failure is a good working example of setting trigger thresh holds and responding to these risks. The accelerated movement was noted through the instrumentation and an appropriate response issued to clear all personnel and equipment from the Area 1 Pit before the ultimate failure in April 2011. An annual inspection is performed by a registered professional engineer. Specific details of the monitoring plan are available in Appendix B, "Technical Memo: Area 1 Open Pit – Southern and Western Permafrost Overburden Slope Stability Monitoring", March 23, 2011.

2.3 Southwest Dump Monitoring

At The Southwest Dump (SWD) Minto Ex is currently monitoring:

- 9 Survey hubs; monthly
- 2 Slope Indicator holes; twice a month
- 4 Ground Temperature Cables (GTC); monthly
- 6 Vibrating Wire Piezometer; monthly

Performance monitoring is an integral part of the design, construction, and operation of the SWD. The results of the monitoring program form the basis of an adaptive management process that continually reviews the operation of the dump and will provide data for the final closure plan. The monitoring program has the same considerations for long-term creep to contend with as the DSTSF due to the presence of permafrost conditions and an overburden clay interface that has the potential to shear from loading. The risk factor is lower due to the placement of competent waste rock at the perimeters and restricting overburden placement to dedicated areas. A program for visual monitoring of the slope, crest and toe of the dumps are performed regularly and surveyed at the discretion of the engineer on record for signs of deformation. A program of adaptive management practices is assumed for the various threshold warning levels and are established in Appendix C “Geotechnical Design Proposed Southwest Dump Minto Mine, Yukon”, issued to MintoEx in September 2008. An annual inspection is performed by a registered professional engineer.

2.4 Main Waste Dump

The Main Waste Dump is located in the northwest corner of the Minto Mine project area and in the original design was built on the bedrock contact. Therefore the build-up of pore water pressure and the lack of soil sizes susceptible to liquefaction, combined with a competent bedrock contact devoid of permafrost, reduce the risk factor considerably. Nonetheless, two slope indicators are installed on the Main Waste Dump and are monitored monthly. Annual inspections are performed by a registered professional engineer.

2.5 Reclamation Overburden Dump

The Reclamation Overburden Dump is located northwest of the Main Waste Dump and is built on the same competent ground as the Main Waste Dump. Performance is monitored visually on a monthly basis and through on-going survey and as-built designs. Visual monitoring includes observation of the crests, slopes and toes and in particular monitoring for the deposition of ice-rich versus non-ice rich soils to ensure that ice rich soils are deposited in the Ice-Rich Overburden Dump (IROD). The ROD is a temporary structure as a large amount of the material deposited here will be used for cap and cover of the waste dumps and tailings upon closure and through progressive reclamation. An annual inspection is carried out by a professional Geotechnical Engineer. Specific details of the monitoring plan are available in Appendix D, “Geotechnical Design Proposed Reclamation Overburden Dump Minto Mine, Yukon”, February 2008.

3.0 GEOCHEMICAL MONITORING

MintoEx initiated geochemical monitoring in accordance with WUL QZ96-006 Part F section 65 and in Appendix 6 outlined an acid-base accounting (ABA) program designed to test the results presented in a geochemical characterization report presented during environmental screening for Minto Mine. This report predicted that the open pit wall rocks would be net neutral to slightly acid consuming (non-acid generating). Results to date indicate that the open pit wall geochemistry is consistent with the initial geochemical predictions put forward in the original geochemical characterization report.

Outside of the scope of the ABA program, kinetic geochemical testing is currently being conducted as part of ongoing environmental assessment baseline work. As part of the Phase IV Expansion application to YESAB submitted in August 2010, MintoEx developed a metal leaching/acid rock drainage (ML-ARD) assessment. The results of the work undertaken to formulate this assessment characterized both the waste rock and tailings materials during the mine life with respect to metal leaching and potential for acid rock drainage. The results of this work are being used to guide the placement of waste materials during operations, ensuring that materials with ML-ARD potential are tested for use as general construction materials, unless absolutely necessary, and is confined to the assigned waste placement areas. The Company will specify distinct areas for any such material within the waste storage areas, such that should alternate closure measures be required for this material, they will be readily accessible and accurately delineated. This operational information collected, coupled with the proposed closure monitoring of the waste storage areas, will be used in preparing and implementing an Adaptive Management Plan for ML-ARD issues site wide, to be prepared and ready for implementation at closure.

The ML-ARD and Acid Base Accounting Test Program involves regular monitoring and testing of waste rock and tailings mining waste for acid generation/buffering and metal leaching potential; this includes but is not limited to; full scale field lysimiters, barrel leachate trials, and predictive water quality modeling.

The on-site testing also includes a Seepage Monitoring Program designed to eliminate any unknown sources that may be contributing to poor water quality either as high concentrations of leachates or low pH values. Triggers used for adaptive management of leachates is conducted through an ongoing review process by professional engineers from Access Consulting and is outlined in the following documents; from the Phase IV YESAB application and from the WUL QZ96-006 Amendment #7, respectively. Appendix E, “Minto Mine Expansion- Phase IV ML/ARD Assessment And Post-Closure Water Quality Prediction” August, 2010 and Appendix F, “Minto Mine Seepage Monitoring Plan Version 2011-01”, June 22, 2011.

4.0 WATER QUALITY SURVEILLANCE FOR SITE AND RECEIVING WATERS

Water quality monitoring at Minto Mine began in accordance with WUL QZ96-006 Part F sections 58 and 69 and defined further in Appendix 3, adhering to effluent standards in Part E. This program included daily, weekly, monthly and quarterly monitoring of surface water quality at various background sites, sites in the area of operations, points of compliance and receiving water sites. In fall 2009, MintoEx submitted a revised Water Management Plan to YESAB as required under WUL Amendments 4 through 6. In March 2011, Amendment 7 to the WUL was issued with significantly revised effluent standards (Part F, sections 52 through 57) and an expanded monitoring program defined in Appendix 3. In May 2011, MintoEx resubmitted an Adaptive Management and Monitoring Plan (AMMP) to the Yukon Water Board for review and approval. This plan is still under consideration by the Board. The AMMP as proposed is summarized below and enclosed as Appendix G, “Adaptive Management and Monitoring Plan Minto Mine, Yukon Territory. May 2011.”

4.1 Adaptive Management and Monitoring Plan

The AMMP provides specific methods and techniques for water sampling and monitoring as well as threshold triggers for action based on water quality observed in the field and tested on site in an environmental laboratory. This plan is designed to implement the adaptive approach described in the Water Management Plan (Yukon Water Board, application QZ09-094). The goal of the AMMP is to verify water quality results predicted by the models described in the Water Management Plan. It contains mechanisms for protection of aquatic resources through early warning and adaptation of the monitoring and response. The AMMP is crucial to the management of water and effluent discharge at the site.

There are a total of 29 water quality monitoring stations throughout the site. In its simplest form, impacted water will be contained on site for treatment and discharge. The AMMP strategy includes the ability to treat and test water on site. The on-site lab will be able to produce improved turn-around time for results and allow for rapid response to changing conditions at both compliance points; end-of-pipe and in the receiving environment. During the mine life, the scenario of discharging water will be termed an “Event” and so monitoring will typically characterize non-discharging periods. Typical parameters will be measured both in the field and at the external lab including:

- Physical measurements (pH, electrical conductivity and temperature) measured in-situ. Dissolved oxygen will be measured during AMMP events using an YSI multi-meter.
- Routine parameters (TSS, alkalinity, hardness, etc. Full suites of parameters listed in Table F-1).
- Total metals
- Dissolved metals
- Nutrients (ammonia, nitrate, nitrite, phosphorus, etc.)

The AMMP is the guiding document and outlines the actions taken in response to values received from the on-site laboratory for regulated water quality parameters. These are measured at one of the water conveyance network collection areas and compared to effluent quality standards for the end-of-pipe (“compliant” water):

- W15 sump
- W12 Pit Water
- Water Treatment Plant waters
- WSP water (W16)

The results will be verified through duplicate samples, external laboratory analysis and increased frequency sampling. If required, the decision to discharge will be based on on-site results. The circumstances of the trigger activation will be documented and reported. When there is a desire to discharge water, monitoring frequency will increase to Level 2 at these locations:

- Source waters (one of the above locations)
- W3
- MC1
- W2

MintoEx still intends to make decisions regarding discharge based on water quality results measured on site and notify appropriate agencies of the intent to discharge 24 hours in advance. As indicated above, MintoEx will establish a reasonable agreement between the on-site and external laboratories in advance and adhere to a QA/QC program, as required under WUL QZ96-006 Amendment #7 clause 20. Specific details of the AMMP are available in Appendix G.

5.0 WEATHER MONITORING

Monitoring of meteorological parameters is conducted via an Onset HOBO Weather Station, which includes meteorological instrumentation, a data logger and enclosure mounted on a 3-m tripod. The station is located approximately 100m northeast of the airstrip and has been operating since 2005. Data from the station has been collected regularly and is used for development and operational planning purposes. In 2010, following recommendations made by RWDI AIR Inc., a research-grade weather station, including a 10-m tower, was installed to replace the existing HOBO weather station. Particulate matter monitoring equipment has also been installed, to quantify the levels of PM10 and PM2.5 observed in camp.

6.0 BIOLOGICAL MONITORING

Pursuant to the requirements under QML-0001 (Schedule B) and WUL-QZ96-006 (clause 72) the following describes the annual biological monitoring programs for sediment, periphyton, benthic invertebrates and fish and fish habitat. To better understand the relationship between water quality and potential impacts on aquatic biota a more intensive stream sediment study will also be undertaken Sampling will be conducted annually during/throughout the open water season on the Minto Creek watershed and reference systems (where applicable). Annual reports detailing each sampling program, results and interpretation of those results will be prepared and submitted with the annual reports required for QML-0001 and WUL-QZ96-006.

6.1 The Sediment and Benthic Invertebrate Program

This Monitoring Program will evaluate the condition of the benthic invertebrate community of Minto Creek and provide data to allow interpretation of the potential influence of the Minto Mine on the benthic invertebrate community using temporal comparisons and spatial comparisons (control-impact design). This monitoring is to be conducted in addition to benthic invertebrate community monitoring required every three years as part of Environmental Effects Monitoring (EEM) under the Metal Mining Effluent Regulation of the federal Fisheries Act. Another purpose of this plan is to monitor sediment quality of Minto Creek and to provide data to allow interpretation of the potential influence of the Minto Mine on sediment quality using temporal comparisons, spatial comparisons (control-impact design) and Canadian Environmental Quality Guidelines for sediment (CCME 1999). Specific details of the Benthic

Invertebrate Monitoring Program are addressed in Appendix H, “Description of WUL Sediment and Benthic Monitoring”, June 2011.

The current water use licence requires sampling of benthic invertebrates every two years at four stations (W2, W3, W6, and W7). Two cycles of sampling have been conducted to date and both demonstrated limitations with using W6 and W7 as reference sites. Both sites are very limiting in terms of suitable cobble substrate where benthic samples can be obtained. Therefore, reference sites will be re-situated to creeks within the vicinity of Minto Creek with similar physical characteristics. Additionally, sampling will be conducted annually as opposed to biannually and will follow protocols outlined in MMER’s Environmental Effects Monitoring (EEM) Program. An effects assessment on benthic invertebrates is also required under MMER as part of the EEM program on two or three year cycles. Sampling for years 1 and 2 will be conducted following methods and protocols according to the MMER EEM Cycle II Study Design for the Minto Mine. Sampling beginning in year 3 will revert to the frequency dictated by the EEM Program (i.e. 2 to 3 year cycles)

6.2 Fisheries Program

An annual fisheries monitoring program will be conducted in order to assess and characterize fish usage in Minto Creek. The annual program will focus on the most predominant species using the system, Chinook salmon, but will also characterize potential use by other species (i.e., slimy sculpin, arctic grayling and round whitefish have been previously captured in low numbers). Usage and characterization will be primarily focused on extent and timing of use as well as quantitative use. Relative use of Minto Creek will be reported for each sampling interval through determination of Catch per Unit Effort (CPUE). A description of water chemistry in the receiving environment and mine discharge actions during the open water period will also be reported. Specific details of the fisheries monitoring program are addressed in Appendix I, “Minto Creek Annual Fish Monitoring Program”, June 2011. An annual report will be prepared detailing the results of the sampling program.

Sampling for effects on fish is not currently a requirement in the WUL. An effects assessment on fish however is a requirement under MMER as part of the EEM program. As with the benthic invertebrate program, the EEM program requires studies be conducted every two to three years. However, MintoEx will conduct additional fish studies in Minto Creek on an annual basis to characterize fish usage of the system (timing, duration and extent) by juvenile Chinook salmon and other species, and to monitor possible use of lower Minto Creek by adult Chinook during their spawning period.

6.3 Periphyton Program

Periphyton is a type of algae that attaches itself to stream substrate and is directly affected by physical and chemical changes that occur in a stream over time. MintoEx will initiate a program to track the influence of mining activity on the periphyton community in Minto Creek. Sampling for periphyton will be conducted annually assessing relative abundance and community composition. Sampling is relatively easy and will be conducted at the same stations where benthic invertebrates were collected. As with the benthic monitoring program, sampling will be conducted in late summer/early fall. Year to year comparisons will be made with respect to community composition, and diversity as well as a review of tolerant and/or sensitive taxonomic groups Specific details of the periphyton monitoring program are addressed in Appendix J, “Periphyton Monitoring Program”, June 2011. An annual report will be prepared detailing the results of the sampling program.

7.0 RECLAMATION EFFECTIVENESS MONITORING PROGRAM

Monitoring details are outlined and detailed in the Detailed Reclamation and Closure Plan Rev3.1 and have been specifically scoped to fulfill the requirements under the Yukon Environmental and Socio-economic Assessment Act (YESAA) for quartz mining projects proposed in the Yukon. It is important to understand that activities associated with Phase IV of the Minto Mine have not yet been constructed and as such there may be changes to designs, or situations encountered during infrastructure development, that impact on the information presented in this document.

A systematic approach to decommissioning and closure reclamation has been developed for the Minto project. Progressive reclamation measures will be implemented where possible during mine construction and operations. This approach will not only provide valuable reclamation success feedback for use in advanced/final closure, but progressive reclamation will reduce final reclamation liability and costs and shorten the overall reclamation implementation schedule. These progressive efforts will also help reduce slope erosion through physical slope stabilization and re-vegetation efforts, enhancing ultimate reclamation success.

The overall goal of closure at the Minto site is to leave the area as a self-sustaining ecosystem, ensuring that land use after closure is compatible with the surrounding lands, and that the site vegetation returns to a state as near as possible to that in existence prior to mining activities. Operations phase material characterization programs and the application of passive mitigation treatments such as engineered covers to reduce metal loadings from mine infrastructure components are the primary means by which the Company proposes to achieve this goal.

Reclamation monitoring for the Minto Mine Site to date has focused primarily on vegetation trials, soil composition studies and nutrient availability. Through annual inspections of reclamation plots measured for growth and coverage, Minto Ex, has determined a seed mix suitable for initial re-vegetation, to establish colonization by native vegetation, amend the soil and promote evapotranspiration. Developing a primary cover crop will encourage the establishment and growth of species of hedges, shrubs and trees which will be tracked though the reclamation monitoring program. Secondly, and in conjunction with developing ground cover is to build an engineered soil cover or cap over the dumps and tailings to decrease infiltration and reduce the potential for rapid oxidation and weathering of the waste rock and tailings. Infiltration monitoring will be carried out through a full scale lysimeter trial during the summer of 2011. These studies will monitor the effectiveness of the covers based on cover thickness, soil fractions and soil gradients to prevent water infiltration. Decreasing water infiltration is shown to have a positive correlation to improved water quality and reduced metal loadings. Monitoring for reclamation effectiveness will continue into post closure through ongoing water quality monitoring and re-vegetation monitoring. Full details of monitoring efforts that will occur through closure and post closure are detailed in Appendix K “Decommissioning and Reclamation Plan Minto Mine, Yukon Territory”, June 2011.

8.0 PERMAFROST PROTECTION PLAN

MintoEx proposes to incorporate additional or improved measures to monitor permafrost conditions into the Physical Monitoring Program described above. This information will be used to update engineering plans throughout the site and minimize thawing conditions wherever possible. The results will be summarized in the QML Annual Report.

Currently, permafrost conditions are monitored in a number of ways at Minto Mine including thermistors, ground temperature cables and survey stakes which are monitored regularly in accordance with the engineering design. The readings from these instruments provide valuable in-situ information that helps determine whether the related mine component (dry stack tailings, waste dumps, water retention dam, etc.) is performing as predicted by the design. The survey stakes provide information on small-scale ground movement that may indicate unfrozen conditions.

In addition, a meteorological station has been in place collecting continuous data on air temperature, precipitation, relative humidity, wind speed and direction, solar radiation and atmospheric pressure. This detailed log, along with information on regional and global climate trends will also be used to revisit engineering assumptions and if necessary revise thawing thresholds triggering actions. The review of this information is conducted as part of annual geotechnical inspections of various mine components (dry stack tailings facility, mine waste dumps, water retention dam, etc.) by the engineer of record

General construction practices in known permafrost regimes inform day to day earthworks at Minto Mine. These include the following:

- Avoiding deep snow accumulation in critical or sensitive permafrost areas; if practical and necessary, snow clearing in winter would result in colder ground.
- When possible, preserving the original surficial organic/peat layer; removing or compressing the organic/peat layer would normally result in a deep active layer and warm permafrost.
- When fill placement over the original ground is required, preferred practice would be placing the fill during late winter when the active layer in the original ground is completely frozen.
- When possible, avoiding ponding water over the permafrost.
- Depending on site conditions and construction schedule, placement of a thick fill (preferably light color) would help preserve the underlying permafrost.

- For areas where protection of the permafrost is critical, engineering measures coupled with thermal design and evaluation may be required.

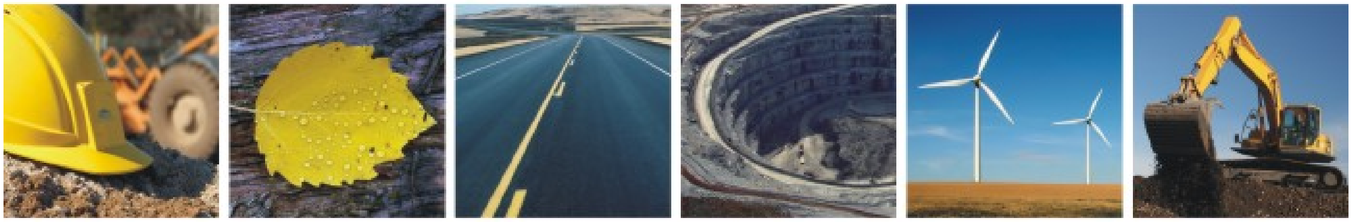
MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

APPENDIX A

DSTSF Operation, Maintenance and Surveillance Manual

MINTO EXPLORATIONS LTD.

REVISION 2011-1
OPERATION, MAINTENANCE, AND SURVEILLANCE MANUAL DRY STACK TAILINGS STORAGE FACILITY MINTO MINE, YT



MANUAL

JANUARY 2011
ISSUED FOR USE
EBA FILE: W14101068.001

creating & delivering | BETTER SOLUTIONS

A TETRA TECH COMPANY

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

This Operation, Maintenance, and Surveillance (OMS) manual has been prepared for the Dry Stack Tailings Storage Facility (DSTSF) at the Minto Mine, YT, and acts as a reference document for its operation, maintenance, and surveillance.

Minto Explorations Ltd. (Minto) and EBA, A Tetra Tech Company (EBA), have provided representatives from site operations personnel and management (Minto) and the facility designers (EBA) to form the OMS manual development team and complete the OMS manual.

1.1 Objective of the OMS Manual

The objective of the OMS manual is to define and describe:

- Roles and responsibilities of personnel assigned to the facility;
- Procedures and processes for managing change;
- The key components of the facility;
- Procedures required to operate, monitor the performance of, and maintain the facility to ensure that it functions in accordance with its design, meets regulatory and corporate policy obligations, and links to emergency planning and response; and
- Requirements for analysis and documentation of the performance of the facility.

2.0 ROLES AND RESPONSIBILITIES

2.1 Organization, Structure, and Individual Responsibilities

The operation, maintenance, surveillance or emergency preparedness and response of the DSTSF is the responsibility of the Tailings Management Team (TMT). This team comprises individuals from Minto and EBA. Minto is the lead coordinator of the OMS manual and is ultimately responsible to ensure all aspects of the OMS manual of the DSTSF are met. EBA is the facilities designer and acts as a geotechnical consultant for Minto.

Designated personnel within the TMT, along with their position and responsibilities, are summarized in Table 1.

Table 1 Designated Personnel for TMT

Personnel and Contact Information	Position	Responsibilities
John Knapp 604-759-0860 ext 439	General Manager	Overall project review and implementation, and budget allocation
Jason Nickel 604-759-0860 ext 453 jasonn@mintomine.com	Chief Engineer/Mine Manager	Group coordinator of DSTSF, project review and implementation. Technical support and coordination of monitoring at Minto Mine site
Ted Kenny 604-759-0860 ext 454	Mill Superintendent,	Pumping and conveyor operations and maintenance of tailings filter system to tailings stockpile location
Barry Perreault/Tomas Kubalcik 604-759-0860 ext 442	Construction Monitor	Routine inspections for quality assurance and quality control, data collection, surveying, providing planning direction to construction superintendent
Pelly Construction 778-785-3184 minto@pelly.net	Construction Superintendent	Contractor for haul, placement, and compaction of tailings in DSTSF, general operations, maintenance
Brian Cutts 250-505-4467 bcutts@eba.ca	Geotechnical Consultant, EBA	Periodic inspections for quality assurance, annual compliance reporting, geotechnical analysis and risk management of ongoing construction, instrumentation data review
Colleen Roche/Rob Wilson 604-759-0860 ext 462	Environmental Manager	Permitting requirements, annual environmental reports, water quality and level monitoring
Mark Goebel 604-759-0860 ext 444	Safety Coordinator	Training and/or job hazard analysis are completed as required

Responsibility of the TMT and the ongoing operation, monitoring, maintenance, and surveillance of the DSTSF falls under the Mine Manager. Furthermore, the Mine Manager must ensure adequate resources (financial and staff) are made available to ensure the safe operation of the DSTSF. Undertakings at the DSTSF must be prioritized and scheduled with the knowledge of the TMT.

2.2 Competency and Training

Appropriate training programs are required for all personnel involved in the operation, maintenance, and surveillance of the DSTSF, including all its components.

The Mine Manager and Construction Monitors are required to fully understand and implement the operation, maintenance, and surveillance requirements of the DSTSF, and ensure the contractor, Pelly Construction, follows the design criteria for the facility. This is achieved through consultation with the facility designer and geotechnical consultant, EBA, and the environmental department.

The Construction Superintendent is responsible to ensure Pelly Construction's supervisors and operators understand the operational and maintenance requirements of the DSTSF to meet the design criteria for the facility.

All personnel working at the DSTSF are to have an appropriate understanding of the OMS manual and their respective roles and responsibilities. Relevant procedures include the Minto Emergency Procedures, the

Minto Spill Response Plan, and DSTSF Emergency Preparedness Plan. It is the role of the specific supervisor of the personnel to ensure this is the case.

As well as understanding of the OMS manual, all site personnel are responsible for continually being alert to visual queues regarding facility performance. Anything observed to be outside of normal operating parameters, as outlined in this manual, must be reported immediately to the Mine Manager.

3.0 OMS MANUAL CONTROL AND UPDATE

This OMS manual is a controlled document, with specified procedures for:

- Distributing, removing and archiving out-of-date materials;
- Filing the manual and supporting documents; and
- Reviewing and updating the manual.

3.1 Distribution of Material

This OMS manual is to be distributed as follows:

- 1 copy to the Mine Manager;
- 1 copy to the Construction Superintendent (Pelly);
- 1 copy to the Mill Superintendent;
- 1 copy to the Construction Monitor;
- 1 copy to MintoEx/SWC Vancouver library;
- 1 copy to the Geotechnical Consultant (EBA); and
- 1 copy to the Environmental Department.

Additional copies are to be submitted to all regulatory agencies, as required.

Copies of this manual are to be available to all personnel who are responsible or involved in the operation, maintenance, and surveillance of the DSTSF.

The Mine Manager is responsible for maintaining the record of location of each copy of the OMS manual and to ensure that all copies are updated, as and when required.

Any requests for copies are to be made to the Mine Manager who will have that name added to the distribution list, providing a numbered copy for the user, and in doing so, ensure the recipient receives ongoing updates. No other copies are to be made.

Out-of-date DSTSF materials are to be archived by the Mine Manager. Out-of-date copies of the OMS manual are to be collected by the Mine Manager and destroyed. Several copies of the most recently superseded versions are to be archived in secure storage as required for legal purposes.

3.2 Manual and Supporting Document Location

The original copy of the OMS manual along with the following supporting documents will be stored electronically on the Mine Engineering server and/or in the Mine Manager's office on site. These documents are maintained and under the control of the Mine Manager.

The following items shall be covered or referenced in the filing system:

- Operation, Maintenance, and Surveillance Manual;
- As-built drawings from original construction and all subsequent construction phases;
- Construction records including performance and construction plans;
- All design data including both original design data and all modifications or revisions;
- All inspections and annual reviews;
- Photographic records;
- Correspondence with facility designers with relevant supporting information; and
- Correspondence with Regulatory Agencies complete with records of compliance and details of any remedial action.

Along with the above referenced documents, the following specific reports dealing with the DSTSF will be stored in the Mine Manager's office.

- **Emergency Planning Documents**
  - A report by Minto entitled "Minto Project Environmental Monitoring Plan", submitted for the Type A Water Use License 1996.
  - A report by Minto entitled "Minto Project Spill Contingency Plan", submitted for the Type A Water Use License 1996. The report is annually updated.
  - MSDS documentation for any material used within the DSTSF.
- **DSTSF Approval Documents**
  - A letter by Yukon Government – Energy, Mines and Resources entitled "Approval of Minto Mine Tailings Management Plan", dated April 17, 2007.
  - A letter by Minto entitled "QML-0001-Minto Tailings Management Plan, Additional Information", dated March 15, 2007.
  - A report by Access Mining Consultants Ltd. (Access) entitled "Minto Mine, Tailings Management Plan", dated January 2007.
- **Design Reports**
  - A letter by EBA entitled "Response to Review Questions – Minto Tailings Management Plan", dated March 15, 2007.

- A report by EBA entitled “Geotechnical Design Report, “Dry” Stack Tailings Storage Facility”, dated January 2007. This report includes a technical memo by EBA entitled “Thermal Analysis of “Dry” Stacked Tailings Area”, dated December 11, 2006.
- A letter by EBA entitled “Final Preliminary Design – Mill Water Pond”, dated June 17, 1997. This report includes the preliminary design of the Airstrip Road diversion ditch.
- A report by Hallam Knight Piesold entitled “Minto Creek Surface Hydrology Report”, dated November 1994.
- A report by Lakefield Research entitled “The Environmental Characterization of Samples submitted by Minto Explorations Ltd.”, Progress Report No. 2, dated September 1994.
- A report by Lakefield Research entitled “An Investigation of The Stability of Flotation Tailings from DEF Project Samples submitted by United Keno Hill Mines Ltd.”, Progress Report No. 4, dated January 1977.

- **Monitoring Documents**
  - A letter by EBA entitled “Dry Stack Tailings Storage Facility – Foundation Movement Monitoring Update”, dated September 7, 2010.
  - A technical memo by EBA entitled, “Dry Stack Tailings Storage Facility – Instrumentation Data Update”, dated April 23, 2010.
- **Construction Reviews**
  - A technical memo by EBA entitled, “Review of Compaction and Moisture Content at the Dry Stack Tailings Storage Facility Mill Moisture”, dated October 8, 2010.
  - A technical memo by EBA entitled, Review of Reduced Trafficability and Compaction with High Mill Moisture Content to the Dry Stack Tailings Storage Facility Mill moisture, dated September 14, 2010.
  - A report by EBA entitled “Review of Existing DSTSF Surface Water Diversion Berm/Ditch”, dated December 4, 2009.
  - A letter by EBA entitled, “Dry Stack Tailings Storage Facility – Interim As-built Construction Report”, dated June 29, 2007.
  - A letter by EBA entitled, “Inspection Report – Upper Section South Diversion Ditch”, dated December 19, 2006. The upper section south diversion ditch is referenced as the Airstrip Road diversion ditch in this document.
- **Annual Performance Reviews**
  - A report by EBA entitled “Dry Stack Tailings Storage Facility – 2009/2010 Annual Review, Minto Mine”, dated July 20, 2010
  - A report by EBA entitled “Dry Stack Tailings Storage Facility – 2008/2009 Annual Review, Minto Mine”, dated August 30, 2010

  - A report by EBA entitled "South Diversion Ditch – 2008/2009 Annual Review, Minto Mine", dated August 30, 2009.
  - A report by EBA entitled "Dry Stack Tailings Storage Facility – 2008/2009 Annual Review, Minto Mine", dated July 27, 2009.
  - A report by EBA entitled "South Diversion Ditch – 2007/2008 Annual Review, Minto Mine", dated July 2008.
  - A report by EBA entitled "Dry Stack Tailings Storage Facility – 2007/2008 Annual Review, Minto Mine", dated July 2008.
- **Tailings Risk Management Assessment**
  - A report by SRK Engineers and Scientists entitled "Tailings Risk Assessment Minto Project, Yukon Territory", dated February 2009,

3.3 Reviewing and Updating the Manual

This manual is an update of operations, experience, and drafts completed since the 2007-1 OMS Manual, and in its current form will be referred to as Revision 2011-1.

This manual will be updated every five years or after any significant change to personnel, operations, and/or design criteria.

A current OMS Manual will be in place through the full life cycle of the DSTSF through the end of the operating phase and into decommissioning and closure.

Annual tailings management system reviews are to include an evaluation of this OMS manual.

4.0 MANAGING CHANGE

Various changes to the DSTSF will occur during the life of the facility. These changes must not compromise the performance of the DSTSF or the OMS manual developed for its management. It is the role of the Mine Manager to incorporate changes to the DSTSF design or operating parameters into the OMS manual. Also, the Mine Manager is responsible for reviewing, updating, and improving the OMS manual as needed. Overall authorization of changes falls under the responsibility of the TMT.

Changes to the OMS manual may result from the following:

- Evolution of design through capacity changes, operational efficiencies, closure requirements, performance feedback and life-cycle changes;
- Incorporation of as-built records of construction;
- Variation of performance from design;
- Changes in site management organization, facility description, roles and responsibilities, and operating and reporting procedures;
- Suggestions for improvement;

- Succession planning/training; and
- Regulatory change.

In addition to updating this OMS manual on an as needed basis, Minto commits to the following:

- Assurance that the standards used for the facility are consistent with applicable legislation, codes of practice, relevant standards, and sound engineering practice;
- Regular reviews of DSTSF issues by the TMT;
- Regular updates to all copies of the OMS Manual;
- Appropriate training for all new personnel assigned to tasks dealing with the DSTSF; and
- Communication of any changes to the OMS Manual to all relevant personnel.

5.0 FACILITY DESIGN DESCRIPTION

The following sections summarize the design of the DSTSF and the background information used for the design. Additional detailed information can be found in the following reports:

- A letter by EBA titled "Response to Review Questions – Minto Tailings Management Plan", dated March 15, 2007; and
- A report by EBA titled "Geotechnical Design Report, "Dry" Stack Tailings Storage Facility", dated January 2007. This report includes a technical memo by EBA entitled "Thermal Analysis of "Dry" Stacked Tailings Area", dated December 11, 2006.

5.1 Facility Overview

The DSTSF is situated southeast of the mill and tailings filter building within the valley profile south of Minto Creek and west of the Water Retention Dam as shown in Figure 1. The DSTSF area covers an area of approximately 0.4 km^2 and is designed to provide for storage and confinement of the tailings based on the Hatch 2006 feasibility plan.

The tailings are hauled from the tailings stockpile directly south of the tailings filter building to the DSTSF and mechanically spread and compacted in controlled lifts to form a stacked tailings deposit.

Components of the DSTSF include a starter bench and drainage blanket for slope under-drainage; finger drains along the valley lines within the DSTSF footprint; surface water diversion berm and ditch for run-on surface water management; an exterior slope waste rock shell; the tailings stack; and the reclamation material. Also included is instrumentation to monitor the foundation sideslope performance of the DSTSF that consists of vibrating wire piezometers, ground temperature cables, slope inclinometers, and survey monuments. The location of the instrumentation is shown in Figures 1 and 2.

The toe of the DSTSF has been located to be above the flood level of Minto Creek and well above the reservoir level created by the Water Storage Pond Dam (formally known as the Water Retention Dam). The DSTSF will have an outer slope of 4:1 (horizontal:vertical) or 14 degrees and a final elevation at the

Waste Rock Shell of 788.0 m. The tailings will be up to 26 m deep in the central area of the DSTSF. A typical cross-section for the DSTSF is shown in Figure 3.

5.2 Facility Components

The DSTSF is made up of the components outlined in Table 2 and shown in Figures 1.and 2.

Table 2 DSTSF Components

Components	Details
Starter Bench and Drainage Blanket	Located beneath the ultimate slope and crest of the DSTSF, they provide under-drainage beneath the 4H:1V sideslope. This will allow any excess water, whether surface or from the active layer, to drain away and not build up porewater pressures with the tailings.
Finger Drains	Located along the valley lines beneath the tailings stack to intercept and manage existing seepage flows beneath and from the DSTSF, if any.
Tailings Diversion Ditch	Located outside the south and east tailings stack perimeter to divert run on surface water away from the tailings stack.
South Diversion Ditch	Located along the upstream shoulder of the airstrip road to divert upgradient surface water to the Mill Water Pond.
Waste Rock Shell	Located above the starter bench, it accounts for the outside 20 m of the sideslope of the DSTSF. The shell acts as an access road for the placement of the tailings and provides additional stability to the ultimate sideslope.
Tailings Stack	Mechanically placed and compacted tailings
Reclamation Material	Growth medium to be used as cover over the waste rock shell and tailings during reclamation of the DSTSF (not shown on Figure 1)
Instrumentation	Vibrating wire piezometers, ground temperature cables, slope inclinometers, and survey monuments for the monitoring the foundation and sideslope conditions of the DSTSF.

5.3 Basis of Design and Design Criteria

The basis of design and design criteria for the DSTSF can be found in Section 6.0 of the Geotechnical Design Report “Dry” Stack Tailings Facility, Minto Mine, Yukon attached in Appendix A.

5.4 Site Conditions

5.4.1 General Surficial Geology

Boreholes drilled within the plan area of the DSTSF show that overburden thicknesses may range up to 60 m based on exploration drilling. These deposits are thought to be an extension of an infilled valley which also passes through the southern end of the open pit. The overburden soils generally comprise colluvial sediments of silt and sand with trace gravel overlying medium to high plastic clay.

5.4.2 Surface Features

The DSTSF site is located over a gently sloping (about 3° to 10°) terrain, south of the mill buildings and Minto Creek. The terrain steepens to the south and southwest of the DSTSF. The access road to the airstrip bisects these slopes upslope of the DSTSF. The South Diversion Ditch has been constructed along the upstream side of this road (see Figure 1).

The DSTSF area originally had sparse to locally dense tree cover; however, a forest fire in 1995 resulted in areas of fallen trees with deciduous species regrowth.

5.4.3 Subsurface Conditions

Geotechnical investigations from previous projects undertaken by EBA on or near the site indicate that the subsurface conditions generally comprise a thin veneer of peat and vegetation overlying a fine-grained silt or silt and sand overlying medium to high plastic clay overlying coarse-grained sand and weathered bedrock.

The fine-grained sand and silt is believed to be colluvial, the clay is believed to be lacustrine, and the coarser sand is considered to be a residual soil (residuum). Throughout the mine site, these residual soils grade into weathered bedrock.

5.4.4 Groundwater

No groundwater was reported in any of the boreholes drilled within the DSTSF but is expected within the active layer during the summer and fall.

5.4.5 Permafrost

Permafrost underlying the DSTSF typically varies with the stratigraphy. Sand and silt typically contains approximately 10% to 20% excess visible ice. The lacsutrine clay typically contains 10% to 60% ice. Massive ice beds up to 4 m thick were encountered during drilling.

The ground temperature cables installed in and around the DSTSF have shown foundation soil temperatures ranging from -0.5°C to -0.8°C and a typical active layer depth of 2 to 3 m.

5.4.6 Bedrock

Depths to bedrock (granodiorite) are indicated to range up to 80 m based on exploration borings drilled nearby. Weathered bedrock outcrops are present within the vicinity of the airstrip, south of the upper reaches of the DSTSF. There is no exposed bedrock within the DSTSF. The haul road across the Minto Creek valley is cut into residuum, and the bedrock is assumed to be no more than 10 m below ground along the road alignment.

5.5 Climate

No long-term climate data is available from the Minto Mine site. A complete meteorological station was established at the site in September 2005 and data for the station was available up to mid-July 2006 during the design. Snow surveys had been carried out by J. Gibson & Associates in 1994, 1995, 1998, and annually since 2006 at three locations in the Minto Creek area.

The closest meteorological station to the Minto site with a long-term climatic record is Pelly Ranch, which is situated about 40 km northeast of the Minto site. In addition, the Carmacks meteorological station is located about 70 km southeast of the site.

The long-term mean climatic data estimated for the Minto site for the geotechnical design of the DSTSF is summarized in Table 3.

Table 3 Summary of Mean Climatic Conditions at Minto Used in Thermal Analyses

Month	Monthly Air Temperature[(a)] (^oC)	Monthly Wind Speed[(b)] (km/h)	Month-End Snow Cover[(c)] (m)	Daily Solar Radiation[(d)] (W/m^2)
January	-28.2	7.5	0.40	10.2
February	-21.8	8.9	0.43	39.0
March	-12.4	10.0	0.48	102.0
April	-1.1	11.7	0.08	180.7
May	6.3	11.8	0.00	229.9
June	11.7	10.8	0.00	255.4
July	13.8	9.5	0.00	225.8
August	11.2	9.6	0.00	170.1
September	5.0	10.7	0.01	99.1
October	-4.0	11.9	0.10	41.5
November	-17.1	8.9	0.23	14.2
December	-25.0	7.8	0.31	5.3

Notes:

(a) based on Climate Normals 1971-2000 at Pelly Ranch (Environment Canada website), measured mean air temperatures at Carmacks and Pelly Ranch for the period of 1963 to 2004 (Environment Canada website), and Johnston (1981)

(b) based on Climate Normals 1971-2000 for Burwash, Mayo, Watson Lake, and Whitehorse (Environment Canada website)

(c) based on snow depth survey data at Minto and mean month-end snow data at Mayo (Climate Normals 1971-2000, Environment Canada website)

(d) based on Climatic Normals 1951-1980 at Norman Wells and Whitehorse (Environment Canada, 1982)

5.5.1 Temperature

Measured long-term air temperatures are available for both the stations from the National Climate Data and Information Archive operated by Environment Canada (http://www.climate.weatheroffice.ec.gc.ca). Comparison of the measured air temperatures at the two stations for 29 years of the overlapped periods with complete data indicated that the monthly air temperatures at Carmacks are generally warmer than those at Pelly Ranch. The two stations are located at similar elevations (an average of approximately 490 m), which is lower than the toe of the tailings placement area at an elevation of approximately 760 m. Johnston (1981) reported that climatologists typically estimate a 6°C decrease in temperature for every kilometre increase in elevation for mountain slopes. Therefore, the long-term mean monthly air temperatures at the Minto site for the design were first estimated by interpolating the long-term mean monthly air temperatures at Pelly Ranch and Carmacks based on the distances to the Minto site and then adjusted for the temperature change due to the elevation difference of 270 m. Accordingly, the estimated mean annual air temperature at the Minto site is -5.1°C.

The measured air temperatures for the period from early-September 2005 to mid-July 2006 at the Minto site were warmer (about 1°C in long-term mean annual air temperatures) than the estimated long-term mean values. However, the limited short-term measured air temperatures were not sufficient to verify or adjust the estimated long-term mean values used for the design.

5.5.2 Wind

Long-term mean wind speed data are not available at the Pelly Ranch and Carmacks stations. The mean wind speed data for the design was estimated by averaging those from four meteorological stations in the Yukon: Burwash, Mayo, Watson Lake, and Whitehorse (http://www.climate.weatheroffice.ec.gc.ca). Measured wind speed data from the Minto site were available for a short period (September 2005 to July 2006). Comparison of the monthly wind speed data indicated that the estimated wind speeds are similar to the measured during the summer of 2006 and higher than the measured during the winter of 2005.

5.5.3 Snow

Snow depth surveys at the Minto site were conducted in March, April, and May of 1994, 1995, 1998, and annually since 2006. The mean monthly snow depths in March, April, and May for the design were estimated by averaging the measured monthly values. The mean monthly snow depths for the other months were estimated based on the mean monthly snow depths at Mayo and then adjusted for the measured snow depth differences between the two sites between March and May. Mayo, located approximately 120 km northeast of the Minto site, is situated in the same snow-depth contour zone as the Minto site based on the snow depth maps presented in Natural Resources Canada's webpage (http://atlas.nrcan.gc.ca).

5.5.4 Solar Radiation

Norman Wells and Whitehorse are the closest stations to the Minto site (latitude of 62°36') with long-term solar radiation data. Norman Wells (latitude of 65°17') is located about 580 km northeast of the Minto site and Whitehorse (latitude of 60°43') is located about 220 km southeast of the Minto site. The mean monthly solar radiation data at the Minto site for the design were estimated by interpolating the long-term mean monthly solar radiation data at Norman Wells and Whitehorse based on the latitudes of the three sites. Measured solar radiation data were available at the Minto site for the period from September 2005 to July 2006. The measured monthly solar radiation data were similar to the estimated.

5.6 Hydrology

Two hydrologic report documents were reviewed during the design to establish the hydrologic site conditions.

- A memo by Clearwater Consultants Ltd. titled "Memorandum CCL-MC1" dated December 4, 2006.
- A report by Hallam Knight Piésold titled "Minto Creek Surface Hydrology Report" dated November 1994.

Information found in Clearwater 2006 memo tends to address average flows and is intended for use in water balance calculations. The design of any diversion or routing structures should be conducted for a peak instantaneous flow.

Hallam Knight Piésold 1994 is a more comprehensive hydrology report and contains a section on peak instantaneous flows for several return intervals, which are specific to the DSTSF. Data presented in this section is described in more detail in Hallam Knight Piésold 1994.

5.6.1 Hydrological Conditions

A regional analysis was conducted on data presented in Hallam Knight Piesold 1994 to determine the peak instantaneous flow rates for six sub-catchment areas in the DSTSF. These six sub-catchment areas are presented in Figure 4. The peak instantaneous flow rates for the six sub-catchments of the tailings facility are presented in Table 4.

Table 4 Sub-Catchment Area Frequency Analysis

Return Period (years)	Peak Instantaneous Flow Rates (m^3/s)							
	Total West Portion	Lower West	Upper West	Upper Southwest	Total East Portion	Lower East	Upper East	Upper Southeast
2	**0.33**	0.16	0.13	0.17	**0.27**	0.13	0.14	0.11
10	**0.56**	0.27	0.22	0.29	**0.45**	0.22	0.23	0.18
25	**0.69**	0.33	0.27	0.35	**0.56**	0.27	0.28	0.23
50	**0.83**	0.40	0.33	0.43	**0.68**	0.32	0.34	0.28
100	**0.85**	0.41	0.34	0.44	**0.69**	0.33	0.35	0.28
200	**0.91**	0.43	0.36	0.47	**0.74**	0.35	0.37	0.30

5.7 Seismicity

Information regarding seismicity for the Minto Mine was provided by the Canadian Geological Survey Pacific Geosciences Centre. The mine site is characterized as being in Acceleration Zone 3 and Velocity Zone 4. An acceleration of 0.055 g would have a 10% probability of being exceeded in 50 years, which equates to an annual probability of exceedance of 1/475. This probability of exceedance was used in the DSTSF design.

When work was originally undertaken on the mine site in the late 1990s, the Canadian Geological Survey Pacific Geosciences Centre provided a value for the peak horizontal acceleration for the site of 0.15 g (10% probability of being exceeded in 50 years). An updated value for the site has been provided by the Pacific Geosciences Centre and the current peak horizontal acceleration that corresponds to a 10% probability of exceedance in 50 years is 0.055 g. The decrease in the peak ground acceleration provided by the Pacific Geosciences Centre is because seismic data information has increased substantially in the Yukon in recent years. A better understanding of ground motion and improved modelling has resulted in revised predictions, which are considered to be more accurate and representative for the mine site.

5.8 Tailings Characteristics

5.8.1 Tailings Production

The life of mine plan during the design indicated that the total production of tailings would be in the order of 5,517,000 tonnes during the eight year mine life. The anticipated tailings production by year (based on the 2006 Hatch mine plan) is presented in Table 5.

Table 5 Anticipated Tailings Production

Year	Production (tonnes)
1	489,940
2	766,960
3	812,350
4	824,930
5	820,160
6	836,690
7	847,600
8	118,330
Total	**5,516,950**

5.8.2 Tailings Characterization

EBA undertook two separate laboratory programs to evaluate the geotechnical properties of a tailings sample provided by Minto. A summary of the laboratory test results is presented in Table 6.

Table 6 Tailings Laboratory Test Results

Type of Test	Results
Particle Size Distribution	Clay: 6%, Silt: 35%, Sand 59% Clay: 7%, Silt: 36%, Sand 57%
Specific Gravity Determination	Specific gravity of solids: 2.79
Atterberg Limits	Liquid Limit: 23, Plastic Limit: 16, Plasticity Index: 7 Liquid Limit: 20, Plastic Limit: 16, Plasticity Index: 4
Moisture Density Relationship	Optimum moisture content: 17.5%, Maximum Dry Density (MDD), standard effort: 1685 kg/m^3
Constant Head Permeability Test	k = 9.65 x 10^{-8} m/s
Direct Shear Test	Peak Strength: θ´ = 35.1°, c´ = 11 kPa

Note: The above tests report moisture content as a percentage ratio of the mass of water divided by the mass of dry solids, this is consistent with geotechnical engineering practice.

5.8.3 Acid Generation Potential

Results from static ABA testing of tailings solids by Lakefield Research in 1977 (one sample) and 1994 (three samples) indicate that tailings from milling both the higher and lower grade ores will be acid consuming, with NP/AP ratios from 8.15:1 to 19.85:1. This indicates that acid-generation should not be an issue with the tailings material produced.

6.0 REGULATORY REQUIREMENTS

6.1 Regulatory Agencies

The regulatory agencies involved in the operation, maintenance, and surveillance of the DSTSF include:

- **Mineral Development, Energy, Mines and Resources**
  - To the Chief: Director, Mineral Resources, Department of Energy, Mines and Resources, P.O. Box 2703, K-9 Whitehorse, Yukon, Y1A 2C6, (fax) 867.456.3899
- **Yukon Water Board**
  - To the Water Board: Yukon Water Board, Suite 106, 419 Range Road, Whitehorse, Yukon, Y1A 3V1, (fax) 867.456.3890

6.2 Regulatory Approval

The DSTSF is authorized with the following document:

- A letter titled, “Approval of Minto Mine Tailings Management Plan”, dated April 17, 2007.

6.3 Regulatory Requirements

The regulatory requirements for the DSTSF are outlined in the following document:

- A letter titled, “Approval of Minto Mine Tailings Management Plan”, dated April 17, 2007.

7.0 CONSTRUCTION HISTORY

7.1 Design Criteria Based on Operating Data

The design criteria based on operating data for the DSTSF are presented in Table 7.

Table 7 Design Criteria Based on Operating Data

Operating Data	Details
Life of Mine	Dry stack to be complete July 2011
Mill tonnage	Current allowable milling rate 3600 tpd
Operations	365 days per year
Tailings Solids Content	83% by mass has been the target rate
Tailings Characteristics	Particle Size Distribution[1]: 5% clay, 46% silt, 49% sand Specific Gravity Determination: 2.79 Atterberg Limits: Non plastic Moisture Density Relationship[2]: Optimum Moisture Content: 14.4%, Standard Proctor Maximum Dry Density: Average 1800 kg/m^3 Direct Shear Test: Peak Strength: θ´ = 35.1º, c´ = 11 kPa
In situ Tailings Dry Density	1710 kg/m^3 based on 95 % of Maximum Dry Density, standard effort of 1800 kg/m^3 These values change as material properties change and are confirmed at least quarterly. The averages are presented here.

Notes:

1. These results are the average of 21 tests conducted between 2007 and 2010.
2. These results are the average of 14 tests conducted between 2007 and 2010.

7.2 Climate

A complete meteorological station was established at the site in September 2005. Data for the station was available up to mid-July 2006 during the design as were snow surveys that had been carried out by J. Gibson & Associates in 1994, 1995, 1998, and annually since 2006 at three locations in the Minto Creek area.

The closest meteorological station to the Minto site with a long-term climatic record is Pelly Ranch, which is about 40 km northeast of the Minto site. In addition, the Carmacks meteorological station is about 70 km southeast of the site.

The long-term mean climatic data estimated for the Minto site used for this report is summarized in Table 8.

Table 8 Summary of Mean Climatic Conditions at Minto Used in Thermal Analyses

Month	Monthly Air Temperature[(a)] (^oC)	Monthly Wind Speed[(b)] (km/h)	Month-End Snow Cover[(c)] (m)	Daily Solar Radiation[(d)] (W/m^2)
January	-19.1	14.4	0.40	9
February	-15.4	21.6	0.43	40
March	-11.3	13.7	0.48	104
April	0.0	9.7	0.08	185
May	7.6	10.8	0.00	218
June	13.3	9.7	0.00	242
July	15.4	9.4	0.00	218
August	11.8	7.6	0.00	162
September	6.6	7.6	0.01	100
October	-2.5	9.4	0.10	45
November	-13.9	19.4	0.23	13
December	-15.4	14.8	0.31	5

Notes:

(a) based on Climate Normals 1971-2000 at Pelly Ranch (Environment Canada website), measured mean air temperatures at Carmacks and Pelly Ranch for the period of 1963 to 2004 (Environment Canada website), and Johnston (1981)

(b) based on Climate Normals 1971-2000 for Burwash, Mayo, Watson Lake, and Whitehorse (Environment Canada website)

(c) based on snow depth survey data at Minto and mean month-end snow data at Mayo (Climate Normals 1971-2000, Environment Canada website)

(d) based on Climatic Normals 1951-1980 at Norman Wells and Whitehorse (Environment Canada, 1982)

7.3 Tailings Production

The life of mine plan during the design indicated that the total production of tailings would be in the order of 5,517,000 tonnes during the eight-year mine life. The achieved and projected tailings production by year is presented in Table 9.

Table 9 Achieved and Projected Tailings Production

Year	Production (tonnes)
2007	225,850
2008	754,800
2009	970,000
2010	867,900
2011*	572,500
Total	**3,391,050**

* Projected number until June 30, 2011

8.0 OPERATION

8.1 Objective

Operation of the DSTSF comprises ongoing construction of the facility and its related components. Construction of the tailings stack itself occurs daily where as the other DSTSF components, the starter bench and drainage blanket, finger drains, surface water diversion berm and ditches, waste rock shell, instrumentation, and reclamation material, are completed on a specific project basis. The timeline for constructing these components is based on the upcoming year's tailings placement plan. The airstrip road diversion ditch was constructed in 2006. Instrumentation for the west portion of the DSTSF was installed in November 2007.

Operations of the DSTSF must ensure the following:

- The basis of design remains valid and design criteria are being achieved;
- Changes in the mine plan, milling throughput, and filtering operations are accounted for; and
- Construction planning takes into consideration restrictions on availability of construction materials and time of year construction requirements.

The Mine Manager and the Construction Monitors are responsible for overseeing the general construction of the DSTSF with the support of the geotechnical and environmental consultants. The Construction Superintendent is in charge of completing day to day tailings placement and compaction and specific component projects as required.

8.2 DSTSF Construction Plan

8.2.1 Design Life Construction Plan

The ultimate footprint of the DSTSF and the location of its components are presented in Figure 1. Figure 2 shows the instrumentation installed in the waste rock shell and Figure 3 presents the typical cross-sections for the DSTSF.

Based on Phase 2 mill throughput, the ore reserves of the Minto Pit – Optimized Mine Plan, August 2007 will be mined in the second quarter of 2011 and milled by the end of the first quarter of 2012.

8.2.2 Annual Construction Plan

Minto anticipates placing 572,500 dry tonnes of tailings in the DSTSF in 2011. Table 10 details construction completed to date and Minto's plans for the ongoing construction of the DSTSF.

Table 10 Annual Construction Plan

Year	Details
2007	Starter bench and drainage blanket constructed from Sta. 0+000 to 0+415. The 75 mm filter material on the upstream slope is still required from Sta. 0+290 to 0+415. Finger drains within west portion constructed. Tailings placement between Sta. 0+000 to 0+280 south of the drainage blanket.
2008	Ground surface preparation in the winter of 2008 for construction of the starter bench, drainage blanket, finger drains and 2008 tailings placement area. Lifts 1 and 2 of the toe berm were completed. Work resumed on finger drains 1, 2, and 3.
2009	Lifts 3 thru 6 of the toe berm were completed. Construction of finger drains 2 and 3 were completed. A fourth finger drain was added to catch water East of finger drain 3. The diversion ditch was constructed above the DSTSF to catch and convey water away from the DSTSF. The drainage blanket on the Eastern portion of the DSTSF was constructed
2010	Lift 7 of the toe berm was constructed A lined ditch was constructed to convey the water captured in the diversion ditch away from the DSTSF.
2011	Commencement of reclamation efforts. Ongoing review of proposal to place tailings into main pit. Construct Lift 8 of the toe berm. Extend and remediate the diversion ditch above the DSTSF.

8.2.3 Contingency Plan

Daily monitoring and observational approaches are expected to forewarn of potential adverse conditions that may be a result of thaw induced deformation. These include, but are not limited to, excessive tension cracking on the construction surface, visible slope deformation on the downstream sideslope of the waste rock shell, and scarping on the construction surface, and monitoring of instrumentation. These kinds of observations would trigger geotechnical engineering support and increased measurement frequencies of the instrumentation.

Severity triggers are not easily defined, and therefore any conditions and/or trends observed to be uncharacteristic would be handled with urgency to seek a better understanding of risk. Once the risk has been defined, appropriate steps can be engineered and implemented to rectify any nonconformance.

8.3 DSTSF Construction Components

8.3.1 Starter Bench and Drainage Blanket

8.3.1.1 Ground Surface Preparation

Surface preparation within the starter bench and drainage blanket footprint is limited to the sequential flattening and removal of trees. This must be completed in the winter with the standing trees being sheared off just above the ground surface. Minimal disturbance to the ground surface is required to protect the underlying permafrost foundation material. Trees that are removed should be stockpiled (not burnt) and then placed against the toe of the starter bench, for additional permafrost preservation.

8.3.1.2 Material Composition and Placement

The starter bench and drainage blanket are constructed with select waste rock material from the development of the open pit. The drainage blanket is then covered with 75 mm filter material or equivalent to act as a separator between waste rock material and overlying tailings. This material will act as a filter for the tailings and restrict it from infiltrating the coarser waste rock material. The use of a properly bedded heavy-weight nonwoven geotextile may be used in lieu of the 75 mm filter material. The starter bench does not require a filter material as the waste rock shell will be constructed above it, which is comprised of the same waste rock material.

The waste rock material is specified to have a nominal size of 300 mm, and the fines (< 0.080 mm sieve size) content must be less than 5% by weight. The maximum particle size allowed is 1.0 m, or as approved by the Engineer. It should be placed and compacted in maximum 1.5 m lifts. Compaction of this material is achieved by routing heavy equipment (i.e., haul trucks,) evenly over each lift. A minimum of 5 passes is recommended. This material must be placed in a manner that will minimize segregation or nesting of coarse particles. The effectiveness of this construction technique will be evaluated in the field by the Geotechnical Engineer and changes to the construction procedure will be made as required. Boulders greater than 750 mm size should be removed from the fill as much as practically possible and pushed to the slope face.

The 75 mm filter material must be well-graded sand and gravel with a 75 mm maximum aggregate size and a fines content (< 0.080 mm sieve size) limited to 15%. The recommended gradation for the filter material is shown in Table 11, or other materials as approved by the Engineer.

Table 11 Recommended Gradation of 75 MM Filter Material

Sieve Size (mm)	% Passing by Mass
75.0	100
25.0	65 – 100
12.5	50 – 100
5.0	35 – 90
0.825	17 – 50
0.425	10 – 35
0.160	2 – 23
0.080	0 – 15

The 75 mm filter material is to be placed in maximum lift thicknesses of 300 mm, with each lift compacted at existing moisture content to approximately 95% of MDD.

8.3.2 Surface Water Diversion Berms

8.3.2.1 Ground Surface Preparation

Surface preparation within the surface water diversion berm footprint is limited to the sequential flattening and removal of trees. This must be completed in the winter with the standing trees being sheared off just above the ground surface. Minimal disturbance to the ground surface is required to protect the underlying permafrost foundation material. Trees that are removed should be stockpiled (not burnt) outside the berm footprint.

8.3.2.2 Material Composition and Placement

The 200 mm material will be used to construct the surface diversion berms. It must be a well-graded material with a nominal 200 mm maximum aggregate size and a fines content (< 0.080 mm sieve size) limited to about 15%, or as approved by the Engineer.

The 200 mm filter material for surface water diversion berms should be placed in maximum lift thicknesses of 400 mm and each lift compacted to approximately 95% of MDD.

Note that the surface water diversion berm was not constructed to the general specifications provided above and will require modifications to provide surface water diversion for operations as per Section 8.6.

8.3.3 Airstrip Road South Diversion Ditch

The airstrip road diversion ditch was constructed in 2006 and will only require event-driven maintenance throughout the design life of the DSTSF.

8.3.4 Finger Drains

8.3.4.1 Ground Surface Preparation

Surface preparation within the finger drain footprint was limited to the sequential flattening and removal of trees. This was completed in the winter with the standing trees being sheared off just above the ground surface. Minimal disturbance to the ground surface was observed to protect the underlying permafrost foundation material.

8.3.4.2 Material Composition and Placement

The finger drains were constructed with select waste rock material from the development of the open pit and then covered with 75 mm filter material (residuum) which acts as a separator between waste rock material and the overlying tailings. This filter material acts as a filter for the tailings and restricts it from infiltrating the coarser waste rock material.

The finger drain material was selected to promote free draining and is a nominal size of 300 mm. To facilitate proper drainage, the fines (< 0.080 mm sieve size) content was kept to less than less than 5% by weight.

The finger drain material was placed and nominally compacted to ensure rock-on-rock contact, as directed by the Geotechnical Engineer. This material was placed in a manner that minimized segregation or nesting of coarse particles.

The 75 mm filter material was tested and found to be well-graded sand and gravel with a 75 mm maximum aggregate size and a fines content (< 0.080 mm sieve size) limited to 15%. The recommended gradation for the filter material is shown in Table 10 (above).

The 75 mm filter material was placed with a maximum lift thicknesses of 300 mm.

8.3.5 Waste Rock Shell

8.3.5.1 Ground Surface Preparation

Ground surface preparation is not required for the waste rock shell as it is founded on the starter bench.

8.3.5.2 Material Composition and Placement

The waste rock shell is constructed with select waste rock material from the open pit development. A 300 mm layer of 75 mm filter material was placed on the inside of the waste rock shell on the tailings sideslope to act as a separator between waste rock material and tailings. This filter material will act as a filter for the tailings and restrict it from infiltrating the coarser waste rock material.

The waste rock material as specified has a nominal size of 300 mm, with the fines (< 0.080 mm sieve size) content being less than 5% by weight. The maximum particle size is less than 1.0 m. Compaction of this material was achieved by routing heavy equipment (i.e., haul trucks,) evenly over each lift. This material was placed in a manner that minimized segregation or nesting of coarse particles.

The 75 mm filter material used is well-graded sand and gravel with a 75 mm maximum aggregate size and a fines content (< 0.080 mm sieve size) limited to 15%. The recommended gradation for the filter material is shown in Table 10 (above), or other materials as approved by the Engineer.

The 75 mm filter material should be placed in maximum lift thicknesses of 300 mm.

8.3.6 Tailings Stack

8.3.6.1 Ground Surface Preparation

Surface preparation within the tailings footprint, excluding the drainage blanket area, was limited to the sequential flattening of trees. This was completed in the winter with the standing trees being sheared off just above the ground surface. Minimal disturbance to the ground surface was adhered to in order to protect the underlying permafrost foundation material.

8.3.6.2 Material Composition and Placement

The composition of the tailings is subject to the milling and filtering processes. Milling operations, particularly the ore crushing and grinding system, are not subject to dramatic changes; therefore, the particle size distribution of the tailings is fairly consistent. Any planned changes to the grinding will continue to be monitored closely against tailings particle size distribution, moisture content, and compaction performance. The filter system is to produce the dry stack tailings to have a solids content of 83% for the solid-water mixture when delivered to the DSTSF.

The tailings should be placed in maximum lift thicknesses of 500 mm and should be adjusted based on the condition of the material and the size of the packer being used. Each lift is to be compacted to no less than 95% of MDD.

8.3.7 Reclamation Material

8.3.7.1 Ground Surface Preparation

No ground surface preparation is required prior to the placement of the reclamation material.

8.3.7.2 Material Composition and Placement

The reclamation material will comprise select overburden material sourced during open pit development. It must provide a suitable growth medium for revegetation. Some reclamation material to be used for progressive reclamation of the DSTSF is currently stockpiled between the ore stockpiles and the exploration camp on the downstream slope of the Airstrip Road.

8.4 Equipment Used for Construction

The mining contractor, Pelly Construction, will provide the necessary tools for all aspects of construction to achieve the design criteria of DSTSF. Table 12 lists typical equipment employed in the construction of the DSTSF.

Table 12 Construction equipment

Unit	Use
Cat 990 Wheel Loader	Loading tailings from stockpile at the tailings filter building into the haul truck
Cat D6 LGP Dozer	Spreading of construction material and construction of components
Cat 740 Articulated Rock Truck	Hauling tailings from stockpile to the DSTSF
Cat 773 Rock Truck	Hauling waste rock, 75 mm filter material, 200 mm material and reclamation material to the DSTSF
Cat 573 Packer	Packing placed tailings to achieve design criteria
Cat 14G/16G Grader	Clearing and leveling lifts for general erosion control and snow removal

8.5 Adverse Operating Conditions

Potentially adverse conditions must be accounted for in the operation of the DSTSF. These conditions, along with mitigative measures of dealing with them, are as follows.

- High Rainfall
  - Erosion control – grade control and compaction of tailings stack during construction to seal lifts and prevent pooling of water.
  - Compaction – may require drying out material prior to achieving compaction. At the discretion of the Geotechnical Engineer, material requiring additional compactive effort will be moved to less critical areas of the DSTSF; i.e. south portion of the placement area away from the ultimate tailings slope, if required.
- High snow accumulation
  - Removal prior to lift placements.
  - Snow dumps will be sited to minimize any erosional impacts during thaw conditions.

- Freezing temperatures
  - Location of placement – south portion of placement area away from the ultimate tailings slope as compaction prior to freezing problematic.
  - Compaction – must be completed prior to the tailings freezing
- Tailings Characteristics (higher moisture)
  - Location of placement – south portion of placement area away from the ultimate tailings slope
  - Compaction – may require drying out material prior to achieving compaction. At the discretion of the Geotechnical Engineer, material requiring additional compactive effort will be moved to less critical areas of the DSTSF; i.e. south portion of the placement area away from the ultimate tailings slope, if required.

8.6 Surface Water Management

Run-on surface water entering the DSTSF is managed through the construction of the surface water diversion berm and the Airstrip Road diversion ditch.

Surface water within the DSTSF is managed with the construction of a starter bench, drainage blanket, and finger drains, and ensuring the tailings stack is graded to reduce the potential of surface erosion and direct any surface water to areas in which it can drain away from the facility.

Any surface water that does enter the DSTSF is directed towards the toe berm where it is then pumped on top of the waste rock shell and allowed to filter through the residuum layer beneath. In doing so, all water will report to the, not yet constructed, sump where it will be pumped up to the WTP.

As part of the efforts to reduce surface runoff from entering the DSTSF, Minto will be upgrading and extending the current Tailings Diversion Ditch, to south of the DSTSF. Completion of construction is expected before freshet 2011.

8.7 Environmental Protection

It is every employee's responsibility to report a suspected spill or uncontrolled release event to their supervisor. This includes suspicious flows of water out of the area, escaping tailings, turbid creek water, etc. The significance of multiple sets of eyes is that time plays a critical role in mitigating an emergency situation. The sooner appropriate persons can begin to correct a situation, the less likely it is that severe effects will follow.

Given that the tailings are placed in an unsaturated state and filter materials are a part of the design to restrict the tailings from transport, it is not likely that any tailings will be released from the DSTSF. Although unlikely, any tailings that are released from the DSTSF would eventually report to the pond above the Water Retention Dam.

8.8 Health, Safety, and Security

The Minto Mine is located in a remote setting approximately 240 km northwest of Whitehorse and is accessed either by land via the North Klondike highway and the radio controlled Minto access road or by air. Access by land requires crossing the Yukon River; this is completed by barge in the summer and ice road in the winter. For a short time in the spring and fall, land access is not possible because neither the ice road nor barge is available for use. The mine site is not subject to general public traffic.

Access roads from the mill site to and around the DSTSF are shown on Figure 1.

Established communication throughout the mine site and the DSTSF consists of a VHF radio.

All personnel working at the DSTSF, including contractors, are to have an appropriate understanding of the OMS manual and their respective roles and responsibilities. It is the role of the specific supervisor of the personnel to ensure this is the case. In addition to the general understanding of the OMS manual, it is the responsibility of all personnel involved in the construction of the DSTFS to be continually vigilant of changes reflecting facility performance. Anything observed to be outside of normal operating parameters, as outlined in this manual, are to be reported immediately to the Mine Manager.

The tailings materials themselves contain trace amounts of reagents added in the milling process. These reagents include, but may not be limited to, Flomin F500 (frother), AE4270 (polymer), AE4330 (polymer) and C3505 (better known as PAX). As a general precaution, it is recommended that any worker handling or coming into contact with the tailings wash there hands prior to ingesting any food. Further information regarding these reagents is available in the MSDS compilations found around site and in the Mine Manager’s office.

Workplace safe operating procedures will be in place for those working in the area.

8.9 Documentation

Table 13 identifies the overall responsibilities for operational record keeping completed by Minto personnel:

Table 13 DSTSF Operations Documentation

Task	Responsible Party	Information Recipients
Daily Dry Tailings Production	Completed by Mill Operations –under Mill Superintendent	Mine Manager – copy; Minto Mill Engineering Server
Daily Construction Activity	Construction Superintendent	Mine Manager – copy; Original with Pelly Construction
Daily Check Sheet	Completed by Construction Monitor	Mine Manager – copy; Minto Mine Engineering Server
Monthly Placement As built	Completed by Construction Monitor	Mine Manager – copy; Minto Mine Engineering Server
Instrumentation Data	Completed by Construction Monitor	Mine Manager – copy; Minto Mine Engineering Server
Construction Photographs	Completed by Construction Monitor	Mine Manager – copy; Minto Mine Engineering Server

All consultants' reports are retained in the Mine Manager's files. Consultants' reports include, but are not limited to:

- Particle size distribution testing for construction materials;
- Moisture density relationship testing for construction materials;
- Density testing on placed tailings; and
- Water quality monitoring.

8.10 Reporting

Any observations through the daily monitoring of the facility that identify significant change in the condition of the facility, or that the design criteria are not being achieved should be reported to the Mine Manager, the facility designer, and the geotechnical consultant. This includes the Tailings Diversion Ditch and the Waste Rock Shell.

Changes to the ongoing operations of the DSTSF should be reported to the facility designer and the geotechnical consultant.

Any environmental changes to the DSTSF should be reported to the Environment department and the General Manager.

9.0 MAINTENANCE

9.1 Objective

The objective of the maintenance program is to maintain the DSTSF in accordance with all the performance criteria, legislative requirements, Minto company standards, and sound operating practices.

Maintenance for the DSTSF is limited to the heavy equipment used for the ongoing construction and the DSTSF components themselves. Maintenance of the heavy equipment could consist of routine, predictive, and event-driven maintenance and will be managed by the Construction Superintendent. Maintenance for the DSTSF components is strictly event-driven maintenance and will result from inspections completed by the Construction Monitor, Mine Manager, or the geotechnical consultant.

9.2 Maintenance Procedures

A preventive maintenance program is in place for the heavy equipment used by the contractor at the DSTSF under the direction of the Construction Superintendent. This program is the direct responsibility of the contractor. Event-driven maintenance for the heavy equipment would be due to breakdowns or incidents. Whether a piece of equipment is down due to preventive, routine, or event-driven maintenance, other equipment on site can be made available for use at the DSTSF as required.

Event-driven maintenance to the DSTSF components will be directed by the Construction Monitor or Mine Manager under the consultation of the facility designer and geotechnical consultant. The actual maintenance program completed will depend on the severity of the occurrence.

9.3 Documentation

Record keeping and documentation of any heavy equipment maintenance is the responsibility of the Construction Superintendent.

Event-driven maintenance for a DSTSF component is the responsibility of the Construction Monitor. It involves completing inspection reports and, depending on the severity of the event, may involve the geotechnical consultant. Documentation of any maintenance completed will be used to assess the performance of the specific component and determine whether the design, operation, or surveillance of that component must be adjusted.

9.4 Reporting

Reporting of any heavy equipment maintenance is limited to a specific request by the Mine Manager to the Construction Superintendent.

Inspection reports and any other documentation regarding event-driven maintenance for a DSTSF component should be submitted to the facility designer and geotechnical consultant to determine whether any adjustments to the design, operation, or surveillance are required.

10.0 SURVEILLANCE

10.1 Objective

Surveillance involves inspection and monitoring of the operation, structural integrity, and safety of a DSTSF, and must be consistent with the life cycle and regulatory requirements of the facility. Surveillance of the DSTSF consists of both routine and event-driven activities.

Key surveillance parameters and procedures must be identified for:

- Monitoring the operation, safety, and environmental performance of the DSTSF;
- Promptly identifying and evaluating deviations from expected behaviour that affect operation safety, structural integrity, and environmental performance of the facility; and
- Reporting significant observations for response.

The DSTSF surveillance program will continue to evolve as the facility changes in design or performance criteria, site conditions and/or the operation it is accommodating.

All personnel working at the DSTSF will be involved in surveillance as a routine part of daily activities, maintaining visual awareness of the facility in the course of their regular and/or routine duties, in addition to surveillance-specific site engineering, instrument monitoring, analysis, inspection, periodic review and oversight.

Regular inspections assisted by the eyes of all site personnel ensures continued integrity and performance of the facility. Outside consultants will also be on site periodically inspecting the facility as part of a regular program of expert review.

10.2 Responsibility

A number of personnel conduct routine inspections of the DSTSF. The Construction Monitor, or designated replacement, is assigned the responsibility of obtaining the monitoring information and preparing a monthly report for the facility designer and geotechnical consultant to review.

10.3 Surveillance Parameters

Key parameters of surveillance are identified through identifying and describing potential failure modes of the DSTSF.

Visual observations of the DSTSF can indicate potential failure modes such as:

- Surface – cracking, bulging, depressions, sink holes;
- Seepage – new seepage areas, changes in seepage areas;
- Turbid water in the natural drainages around or downstream of the facility;
- Water or tailings flowing down the stack indicating improper grading; and
- A failure or breach of a component of the facility.

Routine monitoring for ensuring facility performance include:

- Checking for settlement or holes in embankment crest or benches;
- Checking for holes on the surface of the tailings indicating possible piping of material to outside;
- Measuring piezometer pore pressures in the foundation soils during operation;
- Measuring ground temperatures using cables in the foundation soils during operation;
- Surveying DSTSF components – displacements of waste rock shell and/or survey monuments;
- Water sampling of Minto Creek – quality in surrounding and downstream Minto Creek; and
- Recording weather conditions.

These parameters are further described in the following sections.

10.4 Surveillance Procedures

Table 14 summarizes surveillance requirements for the components of the DSTSF as detailed in Minto's letter "QML-0001 – Minto Mine Tailings Management Plan, Additional Information" dated March 15, 2007. These surveillance requirements are the licensed monitoring requirements and conditions regarding the tailings presented in Minto's Quartz Mining and Water Use licences.

Table 14 Operational Monitoring Schedule for DSTSF

Frequency	Provision	Source/Location	Personnel	Scope	Deliverable
Periodically During Construction	EBA Design Report and Quality Assurance Program	Entire Facility	Engineering Supervision	Follow monitoring and inspection procedures in Quality Assurance Program	Interim Reporting to Site Management with recommendations for construction process
Daily	WUL Application Table 10.2 – Operational Monitoring Program	Structure of the tailings (toe, dam, tailings, etc.)	Operational personnel	Visual assessment of tailings, diversion ditches, dam, diversion berms, finger drains, condition of Minto Valley directly below the DSTSF	Daily Log, included in annual report.
Weekly	WUL Application – 5.2.9(d)	Tailings final runoff	Operational personnel	Visual inspection for suspended solids and erosion evidence, at W-8 and W-8A	Weekly, included in annual report.
Weekly	WUL Application – 5.2.9(e)	Diversion ditches	Operational personnel	Visual inspection for failures (possible or occurring) with more frequent checks during spring breakup period	Weekly, included in annual report.
Daily	WUL – Section 66 and WUL Application 5.2.9(a)	Tailings Material	Operational personnel	Record tailings moisture content	Daily Log, included in annual report.
Daily	WUL Appendix 6 ABA Test Program	Tailings Solids ABA Testing	Operational Personnel	Split a 200-500 g sample from the daily 24-dried, metallurgical composite sample and retain in a plastic bag	Send a composite sample once per month to an accredited laboratory, as per Appendix C – evaluate results
Weekly	EBA Update Report	Slope Inclinometers	Operational Personnel (Engineer review)	Record readings and submit to Engineer for review	Results included in annual report.
Monthly (May – Oct) Monthly (Nov – Apr)	EBA Design Report	Vibrating Wire Piezometer	Operational Personnel (Engineer review)	Record readings and submit to Engineer for review	Results included in annual report.

Table 14 Operational Monitoring Schedule for DSTSF

Frequency	Provision	Source/Location	Personnel	Scope	Deliverable
Monthly	EBA Design Report	Ground Temperature Cable	Operational Personnel (Engineer review)	Record readings and submit to Engineer for review	Results included in annual report.
Monthly	EBA Design Report	Settlement Monument Survey	Qualified Surveyor (Engineer review)	Record elevations and submit to Engineer for review	Results included in annual report.
Monthly	EBA Design Report	Tailings Deposit	Operational Personnel	Confirm design moisture content density is being achieved	Results included in annual report.
Monthly	WUL Application Table 10.2 – Operational Monitoring Program	Tailings Seepage	Operational Personnel	Sample and lab analysis of tailings supernatant, inspect for seepage, estimate flow – at W8 regular sampling location	Representative samples shall be collected for laboratory analyses according to Set A[1] requirements outlined in the WUL.[2]
Quarterly	WUL Application 5.3.5 and License Appendix 6 ABA Test Program	Pit and Borrow Sources	Operational Personnel	ABA sampling and testing of potential material to be used for the construction of the starter bench/access road	Non-acid-generating material will be used as construction material for the tailings deposition area.[2]
Bi-annually (on or about June 1 and November 1)	WUL Application – 5.2.9(b)	Tailings Disposal Basin	Qualified surveyor	A surface profile of the tailings along the centre line of the tailings disposal basin	Map and written description of profile.[2]
Annually	QML – Section 9.3.2	Tailings Disposal Basin	Professional engineer licensed to practice in the Yukon	Thorough visual assessment and physical inspection of the tailings, review of monitoring data to confirm design assumptions, preparation of inspection report	Representative samples shall be collected for laboratory analyses of grain size distribution, densities and moisture content.[2] Submission of inspection report.

Table 14 Operational Monitoring Schedule for DSTSF

Frequency	Provision	Source/Location	Personnel	Scope	Deliverable
Annually	WUL – Section 67 and WUL Application 5.2.9(c)	Centreline of Tailings	Operational personnel	Full depth of tailings will be sampled at four stations along the centreline.	Samples will be checked in the field for the presence of frozen tailings. Screen analyses will be done in the laboratory as a check on the homogeneity of the tailings and densities and moisture contents will be determined.[2]

Notes:

[1] Set A - water quality analysis includes physical parameters, anions, nutrients, dissolved metals, total metals, and total suspended solids (Table 10.2 - WUL Application)

[2] All results from the operation monitoring schedule will be included in the annual report to the Water Board

10.5 Adaptive Management

Fundamental to successful adaptive management of the tailings production, handling and placement are triggers for management action. If the tailings handling and deposition is not meeting critical performance objectives according to specific conditions within either the WUL or the QML, the Mine Manager will be expected to follow Table 15 for appropriate corrective action. Close monitoring of the performance of the DSTSF will be critical in determining if and when action will be required.

Table 15 Triggers and Actions under Adaptive Management for Tailings Management

Provision	Monitored Item	Triggers/Thresholds	Action
EBA Nov. 2010	Inclinometers	Acceleration of Movement	▪ Engineer will review existing inclinometer data ▪ Engineer will conduct a site visit and determine if tailings placement and/or construction plan requires modification ▪ Monitoring and review will be increased to daily until determined unnecessary. ▪ Engineer will determine if additional instrumentation is required. ▪ Engineer will complete analysis of mitigative measures should exceedance continue.

EBA March 2007	Vibrating Wire Piezometers DSP-3A, DSP-3B, DSP-4A, DSP-4B	Tip @ 1.0 or 1.7 m depth - Porewater pressure parameter (Ru) exceeds 0.4	▪ Engineer will review existing piezometer data ▪ Engineer will conduct a site visit and determine if tailings placement and/or construction plan requires modification ▪ Monitoring and review will be increased to daily until determined unnecessary. ▪ Engineer will determine if additional instrumentation is required. ▪ Engineer will complete analysis of mitigative measures should exceedance continue.
EBA March 2007	Ground Temperature Cables DST-3, DST-4, DST-6, DST-7	Temperature > 0°C at 1.5 m depth	▪ Engineer will review temperature data.
EBA March 2007	Ground Temperature Cables DST-3, DST-4, DST-6, DST-7	Temperature > 0°C at 2.0 m depth and greater	▪ Engineer will review existing temperature data ▪ Engineer will conduct a site visit and determine if tailings placement and/or construction plan requires modification ▪ Engineer will determine if additional instrumentation or analysis is required. ▪ Engineer will complete analysis of mitigative measures should exceedance continue. ▪ Minto to complete survey of area of interest to monitor any future displacement, if any.
EBA March 2007	Survey Monuments DSSH-1, -2, -5 to -12	Displacements between 150 and 500 mm in any direction	▪ Engineer will review survey data. ▪ Monitoring and review will be increased to bi-weekly until determined unnecessary. ▪ Minto to complete survey of area of interest to monitor any future displacement, if any. ▪ Engineer will determine if tailings placement and/or construction plan requires modification. ▪ Engineer will determine if additional instrumentation is required.

EBA March 2007	Survey Monuments DSSH-1, -2, -5 to -12	Displacements greater than 500 mm in any direction	▪ Engineer will review existing piezometer, temperature, and survey data. ▪ Engineer will conduct a site visit and determine if tailings placement and/or construction plan requires modification. ▪ Monitoring and review will be increased to semi-weekly until determined unnecessary. ▪ Minto to complete survey of area of interest to monitor any future displacement, if any. ▪ Engineer will determine if additional instrumentation is required. ▪ Engineer will complete analysis of mitigative measures should exceedance continue.
WUL – clause 47, revised for new tailings specification	Tailings Material Moisture Content	If tailings are less than 82% solids by weight	▪ Evaluate filter operations to determine methods to increase efficiency in collecting water from mill slurry
WUL Physical Monitoring Program	Diversion Ditches	Presence of abnormal cracking or failure	▪ Report to mine managers, take corrective action as required
None	Tailings Runoff	Visible turbidity in runoff and/or excessive erosion evidence	▪ Address runoff at source ▪ Apply appropriate runoff, erosion or sediment control measures
WUL Appendix 6 – ABA Test Program	Tailings Solids	ARD potential is indicated	▪ Expand monitoring program ▪ Conduct study of options to minimize acid generation
WUL Application S.5.3.5	Pit and Borrow Sources (Construction Material)	ARD potential is indicated	▪ Change source material and use material without ARD potential
WUL Application - Section 5.2.10 (b)	Tailings Surface Elevation	Survey indicates >3 m/season tailings placement	▪ Stop tailings placement in that area. ▪ EBA review ground temperature data and assess permafrost development.
		EBA determines not sufficient freezing in area with >3 m/y placement	▪ Regrade and compact tailings to comply with maximum of 3.0 m depth criteria. ▪ Re-survey/regrade/compact until tailings depth meets criteria.
WUL Application - Section 5.2.10 (c)	Tailings Cores along Centreline	Tailings core characteristics not consistent with EBA's Design Report thermal modeling	▪ Re-evaluate thermal model against existing conditions. ▪ EBA to re-assess implications to stability.

10.6 Documentation

Routine reporting of surveillance results is essential to provide time to make adjustments to existing systems or to initiate Emergency Response Plans. It is imperative that any unusual information (outliers) gathered from these undertakings be communicated to the facility designer, geotechnical and/or environmental consultant.

Document control is vital to ensuring the ongoing performance of the facility. The topic was presented in Section 3.0.

Table 16 identifies the overall responsibilities for surveillance record keeping:

Table 16 DSTSF Surveillance Documentation

Task	Responsible Party	Information Recipients
Weekly Check Sheet	Completed by Construction Monitor	Mine Manager – copy; Minto Mine Engineering Server
Monthly Placement As-built	Completed by Construction Monitor	Mine Manager – copy; Minto Mine Engineering Server EBA – copy
Instrumentation Data	Completed by Construction Monitor	Mine Manager – copy; Minto Mine Engineering Server EBA - copy
Construction Photographs	Completed by Construction Monitor	Mine Manager – copy; Minto Mine Engineering Server
ABA Testing	Completed by Geology Dept	Mine Manager – copy; Minto Mine Engineering Server
Water Quality Monitoring	Completed by Environmental Consultant	Mine Manager and Yukon Water Board Original reports located with Manager of Regulatory and Corporate Affairs

10.7 Reporting

Observation of any unusual occurrence should be reported immediately to the Mine Manager, facility designer, geotechnical, and/or environmental consultant. Unusual occurrences include but are not limited to the following:

- Triggers/Thresholds outlined in Table 14;
- Any seismic event;
- Settlement, cracks or slumping of the tailings stack;
- Slope failure of any of the slopes;
- Abnormal seepage from any of the slopes;
- Increased or high turbidity flow from the finger drains; and
- Damage to any component of the DSTSF.

All reports are to be maintained by the Mine Manager and filed in a suitable format and location for easy access by authorized mine personnel, and for review by government agencies. Annual performance reviews will be copied to the regulatory agencies.

The requirements of the consulting geotechnical engineer, other departments, or governmental agencies may dictate certain items that require inspection, monitoring, or reporting.

11.0 EMERGENCY PLANNING AND RESPONSE

11.1 Minto Emergency Procedures

The mine site has established procedures and response plans detailing in the following reports:

- A report by Minto entitled "Minto Project Spill Contingency Plan", submitted for the Type A Water Use License 1996, updated regularly and submitted with the QZ96-006 Annual Report.
- MSDS documentation for any material used within the DSTSF.

These documents provide the detailed plans on actions to be taken in case of an emergency. They also provide notification procedures.

11.2 DSTSF Emergency Procedures

Daily visual and routine instrumentation monitoring programs outlined in Tables 13 and 14 are expected to forewarn of potential adverse conditions to the DSTSF. Triggers/Thresholds presented in Table 14 must be adhered to and reported on as outlined.

The DSTSF has been designed to maintain its structural integrity throughout its operational life; however, a number of conditions can affect the performance of the DSTSF.

11.3 Environmental Emergencies

Environmental emergencies of various natures and their specific response procedures are outlined in the Minto Project Spill Contingency Plan. This document includes immediate response procedures and follow up and notification measures appropriate to the particular nature of the emergency.

11.4 Key Contacts

11.4.1 Minto Contacts

General Number		Phone: 604.759.0860 Fax: 604.759.0861
Chief Engineer:	Jason Nickel	Local 453 Cell: 250.574.1897
Construction Monitor:	Barry Perreault	Local 442
Environment Manager:	Colleen Roche	Local 462 Cell: 778.908.6463

11.4.2 Facility Designer and Geotechnical Consultant

EBA, A Tetra Tech Company – Whitehorse

General Numbers:		Phone: 867.668.3068 Fax: 867.668.4349
Project Manager:	Brian Cutts	Work: 250.505.4467
Project Director:	Richard Trimble	Work: 867.668.2071 x222 Cell: 867.334.1640

11.4.3 Regulatory Agencies

Yukon Government – EMR, Mineral Resources Branch Contact: Joe Hanrath	Phone: 867.456.3884 Fax: 867.667.3193
Yukon Water Board Contact: Carola Scheu, Manager	Phone: 867.456.3980

11.4.4 Local Authorities

RCMP / Fire / Ambulance – Carmacks	911

11.4.5 Climatological Information

Environment Canada Weather office (weather forecasts): http://weatheroffice.ec.gc.ca/canada_e.html

Earthquakes Canada (earthquake information): http://earthquakescanada.nrcan.gc.ca/index-eng.php

FIGURES

Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 001 Dry Stack Tailings\OMS Manual\OMS Manual 2011 Figs.1-4.dwg [FIGURE 1] January 25, 2011 - 4:06:52 pm (BY: BUCHAN, CAMERON)

LEGEND

⊕ BOREHOLES LIMITED TO DSTSF AREA
⊕ INCLINOMETERS LIMITED TO DSTSF AREA
▲ SURVEY HUBS LIMITED TO DSTSF AREA
● GROUND TEMPERATURE CABLES LIMITED TO DSTSF AREA
■ PIEZOMETERS LIMITED TO DSTSF AREA
✚ TESTPITS LIMITED TO DSTSF AREA
⊕ EXPLORATION BOREHOLES LIMITED TO DSTSF AREA

▨ WASTE ROCK
🟥 STOCKPILE
🟩 STOCKPILE
🟧 LAYDOWN
⬜ PLACED TAILINGS TO DECEMBER 2010
🟫 SURFACE DIVERSION BERMS

NOTES :

1. 3m INTERMEDIATE AND 15m INDEX CONTOURS BASED ON APRIL SURVEY DATA PROVIDED BY MINTO AND PRE-DEVELOPMENT 2 m CONTOUR DATA.
2. OVERBURDEN SOILS WERE NOT LOGGED IN EXPLORATION BOREHOLES.

PLAN

0 250

Scale: 1: 7 500 (metres)

STATUS
ISSUED FOR USE

CLIENT

MINTO EXPLORATIONS LTD.

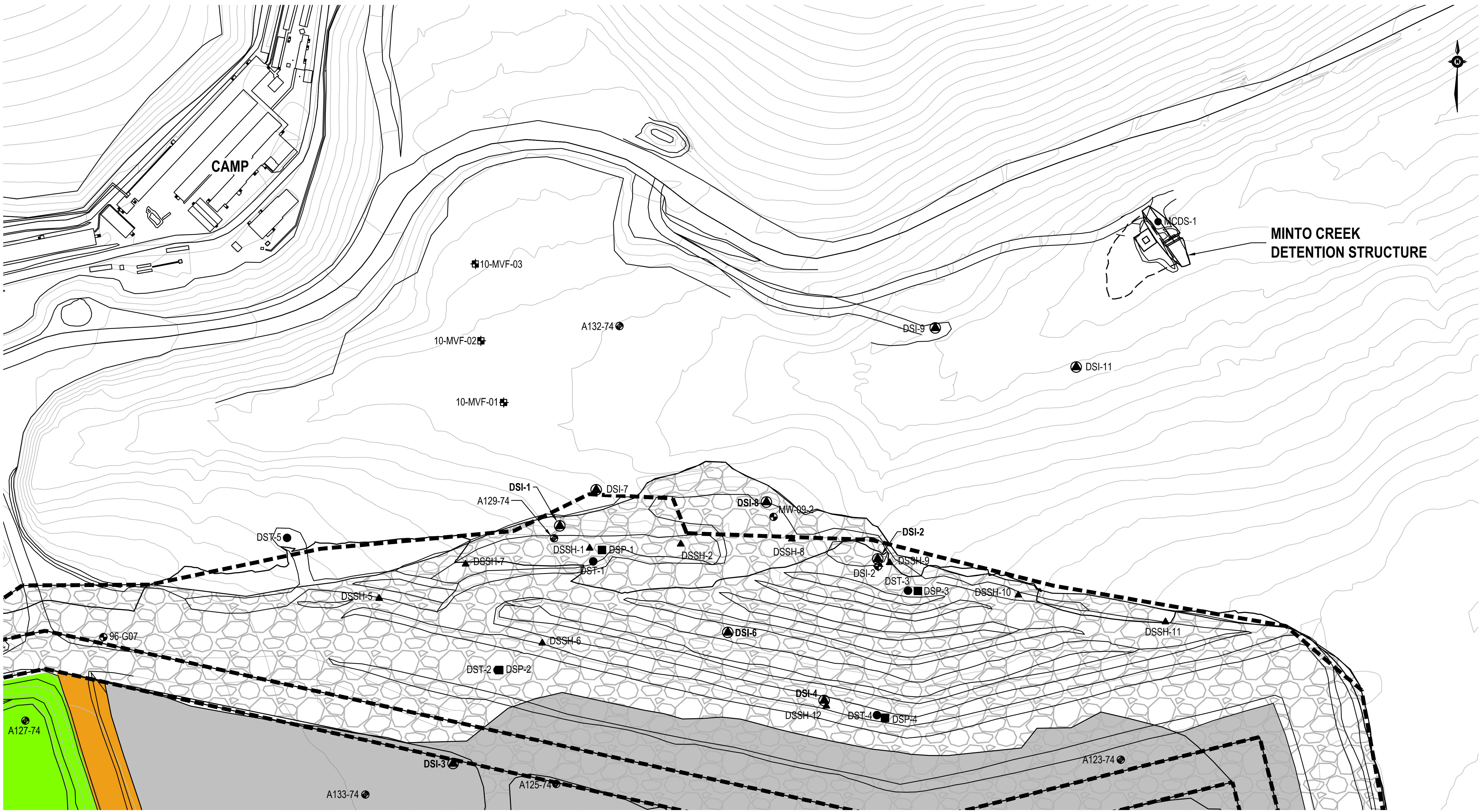
A TETRA TECH COMPANY

OMS MANUAL - DRY STACK TAILINGS STORAGE FACILITY - MINTO MINE, YUKON

OVERALL SITE PLAN

PROJECT NO.	DWN	CKD	REV
W14101068.001	CB	JGD	0
OFFICE	DATE		
EBA-WHSE	January 20, 2011		

Figure 1



LEGEND

- ⊕ BOREHOLES LIMITED TO DSTSF AREA
- ▲ INCLINOMETERS LIMITED TO DSTSF AREA
- ▲ SURVEY HUBS LIMITED TO DSTSF AREA
- ● GROUND TEMPERATURE CABLES LIMITED TO DSTSF AREA
- ■ PIEZOMETERS LIMITED TO DSTSF AREA
- ✚ TESTPITS LIMITED TO DSTSF AREA
- ⊕ EXPLORATION BOREHOLES LIMITED TO DSTSF AREA

- ▨ WASTE ROCK
- 🟥 STOCKPILE
- 🟩 STOCKPILE
- 🟧 LAYDOWN
- ⬜ PLACED TAILINGS
- 🟫 SURFACE DIVERSION BERMS

NOTES :

1. 3m INTERMEDIATE AND 15m INDEX CONTOURS BASED ON APRIL SURVEY DATA PROVIDED BY MINTO AND PRE-DEVELOPMENT 2 m CONTOUR DATA.
2. OVERBURDEN SOILS WERE NOT LOGGED IN EXPLORATION BOREHOLES.

PLAN

0 100
Scale: 1: 2 000 (metres)

STATUS
ISSUED FOR USE

CLIENT
MINTO EXPLORATIONS LTD.

eba
A TETRA TECH COMPANY

OMS MANUAL - DRY STACK TAILINGS STORAGE FACILITY - MINTO MINE, YUKON

SITE PLAN SHOWING INSTRUMENTATION

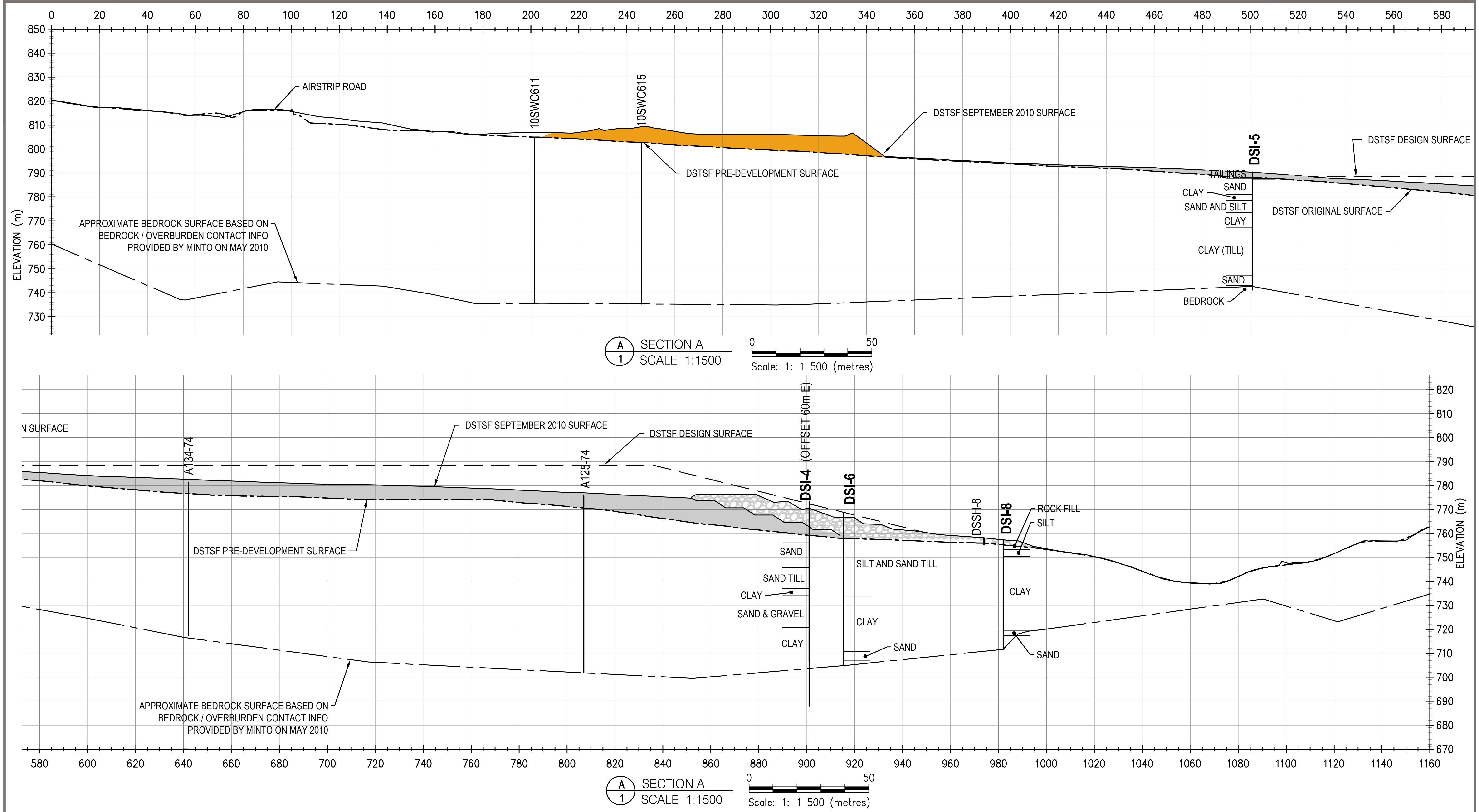
PROJECT NO.	DWN	CKD	REV
W14101068.001	CB	JGD	0

OFFICE
EBA-WHSE

DATE
January 20, 2011

Figure 2

Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 001 Dry Stack Tailings\OMS Manual\OMS Manual 2011 Figs.1-4.dwg [FIGURE 3] January 25, 2011 - 4:07:38 pm (BY: BUCHAN, CAMERON)



LEGEND

▨ PLACED TAILINGS TO DECEMBER 2010

🟧 LAYDOWN

▨ WASTE ROCK

NOTES :

- PRE-DEVELOPMENT SURFACE DERIVED FROM 2m CONTOUR DATA FROM AIR PHOTO INTERPRETATION
- BEDROCK ELEVATION DATA DERIVED FROM GEOTECHNICAL AND EXPLORATION BOREHOLE DATA

STATUS
ISSUED FOR USE

CLIENT
MINTO EXPLORATIONS LTD.

A TETRA TECH COMPANY

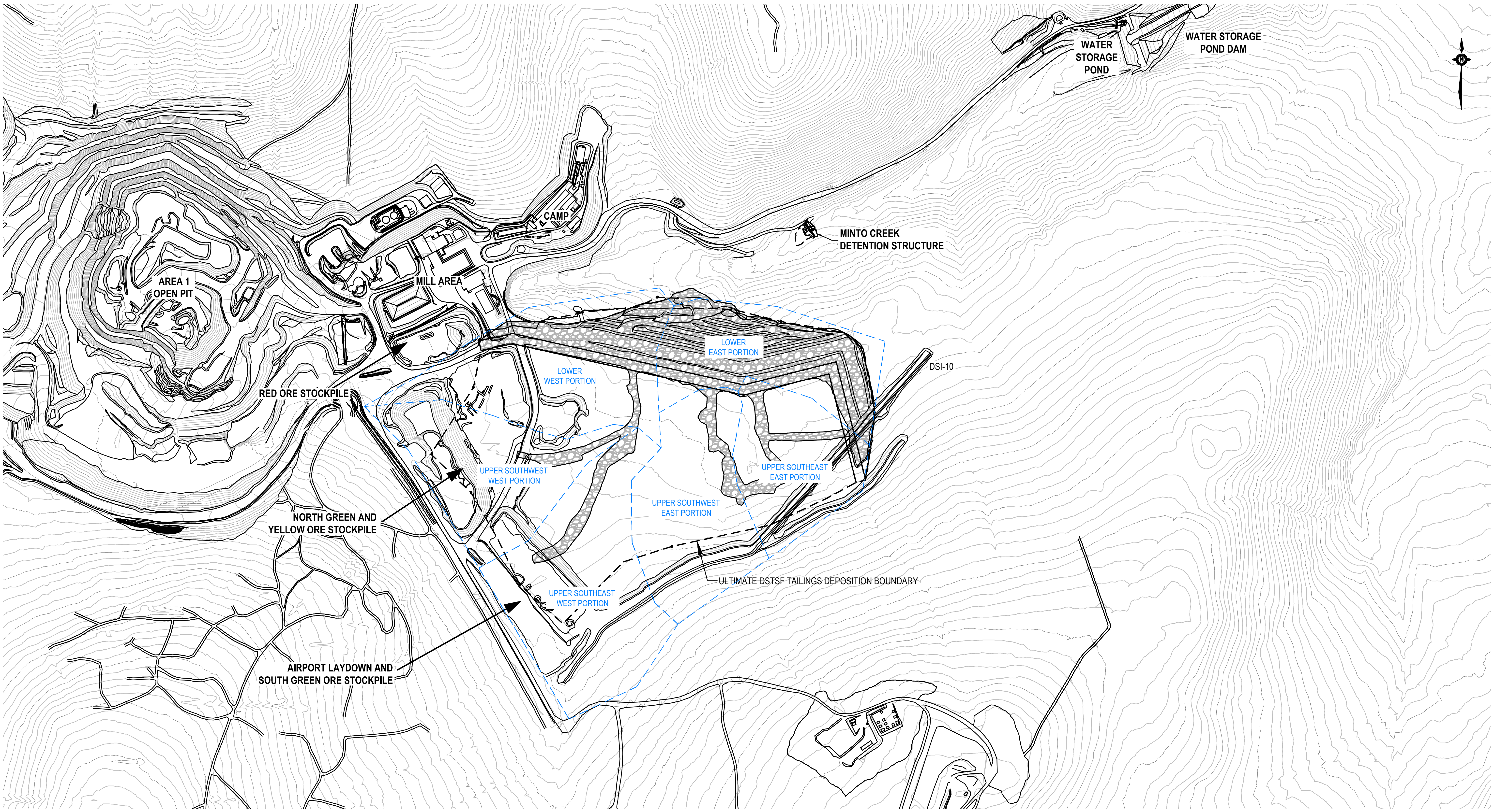
OMS MANUAL - DRY STACK TAILINGS STORAGE FACILITY - MINTO MINE, YUKON

SECTION A

PROJECT NO.	DWN	CKD	REV
W14101068.001	CB	JGD	0

OFFICE	DATE
EBA-WHSE	January 20, 2011

Figure 3



LEGEND

▨ FINGER DRAIN SUB-CATCHMENT LOCATION

PLAN

0 250

Scale: 1: 7 500 (metres)

NOTES :

1. 3m INTERMEDIATE AND 15m INDEX CONTOURS BASED ON APRIL SURVEY DATA PROVIDED BY MINTO AND PRE-DEVELOPMENT 2 m CONTOUR DATA.
2. OVERBURDEN SOILS WERE NOT LOGGED IN EXPLORATION BOREHOLES.

STATUS
ISSUED FOR USE

CLIENT

MINTO EXPLORATIONS LTD.

eba
A TETRA TECH COMPANY

OMS MANUAL - DRY STACK TAILINGS STORAGE FACILITY - MINTO MINE, YUKON

SURFACE DRAINAGE SUB-CATCHMENTS

PROJECT NO.	DWN	CKD	REV
W14101068.001	CB	JGD	0

OFFICE
EBA-WHSE

DATE
January 20, 2011

Figure 4

APPENDIX A

APPENDIX A GEOTECHNICAL DESIGN REPORT – "DRY" STACK TAILINGS FACILITY, MINTO MINE, YUKON

Minto Explorations Ltd.

GEOTECHNICAL DESIGN REPORT
"DRY" STACK TAILINGS STORAGE FACILITY
MINTO MINE, YUKON

EBA FILE: 1200173

January 2007

EBA Engineering Consultants Ltd.
p. 867.668.3068 • f. 867.668.4349
Calcite Business Centre • Unit 6, 151 Industrial Road • Whitehorse, Yukon Y1A 2V3 • CANADA

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

FIGURES

APPENDICES

1.0 INTRODUCTION

The Minto Project is a copper-gold deposit located about 240 km north of Whitehorse in the Yukon and is owned by Minto Explorations Ltd. (Minto). The general location of the Minto Project is shown in Figure 1. The deposit is being developed as an open pit mining operation and is currently in the construction phase with production targeted for mid 2007. EBA Engineering Consultants Ltd. (EBA) was retained by Minto to undertake the geotechnical design of the proposed "Dry" Stacked Tailings Storage Facility (DSTSF) and provide information for the development of the Tailings Management Plan to support a Quartz Mining License (QML-0001). The overall tailings management plan will be developed concurrently by Access Consulting Group (Access) and presented in a separate document. EBA received approval from Minto to proceed with the geotechnical design of the DSTSF facility in November 2006. This report presents a summary of the findings and analytical work associated with the geotechnical design of the DSTSF.

1.1 SCOPE OF WORK

EBA's scope of work was specifically the geotechnical design of the tailings facility, and did not include a detailed tailings deposition plan. Drawings for construction will be prepared based on the design information presented in this report.

2.0 BACKGROUND INFORMATION

EBA developed the geotechnical design from the following background information:

- A drawing supplied by Hatch, overall mine development consultants, entitled "General Tailings Process Flow Sheet No. 5" Drawing Number 100-10-005, Rev A;
- A spreadsheet supplied by Hatch on December 6, 2006 detailing the tailings tonnages for year-1 through to year-8;
- A spreadsheet developed by Access, the project environmental consultants on November 17, 2006 detailing the mine site meteorological data collected to date;
- Four e-mailed documents supplied by Access on November 17, 2006 detailing past snow surveys;
- Regional information supplied by Canadian Geological Survey Pacific Geosciences Centre on January 20, 2006 quantifying the risks associated with earthquakes;
- A report by Hallam Knight Piesold entitled "Minto Creek Surface Hydrology Report" detailing mine site hydrology; and
- A memorandum supplied by Access on December 4, 2006 entitled "Memorandum CCL-MC1" by Clearwater Consultants Ltd. detailing a mine site hydrology update.

In addition, EBA also used the following information from EBA's files:

- A 1995 report entitled "Geotechnical Design Tailings/Water Retention Dam" detailing previous geotechnical investigations and stability analyses;
- A report entitled "1996 Geotechnical Drilling Program" describing previous geotechnical investigations; and
- A 1996 report entitled "Minto Waste Rock Stability Evaluation" summarizing previous geotechnical investigations and stability analyses for the project site when it was being considered as the "south waste dump" in 1996.

Background information has also been obtained from Hatch, Access Consulting, and Minto Explorations during the preparation of this document.

3.0 MINE SITE LAYOUT

The Minto Mine is located approximately 240 km northwest of Whitehorse and is accessed either by land via the North Klondike highway and Minto access road, as shown on Figure 1, or by air. Access by land requires crossing the Yukon River; this is completed by barge in the summer and ice road in the winter. There is a short period of time in the spring and fall that land access is not possible, as neither the ice road nor barge is available for use.

The main infrastructural components of the mine comprise the Access Road, Open Pit, Process Plant, Accommodation Complex, Water Dam, Waste Rock Dump, Ice-Rich Overburden Dump, Airstrip and the "Dry" Stacked Tailings Storage Facility. The locations of these components are depicted in Figures 1 and 2.

This report focuses on the geotechnical design of the "Dry" Stacked Tailings Storage Facility (DSTSF) which occupies an area of approximately 0.4 km^2 and is located southeast of the Process Plant as shown in Figures 2 and 3.

4.0 TAILINGS PRODUCTION AND CHARACTERIZATION

4.1 TAILINGS DISPOSAL ALTERNATIVES

There are three methods for managing tailings waste from milled and processed ore in common usage. The most frequent disposal process is to pump it as a slurry to a retention basin where the solids sediment into a pond with a cover of process water. The pond bottom sediments generally have low shear strength and must be retained behind a tailings dam. The solids to water mass ratio in the slurry is usually in the order of 40 to 50% therefore a high proportion of supernatant water must be managed at the disposal site. This disposal method is attractive for tailings that can produce acidic process water if they are exposed to air. The adoption of a slurry tailings disposal method is contingent on site topography that can provide the large storage volumes required for both the solids and water produced.

More recent northern mining developments have favoured disposal processes that remove as much of the process water as practical in the mill before directing the product to the disposal basin. This disposal method requires dewatering the tailings stream to a solids content in the order of 65% before deposition. The material produced, sometimes referred to as "paste tailings", is deposited in a smaller basin with minimal excess water to manage within the disposal facility. The system lends itself to effective water management within the facility with the solids retained behind a filter dike that lets the free water pass to a downstream water dam. This alternative is adaptable to mountainous regions where V-shaped valley retention ponds with small available storage volumes require high dams to store the water quantities produced by a conventional slurry system. In an arctic environment where formation of permafrost into the tailings deposit can simplify site reclamation, thickened tailings is a very attractive option because the lack of a water cover and higher deposition density enhances the freezing process.

The dewatering process at the ore processing plant can be further enhanced to remove most free water from the tailings stream. This is accomplished with either mechanical pressure filters or vacuum filters. Tailings that are produced in this manner have the consistency of damp sand and can be handled and placed like construction material. The handling and placement process is often referred to as "dry stacking". The benefits of such a system are that the material placement can be engineered to be self contained without a retaining structure. Stability issues commonly associated with failure of tailings impoundments, such as dam failure and liquefaction, do not apply to an engineered stack system.

The original concept for tailings disposal for the Minto mine (Robinsky, 1995) was to dewater the tailings at the mill to a paste consistency and place them hydraulically within the upper basin of Minto Creek. The early testing showed that the tailings would flow at a slope of about 5% and that excess water would accumulate downstream behind the water dam. In later years of the mine, some tailings solids were predicted to accumulate behind the water dam reducing the water storage capacity. The project water license was issued based on the paste tailings deposition plan developed by Robinsky. In order to comply with the conditions of the water license, the tailings would have to meet a minimum criterion for solids density in the slurry of 68% before deposition.

A review by EBA in 2006 found that, this system, although theoretically possible for the site, introduced substantial risk from a practical operating perspective. The test data showed that minor variations in slurry density from the design parameters would result in the material flowing downslope directly into the water reservoir behind the dam. This would have serious consequences to the operation, therefore, an intermediate retention dam was proposed to ensure effective separation of the tailings solids from the process water. The addition of an internal tailings solids retention dyke was not in compliance with the water license. Moreover, there were some technical and environmental advantages to further enhancement the water removal process by addition of pressure filters. This would produce material that could be "dry stacked" and would be self-supporting. The option was attractive because it reduced the overall footprint of the deposition stack, removed tailings from Minto Creek and provided improved opportunities for progressive reclamation. The design described in this report is predicated on the dry stack option in order to realize these important benefits and ensure compliance with the water license.

4.2 TAILINGS PRODUCTION

It is understood from the tailings flowsheet that flotation tailings will be transported by conveyor from the Process Plant to a location within the DSTSF at a solids content of about 83% by mass. The life of mine plan supplied by Hatch indicates that the total production of tailings will be in the order of 5,517,000 tonnes during the eight year mine life. The anticipated tailings production by year is presented in Table 1 below.

TABLE 1: ANTICIPATED TAILINGS PRODUCTION

Year	Production (tonnes)
1	489,940
2	766,960
3	812,350
4	824,930
5	820,160
6	836,690
7	847,600
8	118,330
Total	**5,516,950**

4.1 TAILINGS CHARACTERIZATION

EBA undertook two separate laboratory programs to evaluate the geotechnical properties of a tailings sample provided by Minto. The first program was completed in May 2006 and formed part of the feasibility study. The second program was completed in November 2006 to supplement the data required for the "dry" tailings stack design and tailings management plan.

4.1.1 Initial Laboratory Testing Program May 2006

Tailings samples were sent to EBA's laboratory in Edmonton. Initial sample preparation involved removing the supernatant water and combining the solids to form one composite sample. Samples for the following testwork were sub-sampled from the composite sample.

The following tests were undertaken:

- Particle size distribution (sieve and hydrometer analyses): ASTM D422;
- Specific gravity determination: ASTM D854;
- Atterberg limits: ASTM D423 and D424; and
- Moisture density relationship (Standard Proctor): ASTM D698.

4.1.1.1 Laboratory Test Results

A summary of the laboratory test results is presented in Table 2. The laboratory result sheets are attached in Appendix B.

TABLE 2: LABORATORY TEST RESULTS

Type of Test	Results
Particle size distribution	Clay: 6%, Silt: 35%, Sand 59%
Specific gravity determination	Specific gravity of solids: 2.79
Atterberg limits	Liquid Limit: 23, Plastic Limit: 16, Plasticity Index: 7
Moisture density relationship	Optimum moisture content: 17.5%, Standard Proctor Maximum Dry Density (SPMDD): 1685 kg/m^3

Note: The above tests report moisture content as a percentage ratio of the mass of water divided by the mass of dry solids, this is consistent with geotechnical engineering practice.

4.1.2 Second Laboratory Testing Program November 2006

The tailings sample was a sub-sample from the composite sample used originally in the initial testing. However, it had been used for physical characterization testing by others between this testing program and the initial testing program.

The following tests were undertaken on the tailings sample.

- Particle size distribution (sieve and hydrometer analyses): ASTM D422.
- Atterberg limits: ASTM D423 and D424.
- Constant Head Permeability Test: ASTM D5084.
- Direct Shear Test: ASTM D3080.

4.1.2.1 Laboratory Test Results

A summary of the laboratory test results is presented in Table 3 and the laboratory result sheets are attached in Appendix B.

TABLE 3: LABORATORY TEST RESULTS

Type of Test	Results
Particle size distribution	Clay: 7%, Silt: 36%, Sand 57%
Atterberg limits	Liquid Limit: 20, Plastic Limit: 16, Plasticity Index: 4
Constant head permeability test	k = 9.65 x 10^{-8} m/s
Direct Shear Test	Peak Strength: θ´ = 35.1°, c´ = 11 kPa

Note: The above tests report moisture content as a percentage ratio of the mass of water divided by the mass of dry solids -- this is consistent with geotechnical engineering practice.

4.1.3 Summary of Tailings Geotechnical Characteristics

The above testing programs have found the tailings to typically comprise of approximately 6% clay, 35% silt and 59% sand sized particles with a specific gravity of 2.79. Two separate Atterberg Limit tests determined a Plastic Limit of 16%, the Liquid Limit ranged between 20% and 23% and the corresponding Plasticity Index ranged between 4% and 7%. In geotechnical terms the tailings can be described as sand and silt, trace of clay.

The Standard Proctor test determined an optimum moisture content of 17.5% at a maximum dry density of 1685 kg/m^3. Shearbox tests undertaken at an average density of 1640 kg/m^3 and average moisture content of 20% determined an internal angle of shearing resistance of 35.1° and a cohesion intercept of 11 kPa at peak shear strength. At a density of 1640 kg/m^3, the material was determined to exhibit a hydraulic conductivity of 9.65 x 10^{-8} m/s.

5.0 SITE CONDITIONS

5.1 GENERAL SURFICIAL GEOLOGY

Boreholes drilled within the plan area of the DSTSF have determined that overburden thicknesses may range up to 45 m based on exploration drilling. These deposits are thought to be an extension of an infilled valley which also passes through the southern end of the open pit. The overburden soils generally comprise colluvial sediments of silt and sand with trace gravel, and thin out to the south and east of the DSTSF site.

5.2 SURFACE FEATURES

The DSTSF site is located over a gently sloping (about 3° to 10°) terrain, south of the mill buildings and Minto Creek.

The terrain steepens to the south and southwest of the DSTSF. The access road to the airstrip bisects these slopes upslope of the stack area. A diversion ditch has been constructed along the upstream side of this road (see Figure 2).

The tailings facility area originally had sparse to locally dense tree cover, however the region was subject to a forest fire in 1995 that has resulted in areas of fallen trees with deciduous species regrowth.

5.3 SUBSURFACE CONDITIONS

Geotechnical information from previousl projects undertaken by EBA on or near the site was reviewed as part of this study. This information was compiled during several studies in the mid 1990's, typically for the design for the mill site, a waste rock dump originally proposed for the site and the water retention dam that remains an important part of the project.

Eleven existing geotechnical boreholes, shown on Figure 3, (Nos. 94-G11, 94-G11A, 94-G21, 96-G07 through 96-G13 and 96-G16) were drilled and sampled in the vicinity of the proposed DSTSF. Five of these (Nos. 96-G07 through -G12 excluding -G10) are within the footprint of the facility. Boreholes 96-G10, -G13, and –G16 were drilled within 100 m of the west and northwest perimeter of the facility while boreholes 94-G11, -G11A and -G21 were drilled approximately 150 m to 250 m to the northeast. The boreholes were drilled to depths ranging from 4.8 to 24.4 m. The results from the laboratory and the field-testing programs are shown on the borehole logs, where applicable. The borehole logs along with the accompanying grain size distribution curves are presented in Appendix C.

A ground temperature cable was installed to a depth of 12 m in Borehole 94-G11, 20 m in Borehole 94-G21 and 10 m in 96-G08 at the time of the investigations in 1994 and 1996. Temperature data was collected intermittently for the first year after installation. These instruments are no longer serviceable but the available ground temperature data is presented with the appropriate borehole log in Appendix C.

The geotechnical investigations indicate that the subsurface conditions generally comprise a thin veneer of peat and vegetation overlying a fine-grained silt or silt and sand overlying coarse-grained sand. The exception is Borehole 94-G21 which noted a clay layer from ground surface to 18.9 m.

The fine grained sand and silt is believed to be of colluvial origin while the coarser sand is considered to be a residual soil (residuum). Throughout the mine site these residual soils grade into weathered bedrock. The engineering characteristics of these overburden soils are discussed in Section 7.

5.3.1 Groundwater

No groundwater was reported in any of the boreholes drilled within the DSTSF, but is expected within the active layer during the summer and fall.

5.3.2 Permafrost

Permafrost was encountered in each of the boreholes drilled within the vicinity of the proposed DSTSF, at varying depths. The maximum recorded active layer thickness was about 1.0 m in September 1996, directly under the DSTSF footprint.

The observed ice contents in the five boreholes (Nos. 96-G07 through -G12 excluding -G10) within the footprint of the DSTSF typically ranged from Nbe to visible ice at 10% to 20% of the total volume. Two of the boreholes, 96-G09 and 96-G12, showed ice intervals of 1.5 and 4.0 m thick within the upper 10 m. More detailed information is available in the borehole logs presented in Appendix C.

Initial data from the ground temperature cable installed in 96-G08 indicated a relatively uniform ground temperature of close to -0.8ºC after equilibration with slight seasonal warming over the top 2 or 3 m. The active layer depth was close to 1 m. This cable could not be found in the summer of 2006 and may have been destroyed.

Initial data from the ground temperature cables installed in 1994, 94-G11 and 94–G21, indicates similar temperatures as 96-G08 with a relatively uniform ground temperature of close to -0.8ºC at depth and seasonal warming over the top 5 m. The active layer depth was up to 3 m in 94-G11 and 4 m in 94–G21 (these are on existing disturbed trails). Readings from 2006 for 94-G11 indicate similar ground temperatures and active layer thickness. Cable 94-G21 has not been located to date.

5.3.3 Bedrock

Depths to bedrock (granodiorite) are indicated to range up to 45 m based on exploration borings drilled nearby. Weathered bedrock outcrops are present within the vicinity of the airstrip, south of the upper reaches of the “dry” stack tailings facility. There is no exposed bedrock within the proposed DSTSF. The bedrock is considered too deep at this site to have any significant effect on the system design.

6.0 DESIGN BASIS OF THE “DRY” STACKED TAILINGS STORAGE FACILITY

6.1 TAILINGS VOLUME AND PROPERTIES

The mine plan indicates that approximately 5,517,000 tonnes of tailings will be produced over an eight year period. The tailings will be transported by conveyor to the DSTSF at 83% solids and mechanically placed to form an engineered “dry” stack. The tailings material at 83% solids is equivalent to a gravimetric moisture content of 20%[1]. Referencing this moisture content against the moisture density relationship detailed in Appendix C, the mechanically engineered tailings should achieve a density of 1,600 kg/m^3 which is equivalent to 95% of the Standard Proctor Maximum Dry Density. On this basis a storage volume of 3,758,000 m^3 will be required to accommodate the 5,517,000 tonnes of tailings at a placed density of 1,600 kg/m^3.

Laboratory tests undertaken on samples of tailings material have characterised the material as a sand and silt, with a trace of clay, which generally exhibits the properties of a

---

[1] Moisture content is the percentage ratio of the mass of water divided by the mass of dry solids -- this is consistent with geotechnical engineering practice.

cohesionless material. On the basis that the tailings will be placed at a solids content of approximately 83% and a dry density of 1,600 kg/m^3, little or no bleed water is expected to emanate from the tailings upon placement and compaction. Accordingly, the tailings can be classified as a "dry" stackable material and will be in an unsaturated condition upon placement.

It should be noted that at the above proposed tailings solid content of 83 % solids by weight exceeds the stipulated solids content of 67.5 % in terms of the Water Use Licence QZ96-006 issued by the Yukon Territory Water Board dated November 2005, reference paragraph 47.

6.2 SITE AND ALIGNMENT SELECTION

The tailings site was selected east of the Process Plant within the valley profile above the Minto Creek as shown in Figures 2 and 3 that will meet the storage requirement for 3.8 million m^3. This particular site is in close proximity to the mill and minimizes potential impacts on Minto Creek.

The DSTSF area covers an area of approximately 0.4 km^2 and is designed to provide for storage and confinement of the tailings. The toe of the stack is at an elevation of approximately 758 m, which has been designed to be above the flood level of Minto Creek and well above the reservoir level created by the water dam. The stack will have an outer slope of 4:1 (horizontal:vertical) or 14 degrees and a final stack crest elevation close to 788.5 m. The tailings will be up to 26 m deep in the central area of the DSTSF.

6.3 TAILINGS "DRY" STACK CONCEPT

"Dry" stacked tailings is a recognised method of tailings storage and has been used worldwide including an number of northern mining operations (e.g. Greens Creek Mine, Juneau Alaska, Raglan's Mine in Northern Quebec and Pogo Gold Project near Delta Junction Alaska). "Dry" stacked tailings essentially involves controlled and engineered placement of vacuum or pressure filtered tailings (sometimes referred to as filter cake) in layers to progressively form a stable stack of dense tailings. "Dry" tailings is generally referred to tailings with a moisture content at or below the liquid limit however, this is somewhat dependant on the tailings material characteristics. This method allows the storage of tailings in a dewatered and unsaturated form. In addition, "dry" stacked tailings also allow for progressive reclamation of the outer slopes of the tailings stack with increasing stack height.

As summary of the advantage of "dry" stacking was presented on a report entitled "Examination of Revegetation Methodologies for Dry Stack Tailings in Northern Environments" published by the Mining Environmental Research Group, Government of Yukon (2003) and has been shown to have many long term geotechnical and environmental benefits.

6.4 MINTO "DRY" STACKING PLAN

The DSTSF at the Minto Mine will include; an access road, tailings stack starter bench, slope drainage blanket, finger drains along existing valley drainages, and diversion berms for run-on surface water management.

The tailings starter bench, constructed from waste rock, will provide a horizontal working bench on to which the initial tailings will be mechanically placed, spread and compacted in controlled lifts. The tailings stack will be progressively developed using a bottom up construction approach and will eventually occupy the footprint area designated in Figure 2.

Fundamental to the long term global stability of the stack is; controlled in situ density of the tailings following placement, encouraging seasonal frost penetration, and management and maintenance of the stack under-drainage and surface water diversion berms.

6.5 DESIGN AND CONSTRUCTION CONSIDERATIONS

The primary considerations for the design and management of the tailings stack are as follows:

- Provide a geotechnically stable tailings stack at all stages of construction, with particular attention to permafrost and foundation conditions;
- Surface water management and control to limit surface erosion and washing of the tailings into the water reservoir. This must include management of both run-on water (i.e. water entering into the DSTSF) and run-off water (i.e. water captured within the DSTSF and directed out of the DSTSF);
- Develop the facility in stages to encourage preservation of winter freezing within the stack and limit permafrost degradation from the foundation soils;
- Incorporate field observation and performance monitoring of the stack. During the initial stages of tailings placement this will enable review of design assumptions;
- Account for winter operations, specifically, placement and compaction of the tailings and the water management system (surface water diversion berms and finger drains); and,
- Consider available construction materials.

The following basic criteria were adopted for the design of the tailings stack:

- Design capacity of 5,517,000 tonnes placed at an average bulk density of 1.6 t/m^3;
- Annual tailings production will range from approximately 490,000 to 848,000 tonnes for about eight years;
- Solids content of 83% for the soil-water mixture delivered to the facility;
- Placement and compaction of tailings occurs on a continuous basis;

- Compaction in 500 mm lifts to at least 95% Standard Proctor Maximum Dry Density (per ASTM D698); and
- Maximum annual cumulative thickness of 3.0 m in any one area of the facility.

7.0 TAILINGS STACK DESIGN

7.1 LAYOUT AND GEOMETRY

The trees within the footprint of the DSTSF will be sheared off above the root bulb during the winter and removed from the drainage blanket footprint. Elsewhere under the stack the trees will be sheared off and flattened. The tree clearing will be undertaken incrementally, thus clearing areas only required for the following year tailings placement with the view to maintaining the vegetation cover in the remaining areas to minimize potential degradation of the permafrost. Initially tree clearing will be concentrated towards the toe of the DSTSF (i.e. towards the Minto Creek) in order to place and construct a 120 m wide by (minimum) 1.5 m thick toe drainage blanket and a toe starter bench, details of which are shown in Figure 3. These will be constructed of waste rock material overlain by a filter material, details of which are also shown in Figure 3. Four finger drains have also been incorporated into the design to intercept existing seepage flows beneath and from the DSTSF, if any. Upon completion of the above, spreading and compaction of the tailings material will commence using a bottom up placement sequence.

The stack will be a crescent shaped structure, following the contours of the slope, as shown on Figure 2. The ultimate stack will have a crest elevation at 788.5 m and have a 4:1 sideslope. The maximum thickness of the tailings stack will be in the order of 26 m. This stack will provide sufficient storage for the projected tailings tonnage on the basis of an in situ dry density of 1,600 kg/m^3.

7.2 THERMAL EVALUATION

7.2.1 Analysis Methodology

Thermal analyses were carried out to predict the permafrost response within the foundation soils. The thermal model was calibrated against the measured ground temperatures at the site. Various cases with different assumed tailings placement rates and final heights were simulated. Parametric and sensitivity studies for some cases were also conducted.

Analyses were carried out using EBA's proprietary two-dimensional finite element computer model, GEOTHERM. The model simulates transient, two-dimensional heat conduction with change of phase for a variety of boundary conditions. The heat exchange at the ground surface is modelled with an energy balance equation considering air temperatures, wind velocity, snow depth, and solar radiation. The model facilitates the inclusion of temperature phase change relationships for soils, such that any freezing depression and unfrozen water content variations can be explicitly modelled. The model has been verified by comparing its results with closed-form analytical solutions and many different field observations. The model has successfully formed the basis for thermal evaluations and designs of tailings dykes, dams, foundations, pipelines, utilidor systems, landfills, and ground freezing systems in arctic and sub-arctic regions.

7.2.2 Parameters and Results

Parameters and results from the thermal analysis are described in detail in the Technical Memo "Thermal Analysis of "Dry" Stacked Tailings Area" presented in Appendix D. Specific sections include climatic data, calibration, cases simulated, soil index and thermal properties, results and discussions, and air temperature sensitivities.

7.2.3 Discussion

The following conclusions and recommendations can be drawn from the thermal analysis results:

- The minimum 1.5 m thick sandy gravel drainage blanket recommended for placement over the original ground to drain potential excess porewater should also provide benefit in limiting thaw penetration into the original ground due to tailings placement.
- The predicted long-term tailings temperatures for tailings placement rates of 1.5 m/year and 3.0 m/year are colder than those for a tailings placement rate of 6.0 m/year. Therefore, it is recommended to limit the tailings placement rate to less than 3.0 m/year to promote freeze-back of the summer-placed tailings.
- A thin initial summer-placed tailings layer would promote freeze-back during the following winter, and result in colder tailings/ground temperatures during later stages of the mine life.
- Reduced snow cover will result in colder tailings/ground temperatures. It is recommended that snow be regularly cleared off the tailings surface.
- Snow will tend to accumulate on the lower area along the toe of the tailings perimeter slopes due to both natural snow-drifting and intentional snow-clearing from the tailings surface. It is anticipated that a haul road will be constructed around the toe of the lower portion of the tailings perimeter slopes. It is recommended that snow be regularly cleared off both the slope toe area and the road surface to promote deeper seasonal frost penetration into the original ground.
- The long-term air temperatures at the Minto site may increase with time. Sensitivity thermal analyses using estimated mean air temperatures indicate that the predicted thaw penetration into the original ground could be 0.1 m to 0.4 m deeper than that for the corresponding cases presented in Table 6 in Appendix D. It is recommended that the air temperatures at the Minto site continue to be monitored over the life of the mine, to verify design assumptions.

- It will be necessary to monitor the ground temperatures within and below the stack to predict permafrost response for refinement of placement methods and develop closure designs.

7.3 STABILITY EVALUATION

7.3.1 Analysis Methodology

Limit equilibrium analyses were conducted to determine the factor of safety against slope failure during construction and maintenance of the stack. All analyses were conducted using the commercially available two-dimensional, limit equilibrium software, SLOPE/W (Geo-Slope International Ltd., Version 5.17). The principles underlying the method of limit equilibrium analyses of slope stability are as follows:

- A slip mechanism is postulated;
- The shear resistance required to equilibrate the assumed slip mechanism is calculated by means of statics;
- The calculated shear resistance required for equilibrium is compared with the available shear strength in terms of factor of safety; and
- The slip surface with the lowest factor of safety is determined through iteration.

Factor of safety is used to account for the uncertainty and variability in the strength and porewater pressure parameters, and to limit deformations.

Earthquake loading has been modeled using a pseudostatic peak horizontal ground acceleration.

Stability analyses were carried out for a typical cross-section of the tailings stack. The foundation at this location was inferred to be silt and sand with varying percentages of gravel, grading into residuum and weathered granodiorite bedrock at depth.

The presence of permafrost with ground ice in the foundation soils will be a controlling factor in assessing stack stability. It is the design intent to retain the permafrost within the foundation or at least slow the rate of regression to provide time for dissipation of pore pressure resulting from thaw. There is a direct link between the predicted permafrost behaviour and the potential critical failure mechanisms. It has been postulated, based on previous EBA experience, that some thaw at the base of the active layer will occur and that the shear strength acting along the thawed frozen interface will be a controlling factor in the stack design. The focus of the stability analyses is therefore a deep failure plane cutting through the stack to a receding permafrost interface in the foundation soil. The failure would then follow the potential weak layer and exit at the toe of the slope.

Other shallow potential failure options have been considered but these are of minor consequence and are not considered a controlling mechanism. For purposes of the limit equilibrium analyses the underlying permafrost is considered much stronger than the unfrozen soil therefore the risk of shear failure through the frozen ground is slight. The permafrost soil is warm and can deform or creep under a sustained load. The potential for creep displacements occurring deep within the permafrost has not been specifically analysed as the distribution of ground ice within the soil is poorly understood at the site. Creep displacements, if they were to occur would be identified in the deformation monitoring system and by manifestation of cracking in the slope. These movements are slow, seldom resulting in substantial earth movement and there would be adequate time for mitigative measures such as construction of a downslope rock buttress.

7.3.2 Design Criteria

The guidelines for minimum design factor of safety have been adopted from the British Columbia Interim Guidelines for Investigation and Design of Mine Dumps (Waste Rock Design Manual).

The design criteria adopted from the guidelines are included in Table 4.

TABLE 4: DESIGN FACTORS OF SAFETY

Stability Condition	Minimum Design Factor of Safety
Long Term Stability	1.3
Seismic (Pseudo-static) Stability	1.1

The Waste Rock Design Manual recommends that seismic stability should be evaluated using pseudostatic horizontal accelerations that correspond to a 10% probability of exceedance in 50 years. When work was originally undertaken on this project in the mid 1990's, the Canadian Geological Survey Pacific Geosciences Centre provided a value for the peak horizontal acceleration for the project site of 0.15 g. An updated value for the site has been provided by the Pacific Geosciences Centre and the current peak horizontal acceleration that corresponds to a 10% probability of exceedance in 50 years is 0.055 g. The reasoning for the decrease in the peak ground acceleration provided by the Pacific Geosciences Centre is that seismic data collection has increased substantially in the Yukon in recent years. A better understanding of ground motion and improved modelling has resulted in revised predictions, which are considered to be more accurate and representative for the project area.

7.3.3 Material Properties

The material properties chosen for the tailings stack and foundation materials in the stability analyses are presented in Table 5. The properties for the materials were selected based on the completed laboratory testing, and properties used in the design of the existing facilities on the site.

Table 5: Material Properties used in Stability Analyses

Material	Angle of Internal Friction (º)	Cohesion (kPa)	Unit Weight (kN/m³)
Tailings	28	--	19.4
Waste Rock	35	--	20.0
Active Layer/Thawed Permafrost	28	--	18.4
Permafrost	--	--	--

7.3.3.1 Tailings

The shear strength parameters, internal friction angle and cohesion, were determined by evaluating the results of a direct shear test on a sample of tailings material. The results determined that the peak shear strength parameters were θ´ = 35.1º and c´ = 11 kPa,. However, the tailings showed some evidence of strain weakening; therefore, lower strength parameters of θ´ = 28º and c´ = 0 kPa were used for the stability analyses.

7.3.3.2 Waste Rock

Waste rock from the open pit will be used to construct the drainage blanket, finger drains, starter bench and exterior shell.

Steffen, Robertson and Kirsten Ltd. (SRK) reviewed Minto rock core taken during a 1993 exploration program and produced a report containing geotechnical properties of the rock mass on site with respect to open pit design, hanging wall design and underground mining design issues (SRK, 1994). The bedrock is described as weathered to a depth of about 30 m and it was recommended that ripping with dozers could be used for pit excavation (SRK, 1994). It is believed that this observation justifies that some of the waste rock excavated from the open pit could be treated as "soil like" waste rock with a friction angle of 35°. It is anticipated that the majority of the waste rock produced will be "rock like" with a friction angle of 37º to 38º.

Although it is recommended and expected that only competent waste rock from the open pit will be used for construction, there is the potential for some "soil like" materials to be incorporated. Therefore, the lower friction angle of 35º was used in the stability analyses. The engineer on site during construction will verify that only competent rock is being used, and will direct the contractor to take any "fine grained" loads to the waste dump.

The 35º design friction angle is consistent with values used in previous analyses for the water dam (EBA, 1995) and main waste rock dump (EBA, 1998).

7.3.3.3 Active Layer and Recently Thawed Permafrost

The active layer soils and upper permafrost that may be expected to thaw over the life of the structure is typically a silt and sand with trace to some fine gravel. This material is believed to be representative of the colluvium found on the surface in other areas of the mine site. Direct shear testing of a silty sand colluvium sample from Testpit 97-01 (within the vicinity of the open pit) indicates this material could exhibit strain-softening behaviour with a peak friction angle of 35º and a residual friction angle of 28º. In the present analyses, the residual friction angle of 28º has been used considering that downslope movement and reworking of this material has occurred over time, or that recently thawed permafrost will be in a looser condition than the active layer soils.

The active layer is expected to increase in thickness by up to 0.2 m over the life of the mine. This is predicted to occur at a slow rate; therefore, it is expected that any excess porewater pressures will dissipate as they are generated. However, a pore pressure parameter (Ru) of 0.4 for all unfrozen natural foundation soil below the stack has been adopted for the stability analyses.

7.3.3.4 Permafrost

The permafrost soil found beneath the tailings stack is typically a silt and sand with trace to some fine gravel. For the purpose of these analyses, this material has been modelled to act as bedrock to force the critical failure surface to the contact of the thawed and frozen material.

7.3.4 Porewater Pressure Conditions

7.3.4.1 Natural Stratigraphy

The geotechnical drilling at this site suggested that the existing active layer was relatively dry as there was no free groundwater observed in the boreholes. However, the design accounts for the possibility of the thawing of permafrost and water transport through the drainage blanket. Therefore, it is possible that a shallow perched groundwater table may exist for short periods of the year. For the present stability analyses, a groundwater table at original ground surface was used.

7.3.4.2 Tailings

The potential for a phreatic surface developing within the stack was not considered due to the following:

- The moisture content of the placed tailings, although slightly above the optimum moisture content, will still result in the deposit being in an unsaturated state;
- Construction of the DSTSF will control surface water on the tailings stack; and
- Construction of a drainage blanket beneath the critical tailings slope will allow any excess water to drain away and not build up porewater pressures within the tailings.

- It is anticipated that the deposit will be layered with extensive permafrost conditions created by winter-placed tailings that will remain frozen.

7.3.5 Stability Analyses

The static and pseudostatic analyses have been evaluated assuming that a thin layer at the top of existing permafrost will thaw with some pore water liberated, resulting in reduced shear strength. The active layer and thawed permafrost soil have been assigned a pore pressure parameter (Ru) of zero for a fully drained condition or 0.4 to account for the possibility of porewater pressure build-up within the thawed foundation soil. As expected, the stability of the tailings stack is governed by the case where Ru = 0.4. Based on the thermal analyses predictions, the expected actual site conditions will be closer to Ru = 0 due to the slow rate of thaw.

7.3.5.1 Static Case

The results of the minimum factors of safety calculated during the static stability analyses are summarized in Table 6. Figure 6 presents the typical cross section used for the analyses and the resulting critical slip surface.

TABLE 6: SUMMARY OF STABILITY ANALYSES RESULTS - STATIC

Case		Minimum Factor of Safety of the Tailings Stack
1	Static, only drainage blanket constructed, groundwater table at original grade	3.87
2	Static, drainage blanket/full stack, groundwater table at original grade	2.26
3	Static, drainage blanket/full stack/waste rock slope cover, groundwater table at original grade	2.27
4	Static, only drainage blanket constructed, groundwater table at original grade, Ru = 0.4	1.82
5	Static, drainage blanket/full stack, groundwater table at original grade, Ru = 0.4	1.42
6	Static, drainage blanket/full stack/waste rock slope cover, groundwater table at original grade, Ru = 0.4	1.45

These results indicate that the factor of safety for the tailings stack with a slope gradient of 4:1 exceeds the minimum 1.3 recommended by the Waste Rock Design Manual.

7.3.5.2 Pseudostatic (Earthquake) Case

The results of the minimum factors of safety calculated during the static stability analyses are summarized in Table 7. Figure 6 presents the typical cross section used for the analyses and the resulting critical slip surface.

TABLE 7: SUMMARY OF STABILITY ANALYSES RESULTS – PSEUDOSTATIC (EARTHQUAKE)

Case		Minimum Factor of Safety of the Tailings Stack
7	Seismic – 0.055 g, only drainage blanket constructed, groundwater table at original grade	2.52
8	Seismic – 0.055 g, drainage blanket/full stack, groundwater table at original grade	1.82
9	Seismic – 0.055 g, drainage blanket/full stack/waste rock slope cover, groundwater table at original grade	1.84
10	Seismic – 0.055 g, only drainage blanket constructed, groundwater table at original grade, Ru = 0.4	1.18
11	Seismic – 0.055 g, drainage blanket/full stack, groundwater table at original grade, Ru = 0.4	1.10
12	Seismic – 0.055 g, drainage blanket/full stack/waste rock slope cover, groundwater table at original grade, Ru = 0.4	1.16

These results indicate that the factor of safety, assuming the current design seismic acceleration of 0.055g, for the tailings stack with a slope gradient of 4:1 meets the minimum 1.1 recommended by the Waste Rock Design Manual.

7.3.6 Discussion

As presented in the above sections, constructing only the drainage blanket (Case 1, 4, 7, and 10) provides a high factor of safety against deep seated failure which is to be expected. The factor of safety against deep seated failure for the construction of the drainage blanket and tailings stack (Case 2, 5, 8, and 11) is slightly less than that of the final cross section (Case 3, 6, 9, and 12) when the tailings stack is armoured with waste rock during the reclamation of the stack.

Progressive reclamation of the tailings stack will include armouring the exposed tailings slope with waste rock on an ongoing basis as the elevation of the stack increases. This will greatly reduce the potential for erosion and shallow failures of the tailings slope.

A critical zone for slope stability is the perimeter slope of the stack at full height. Ensuring that pore pressures do not build-up in this area is critical to the overall stability of the stack, and it is therefore recommended that only free-draining rock be placed on the outside of the waste rock shell. The quality of the waste rock from the pit will be variable. In some instances the waste will be primarily rock and some zones will yield weak rock that is more soil-like. The finer grained materials should only be placed up against the tailings slope and coarse free draining materials in the outer shell.

The results of the stability analyses indicate that the critical area of possible slope instability is the downstream slope of the tailings stack. Consequently, the toe of the stack should be checked for instability following each spring thaw and following major precipitation events. Should there be any indications of impending instability (such as tension cracks or localized slumping), the deformation monitoring data must be reviewed and mitigative measures developed by the Geotechnical Engineer.

The analyses described provide are considered a conservative assessment of the stack stability. The combination of wet thawing permafrost in the foundation at the same time as seismic loading to produce the minimum factor of safety has an extremely low probability of occurrence. The uncertainties associated with the behaviour of the permafrost both within the foundation and within the stack itself justify this cautious approach. The data from a well designed monitoring program could provide justification for reconsidering the design slope angle and steepening it from 4:1 to 3:1 during the operations phase of the mine, and allow an increased capacity without a comprehensive re-design process.

7.4 LIQUEFACTION POTENTIAL

Liquefaction potential of the tailings was assessed by comparing an estimated equivalent "N" value of the tailings compacted to 95% SPMDD to empirical relationships related to earthquake magnitude and location. The tailings are generally fine grained silty sand in an unsaturated state, which are not susceptible to liquefaction. Furthermore, as previously noted, the exterior of the tailings slope will be progressively reclaimed with the placement of a waste rock shell. This shell will provide some additional lateral constraint against any instability within the tailings slope.

The drainage blanket material beneath the lower portion of the tailings stack has no potential for liquefaction due to its coarse grained nature and relatively high in situ density.

8.0 TAILINGS STACK WATER DIVERSION

8.1 GENERAL

The toe of the DSTSF is to be constructed at the outlet of a mountain slope catchment. Several small ephemeral creeks currently collect the surface run-off and route it down the mountain side and into Minto Creek. The total watershed is approximately 3.42 km^2 in size, but approximately 2.5 km^2 of this area is upslope of the airstrip access road and the engineered ditch system that forms a part of this road. Construction of the DSTSF will interrupt the natural drainage paths in the remaining area as shown in Figures 2 and 3.

A water diversion system must be constructed to divert the surface run-off water around and under the tailings facility. During operation, the surface of the tailings stack must be contoured to control direct precipitation on the DSTSF.

Two hydrologic report documents were reviewed to establish the hydrologic site conditions.

- Memorandum CCL-MC1, Clearwater Consultants Ltd., 2006.
- Minto Creek Surface Hydrology Report, Hallam Knight Piesold, 1994.

Information found in Clearwater 2006 memorandum tends to address average flows and is intended for use in water balance calculations. The design of any diversion or routing structures should be conducted for a peak instantaneous flow.

Hallam Knight Piesold 1994 is a more comprehensive hydrology report and contains a section on peak instantaneous flows for several return intervals, which are specific to the tailings facility location. Data presented in this section is described in more detail in Hallam Knight Piesold 1994.

8.2 HYDROLOGICAL CONDITIONS

A regional analysis was conducted on data presented in Hallam Knight Piesold 1994 to determine the peak instantaneous flow rates for six sub-catchment areas in the DSTSF. The frequency analysis for the 3.42 km^2 catchment presented in Hallam Knight Piesold 1994 is included in Table 8. The sub-catchment areas are defined by local topography and are show in Figure 4. The sub-catchment properties are summarized in Table 9 and the peak instantaneous flow rates for the six sub-catchments of the tailings facility are presented in Table 10.

TABLE 8: FREQUENCY ANALYSIS (HALLAM KNIGHT PIESOLD, 1994)	
Return Period (years)	Peak Instantaneous Flow (m^3/s)
2	1.8
10	3.0
25	3.7
50	4.3
100	4.6
200	4.9

TABLE 9: PROPERTIES OF SUB-CATCHMENT AREAS		
Sub-Catchment	Area (km^2)	Design Slope (%)
Total West Portion	**0.308**	**7.5**
Lower West	0.108	7.5
Upper West	0.081	3.9
Upper Southwest	0.119	5.1
Total East Portion	**0.228**	**7.4**
Lower East	0.080	7.4
Upper East	0.063	6.5
Upper Southeast	0.086	6.5

The new peak instantaneous flow rates were determined using the following equation:

$$Q_u = Q_k \left(\frac{A_u}{A_k} \right)^n$$

Where: Q_u is the Unknown Peak Instantaneous Flow (m^3/s)

Q_k is the Known Peak Instantaneous Flow (m^3/s)

A_u is the Area of the Basin for the Unknown Flow (km^2)

A_k is the Area of the Basin for the Known Flow (km^2)

n is an adjustment exponent

TABLE 10: SUB-CATCHMENT AREA FREQUENCY ANALYSIS

Return Period (years)	Peak Instantaneous Flow Rates (m³/s)							
	Total West Portion	Lower West	Upper West	Upper Southwest	Total East Portion	Lower East	Upper East	Upper Southeast
2	**0.33**	0.16	0.13	0.17	**0.27**	0.13	0.14	0.11
10	**0.56**	0.27	0.22	0.29	**0.45**	0.22	0.23	0.18
25	**0.69**	0.33	0.27	0.35	**0.56**	0.27	0.28	0.23
50	**0.83**	0.40	0.33	0.43	**0.68**	0.32	0.34	0.28
100	**0.85**	0.41	0.34	0.44	**0.69**	0.33	0.35	0.28
200	**0.91**	0.43	0.36	0.47	**0.74**	0.35	0.37	0.30

8.3 WATER MANAGEMENT SYSTEM

To limit the volume of run-on water entering the DSTSF it is proposed to construct water diversion berms around the perimeter of the proposed facility. These berms will divert run-on from the catchment area above the tailings facility.

Finger drains are to be constructed along existing drainage courses under the tailings stack to intercept near surface seepage, eventually conveying it under the stack towards Minto Creek.

The preliminary sizing of these drains is based on conveying the peak run-off flow obtained from the 1 in 10 event as calculated from data in the above tables. A typical cross section of the finger drains (approximately 7.5 m^2 required) is shown on Figure 3.

The water management system has been designed to function throughout the life of the facility.

9.0 CONSTRUCTION PLAN

9.1 MATERIALS

Construction materials for the DSTSF will comprise waste rock material; 75 mm filter material or equivalent, finger drain material and 200 mm material. All materials will be selected from the open pit or existing borrow sources.

The use of a geosynthetic product as an equivalent to the 75 mm filter material is acceptable, but it must be installed to the manufacturer's specifications or as directed by the Engineer.

9.1.1 Waste Rock Material

The principal use of the waste rock material will be for the construction of the starter bench, drainage blanket/finger drains and the exterior shell of the tailings stack.

The waste rock material will comprise select open pit waste rock with a nominal size of 300 mm. To facilitate proper drainage and no build-up of pore pressure, the fines (<0.080 mm) content must be less than 5% by weight. The maximum particle size allowed is 1.0 m, or as approved by the Engineer.

9.1.2 75 mm Filter Material

The 75 mm filter material or equivalent will be used to act as a separator between the tailings and waste rock material or above/beside the finger drains. This material will act as a filter for the tailings and restrict it from infiltrating the coarser material. The use of a properly bedded heavy-weight non-woven geotextile may be used in lieu of the 75 mm filter material.

The 75 mm filter material must be well-graded sand and gravel with a 75 mm maximum aggregate size and a fines content (i.e. that passing the 0.08 mm sieve size) limited to 15%. The recommended gradation for the filter material is shown in Table 11, or other materials as approved by the Engineer. Select residuum from the open pit will be an acceptable source.

TABLE 11: GRADATION OF 75 mm FILTER MATERIAL

SIEVE SIZE (mm)	% PASSING BY MASS
75.0	100
25.0	65 – 100
12.5	50 – 100
5.0	35 – 90
0.825	17 – 50
0.425	10 – 35
0.160	2 – 23
0.080	0 – 15

9.1.3 Finger Drain Material

The finger drain material must be free draining, and will be comprised of select open pit waste rock with a nominal size of 300 mm. To facilitate proper drainage, the fines (<0.080 mm sieve size) content must be less than 5% by weight. The maximum particle size allowed will be 600 mm, or as approved by the Engineer.

9.1.1 200 mm Material

The 200 mm material will be used to construct the surface diversion berms. It must be a well-graded material with a nominal 200 mm maximum aggregate size and a fines content (< 0.08 mm sieve size) limited to about 15%, or as approved by the Engineer.

9.2 CONSTRUCTION REQUIREMENTS

The following information describes a construction plan for the tailings stack that satisfies requirements for an engineered structure. The proposed construction sequencing and details of the placement and compaction processes can be found in the following sections of this report.

The construction plan must satisfy the following requirements for the structure to meet the design intent.

- The subgrade preparation must sequentially flatten and/or remove all trees from the stack footprint. Disturbance to the organic soil must be minimal. All tree remnants must be removed from below the granular drainage blanket and finger drains.
- The subgrade preparation must be completed in the late winter, sufficiently in advance of spring run-off.
- The waste rock for the starter bench and drainage blanket must be sourced and these components must be constructed prior to the active layer thawing (must be complete by April 30).
- The finger drains must be constructed within the natural drainage courses.
- Tailings placement must be limited to no more than 3.0 m of thickness in any area during a given year, and all tailings must freeze completely in the following winter before any additional tailings are placed.
- Frozen tailings from winter construction should be protected from thawing, where practical.
- The starter bench is to be raised in elevation in conjunction with the tailings stack to provide the required waste rock shell for progressive reclamation.
- A quality assurance program must be implemented that will provide data on fill temperatures, placement water content, lift thicknesses, and in situ density.

The following components are required for construction before start-up of operations as shown in Figures 2 and 3.

- Ground surface preparation over the entire footprint of the tailings stack starter bench and 120 m upslope. Ground surface preparation is limited to the flattening and removal of trees from the area.
- Placement of a tailings starter bench comprising a minimum 2.0 to 2.5 m thick layer of waste rock.
- Placement of a drainage blanket comprising a minimum 1.5 m thick layer of select waste rock overlain by about 0.3 m of 75 mm filter material or equivalent.

- Partial construction of four finger drains along the valley lines as shown in Figure 3. These drains ultimately extent into the upper reaches of the tailings stack catchment area.
- Construction of surface water diversion berms.

The following process is required during mine operations.

- Ground surface preparation in advance of the tailing placement.
- Placement, spreading and compaction of tailings to build up the tailings stack. The tailings lift thickness is to be no more than 0.5 m and compacted to at least 95% SPMDD.
- General maintenance of the surface water diversion berms and finger drains.
- Dust control as required.
- Address localized surface sloughing and slumping issues, if any.
- Keep the tailings area free of snow in the winter to promote deeper seasonal frost penetration.

9.3 SCHEDULE

For construction planning purposes, the following generalized schedule for the stack construction is suggested:

January to March 2007

- Prepare ground surface for the construction for the starter bench and drainage blanket;
- Construct the starter bench and drainage blanket; and
- Prepare ground surface for the Year 1 tailings deposition area.

April 2007

- Placement of filter material, or equivalent.

May 2007 and onwards

- Commence tailings deposition in the Year 1 area;
- Construct the finger drains into the Year 2 tailings deposition area;
- In winter 2007/2008, continue with tailings deposition and prepare surface to Year 3 limits, etc.

9.4 GROUND SURFACE PREPARATION

Surface preparation within the tailings stack area should be limited to the sequential flattening and removal of trees. All trees must be removed from beneath the blanket filter and toe drains, but trees need only be sheared off and flattened under the tailings stack.

This must be completed in the winter with the standing trees being sheared off just above the ground surface. Minimal disturbance to the ground surface is required to protect the underlying permafrost foundation material. Trees that are removed should be stockpiled (not burnt) and then placed against the toe of the starter bench, for additional permafrost preservation.

9.5 MATERIAL PLACEMENT

Materials placement will be detailed in the Construction Drawings, and is summarized in the following sections. The effectiveness of the utilized construction technique will be evaluated in the field by the Geotechnical Engineer and changes to the construction procedure will be made as required.

9.5.1 Waste Rock Material

The waste rock materials for the outer shell and drainage blanket should be placed and compacted in maximum 1.5 m lifts. Compaction of this material will be achieved by routing heavy equipment (i.e. haul trucks,) evenly over each lift. A minimum of 5 passes is recommended. This material must be placed in a manner that will minimize segregation or nesting of coarse particles. The effectiveness of this construction technique will be evaluated in the field by the Geotechnical Engineer and changes to the construction procedure will be made as required. Boulders greater than 750 mm size should be removed from the fill as much as practically possible and pushed to the slope face.

9.5.2 75 mm Filter Material

The 75 mm filter material should be placed in maximum lift thicknesses of 300 mm, with each lift compacted at existing moisture content to approximately 95% of SPMDD.

9.5.3 Finger Drain Material

The finger drain material should be placed on geotextile and nominally compacted, as directed by the Engineer, to minimize settlement by ensuring rock-on-rock contact. This material must be placed in a manner that will minimize segregation or nesting of coarse particles. The effectiveness of the construction technique will be evaluated in the field by the Geotechnical Engineer and changes to the construction procedure will be made as required.

9.5.4 200 mm Material

The 200 mm filter material for surface water diversion berms should be placed in maximum lift thicknesses of 400 mm and each lift compacted to approximately 95% of SPMDD.

9.5.5 Tailings

The tailings should be placed in maximum lift thicknesses of 500 mm, with each lift compacted to no less than 95% of SPMDD. The laboratory results, as presented in Section 6, indicate that 95% of SPMDD equates to a dry density of 1,600 kg/m^3. To achieve this density, the tailings should be at a moisture content of between 12 and 22%

(mass of water/mass of dry solids). Processing plans indicate the tailings will have a moisture content of 20% as it enters the DSTSF; therefore, moisture conditioning during placement is not anticipated. During initial tailings placement, a performance specification should be developed to ensure adequate compaction of each lift.

The Atterberg Limits give an indication of the mechanical sensitivity of the tailings material at different moisture contents. The plastic limit (PL) defines the moisture content at which the material changes from being a semisolid to a plastic state and the liquid limit (LL) defines the moisture content at which the material changes from a plastic state to a liquid state. The tailings have a plastic limit of 16% and a liquid limit between 20% and 23%. Given the tailings will have a moisture content of 20% as it enters the DSTSF, trafficability could be impaired with any increase in moisture content.

9.6 WINTER OPERATION

Winter operation will involve the placement of tailings in subzero temperatures and the management of accumulated snowfall.

Tailings placement and compaction must address freezing temperatures. A procedure must be in place prior to operation, to achieve the required tailings placement design criteria in winter conditions.

Snow must be removed from the tailings stack and placement area. The snow can be graded to the downstream side of the waste rock shell.

9.7 QUALITY ASSURANCE

A construction quality assurance program must be developed to ensure that construction-sensitive features of the design are achieved. The elements of the program should include but not be limited to the following:

- Specific engineering approvals at critical times, such as foundation preparation and fill placement;
- Monitoring and field testing of fill materials on a intermittent basis;
- Specific approval of construction procedures for moisture conditioning and placement of all fill materials;
- Periodic processing and review of temperature data collected from ground temperature cables installed in the fill as part of long-term monitoring (see Section 10);
- Defined procedures for reporting with identified responsibilities for decision making during construction;
- Specific requirements and testing frequencies for the Quality Assurance process during construction are to be set out prior to start-up;
- A Tailings Operations, Maintenance and Surveillance manual be completed prior to start up;

- Photographs of the construction progress;
- Preparation of as-built drawings;
- Conduct a summer 2007 field program to determine an effective placement method which ensures design criteria; and
- Conduct a winter 2007/2008 field program to determine an effective placement method which ensures design criteria.

10.0 LONG TERM MONITORING

10.1 PURPOSE

Performance monitoring is an integral part of the design, construction, and operation of the stack. This section describes a recommended minimum monitoring program for the construction and operation phases of the project. The monitoring program serves three functions:

- Monitor the thermal regime of the foundation materials and tailings stack to validate the thermal predictions;
- Monitor the porewater pressure regime of the foundation materials and tailings stack to validate the stability predictions; and
- Monitor surface movements of the stack.

The results of the monitoring program can be the basis of an adaptive management process that continually reviews the operation and optimizes the placement methods. There are potential opportunities to increase slope angles and lift thicknesses based on appropriate performance data. Additional information on the components of the monitoring program is presented in the following sections. The recommended instrumentation program will be shown on the construction drawings.

10.2 THERMAL REGIME

An instrumentation program is recommended for implementation. A total of five ground temperature cables are to be installed. The manually obtained ground temperature data should be collected and reviewed on a monthly basis.

10.3 PIEZOMETERS

Three piezometers are recommended. These instruments will confirm the assumed phreatic surfaces used for the stability analyses and monitor any build up of porewater pressure.

10.4 DEFORMATION AND SETTLEMENT

The starter bench and tailings stack should be surveyed to determine the as-built profile and to establish a basis for determining future settlements.

Settlement monuments will be installed along the crest of the waste rock starter bench. They should be surveyed and reviewed after construction, after one year and then periodically at the discretion of the Engineer to monitor settlement and horizontal movements.

Should an area show signs of distress, survey pins should be installed and monitored to assess future remedial actions.

11.0 ANNUAL INSPECTION

It is recommended that an annual site inspection be conducted by the Geotechnical Engineer during the operational period to document the performance of the DSTSF. After closure, a revised and less frequent schedule can be adopted. The specific tasks of these visits include:

- inspection of the internal and external slopes for any signs of distress;
- inspection of the crest of the stack for any signs of transverse cracking;
- inspection of the stack for any signs of seepage from the base;
- review of temperature, porewater pressure, settlement and movement data to confirm conformance with design assumptions; and
- preparation of an annual report that summarizes the data and provides recommendations for maintenance or modification to the tailings management plan.

12.0 LIMITATIONS

Geological conditions are innately variable and are seldom spatially uniform. At the time of this report, information on stratigraphy at the project was at identified borehole locations from past studies. In order to develop recommendations from this information, it is necessary to make some assumptions concerning conditions other than at the specifically tested locations. Adequate monitoring should be provided during construction to check that these assumptions are reasonable.

The recommendations prepared and presented in this report are based on the geotechnical data gathered by EBA from previous reports and the current laboratory testing. The provided data, in the form of geotechnical boreholes and associated laboratory index property test results, has been supplemented by EBA's direct observations of the site.

This report and the recommendations contained in it are intended for the sole use of Minto Explorations Ltd. EBA does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report if the information presented in this report is used or relied upon by any party other than that specified above for the proposed DSTSF. Any such unauthorized use of this report is at the sole risk of the user. Additional information regarding the use of this report is presented in the attached General Conditions, which form a part of this report.

13.0 CLOSURE

EBA trusts that this report satisfies you requirements. Please do not hesitate to contact the undersigned should you have any questions or comments.

Respectfully Submitted,
EBA Engineering Consultants Ltd.

J.P.W. BERKERS

J. RICHARD TRIMBLE

Jan 15/07

prepared by:
Jason P.W. Berkers, P.Eng.
Project Engineer
Direct Line: 867.668.2071 x33
jberkers@eba.ca

reviewed by:
J. Richard Trimble, M.Sc. (Eng.), P.Eng.
Project Director, Yukon Region
Direct Line: 867.668.2071 x22
rtrimble@eba.ca

Nigel Goldup

reviewed by:
Nigel Goldup, P.Eng. (AB)
Project Director, Circumpolar Region
Direct Line: 780.451.2130 x301
ngoldup@eba.ca

reviewed by:
Don W. Hayley, P.Eng.
Principal Engineer
Direct Line: 250.767.9033
dhayley@eba.ca

PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
SIGNATURE
Date January 15/07
PERMIT NUMBER PP003
Association of Professional
Engineers of Yukon

REFERENCES

British Columbia Mine Waste Rock Pile Research Committee, 1991. Mined Rock and Overburden Piles Investigation and Design Manual, 128 pages.

Robinsky, E.I and Associates Ltd., 1995. Technical Feasibility Study, Thickened Tailings Disposal System, Minto Project Yukon.

Steffen, Robertson and Kristen Ltd., 1994. Geotechnical Evaluation - Minto Core. Internal report submitted to Minto Explorations, 43 pages.

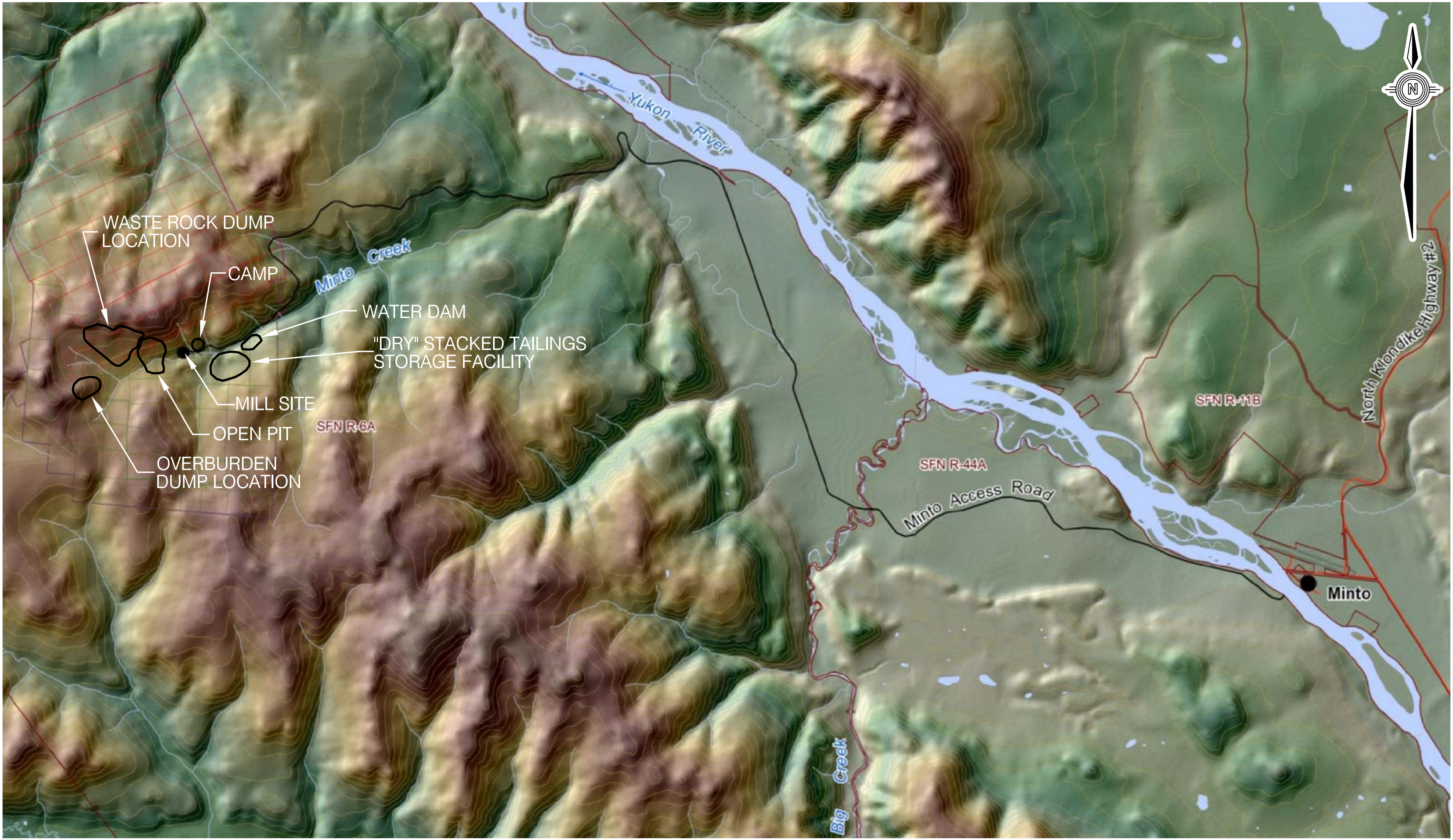
EBA Engineering Consultants Ltd., 1995. Geotechnical Design Tailings/Water Retention Dam, Minto Explorations Ltd., Minto Project, Yukon. (Project No. 0201-95-11509, dated December 1995).

EBA Engineering Consultants Ltd., 1997. 1996 Geotechnical Drilling Program, Minto Exploration Ltd., Minto Mine Property, Yukon. (Project No. 0201-96-11509, dated January 1997).

EBA Engineering Consultants Ltd., 1998. Geotechnical Evaluation – Proposed Main Waste Dump, Minto Explorations Ltd., Minto Project, Yukon. (Project No. 0201-95-11509, dated April 1998).

FIGURES

Q:\Whitehorse\Data\0201drawings\Minto\TAILINGS MANAGEMENT JPB\Report figures\1200173 Figure 1 Loc Plan.dwg [FIG 1 8.5X11L] January 04, 2007 - 5:11:16 pm (BY: CHAD COWAN)



1000m 0 1000m 2000m 3000m 4000m

BAR SCALE

CLIENT

Minto Explorations Ltd.

EBA Engineering Consultants Ltd.

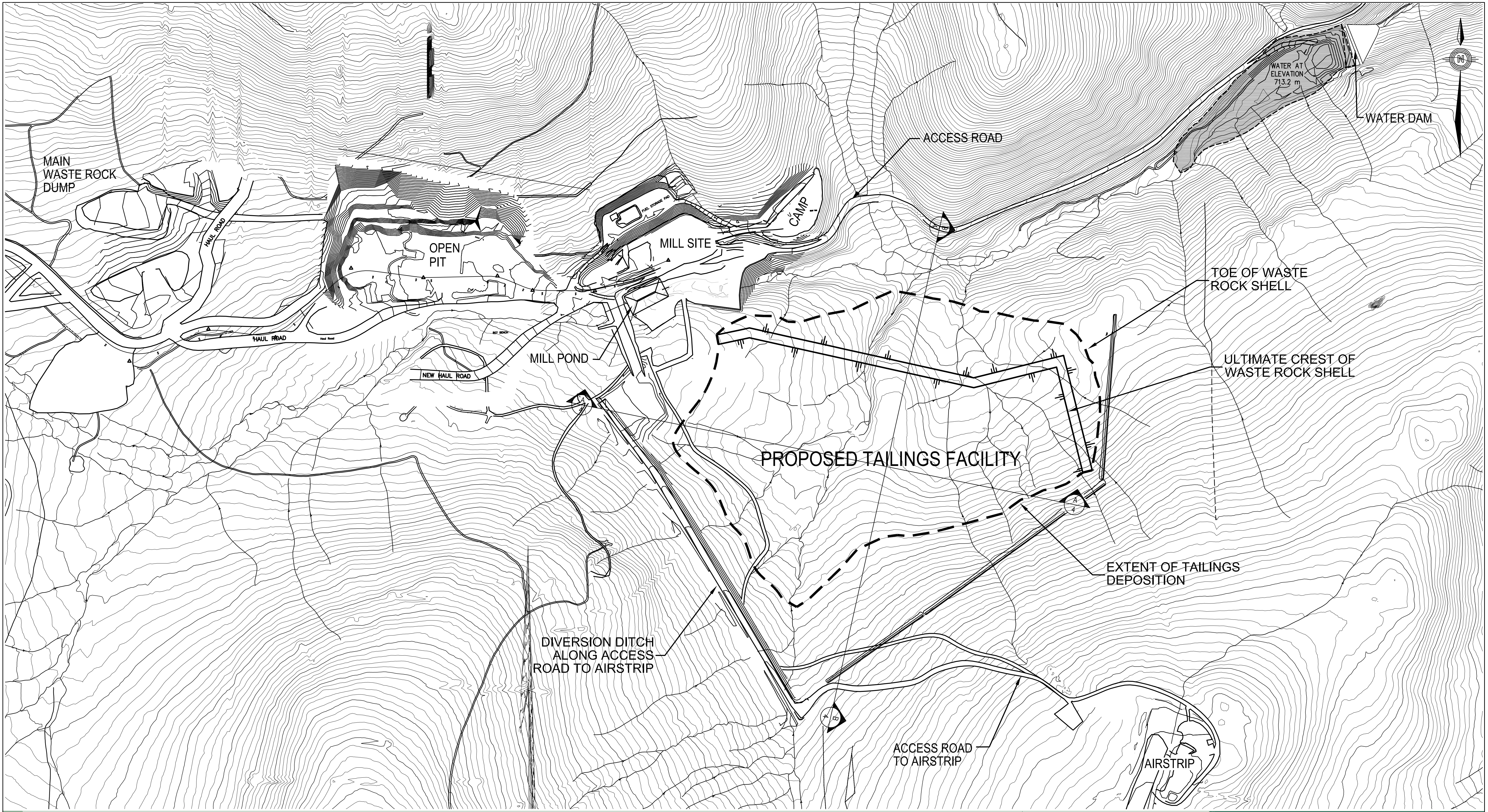
eba

Geotechnical Report
"Dry" Stacked Tailings Storage Facility
Minto Mine, YT

Location Plan

PROJECT NO.	DWN	CKD	REV
1200173	JSB	JRT	0
OFFICE	DATE		
EBA-WHSE	January 5, 2007		

Figure 1



CLIENT

Minto Explorations Ltd.

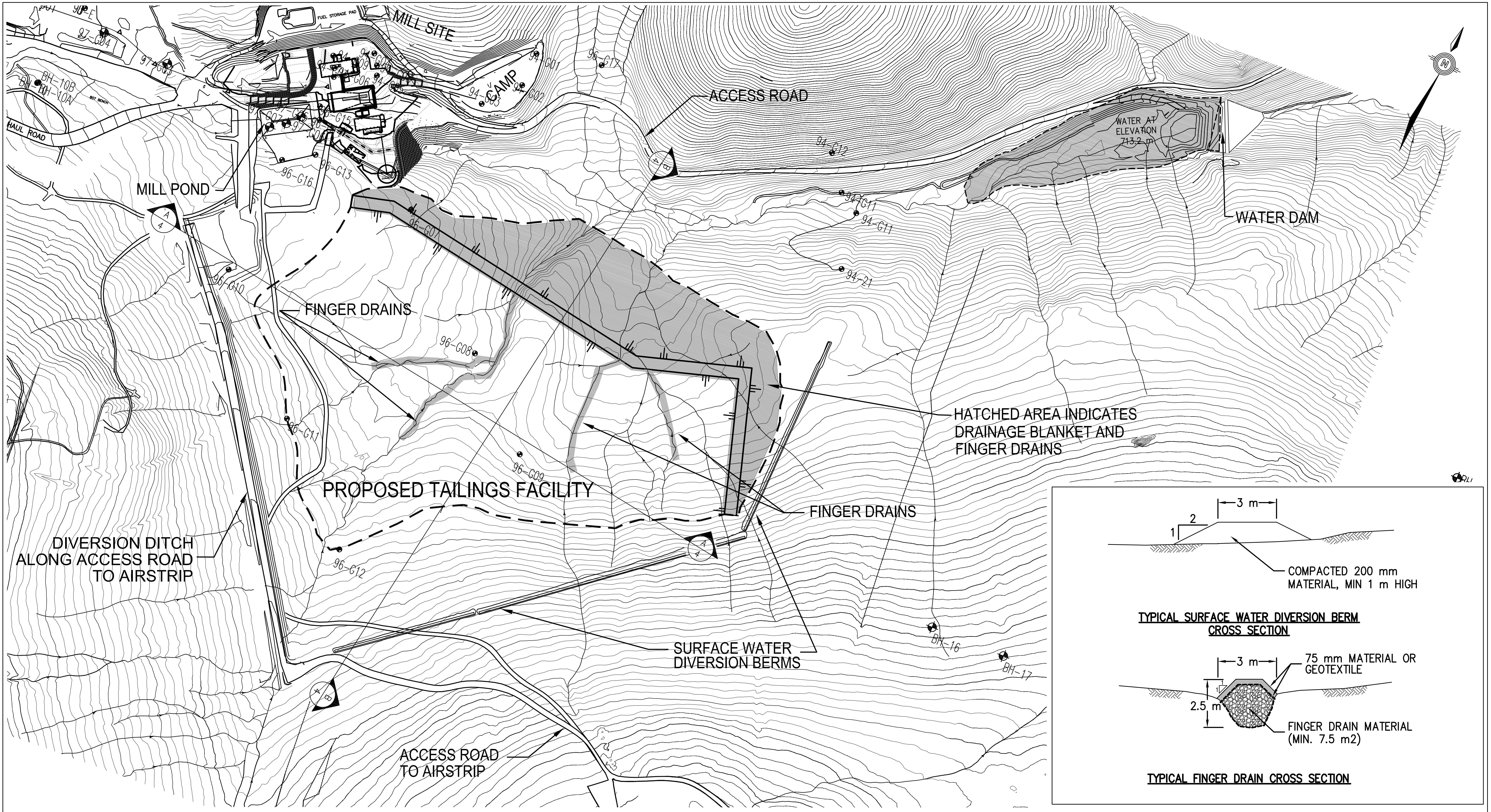
EBA Engineering Consultants Ltd.

Geotechnical Report
"Dry" Stacked Tailings Storage Facility
Minto Mine, YT

General Site Plan

PROJECT NO.	DWN	CKD	REV
1200173	JSB	JRT	0
OFFICE	DATE		
EBA-WHSE	January 5, 2007		

Figure 2



0 250 500 750 metres

SCALE 1 : 6,000

CLIENT

Minto Explorations Ltd.

EBA Engineering Consultants Ltd.

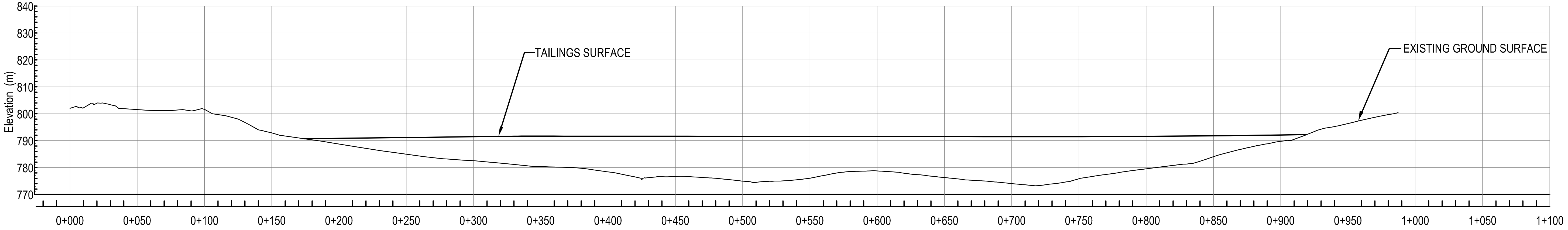
Geotechnical Report
"Dry" Stacked Tailings Storage Facility
Minto Mine, YT

Tailings Facility Site Plan & Details
(Showing Geotechincal Borehole Locations)

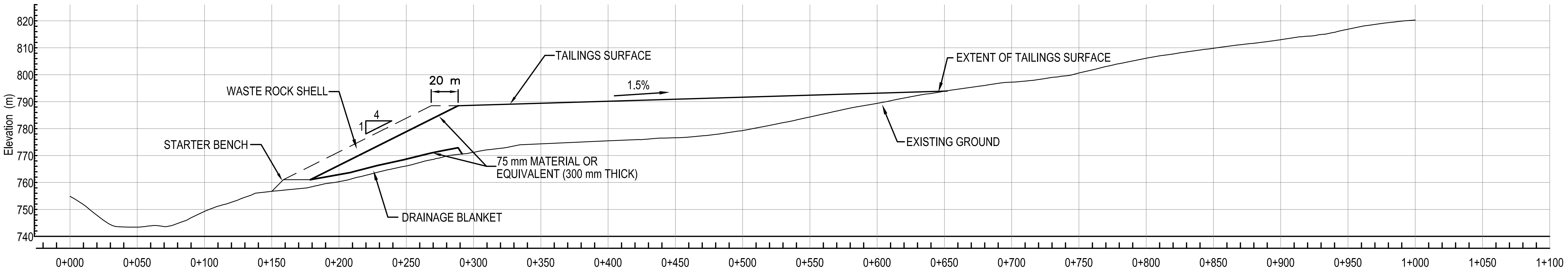
PROJECT NO.	DWN	CKD	REV
1200173	JSB	JRT	0
OFFICE	DATE		
EBA-WHSE	January 5, 2007		

Figure 3

Q:\Whitehorse\Data\0201drawings\Minto\TAILINGS MANAGEMENT JPB\Report figures\1200173 Figure 3 Tailings Plan.dwg [LAYOUT1] January 11, 2007 - 9:57:23 am (BY: JAMES BUYCK)



Cross-Section A



0 100
Scale: Metres, Vertically Exaggerated 2 times

Cross-Section B

CLIENT

Minto Explorations Ltd.

EBA Engineering Consultants Ltd.

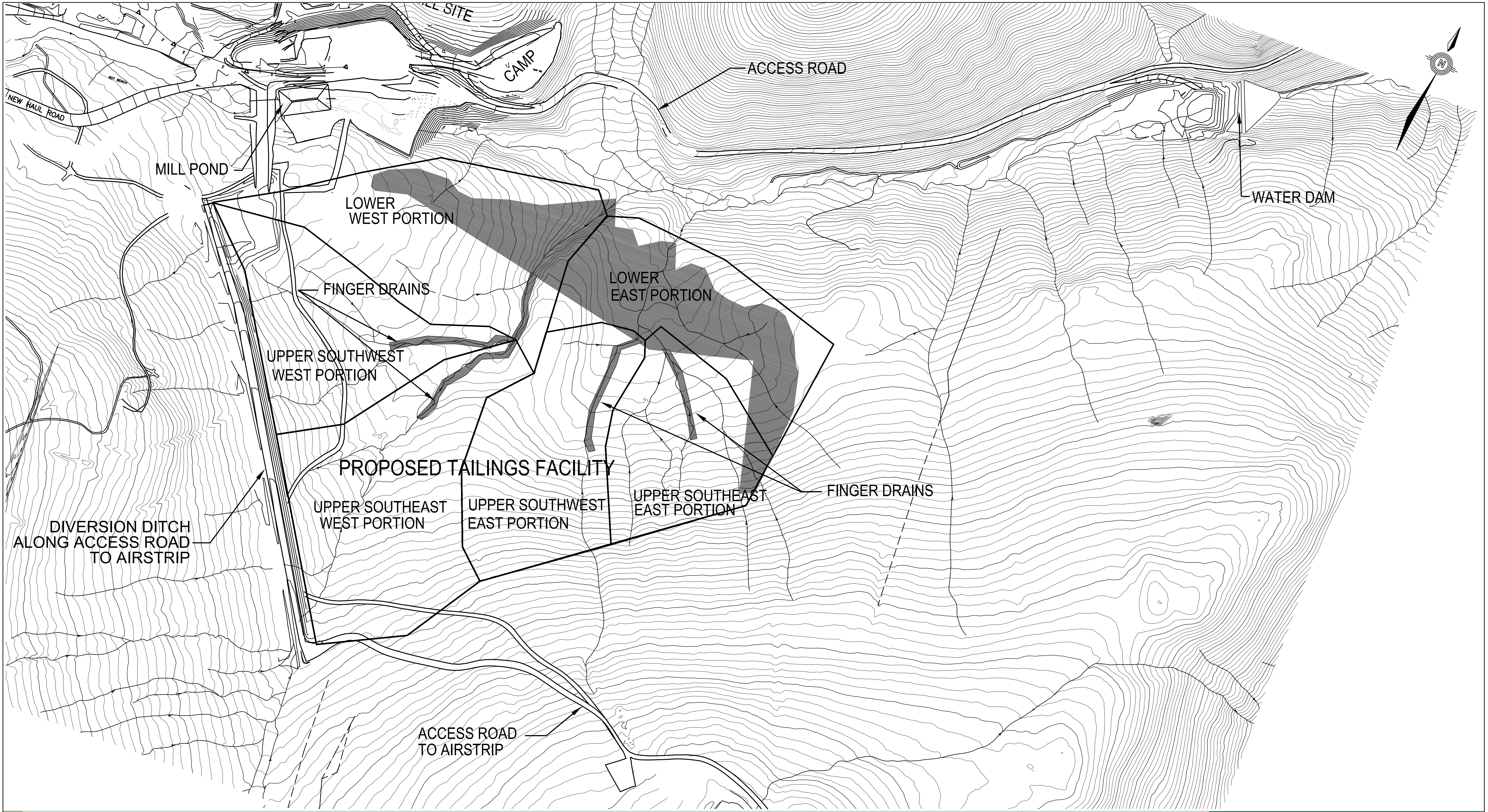
Geotechnical Report
"Dry" Stacked Tailings Storage Facility
Minto Mine, YT

Tailings Facility
Typical Cross Sections

PROJECT NO.	DWN	CKD	REV
1200173	JSB	JRT	0
OFFICE	DATE		
EBA-WHSE	January 5, 2007		

Figure 4

Q:\Whitehorse\Data\0201drawings\Minto\TAILINGS MANAGEMENT JPB\Report figures\1200173 Figure 4 xsection.dwg [LAYOUT1] January 04, 2007 - 5:14:27 pm (BY: CHAD COWAN)



CLIENT

Minto Explorations Ltd.

EBA Engineering Consultants Ltd.

Geotechnical Report
"Dry" Stacked Tailings Storage Facility
Minto Mine, YT

Tailings Facility
Surface Drainage Subcatchments

PROJECT NO.	DWN	CKD	REV
1200173	JSB	JRT	0
OFFICE	DATE		
EBA-WHSE	January 5, 2007		

Figure 5

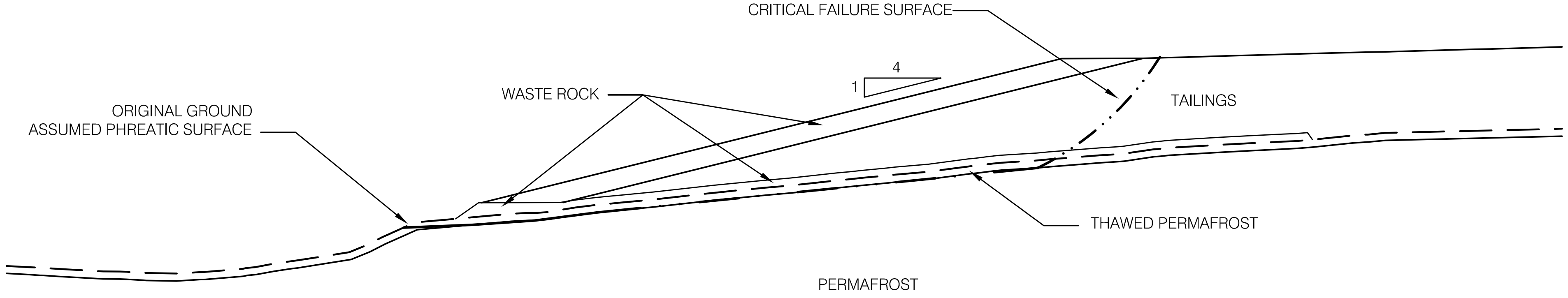
Q:\Whitehorse\Data\0201drawings\Minto\TAILINGS MANAGEMENT JPB\Report figures\1200173 Figure 5 Catchment.dwg [LAYOUT1] January 04, 2007 - 5:15:17 pm (BY: CHAD COWAN)

Q:\Whitehorse\Data\0201drawings\Minto\TAILINGS MANAGEMENT JPB\Report figures\1200173 Figure 6 stability.DWG [LAYOUT1] January 04, 2007 - 5:16:10 pm (BY: CHAD COWAN)

SOIL PARAMETERS

MATERIAL	BULK DENSITY (kN/m3)	FRICTION ANGLE (DEGREES)	COHESION (kPa)
TAILINGS	19.4	28	0
WASTE ROCK	20.0	35	0
THAWED PERMAFROST	18.4	28	0
PERMAFROST	--	--	--

	MINIMUM FACTOR OF SAFETY DOWNSTREAM
STATIC, FINAL SECTION, Ru = 0	2.27
STATIC, FINAL SECTION, Ru = 0.4	1.45
EARTHQUAKE, FINAL SECTION, Ru = 0	1.84
EARTHQUAKE, FINAL SECTION, Ru = 0.4	1.16



SECTION A–A’

0 20 40 60 80 100 metres

SCALE 1:1250

CLIENT

Minto Explorations Ltd.

EBA Engineering Consultants Ltd.

Geotechnical Report
"Dry" Stacked Tailings Storage Facility
Minto Mine, YT

Tailings Facility
Slope Stability Analyses

PROJECT NO.	DWN	CKD	REV
1200173	JSB	JRT	0
OFFICE	DATE		
EBA-WHSE	January 5, 2007		

Figure 6

APPENDIX

APPENDIX A GENERAL CONDITIONS

GEOTECHNICAL REPORT – GENERAL CONDITIONS

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

1.0 USE OF REPORT AND OWNERSHIP

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

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

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 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.

3.0 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.

4.0 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.

5.0 SURFACE WATER AND GROUNDWATER CONDITIONS

Surface and groundwater conditions mentioned in this report are those observed at the times recorded in the report. These conditions vary with geological detail between observation sites; annual, seasonal and special meteorologic conditions; and with development activity. Interpretation of water conditions from observations and records is judgmental and constitutes an evaluation of circumstances as influenced by geology, meteorology and development activity. Deviations from these observations may occur during the course of development activities.

6.0 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.

7.0 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.

8.0 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.

9.0 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.

10.0 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.

11.0 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.

12.0 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.

13.0 STANDARD OF CARE

Services performed by EBA for this report have been conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practising under similar conditions in the jurisdiction in which the services are provided. Engineering judgement has been applied in developing the conclusions and/or recommendations provided in this report. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of this report.

14.0 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.

15.0 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), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by EBA shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancies, the hard copy versions shall govern over the electronic versions. Furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed version archived by EBA shall be deemed to be the overall original for the Project.

The Client agrees that 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. The Client warrants that EBA's instruments of professional service will be used only and exactly as submitted by EBA.

The Client recognizes and agrees that 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.

APPENDIX

APPENDIX B TAILINGS TEST RESULTS

EBA Engineering Consultants Ltd.

MOISTURE - DENSITY RELATIONSHIP

ASTM D698, D1557, or D2049

Project: Minto Copper Mine, YK

Sample Number: 920

Project No.: 0201-1200173

Date Tested: 06/05/30

Client: Minto Exploration Inc.

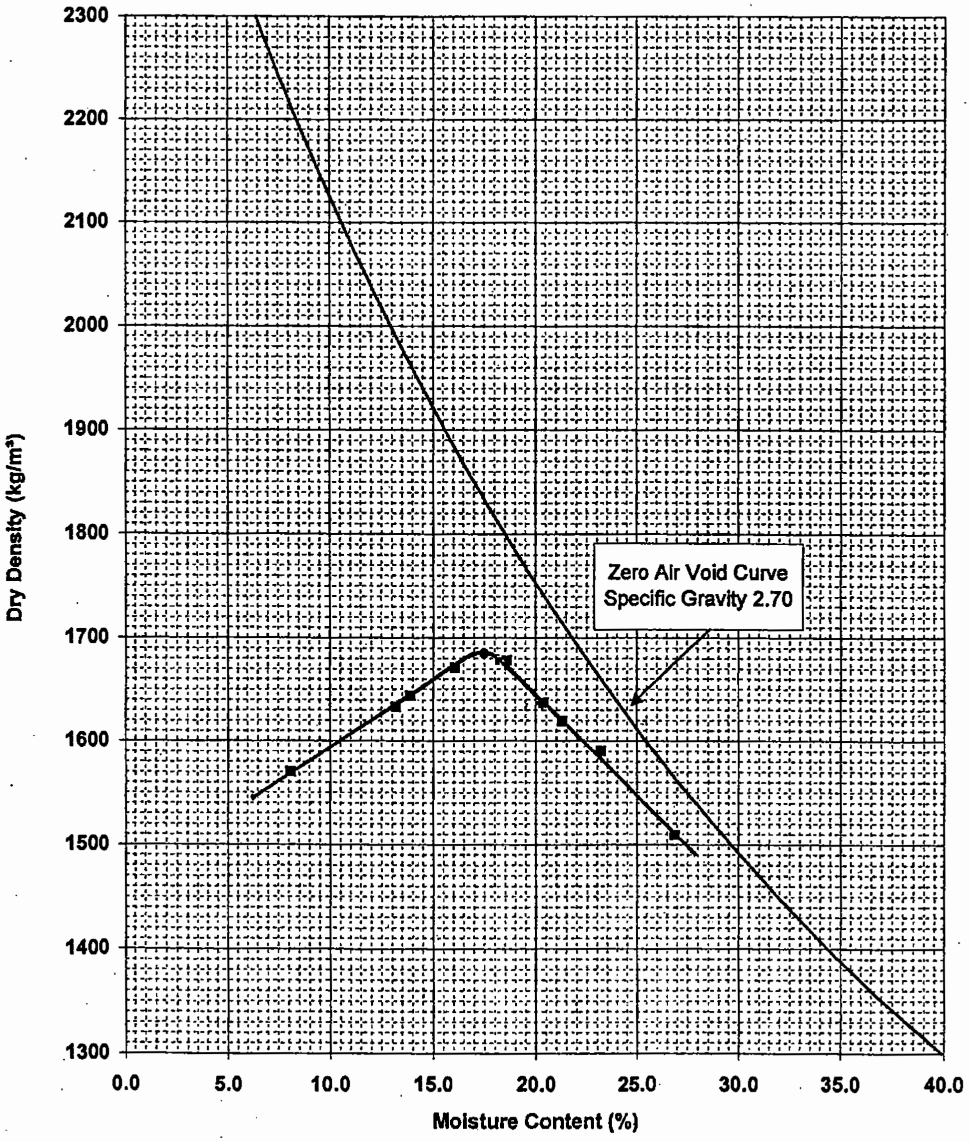
Moisture Content (as received): 12.2%

Soil Description: SAND (uniform, fine), tr. silt - brown

Maximum Dry Density: 1685 kg/m³

Sample Location:

Optimum Moisture Content: 17.5%



STANDARD PROCTOR

ASTM D698

Hammer Mass: 2.494 kg

Hammer Drop: 304.8 mm

Number of Layers: 3

Number of Blows/Layer: 25

Diameter of Mould: 101.4 mm

Height of Mould: 116.3 mm

Mould Volume: 0.000938 m³

Compactive Effort: 593.5 kJ/m³

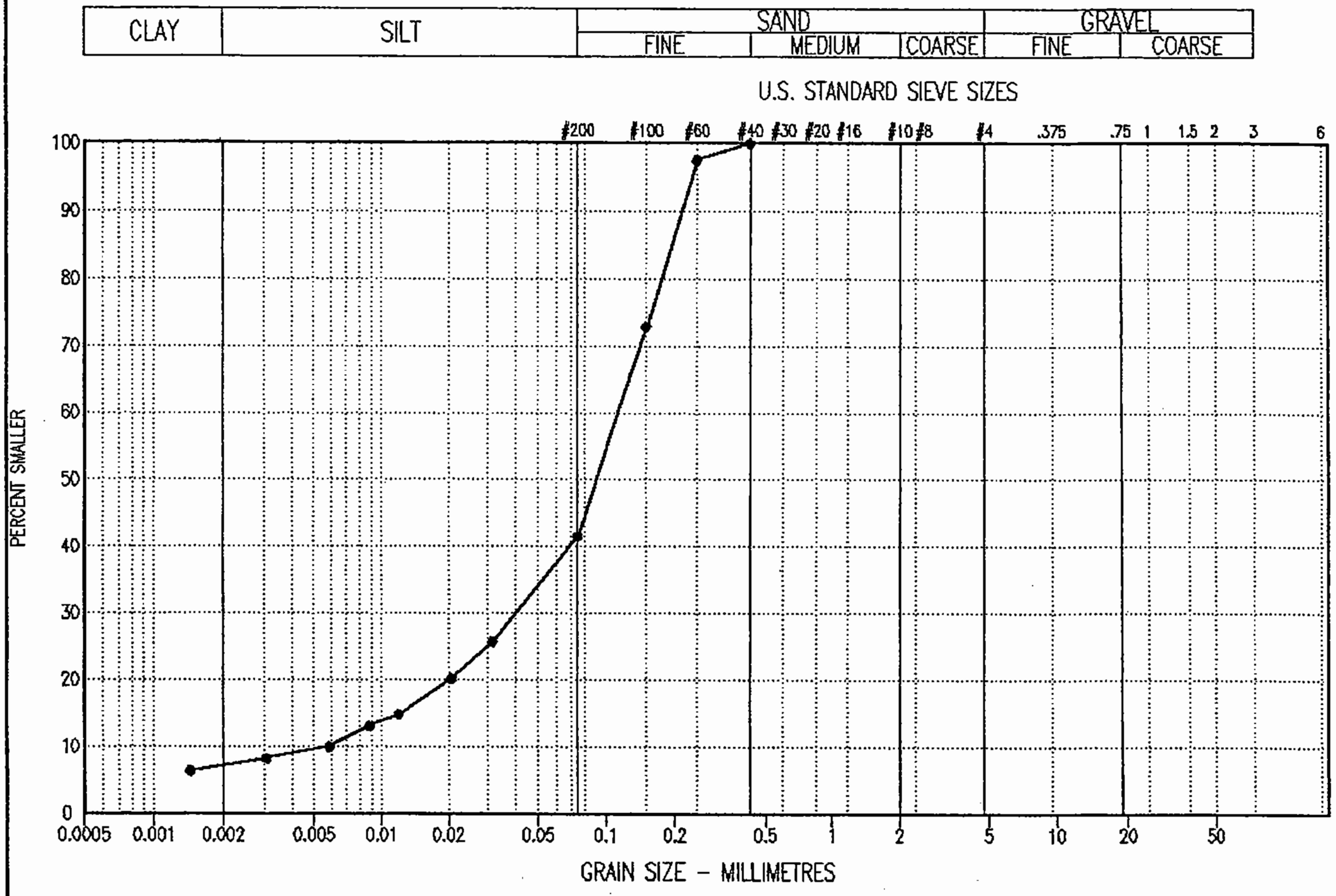
REVIEWED BY:

REMARKS:

eba

EBA Engineering

PARTICLE SIZE – ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (ft)	DESCRIPTION				Cu	Cc	U.S.C
			CLAY %	SILT %	SAND %	GRAVEL %			
●——●	7–BUCKETS	0.00	6.0	35	59	0	20.0	2.7	SM

Project: 0201–1200173

Date Tested: 06/05/29

BY: KP

Tested in accordance with ASTM D422 unless otherwise noted.

EBA Engineering Consultants Ltd.

CONSTANT HEAD PERMEABILITY TEST **MINTO MINE**

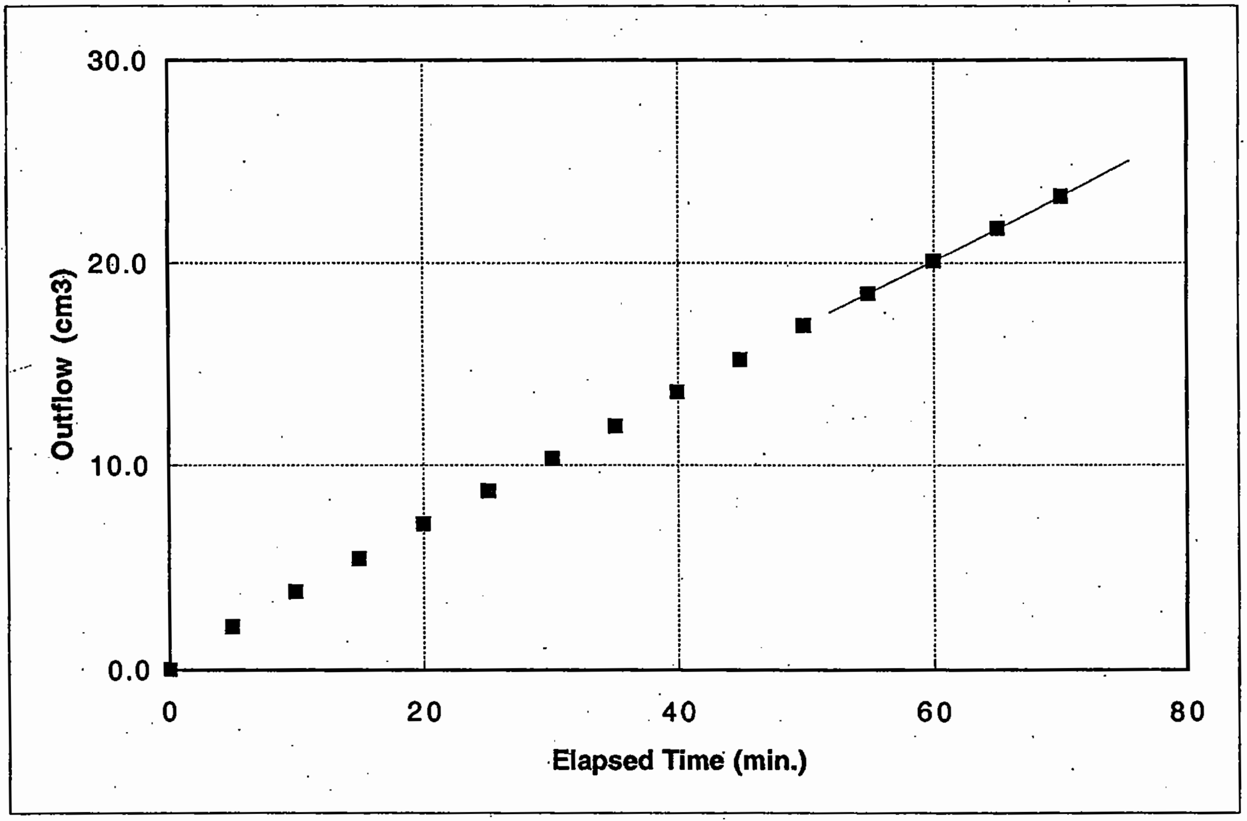
Job Number: 1200173
Sample No.: 1358

Date: 06-11-30
Test No: P-1

Time	Buret (cc)	Elap. (min)	Outflow (cc)
10:22	16.8	0	0.0
10:27	18.9	5	2.1
10:32	20.6	10	3.8
10:37	22.2	15	5.4
10:42	23.9	20	7.1
10:47	25.5	25	8.7
10:52	23.9	30	10.3
10:57	22.3	35	11.9
11:02	20.6	40	13.6
11:07	19.0	45	15.2
11:12	17.3	50	16.9
11:17	15.7	55	18.5
11:22	14.1	60	20.1
11:27	12.5	65	21.7
11:32	10.9	70	23.3

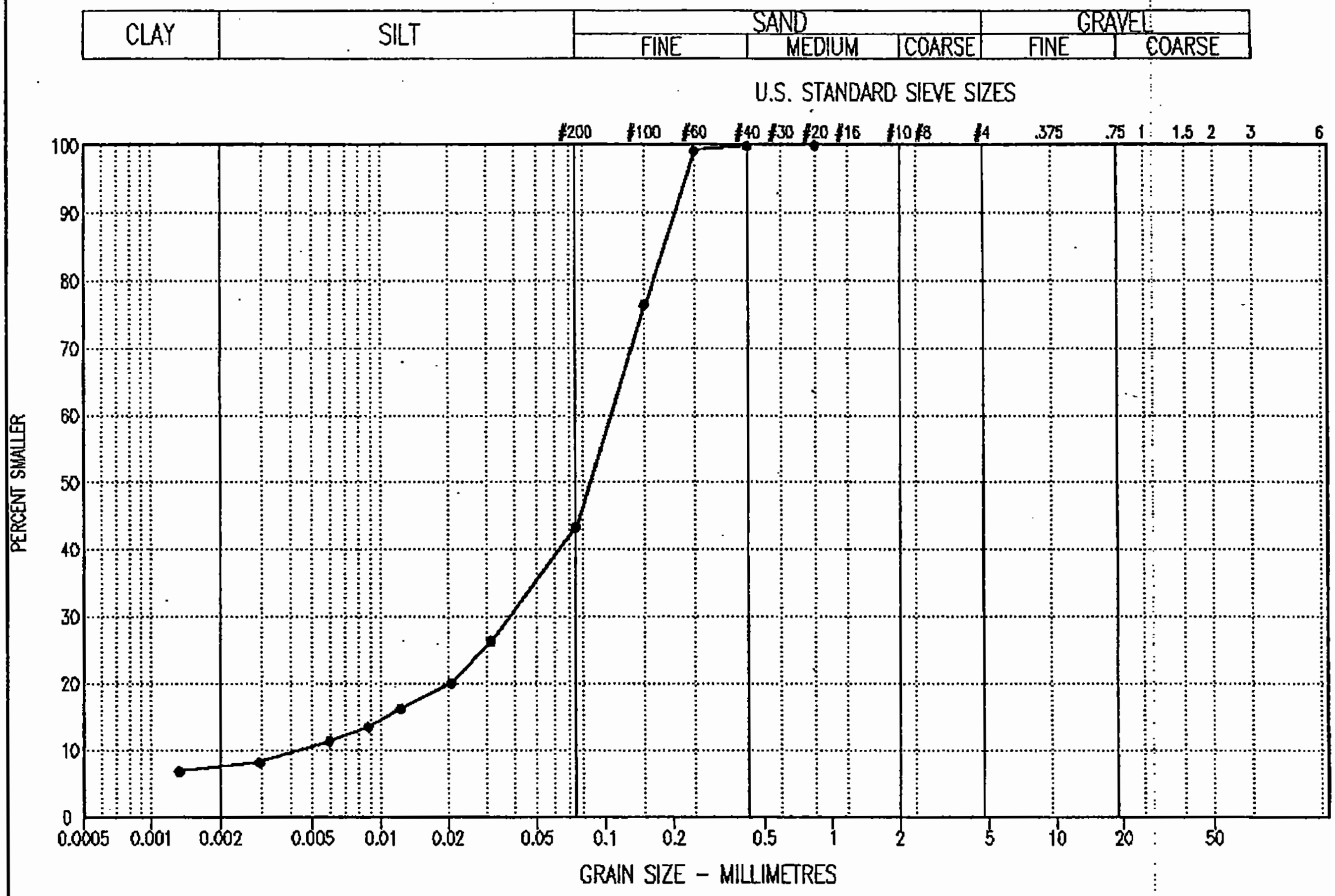
Diameter=	71.14	mm
Height=	50.60	mm
Volume=	201.13	cm^3
Head Diff.=	1	psi
Q=	0.005	cm^3/sec
i=	13.90	
A=	39.75	cm^2

K= 9.65E-06 cm/sec



EBA Engineering

PARTICLE SIZE – ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (ft)	DESCRIPTION				Cu	Cc	U.S.C
			CLAY %	SILT %	SAND %	GRAVEL %			
●—●	1358	0.00	7.0	36	57	0	23.8	3.1	SM

Project: 0201-1200173

Date Tested: 06/11/24

BY: KP

Tested in accordance with ASTM D422 unless otherwise noted.

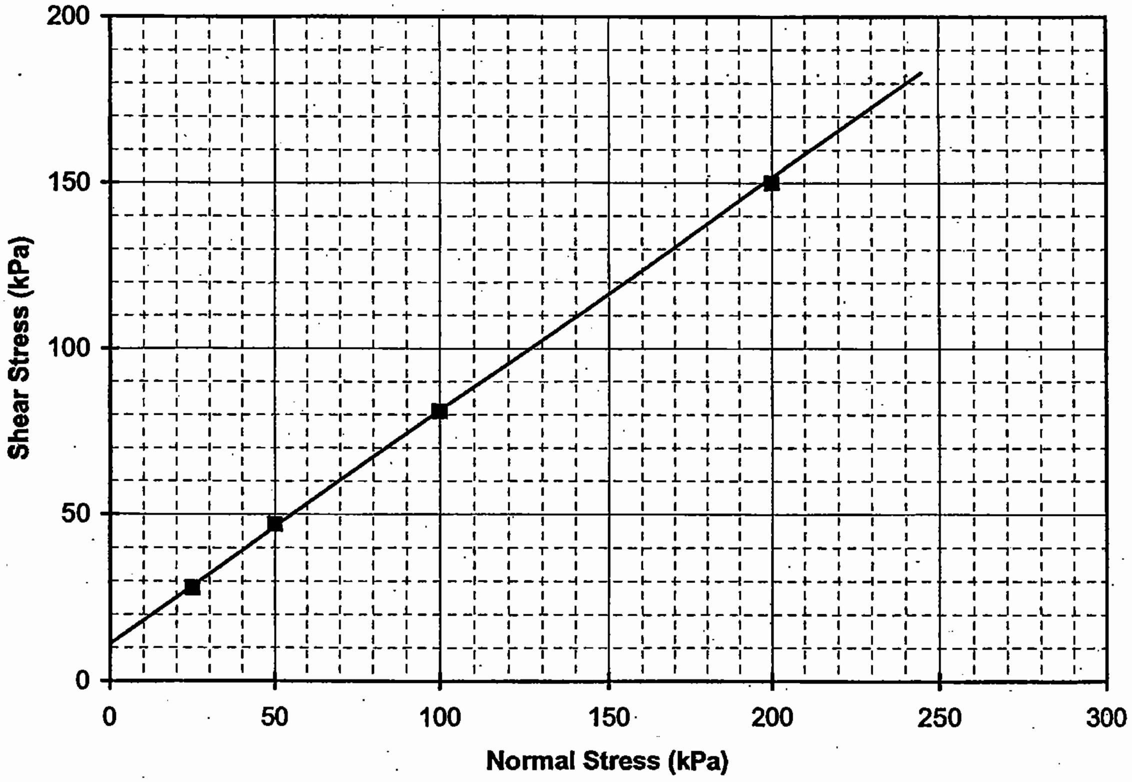
Summary of Direct Shear Test Results

Project : Minto Mine

Project No. : 1200173

Sample No.: 1358

Date : 06-11-29



Inferred Shear Strength Parameters :-

	Cohesion Intercept (kPa)	Inferred Angle of Shearing Resistance (Degrees)
Peak Strength	11	35.1
Residual Strength	n/a	n/a

EBA Engineering Consultants Ltd.

Direct Shear Test

Project No.: 1200173
Date Tested: 06-11-20

Sample No.: 1358
Test Number: DS-1

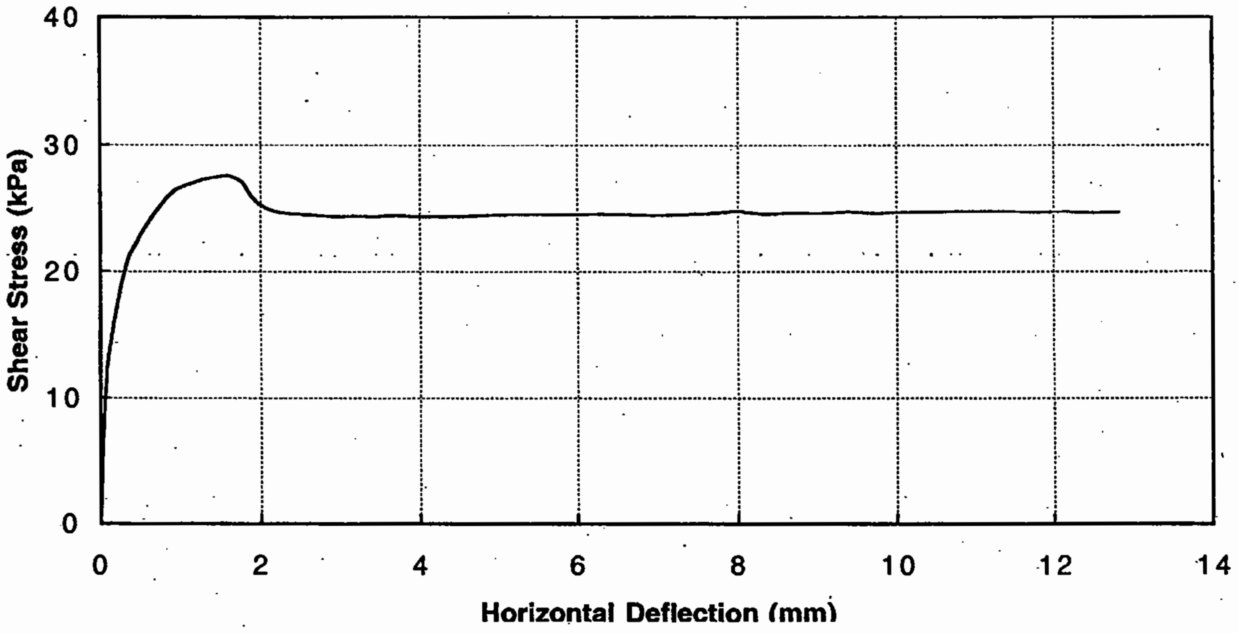
Initial Sample Conditions

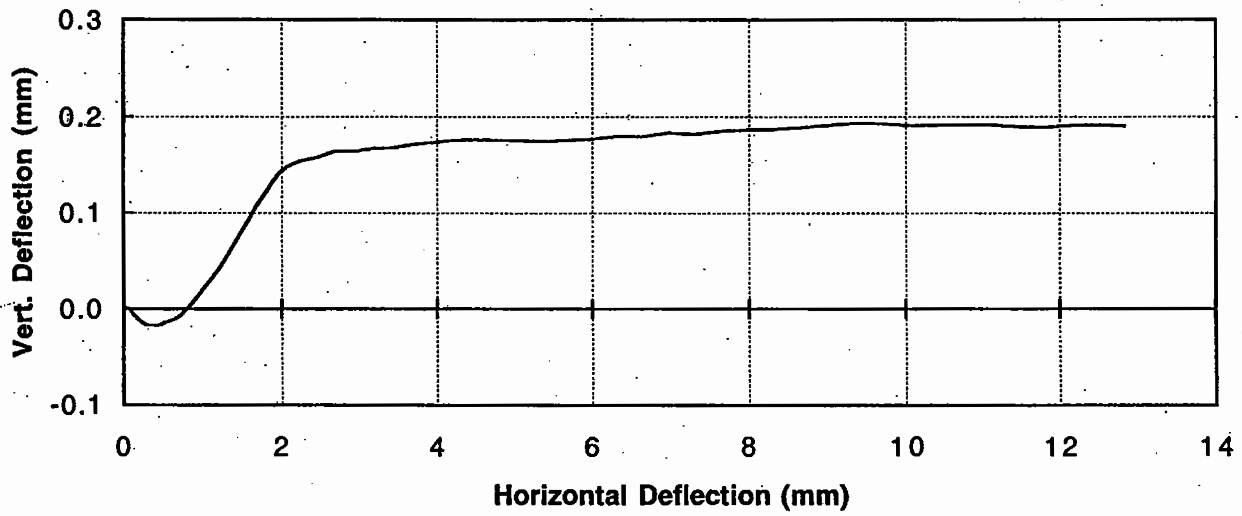
Moisture Content (%): 19.5
Wet Density (Mg/m^3): 1.968
Dry Density (Mg/m^3): 1.647

Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)
0.00	0.000	0.0
0.04	0.001	8.2
0.09	-0.001	12.5
0.13	-0.006	14.4
0.17	-0.010	16.0
0.22	-0.013	17.5
0.26	-0.016	18.9
0.31	-0.017	20.1
0.35	-0.018	21.2
0.45	-0.017	22.2
0.49	-0.016	22.7
0.54	-0.015	23.2
0.63	-0.012	24.1
0.72	-0.008	24.9
0.82	0.001	25.7
0.94	0.012	26.4
1.08	0.028	26.8
1.22	0.042	27.1
1.28	0.050	27.2
1.35	0.058	27.3
1.42	0.068	27.4
1.49	0.078	27.5
1.58	0.091	27.6
1.68	0.106	27.4
1.78	0.118	27.1
1.88	0.130	26.0
1.97	0.141	25.4
2.07	0.148	25.0
2.16	0.151	24.8
2.26	0.154	24.6
2.46	0.157	24.5
2.70	0.164	24.4
2.94	0.164	24.4
3.18	0.167	24.4
3.43	0.168	24.4
3.68	0.171	24.4
3.93	0.173	24.4
4.21	0.175	24.3
4.51	0.176	24.4
4.81	0.175	24.4
5.11	0.175	24.5
5.41	0.174	24.5
5.70	0.175	24.5
6.00	0.177	24.5
6.29	0.179	24.5
6.63	0.179	24.5
6.98	0.183	24.4
7.31	0.182	24.5
7.66	0.185	24.6
7.99	0.186	24.8
8.34	0.187	24.5
8.69	0.189	24.6
9.03	0.191	24.6
9.38	0.193	24.7
9.73	0.193	24.6
10.08	0.191	24.7
10.43	0.191	24.7
10.78	0.191	24.7
11.13	0.191	24.7
11.47	0.190	24.7
11.81	0.189	24.7
12.16	0.191	24.7
12.50	0.191	24.6
12.84	0.190	24.7

Direct Shear Test

Peak Stress = 28 kPa





Sample Number:	1358
Normal Stress(kPa):	25
Displ. Rate(mm/min.):	0.024
Test No.:	DS-1

EBA Engineering Consultants Ltd.

Direct Shear Test

Project No.: 1200173
Date Tested: 06-11-22

Sample No.: 1358
Test Number: DS-2

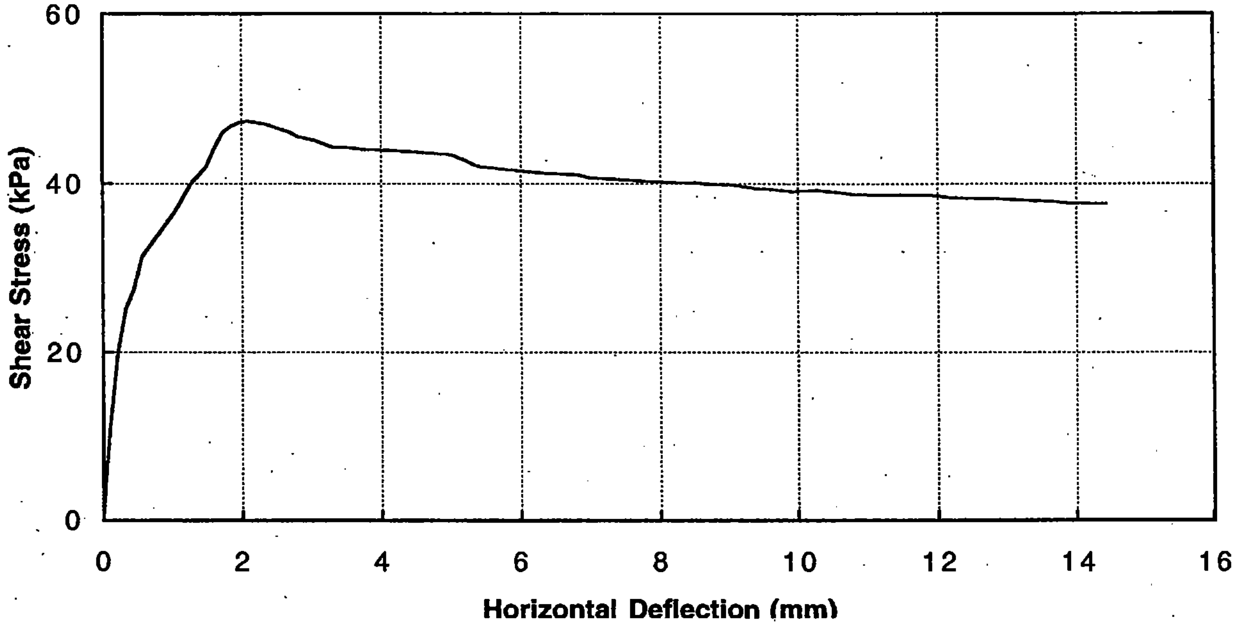
Initial Sample Conditions

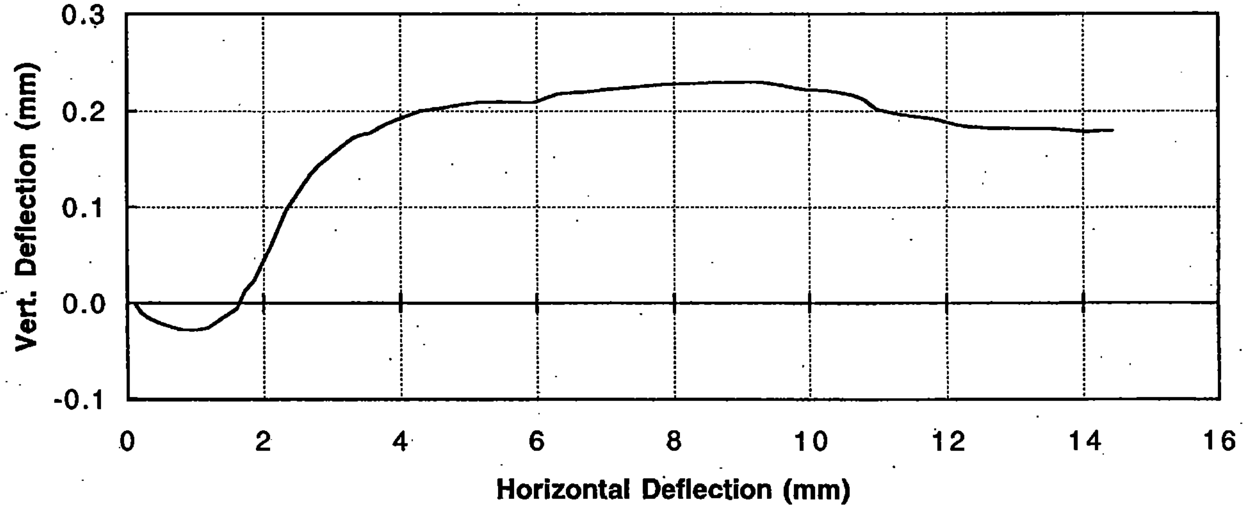
Moisture Content (%): 19.5
Wet Density (Mg/m^3): 1.965
Dry Density (Mg/m^3): 1.645

Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)
0.00	0.000	0.0
0.11	0.000	12.0
0.21	-0.011	20.0
0.32	-0.016	25.2
0.44	-0.020	27.5
0.56	-0.024	31.3
0.80	-0.029	34.0
1.03	-0.029	36.7
1.17	-0.027	38.7
1.25	-0.023	39.8
1.48	-0.012	42.0
1.61	-0.007	44.2
1.73	0.012	46.0
1.85	0.022	46.8
1.97	0.040	47.2
2.09	0.056	47.3
2.33	0.096	47.1
2.70	0.134	46.0
2.82	0.143	45.6
3.06	0.157	45.1
3.31	0.172	44.3
3.43	0.175	44.3
3.56	0.177	44.2
3.81	0.186	44.0
3.94	0.190	44.0
4.29	0.200	43.9
4.64	0.203	43.6
5.00	0.208	43.4
5.17	0.208	42.9
5.34	0.209	42.2
5.44	0.210	42.0
5.97	0.209	41.5
6.31	0.217	41.2
6.83	0.220	41.0
7.00	0.222	40.7
7.34	0.224	40.5
7.85	0.227	40.2
8.19	0.228	40.2
8.54	0.229	40.1
8.71	0.229	40.0
9.06	0.230	39.8
9.23	0.230	39.6
9.41	0.228	39.4
9.58	0.226	39.3
9.93	0.222	39.1
10.28	0.221	39.2
10.45	0.219	39.0
10.63	0.217	38.9
10.80	0.212	38.7
10.98	0.202	38.7
11.32	0.197	38.6
11.84	0.191	38.6
12.01	0.188	38.5
12.18	0.185	38.3
12.35	0.183	38.3
12.69	0.182	38.2
12.87	0.182	38.2
13.38	0.181	38.0
13.55	0.181	37.9
13.72	0.180	37.8
13.90	0.179	37.7
14.07	0.178	37.6
14.25	0.179	37.6
14.42	0.179	37.6

Direct Shear Test

Peak Stress = 47 kPa





Sample Number: 1358
Normal Stress(kPa): 50
Displ. Rate(mm/min.): 0.024
Test No.: DS-2

EBA Engineering Consultants Ltd.

Direct Shear Test

Project No.: 1200173
Date Tested: 06-11-22

Sample No.: 1358
Test Number: DS-3

Initial Sample Conditions

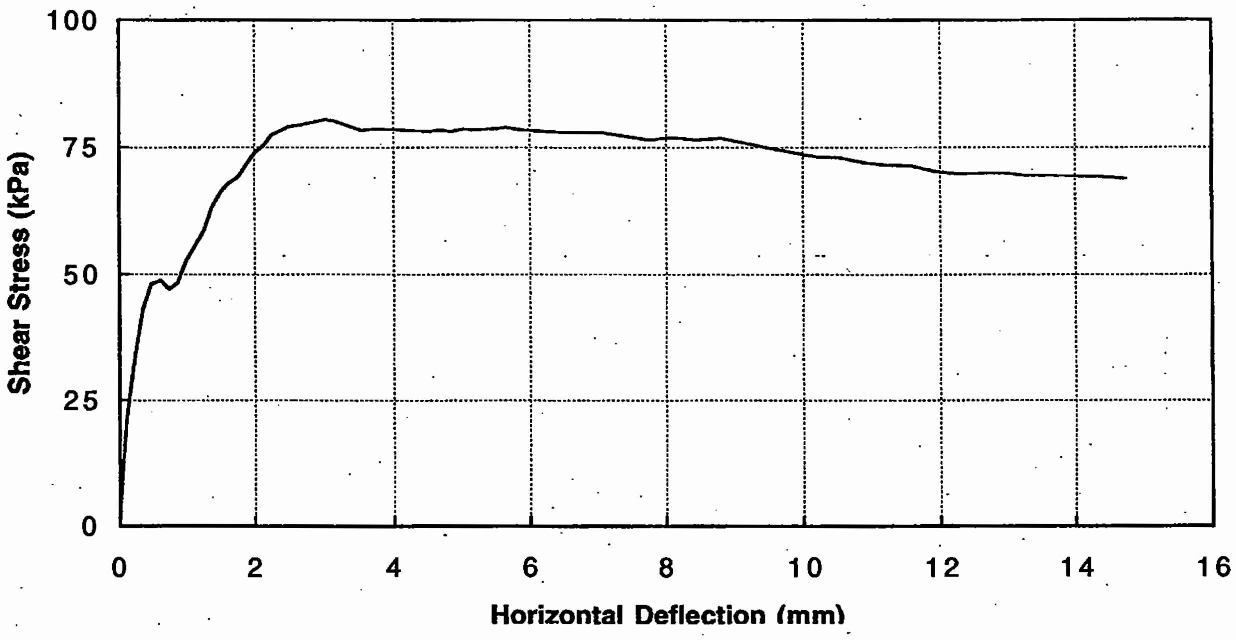
Moisture Content (%): 19.6
Wet Density (Mg/m3): 1.968
Dry Density (Mg/m3): 1.645

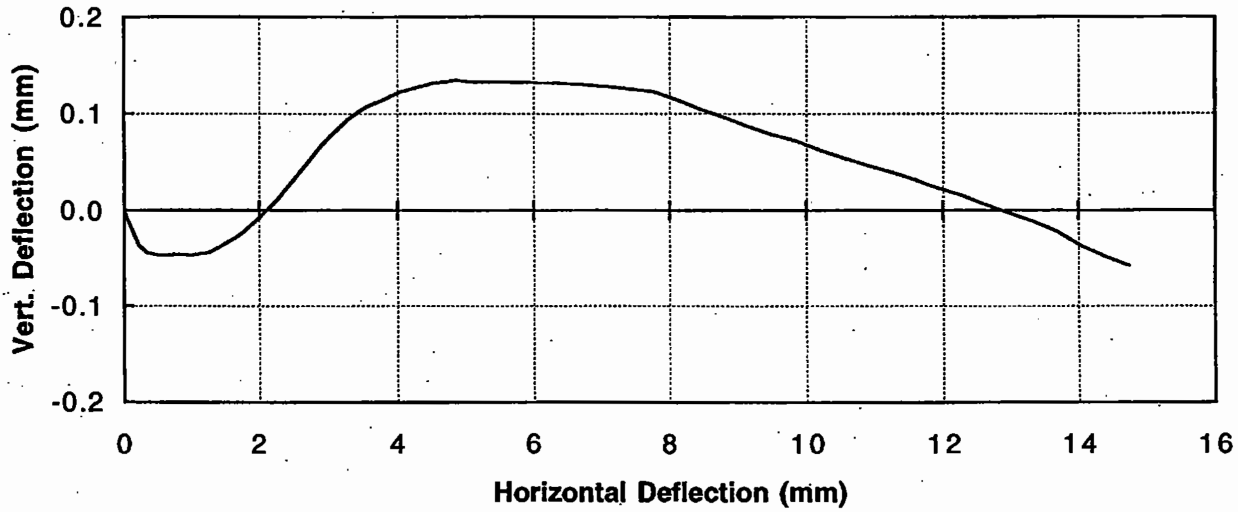
Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)
0.00	0.000	0.0
0.10	-0.017	20.4
0.22	-0.037	32.6
0.34	-0.045	42.9
0.47	-0.047	48.0
0.60	-0.047	48.7
0.73	-0.046	47.0
0.86	-0.047	48.3
0.99	-0.047	52.6
1.25	-0.044	58.4
1.37	-0.040	63.2
1.50	-0.035	66.3
1.63	-0.030	67.9
1.76	-0.023	69.0
2.01	-0.008	73.9
2.14	0.001	75.3
2.26	0.010	77.5
2.52	0.032	79.2
2.65	0.044	79.5
2.91	0.067	80.1
3.03	0.077	80.5
3.16	0.086	80.2
3.28	0.094	79.6
3.42	0.101	79.0
3.54	0.106	78.4
3.79	0.114	78.7
3.92	0.119	78.6
4.05	0.122	78.6
4.17	0.125	78.4
4.52	0.132	78.2
4.69	0.133	78.4
4.86	0.135	78.2
5.03	0.133	78.7
5.20	0.133	78.6
5.55	0.133	78.9
5.66	0.133	79.0
5.83	0.132	78.6
6.01	0.132	78.4
6.36	0.131	78.1
6.54	0.131	77.9
7.06	0.129	77.9
7.23	0.127	77.6
7.41	0.126	77.2
7.76	0.123	76.6
8.11	0.115	77.0
8.46	0.105	76.6
8.82	0.096	76.9
9.17	0.087	75.9
9.52	0.078	74.9
9.86	0.072	74.1
10.20	0.062	73.2
10.56	0.054	73.0
10.90	0.047	71.9
11.25	0.040	71.5
11.59	0.031	71.3
11.94	0.023	70.2
12.28	0.016	69.8
12.63	0.006	69.9
12.98	-0.003	69.9
13.33	-0.011	69.5
13.68	-0.022	69.5
14.04	-0.037	69.3
14.39	-0.048	69.2
14.74	-0.058	68.9

EBA Engineering Consultants Ltd.

Direct Shear Test

Peak Stress = 81 kPa





Sample Number: 1358
Normal Stress(kPa): 100
Displ. Rate(mm/min.): 0.024
Test No.: DS-3

EBA Engineering Consultants Ltd.

Direct Shear Test

Project No.: 1200173
Date Tested: 06-11-20

Sample No.: 1358
Test Number: DS-4

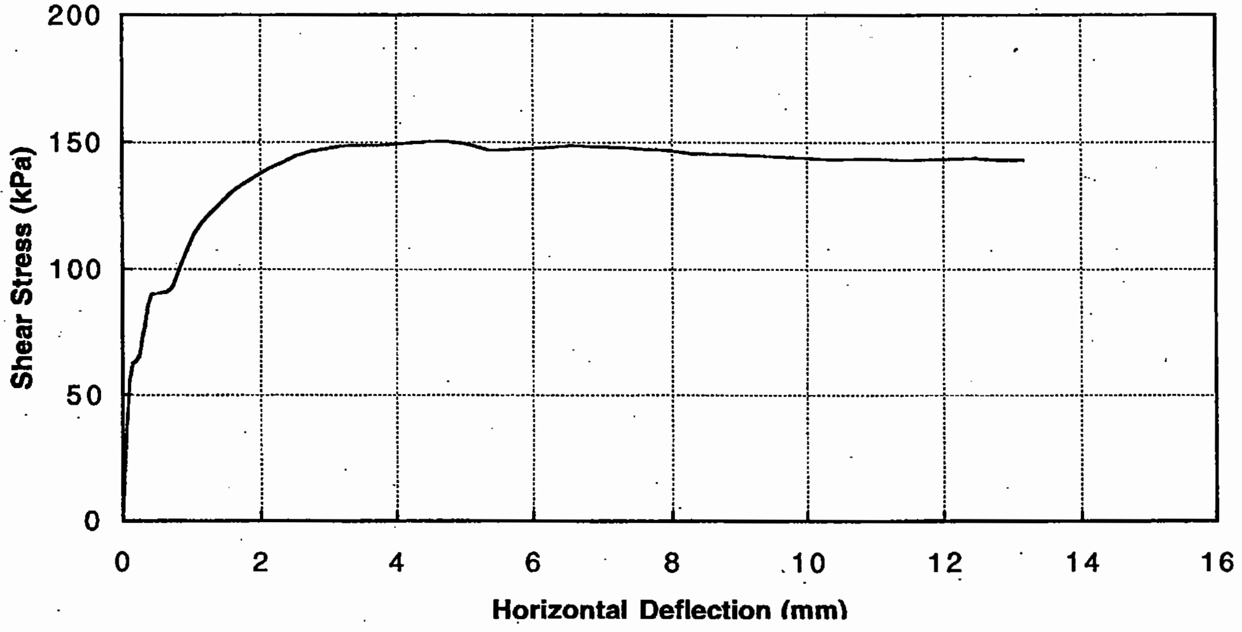
Initial Sample Conditions

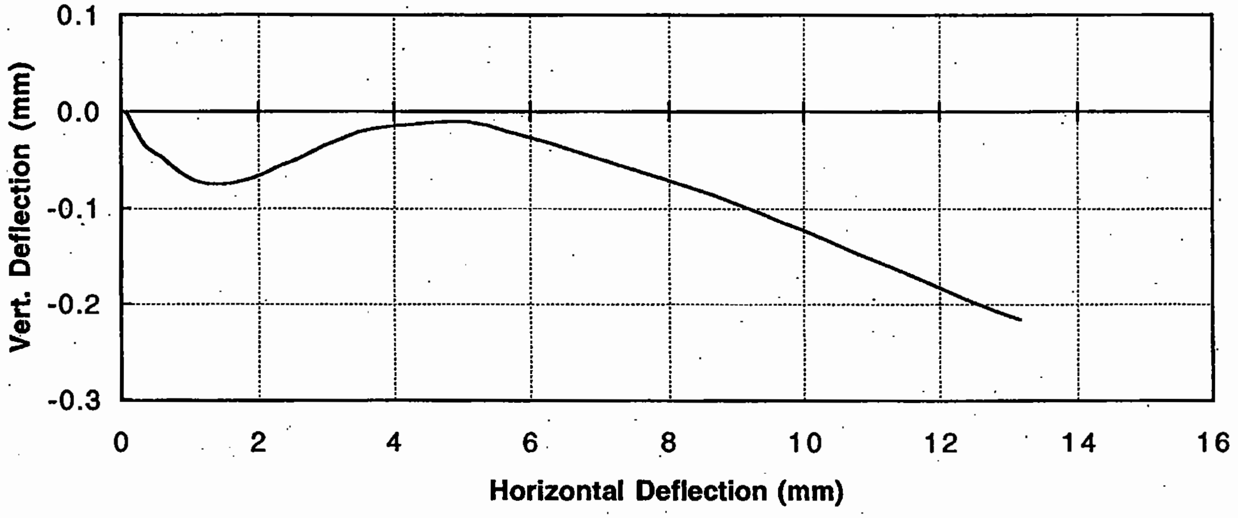
Moisture Content (%): 19.5
Wet Density (Mg/m3): 1.965
Dry Density (Mg/m3): 1.644

Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)	Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)
0.00	0.000	0.0	3.47	-0.021	149.0
0.05	0.000	34.0	3.73	-0.017	149.0
0.10	-0.003	55.6	3.98	-0.015	149.3
0.14	-0.010	62.4	4.24	-0.013	149.7
0.19	-0.017	63.2	4.49	-0.011	150.3
0.24	-0.023	65.6	4.79	-0.010	150.2
0.29	-0.029	73.6	5.08	-0.010	149.3
0.31	-0.032	76.4	5.38	-0.014	147.0
0.34	-0.034	80.1	5.67	-0.020	147.1
0.36	-0.037	85.2	5.97	-0.026	147.6
0.41	-0.039	89.9	6.27	-0.032	148.2
0.46	-0.041	90.2	6.57	-0.039	148.8
0.52	-0.044	90.2	6.90	-0.047	148.3
0.57	-0.046	90.5	7.25	-0.054	148.0
0.62	-0.049	90.7	7.59	-0.062	147.3
0.67	-0.052	91.3	7.95	-0.069	147.0
0.72	-0.055	92.7	8.30	-0.078	145.7
0.77	-0.058	95.9	8.65	-0.086	145.4
0.84	-0.062	101.3	9.00	-0.095	145.1
0.94	-0.067	108.2	9.36	-0.105	144.8
1.04	-0.070	113.8	9.71	-0.115	144.2
1.14	-0.073	118.1	10.05	-0.124	143.7
1.29	-0.075	122.2	10.39	-0.135	143.3
1.44	-0.075	126.4	10.74	-0.145	143.6
1.60	-0.074	130.5	11.08	-0.155	143.6
1.75	-0.072	133.6	11.43	-0.165	143.1
1.93	-0.068	136.3	11.79	-0.176	143.3
2.13	-0.063	139.6	12.13	-0.187	143.6
2.33	-0.056	142.0	12.47	-0.198	143.7
2.53	-0.050	144.6	12.82	-0.207	143.1
2.73	-0.044	146.5	13.17	-0.216	143.0
2.96	-0.035	147.4			
3.22	-0.028	148.5			

Direct Shear Test

Peak Stress = 150 kPa





Sample Number:	1358
Normal Stress(kPa):	200
Displ. Rate(mm/min.):	0.024
Test No.:	DS-4

APPENDIX

APPENDIX C BOREHOLE LOGS

PROPOSED COPPER MINE DEVELOPMENT	CLIENT: MINTO EXPLORATIONS LTD.	BOREHOLE NO: 94-G11
TAILINGS DAM (SOUTH CENTRE)	DRILL: CME-75 C/W HOLLOW STEM AUGERS	PROJECT NO: 0201-11509
MINTO CREEK, YUKON	UTM ZONE: 8 N6949205 E388804	ELEVATION: 724.17 (m)

SAMPLE TYPE ■ GRAB SAMPLE ▨ NO RECOVERY ☒ STANDARD PEN. ▤ 75mm SPLIT SP. ▥ CRREL BARREL ▥ HQ CORE

BACKFILL TYPE ■ BENTONITE ▨ PEA GRAVEL ▥ SLOUGH ▨ GROUT ▨ DRILL CUTTINGS ▨ SAND

SAMPLE NO	SPT(N)
1	
2	7
3	
4	
5	
6	
7	
8	
9	70/120
10	
11	

SOIL DESCRIPTION

PEAT – Fibrous; wet; soft; dark brown

ORGANIC SILT (COLLUVIUM) – clayey to some clay, trace of sand, trace of gravel; frequent peat inclusions, occasional cobbles; wet; soft; dark grey

- permafrost below 3.1 m; Nbe with Vx<5%, some Vr 10% ice in Sample No. 4
- becomes cobbly with depth

SAND AND SILT – trace gravel, frequent cobbles; numerous organic fibres and organic inclusions; angular cobbles and gravel; fine to medium sand; unsorted; frozen Nbe or Nbn; light grey

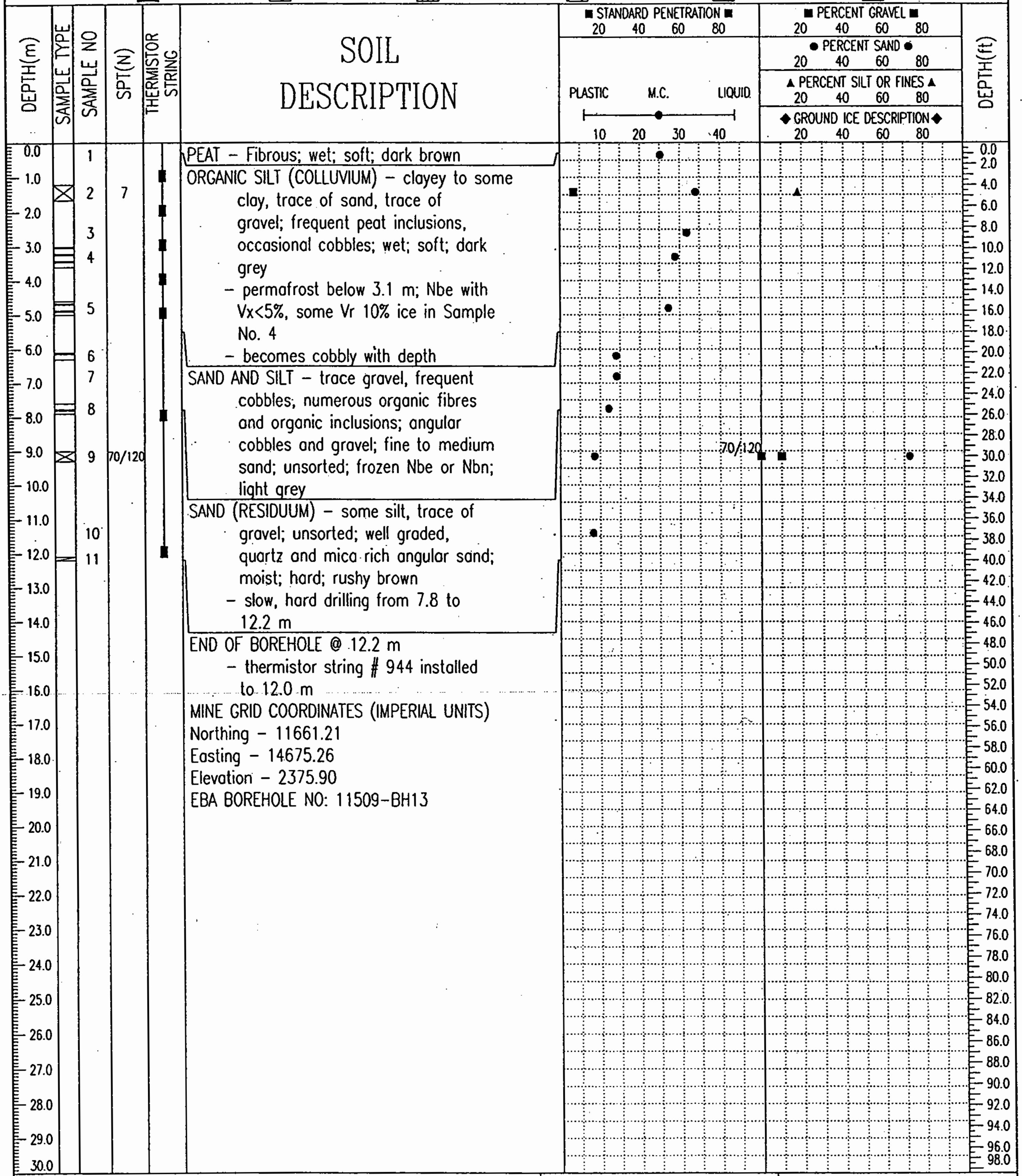
SAND (RESIDUUM) – some silt, trace of gravel; unsorted; well graded, quartz and mica rich angular sand; moist; hard; rushy brown

- slow, hard drilling from 7.8 to 12.2 m

END OF BOREHOLE @ 12.2 m

- thermistor string # 944 installed to 12.0 m

MINE GRID COORDINATES (IMPERIAL UNITS)
Northing – 11661.21
Easting – 14675.26
Elevation – 2375.90
EBA BOREHOLE NO: 11509-BH13

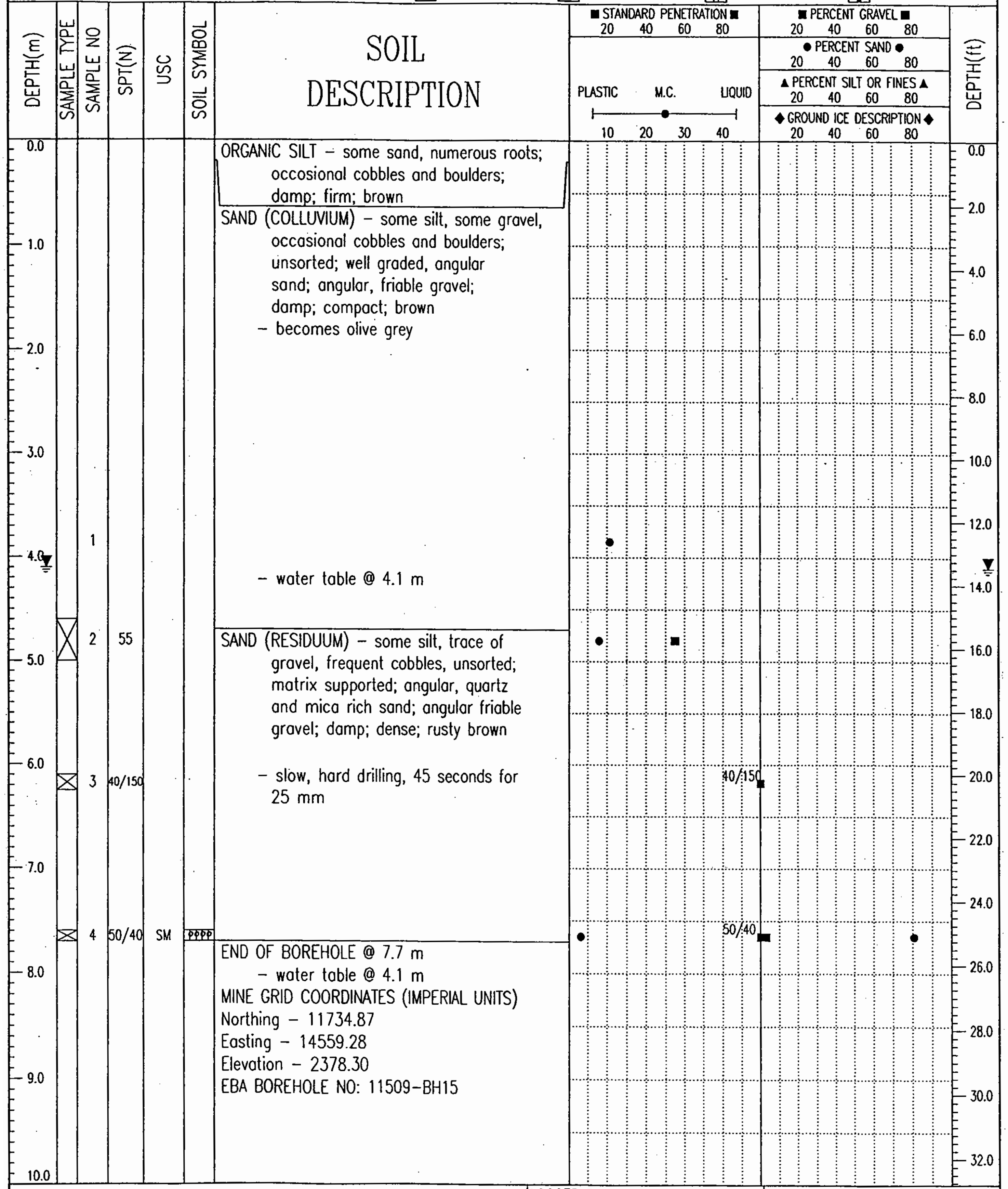


EBA ENGINEERING CONSULTANTS LTD.	LOGGED BY: CRH	COMPLETION DEPTH: 12.2 m
Whitehorse, Yukon	REVIEWED BY: CRH	COMPLETE: 94/06/25
	Fig. No:	Page 1 of 1

95/06/29 10:50AM (0201-30W)

PROPOSED COPPER MINE DEVELOPMENT	CLIENT: MINTO EXPLORATIONS LTD.	BOREHOLE NO: 94-G11A
TAILINGS DAM (NORTH CENTRE ABUTMENT)	DRILL: CME-75 C/W HOLLOW STEM AUGERS	PROJECT NO: 0201-11509
MINTO CREEK, YUKON	UTM ZONE: 8 N6949227 E388768	ELEVATION: 724.91 (m)

SAMPLE TYPE ■ GRAB SAMPLE ◿ NO RECOVERY ☒ STANDARD PEN. ☰ 75mm SPLIT SP. ‖ CRREL BARREL ▮ HQ CORE



ORGANIC SILT – some sand, numerous roots; occosional cobbles and boulders; damp; firm; brown

SAND (COLLUVIUM) – some silt, some gravel, occasional cobbles and boulders; unsorted; well graded, angular sand; angular, friable gravel; damp; compact; brown
- becomes olive grey

- water table @ 4.1 m

SAND (RESIDUUM) – some silt, trace of gravel, frequent cobbles, unsorted; matrix supported; angular, quartz and mica rich sand; angular friable gravel; damp; dense; rusty brown

- slow, hard drilling, 45 seconds for 25 mm

END OF BOREHOLE @ 7.7 m
- water table @ 4.1 m

MINE GRID COORDINATES (IMPERIAL UNITS)
Northing – 11734.87
Easting – 14559.28
Elevation – 2378.30
EBA BOREHOLE NO: 11509-BH15

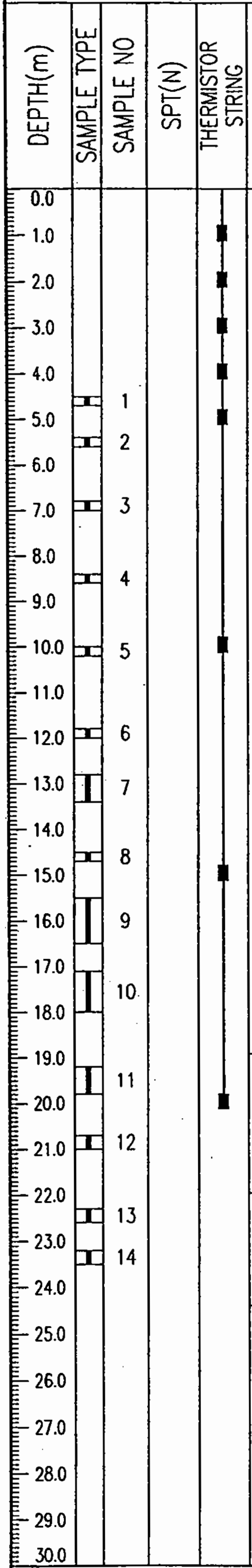
EBA ENGINEERING CONSULTANTS LTD. Whitehorse, Yukon	LOGGED BY: CRH	COMPLETION DEPTH: 7.7 m
	REVIEWED BY: CRH	COMPLETE: 94/06/26
	Fig. No:	Page 1 of 1

95/06/27 05:05PM (0201-10)

PROPOSED COPPER MINE DEVELOPMENT	CLIENT: MINTO EXPLORATIONS LTD.	BOREHOLE NO: 94-21
TAILINGS DAM (SOUTH ABUTMENT)	DRILL: LONGYEAR 38, 3 7/8 TRICONE, HW	PROJECT NO: 0201-11509
MINTO CREEK, YUKON	UTM ZONE: 8 N6949111 E388820	ELEVATION: 752.43 (m)

SAMPLE TYPE ■ GRAB SAMPLE ▨ NO RECOVERY ☒ STANDARD PEN. ☰ 75mm SPLIT SP. ▥ CRREL BARREL ▥ HQ CORE

BACKFILL TYPE ■ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ▨ GROUT ▨ DRILL CUTTINGS ▩ SAND



SOIL DESCRIPTION

CLAY – silty, some sand, some gravel, some cobbles, angular gravel and sand; low plastic; unsorted; frozen Nbe; wet; dark brown/grey

- some silt, trace of sand, occasional gravel and cobbles, Nbe

- occasional ice lenses below 5.2 m, up to 1 cm Vr, 5%
- clear ice lenses

- becoming sand and silt, some clay; frequent cobbles; Vbe

- becoming silt, some clay, trace of sand, occasional gravel and cobbles
- Nbe, occasional Vx <5%

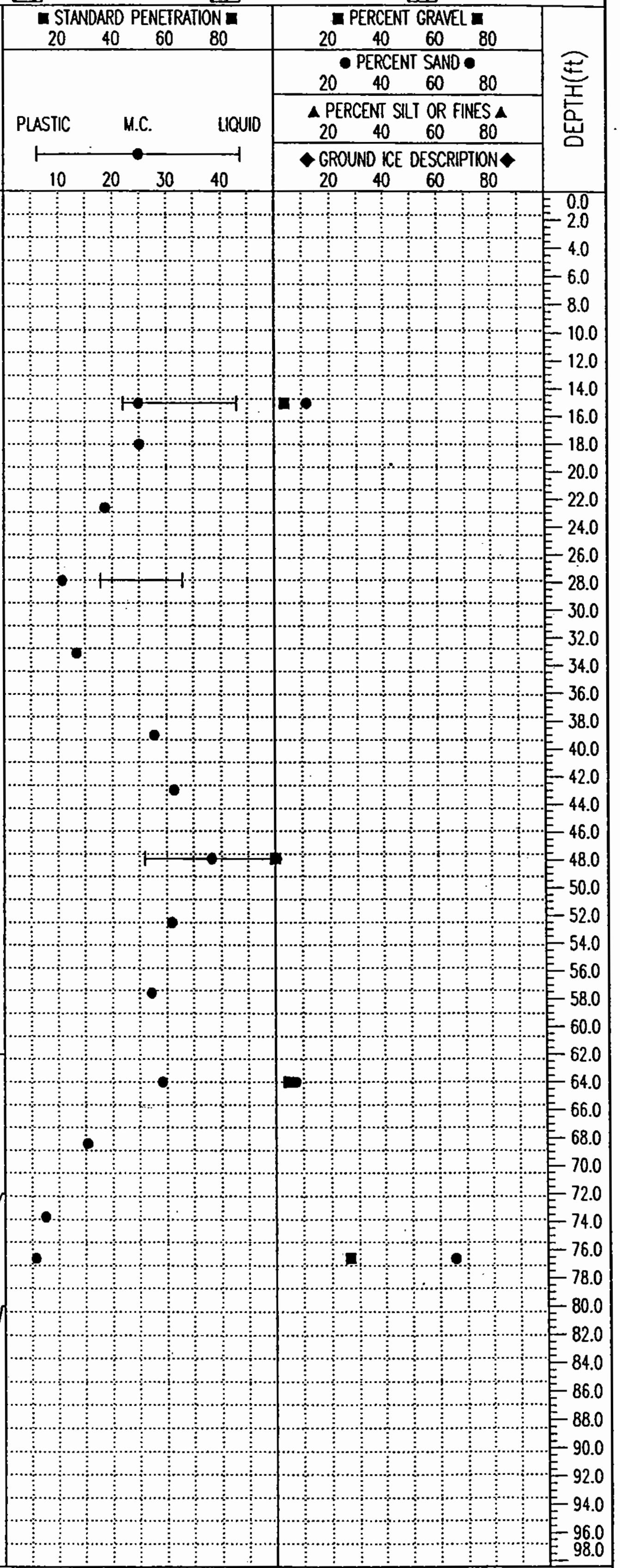
- Vx, Vr 30%

SILT AND SAND (RESIDUUM) – some to trace gravel, trace of clay, Nbe with light occasional Vr, Vx, <5% ice
- becomes more sandy and gravelly with depth

SAND (RESIDUUM) – some silt, some gravel, occasional cobbles, frozen Nbn–Nbe; rusty brown
- becomes more competent with depth

END OF BOREHOLE @ 24.4 m
- thermistor string #945 installed to 20 m

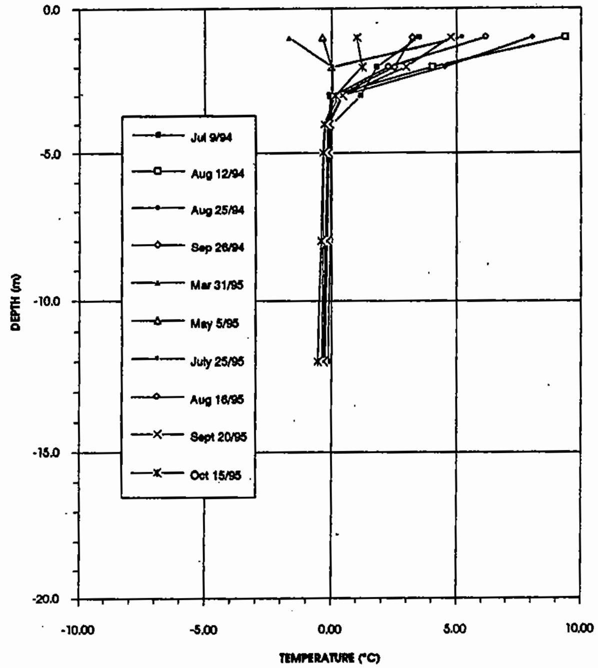
MINE GRID COORDINATES (IMPERIAL UNITS)
Northing – 11350.36
Easting – 14714.81
Elevation – 2468.60
EBA BOREHOLE NO: 11509-BH19



EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: CRH	COMPLETION DEPTH: 24.4 m
	REVIEWED BY: CRH	COMPLETE: 94/08/22
	Fig. No:	Page 1 of 1

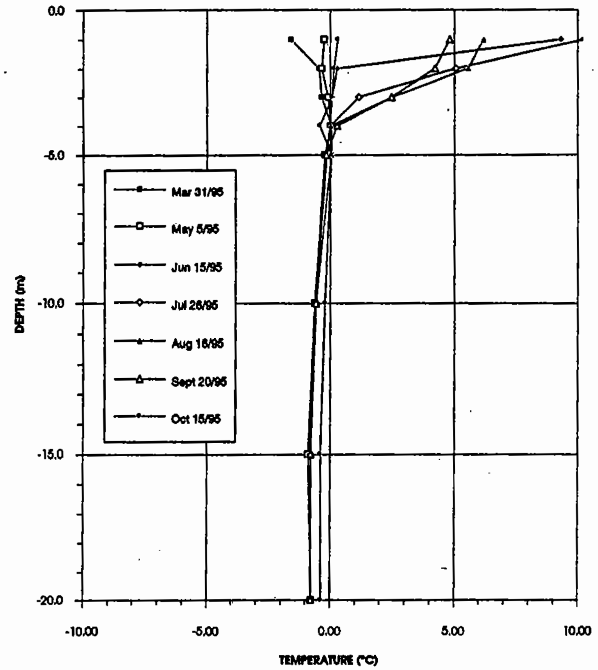
95/07/04 04:59PM (0201-30W)

Thermistor No.: 944
Date Installed: Jun 25/94



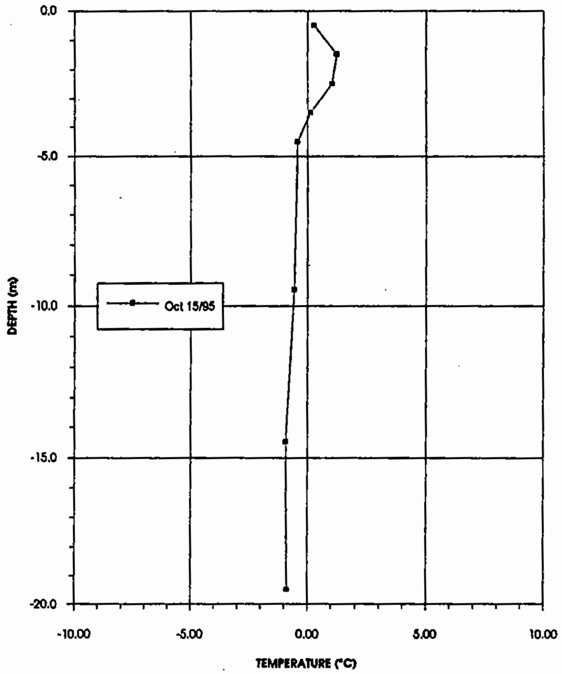
GROUND TEMPERATURE PROFILE
MINTO PROJECT - TAILINGS POND
LOWER SITE (BH 94-G11, El.=724.17 m)

Thermistor No.: 945
Date Installed: Aug.22/94



GROUND TEMPERATURE PROFILE
MINTO PROJECT - TAILINGS POND
UPPER SITE (BH 94-21, El.=752.43 m)

Thermistor No.: 990
Date Installed: Sept. 25/95



GROUND TEMPERATURE PROFILE
MINTO PROJECT - TAILINGS POND
SOUTH ABUTMENT (BH 95-G11 El.=724.8 m)

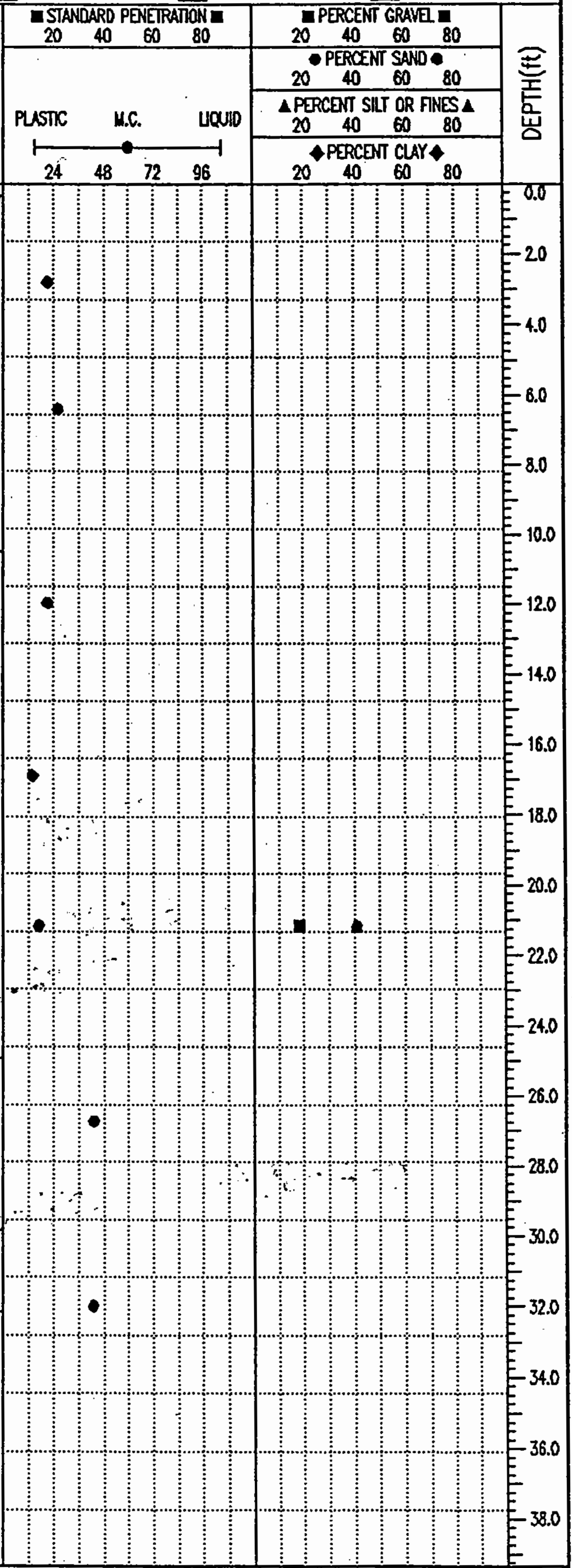
EBA Engineering Consultants Ltd.

CLIENT	MINTO EXPLORATIONS LTD.		PROJECT	MINTO PROJECT NORTHWEST OF CARMACKS, YUKON	
			TITLE	GROUND TEMPERATURES TAILINGS AREA	
DATE 95-12-18	DWN. DRG	CHKD. KWJ	FILE NO.	201-11509	FIGURE 5

MINTO CREEK MINE DEVELOPMENT	CLIENT: MINTO EXPLORATIONS LTD.	BOREHOLE NO: 96-G07
GEOTECHNICAL EVALUATION-SOUTH WASTE DUMP	DRILL: CME-75 C/W SOLID SHAFT AUGERS	PROJECT NO: 0201-11509
MINTO CREEK, YUKON	UTM ZONE: 8 N6944790.3 E385412.7	ELEVATION: 2566.30 (m)

SAMPLE TYPE ■ GRAB ▨ NO RECOVERY ☒ STANDARD PEN. ☰ 75 mm SPOON ▯ CRREL BARREL ▮ DISTURBED

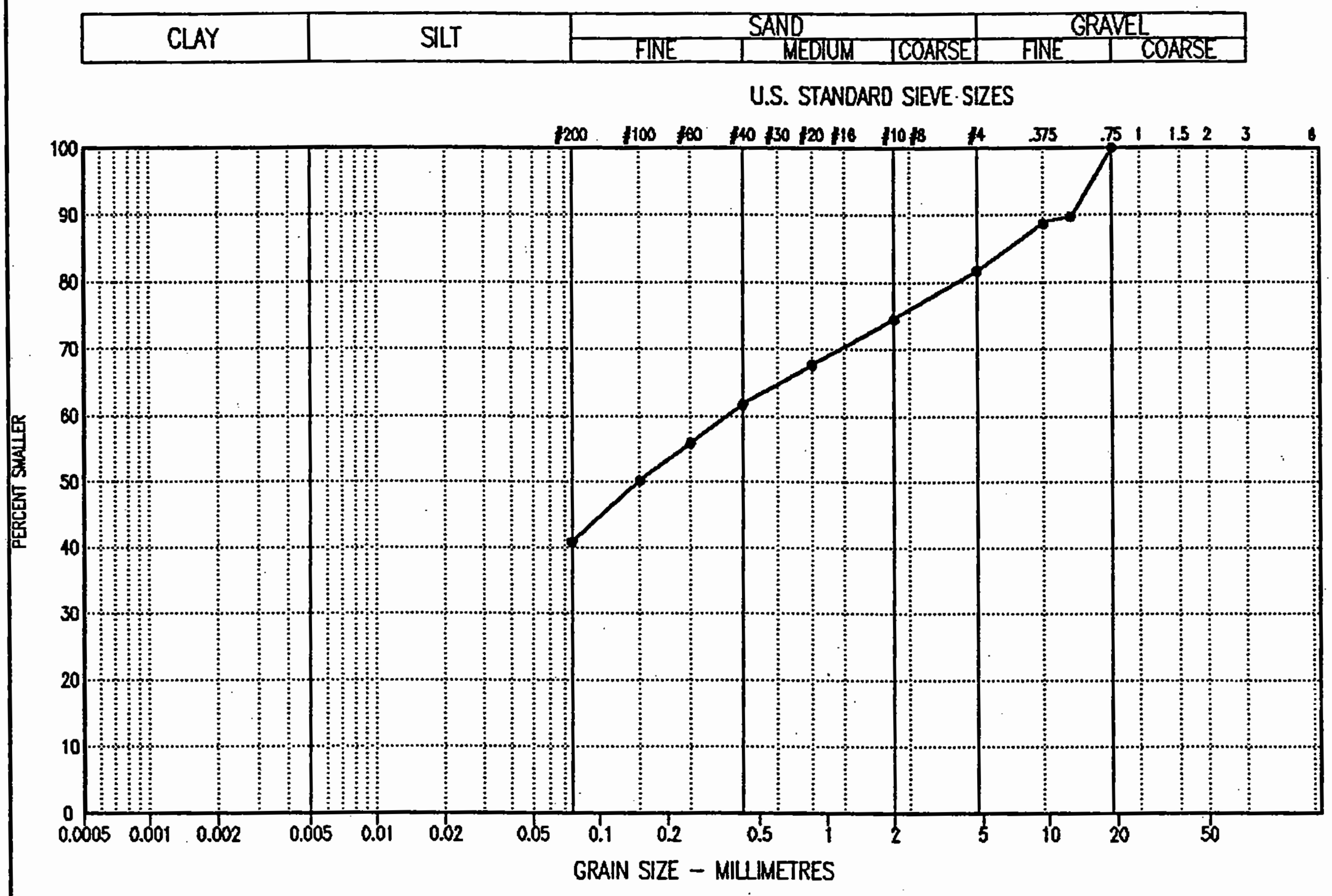
DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION
0.0						ORGANIC SILT/MOSS
						SILT – sandy, some clay, trace of fine gravel; fine sand and silt matrix, coarse sand clasts; low plastic; (moderate dry strength); frozen at 0.15 m; Nbe; brown – isolated organic silt inclusions to 0.3 m – grading in colour to grey
1.0	☰	1				
2.0	■	2				
3.0						SAND AND SILT – some gravel to gravelly, occasional organic fibers and wood fibers; fine sand and silt matrix; coarse sand clasts; fine to coarse subrounded to subangular gravel; Vx, 10 to 15% ICE; grey – gravel content increasing with depth – zones of low and high gravel content – rough grinding drilling through gravel zones – occasional ICE inclusions to 75 mm; Vx, 10 to 15% ICE; olive grey with light brown inclusions
4.0	☰	3				
5.0	■	4				
6.0	☰	5				
7.0						SILT – some clay to clayey; some fine sand; low plastic; frozen, Vx,r 15 to 25%, lens to 25 mm; grey
8.0	■	6				
9.0						
10.0	☰	7				END OF BOREHOLE @ 9.8 m
11.0						
12.0						



EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: CRH	COMPLETION DEPTH: 9.8 m
	REVIEWED BY: CRH	COMPLETE: 96/07/07
	Fig. No:	Page 1 of 1

96/08/14 10:37AM (YUKON12)

PARTICLE SIZE – ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION			Cu	Cc	U.S.C
			CLAY & SILT %	SAND %	GRAVEL %			
●—●	96-G07	6.40 - 6.50	40.8	40.8	18.4	20.3	0.4	SM

Project: 0201-11509

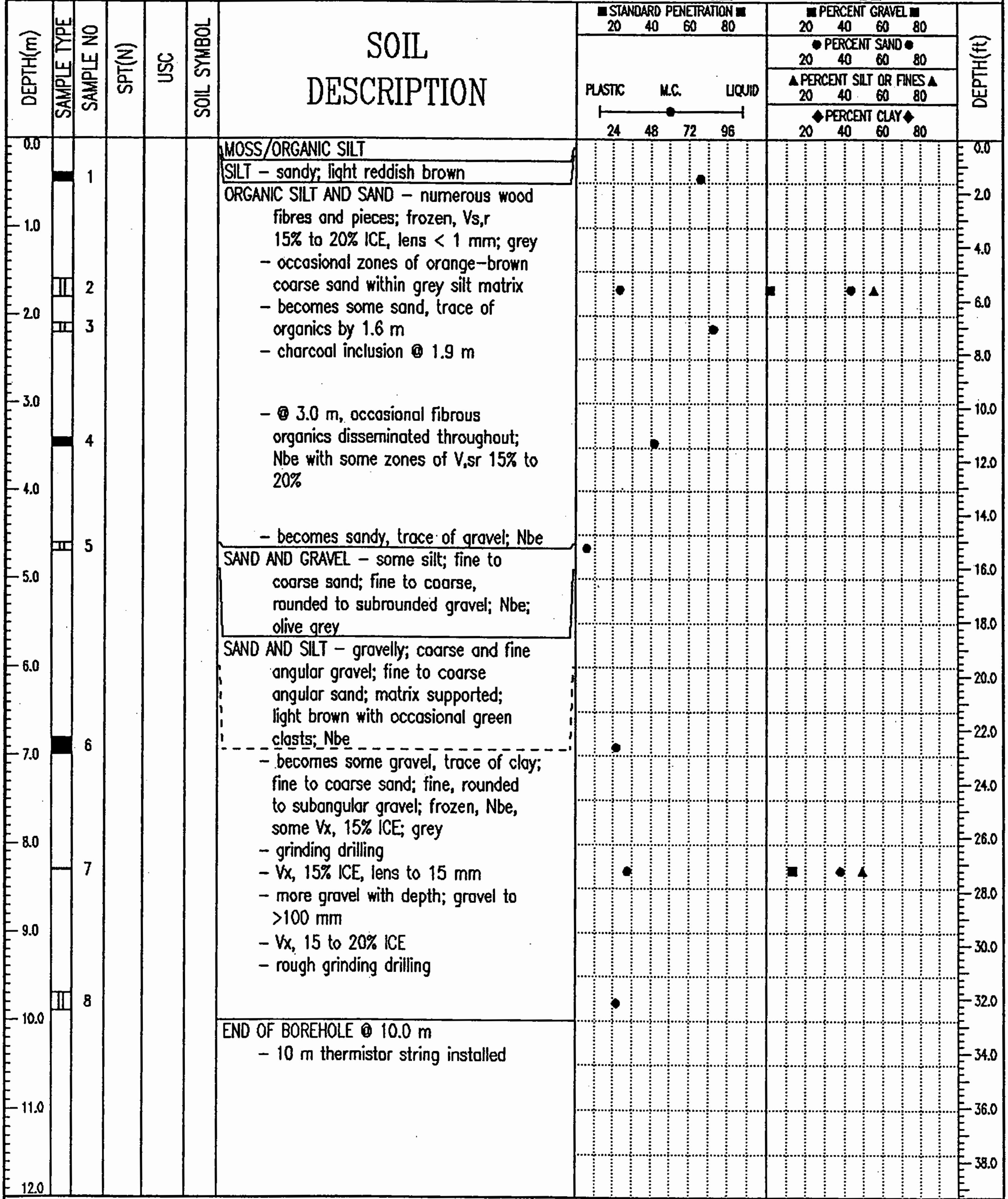
Date Tested: 96/07/11

BY: AA

Tested in accordance with ASTM D422 unless otherwise noted.

MINTO CREEK MINE DEVELOPMENT	CLIENT: MINTO EXPLORATIONS LTD.	BOREHOLE NO: 96-G08
GEOTECHNICAL EVALUATION-SOUTH WASTE DUMP	DRILL: CME-75 C/W SOLID SHAFT AUGERS	PROJECT NO: 0201-11509
MINTO CREEK, YUKON	UTM ZONE: 8 N6944602.8 E385593.3	ELEVATION: 2532.30 (m)

SAMPLE TYPE ■ GRAB ◪ NO RECOVERY ☒ STANDARD PEN. ☰ 75 mm SPOON ▯ CRREL BARREL ▮ DISTURBED



SOIL DESCRIPTION

MOSS/ORGANIC SILT

SILT - sandy; light reddish brown

ORGANIC SILT AND SAND - numerous wood fibres and pieces; frozen, Vs,r 15% to 20% ICE, lens < 1 mm; grey
- occasional zones of orange-brown coarse sand within grey silt matrix
- becomes some sand, trace of organics by 1.6 m
- charcoal inclusion @ 1.9 m
- @ 3.0 m, occasional fibrous organics disseminated throughout; Nbe with some zones of V,sr 15% to 20%
- becomes sandy, trace of gravel; Nbe

SAND AND GRAVEL - some silt; fine to coarse sand; fine to coarse, rounded to subrounded gravel; Nbe; olive grey

SAND AND SILT - gravelly; coarse and fine angular gravel; fine to coarse angular sand; matrix supported; light brown with occasional green clasts; Nbe
- becomes some gravel, trace of clay; fine to coarse sand; fine, rounded to subangular gravel; frozen, Nbe, some Vx, 15% ICE; grey
- grinding drilling
- Vx, 15% ICE, lens to 15 mm
- more gravel with depth; gravel to >100 mm
- Vx, 15 to 20% ICE
- rough grinding drilling

END OF BOREHOLE @ 10.0 m
- 10 m thermistor string installed

EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: CRH	COMPLETION DEPTH: 10.0 m
	REVIEWED BY: CRH	COMPLETE: 96/07/07
	Fig. No:	Page 1 of 1

96/08/13 04:11PM (YUKON12)

Thermistor No.: 1064
Date Installed: Jul. 7, 1996

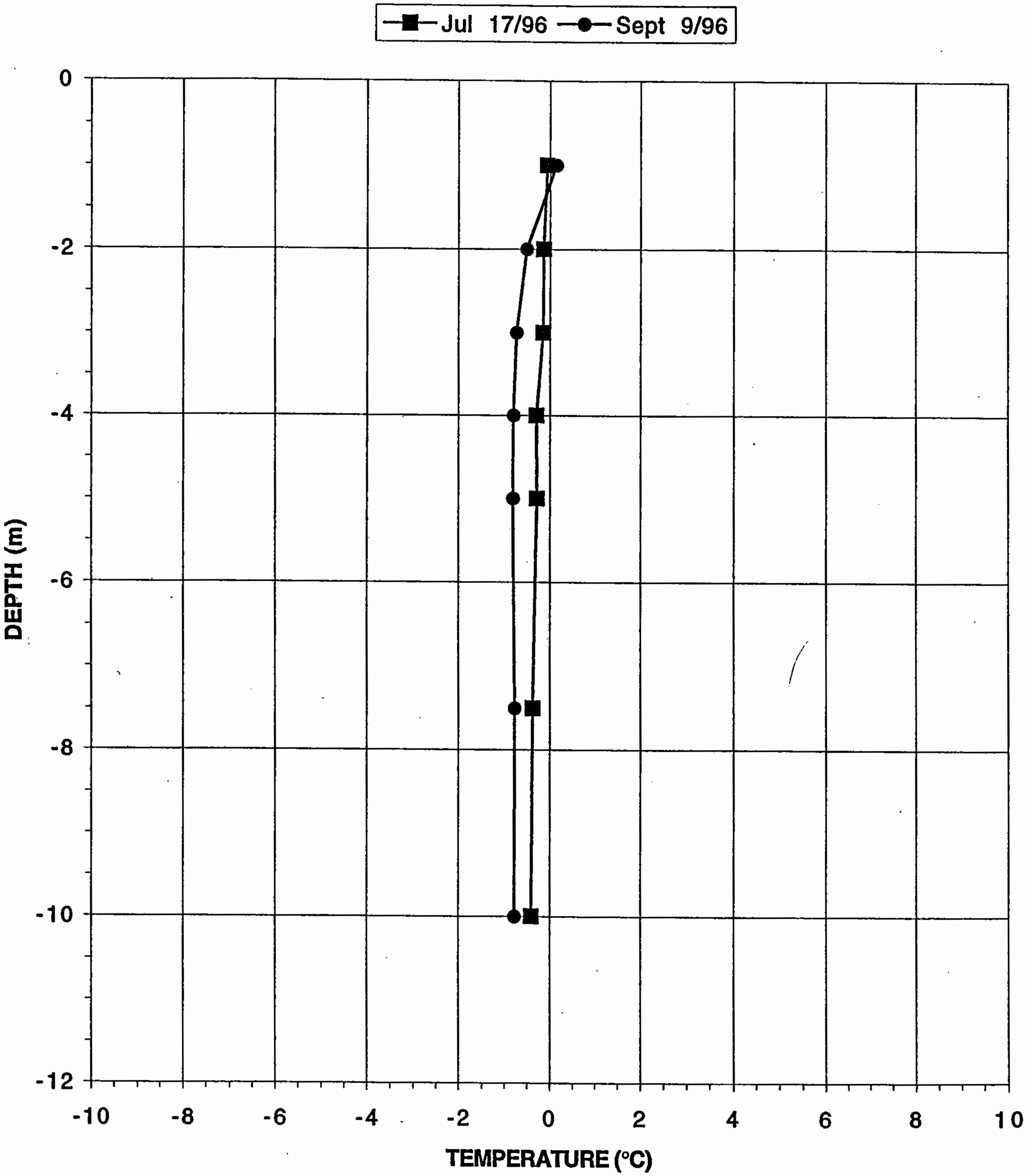
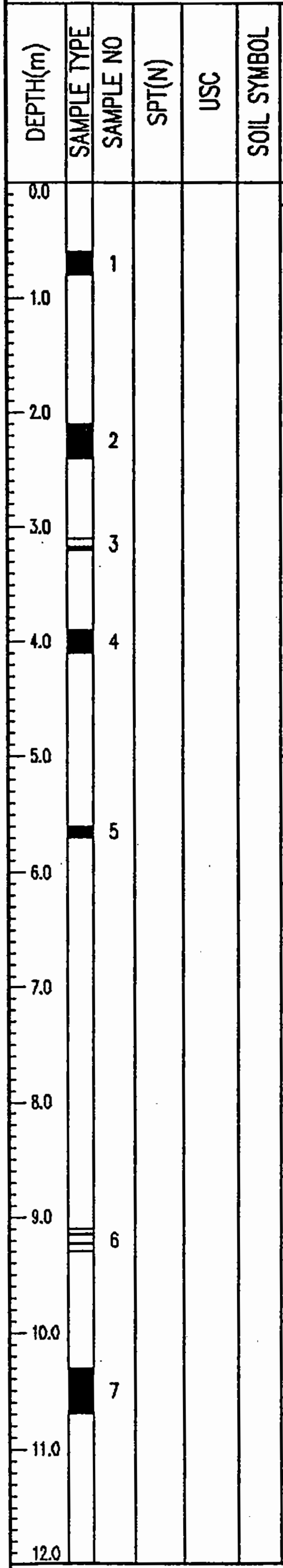


FIGURE 1: GROUND TEMPERATURE PROFILE
MINTO PROJECT - SOUTH WASTE DUMP
(BH 96-G08)

eba

MINTO CREEK MINE DEVELOPMENT	CLIENT: MINTO EXPLORATIONS LTD.	BOREHOLE NO: 96-G09
GEOTECHNICAL EVALUATION-SOUTH WASTE DUMP	DRILL: CME-75 C/W SOLID SHAFT AUGERS	PROJECT NO: 0201-11509
MINTO CREEK, YUKON	UTM ZONE: 8 N6944471.2 E385720	ELEVATION: 2552.90 (m)

SAMPLE TYPE ■ GRAB ▨ NO RECOVERY ☒ STANDARD PEN. ☰ 75 mm SPOON ▯ CRREL BARREL ▯ DISTURBED



SOIL DESCRIPTION

MOSS/ORGANIC SILT – roots

SILT – sandy, trace of fine gravel, trace of clay; low plastic; fine to medium sand; frozen; Vx,r 10 to 15% ICE; brown

- becomes Nbe, trace to some clay, dark olive grey by 1.5 m
- faint organic odour @ 2.0 m

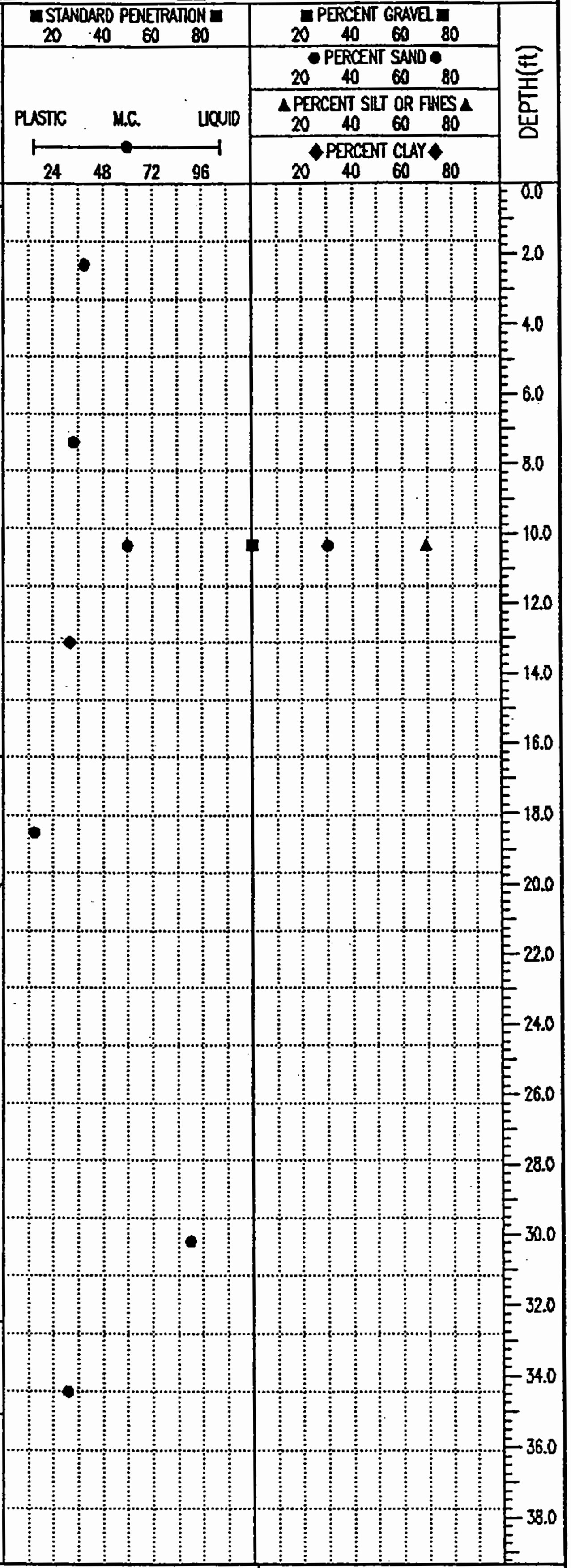
- @ 3.1 m; Vx, 15% ICE, ice grains < 2 mm
- zone of ICE augered up between 3.1 and 4.5 m

- grades into light olive grey, SAND AND SILT – trace to some clay, trace of gravel; fine to coarse sand; subangular, fine gravel; low plastic

ICE AND SILT – trace of sand and clay; 50 to 60% ICE; zones of 80%+ ICE on augers
- soil content varies from 40% to 60%

SAND AND SILT – some clay, trace of fine gravel; Vx, 10 to 20% ICE; light olive brown

END OF BOREHOLE @ 10.7 m



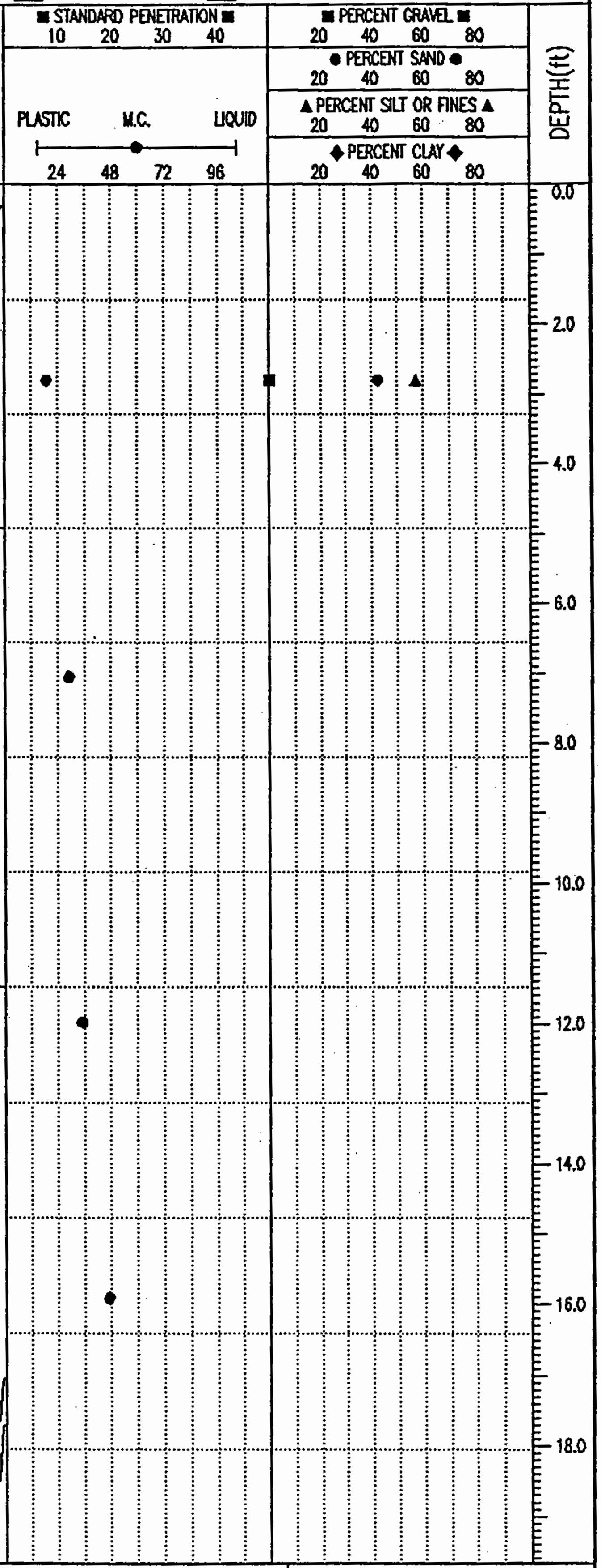
EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: CRH	COMPLETION DEPTH: 10.7 m
	REVIEWED BY: CRH	COMPLETE: 96/07/06
	Fig. No:	Page 1 of 1

96/08/13 04:12PM (YUKON12)

MINTO CREEK MINE DEVELOPMENT	CLIENT: MINTO EXPLORATIONS LTD.	TEST PIT NO: 96-G10
GEOTECHNICAL EVALUATION-SOUTH WASTE DUMP	DRILL: CME-75 C/W SOLID SHAFT AUGERS	PROJECT NO: 0201-11509
MINTO CREEK, YUKON	UTM ZONE: 8 N6944593.9 E385162.8	ELEVATION: 2609.20 (m)

SAMPLE TYPE ■ GRAB SAMPLE ▨ NO RECOVERY ☒ STANDARD PEN. ☰ 75 mm SPOON ▥ CRREL BARREL

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL	SOIL DESCRIPTION
0.0					ORGANIC SILT/MOSS
					SILT – some sand to sandy, some to trace of clay; low plastic; frozen Vs, 10 to 15% ICE, lens < 1mm; olive brown – becomes Vx, <5% ICE @ 0.6 m
	▥	1			
1.0					– lens of silty sand, Vx 10% ICE, coarse to medium snad @ 0.9 to 1.0 m
					SAND AND SILT – some clay, frequent organic fibers; fine to medium sand; faint organic odour; low plastic; frozen, Nbe; olive grey
2.0	■	2			– occasional seams of sandy silt with coarse orange-brown sand
3.0					
	▥	3			– becomes non plastic with fine sand
4.0					– becomes brown, no organics, Nbe
	▥	4			
5.0					– ice wedge from 5.0 m to end of hole; vertical wedge with several vertical soil inclusions
					ICE – granular, frequent small soil inclusions
					END OF BOREHOLE @ 5.4 m
6.0					



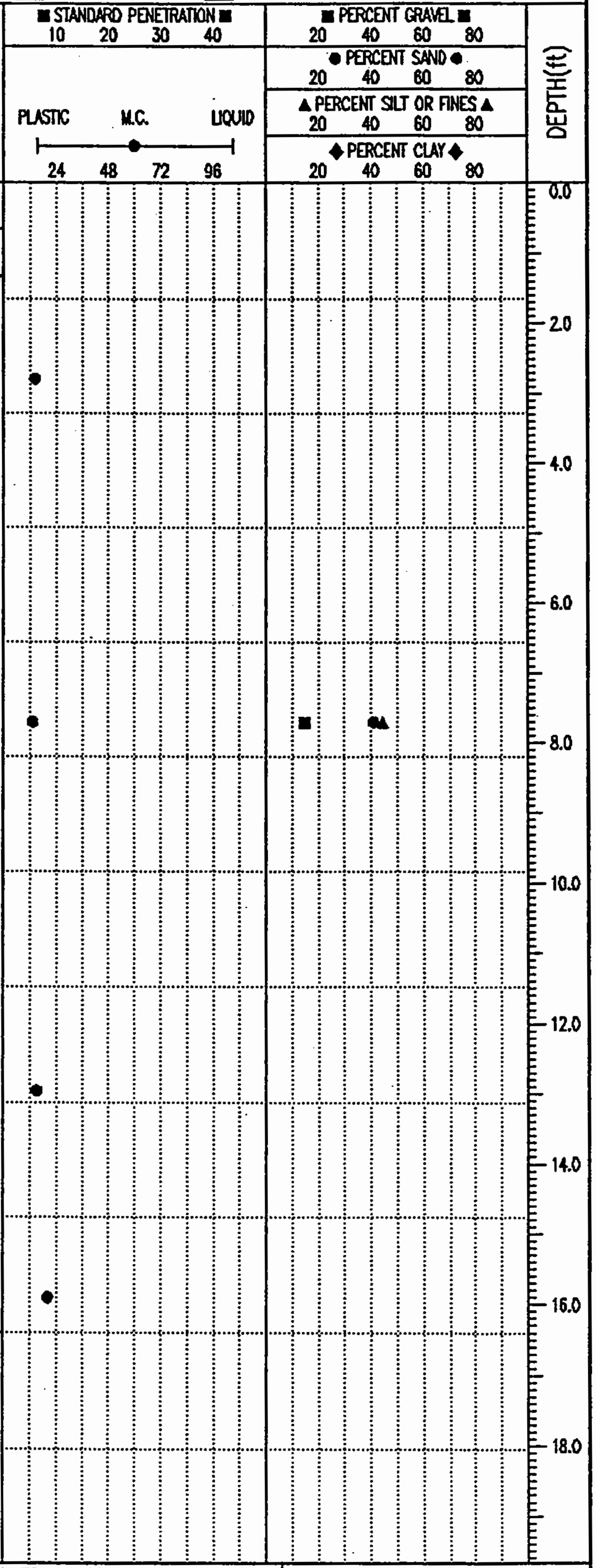
EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: CRH	COMPLETION DEPTH: 5.4 m
	REVIEWED BY: CRH	COMPLETE: 96/07/08
	Fig. No:	Page 1 of 1

96/08/13 04:34PM (YUKON-6)

MINTO CREEK MINE DEVELOPMENT	CLIENT: MINTO EXPLORATIONS LTD.	TEST PIT NO: 96-G11
GEOTECHNICAL EVALUATION-SOUTH WASTE DUMP	DRILL: CME-75 C/W SOLID SHAFT AUGERS	PROJECT NO: 0201-11509
MINTO CREEK, YUKON	UTM ZONE: 8 N6944395.1 E385337.8	ELEVATION: 2607.50 (m)

SAMPLE TYPE ■ GRAB SAMPLE ▧ NO RECOVERY ☒ STANDARD PEN. ☰ 75 mm SPOON ▥ CRREL BARREL

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL	SOIL DESCRIPTION
0.0					MOSS/ORGANIC SILT/ROOTS
					ORGANIC SAND AND SILT – numerous roots; wet; black/brown; soft
					SAND AND SILT – some gravel, trace to some clay; fine to medium sand; fine subrounded gravel; matrix is silt and fine sand; frozen Vs, 5 to 10%, lens to 3 mm; brown
	▥	1			
1.0					– becomes Nbe
2.0					
	■	2			
3.0					– gravel to 100 mm
	■	3			
4.0					– Vx, <5% ICE
	▥	4			
5.0					END OF BOREHOLE @ 5.0 m
6.0					

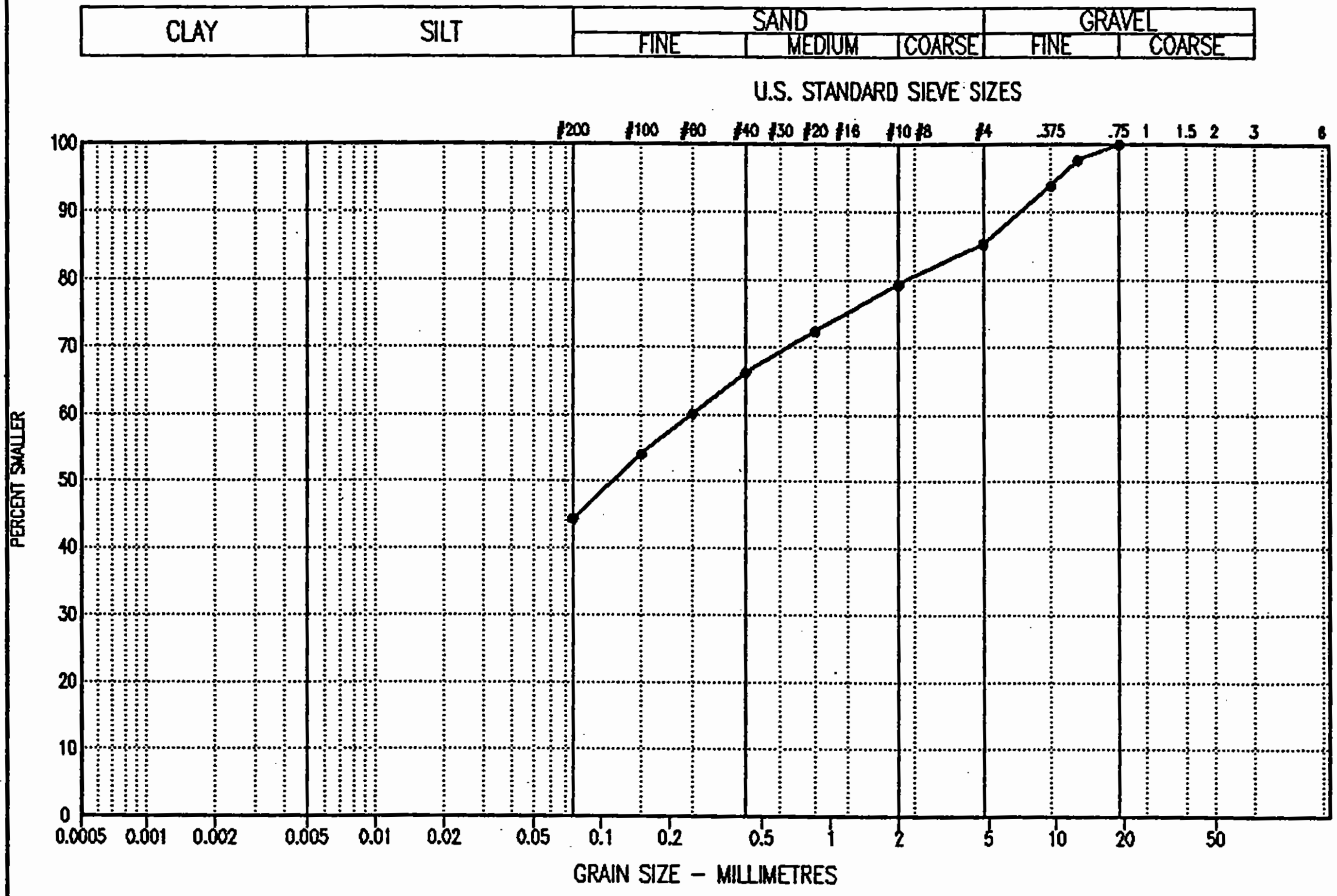


EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: CRH	COMPLETION DEPTH: 5.0 m
	REVIEWED BY: CRH	COMPLETE: 96/07/08
	Fig. No:	Page 1 of 1

96/08/13 04:35PM (YUKON-6)

EBA Engineering

PARTICLE SIZE – ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION			Cu	Cc	U.S.C
			CLAY & SILT %	SAND %	GRAVEL %			
●—●	96-G11	2.30 - 2.40	44.3	40.9	14.8	14.7	0.6	SM

Project: 0201-11509

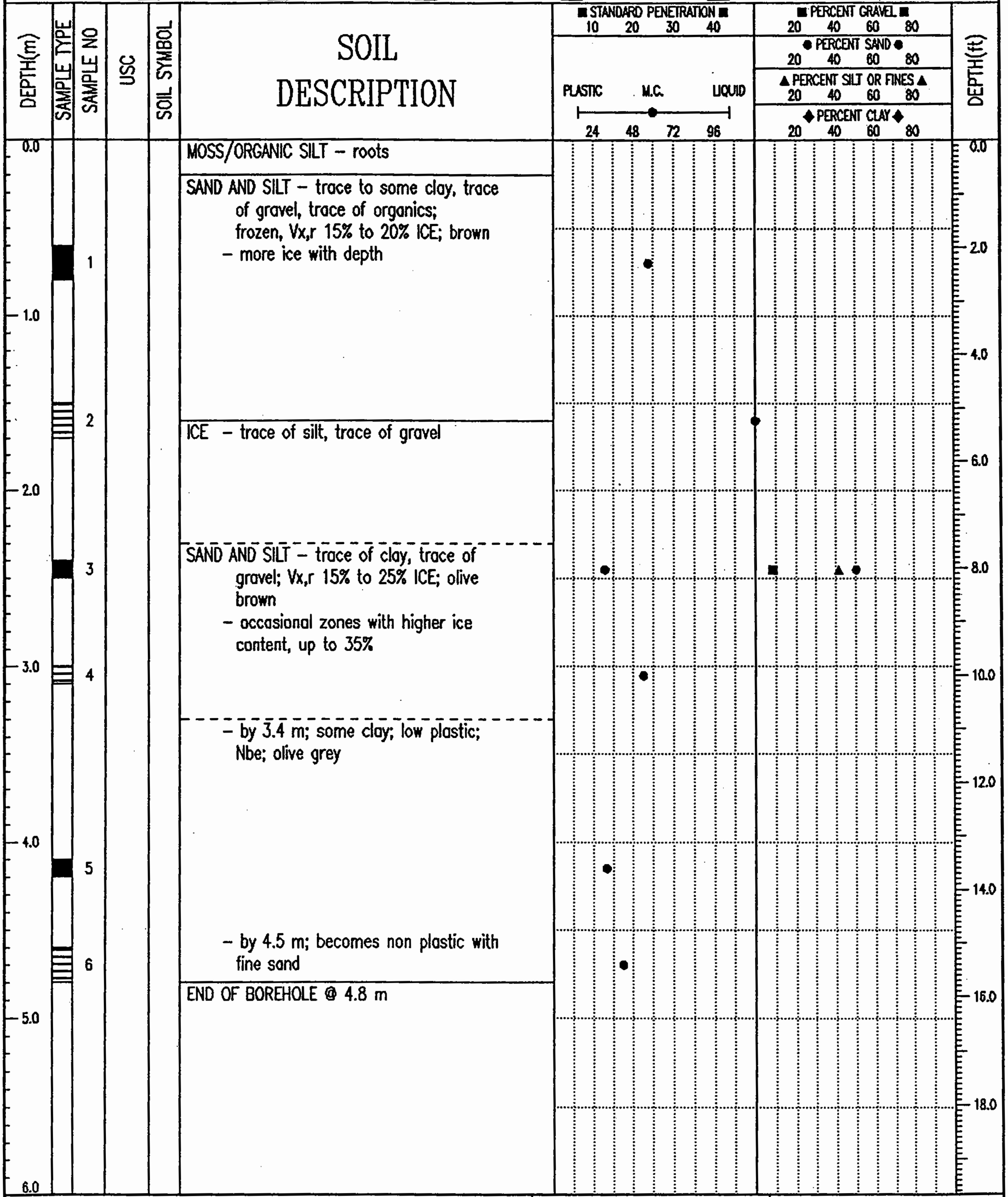
Date Tested: 96/07/11

BY: AA

Tested in accordance with ASTM D422 unless otherwise noted.

MINTO CREEK MINE DEVELOPMENT	CLIENT: MINTO EXPLORATIONS LTD.	TEST PIT NO: 96-G12
GEOTECHNICAL EVALUATION-SOUTH WASTE DUMP	DRILL: CME-75 C/W SOLID SHAFT AUGERS	PROJECT NO: 0201-11509
MINTO CREEK, YUKON	UTM ZONE: 8 N6944221.3 E385493.2	ELEVATION: 2612.50 (m)

SAMPLE TYPE ■ GRAB SAMPLE ◿ NO RECOVERY ☒ STANDARD PEN. ☰ 75 mm SPOON ▥ CRREL BARREL



MOSS/ORGANIC SILT – roots

SAND AND SILT – trace to some clay, trace of gravel, trace of organics; frozen, Vx,r 15% to 20% ICE; brown
– more ice with depth

ICE – trace of silt, trace of gravel

SAND AND SILT – trace of clay, trace of gravel; Vx,r 15% to 25% ICE; olive brown
– occasional zones with higher ice content, up to 35%

– by 3.4 m; some clay; low plastic; Nbe; olive grey

– by 4.5 m; becomes non plastic with fine sand

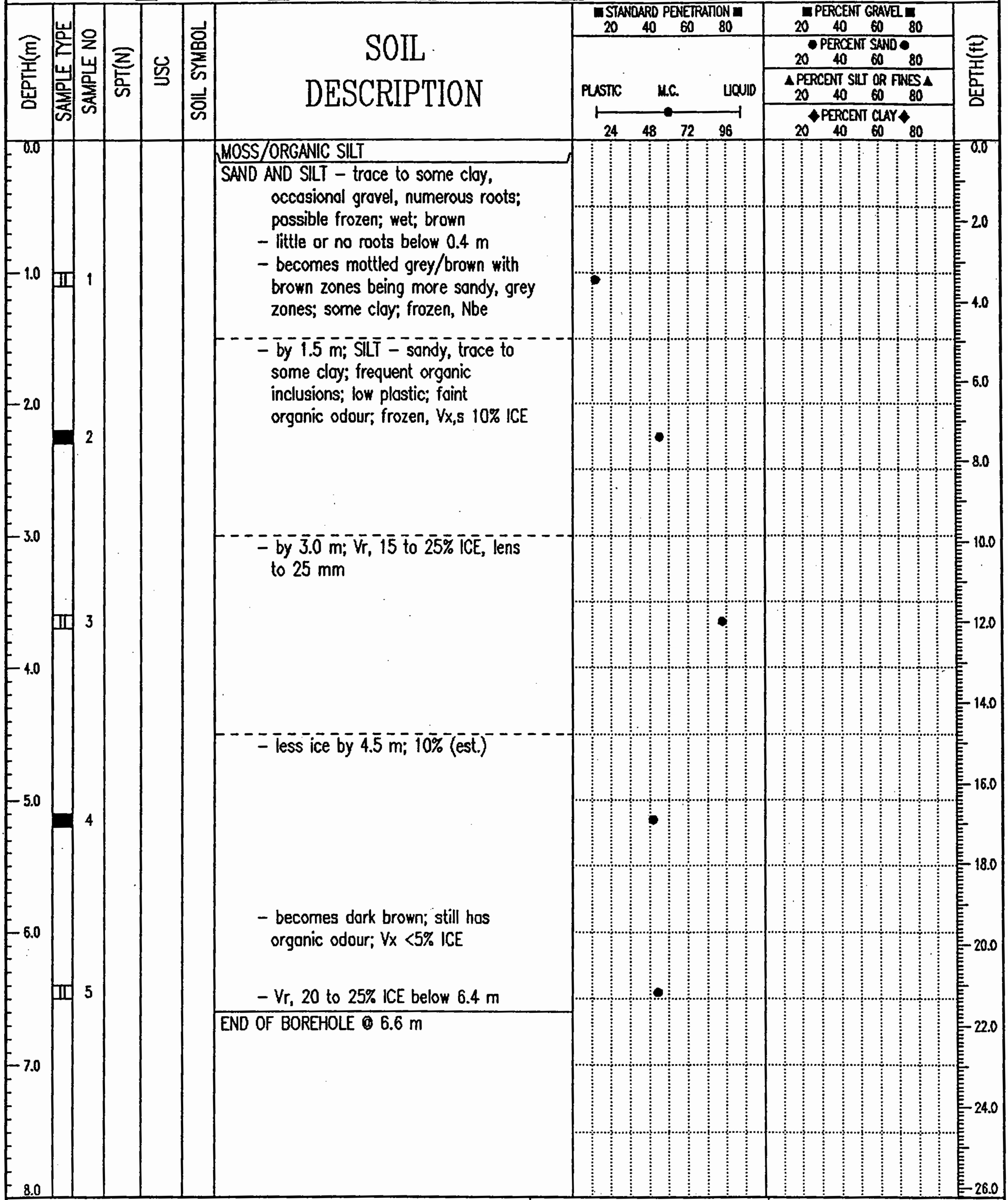
END OF BOREHOLE @ 4.8 m

EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: CRH	COMPLETION DEPTH: 4.8 m
	REVIEWED BY: CRH	COMPLETE: 96/07/06
	Fig. No:	Page 1 of 1

96/08/13 04:36PM (YUKON-6)

MINTO CREEK MINE DEVELOPMENT	CLIENT: MINTO EXPLORATIONS LTD.	BOREHOLE NO: 96-G13
MILL WATER POND – SOUTH ABUTMENT	DRILL: CME-75 C/W SOLID SHAFT AUGERS	PROJECT NO: 0201-11509
MINTO CREEK, YUKON	UTM ZONE: 8 N6944821.6 E385233	ELEVATION: 2585.80 (m)

SAMPLE TYPE ■ GRAB SAMPLE ◪ NO RECOVERY ☒ STANDARD PEN. ☰ 75 mm SPOON ▥ CRREL BARREL



SOIL DESCRIPTION

MOSS/ORGANIC SILT

SAND AND SILT – trace to some clay, occasional gravel, numerous roots; possible frozen; wet; brown
- little or no roots below 0.4 m
- becomes mottled grey/brown with brown zones being more sandy, grey zones; some clay; frozen, Nbe

- by 1.5 m; SILT – sandy, trace to some clay; frequent organic inclusions; low plastic; faint organic odour; frozen, Vx,s 10% ICE

- by 3.0 m; Vr, 15 to 25% ICE, lens to 25 mm

- less ice by 4.5 m; 10% (est.)

- becomes dark brown; still has organic odour; Vx <5% ICE

- Vr, 20 to 25% ICE below 6.4 m

END OF BOREHOLE @ 6.6 m

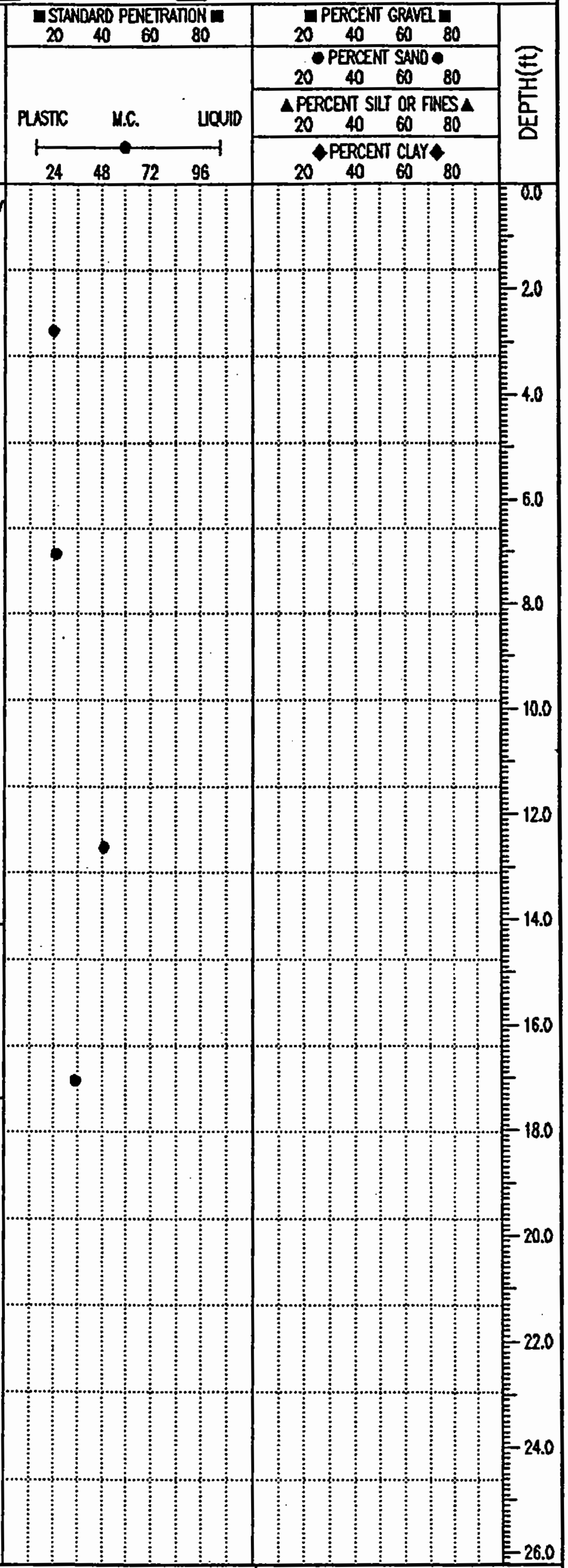
EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: CRH	COMPLETION DEPTH: 6.6 m
	REVIEWED BY: CRH	COMPLETE: 96/07/08
	Fig. No:	Page 1 of 1

96/08/14 02:49PM (YUKON-8)

MINTO CREEK MINE DEVELOPMENT	CLIENT: MINTO EXPLORATIONS LTD.	BOREHOLE NO: 96-G16
MILL WATER POND – SOUTH SLOPE	DRILL: CME-75 C/W SOLID SHAFT AUGERS	PROJECT NO: 0201-11509
MINTO CREEK, YUKON	UTM ZONE: 8 N6944794.7 E385183.9	ELEVATION: 2582.80 (m)

SAMPLE TYPE ■ GRAB SAMPLE ▨ NO RECOVERY ☒ STANDARD PEN. ☰ 75 mm SPOON ▥ CRREL BARREL

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION
0.0						MOSS/ORGANIC SILT
						SAND AND SILT – trace of gravel, trace of clay; fine to coarse sand; fine, subrounded to rounded gravel; matrix of silt and fine sand; frozen, Nbe; brown with rusty brown mottling – occasional wood fibers; faint organic odour – thawed to 0.3 m – becomes grey, more clayey with depth – occasional subangular gravel
	▥	1				
	■	2				
						– grades into a grey clayey silt and sand – trace of gravel; Vr, 10% to 20% ICE, ice lens to 10 mm, mostly vertical; occasional wood fibres; faint organic odour
	▥	3				
						– becomes clayey silt and sand clasts in ice matrix with fine gravel inclusions; Vr, 20% to 25% ICE, lens to 15 mm
	▥	4				
5.3						END OF BOREHOLE @ 5.3 m



DEPTH(m): 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0

EBA Engineering Consultants Ltd.
Whitehorse, Yukon

LOGGED BY: CRH	COMPLETION DEPTH: 5.3 m
REVIEWED BY: CRH	COMPLETE: 96/07/08
Fig. No:	Page 1 of 1

96/08/14 01:23PM (YUKON-8)

APPENDIX

APPENDIX D THERMAL ANALYSES

TO: Jason Berkers **DATE:** December 11, 2006
FROM: Gordon Zhang **FILE:** 1200173
SUBJECT: **Thermal Analysis of "Dry" Stacked Tailings Area Minto Project, YT**

1.0 INTRODUCTION

EBA Engineering Consultants Ltd. (EBA) was retained by Minto Explorations Ltd. (Minto) to develop a "dry" stacked tailings placement plan and to design the associated facilities for the tailings placement at the Minto mine site. As part of the design, thermal analyses were carried out to predict the thermal regime of "dry" stacked tailings placed over a 1.5 m thick sandy gravel drainage blanket overlying the original ground and to evaluate the impacts of the placed tailings on the thermal regime of the native subgrade during the life of the Minto Mine (2007 to 2014). The thermal model was calibrated against the measured ground temperatures at the site. Various cases with different assumed tailings placement rates and final heights were simulated. Parametric and sensitivity studies for some cases were also conducted. This memo summarizes the methodology, input data, and results of the thermal analyses. Conclusions and recommendations drawn from the results of the thermal analyses are also presented in this technical memo.

2.0 THERMAL ANALYSES METHODOLOGY

Analyses were carried out using EBA's proprietary two-dimensional finite element computer model, GEOTHERM. The model simulates transient, two-dimensional heat conduction with change of phase for a variety of boundary conditions. The heat exchange at the ground surface is modelled with an energy balance equation considering air temperatures, wind velocity, snow depth, and solar radiation. The model facilitates the inclusion of temperature phase change relationships for soils, such that any freezing depression and unfrozen water content variations can be explicitly modelled. The model has been verified by comparing its results with closed-form analytical solutions and many different field observations. The model has successfully formed the basis for thermal evaluations and designs of tailings dykes, dams, foundations, pipelines, utilidor systems, landfills, and ground freezing systems in arctic and sub-arctic regions.

3.0 CLIMATIC DATA FOR THERMAL EVALUATION

Climatic data required for the thermal analyses includes monthly air temperature, wind speed, solar radiation, and snow cover. No long-term climatic data is available from the Minto Mine site. A complete meteorological station was established at the site in September 2005 and data for the station is available up to mid-July 2006 (Access Consulting Group, 2006). Snow surveys have been carried out by J. Gibson & Associates in 1994, 1995, 1998 and 2006 at three locations in the Minto Creek area (Access Consulting Group, 2006).

The closest meteorological station to the Minto site with a long-term climatic record is Pelly Ranch, which is situated about 40 km northeast of the Minto site. In addition, the Carmacks meteorological station is located about 70 km southeast of the site. Measured long-term air temperatures are available for both the stations from the National Climate Data and Information Archive operated by Environment Canada (http://www.climate.weatheroffice.ec.gc.ca). Comparison of the measured air temperatures at the two stations for 29 years of the overlapped periods with complete data indicates that the monthly air temperatures at Carmacks are generally warmer than those at Pelly Ranch. The two stations are located at similar elevations (an average of approximately 490 m), which is lower than the toe of the tailings placement area at an elevation of approximately 760 m. Johnston (1981) reported that climatologists typically estimate a 6°C decrease in temperature for every kilometre increase in elevation for mountain slopes. Therefore, the long-term mean monthly air temperatures at the Minto site for this study were first estimated by interpolating the long-term mean monthly air temperatures at Pelly Ranch and Carmacks based on the distances to the Minto site and then adjusted for the temperature change due to the elevation difference of 270 m. Accordingly, the estimated mean annual air temperature at the Minto site is -5.1°C.

The measured air temperatures for the period from early-September 2005 to mid-July 2006 at the Minto site were warmer (about 1°C in long-term mean annual air temperatures) than the estimated long-term mean values. However, the limited short-term measured air temperatures are not sufficient to verify or adjust the estimated long-term mean values used for this study. Further detailed discussions on the measured and estimated air temperatures at the Minto site are presented in Section 6.0 of this memorandum.

Long-term mean wind speed data are not available at the Pelly Ranch and Carmacks stations. The mean wind speed data for this study was estimated by averaging those from four meteorological stations in the Yukon: Burwash, Mayo, Watson Lake, and Whitehorse (http://www.climate.weatheroffice.ec.gc.ca). Measured wind speed data from the Minto site are available for a short period (September 2005 to July 2006) (Access Consulting Group, 2006). Comparison of the monthly wind speed data indicates that the estimated wind speeds are similar to the measured during the summer of 2006 and higher than the measured during the winter of 2005.

Snow depth surveys at the Minto site were conducted in March, April and May of 1994, 1995, 1998, and 2006. The mean monthly snow depths in March, April and May for this study were estimated by averaging the measured monthly values. The mean monthly snow depths for the other months were estimated based on the mean monthly snow depths at Mayo and then adjusted for the measured snow depth differences between the two sites between March and May. Mayo, located approximately 120 km northeast of the Minto site, is situated in the same snow-depth contour zone as the Minto site based on the snow depth maps presented in Natural Resources Canada's webpage (http://atlas.nrcan.gc.ca).

Norman Wells and Whitehorse are the closest stations to the Minto site (latitude of 62°36') with long-term solar radiation data. Norman Wells (latitude of 65°17') is located about 580 km northeast of the Minto site and Whitehorse (latitude of 60°43') is located about 220 km southeast of the Minto site. The mean monthly solar radiation data at the Minto site for this study were estimated by interpolating the long-term mean monthly solar radiation data at Norman Wells and Whitehorse based on the latitudes of the three sites. Measured solar radiation data are available at the Minto site for the period from September 2005 to July 2006 (Access Consulting Group, 2006). The measured monthly solar radiation data are similar to the estimated.

The long-term mean climatic data estimated for the Minto site for this study is summarized in Table 1.

TABLE 1: SUMMARY OF MEAN CLIMATIC CONDITIONS AT MINTO USED IN THERMAL ANALYSES

Month	Monthly Air Temperature[(a)] (°C)	Monthly Wind Speed[(b)] (km/h)	Month-End Snow Cover[(c)] (m)	Daily Solar Radiation[(d)] (W/m²)
January	-28.2	7.5	0.40	10.2
February	-21.8	8.9	0.43	39.0
March	-12.4	10.0	0.48	102.0
April	-1.1	11.7	0.08	180.7
May	6.3	11.8	0.00	229.9
June	11.7	10.8	0.00	255.4
July	13.8	9.5	0.00	225.8
August	11.2	9.6	0.00	170.1
September	5.0	10.7	0.01	99.1
October	-4.0	11.9	0.10	41.5
November	-17.1	8.9	0.23	14.2
December	-25.0	7.8	0.31	5.3

Notes:

(a) based on Climate Normals 1971-2000 at Pelly Ranch (Environment Canada website), measured mean air temperatures at Carmacks and Pelly Ranch for the period of 1963 to 2004 (Environment Canada website), and Johnston (1981)

(b) based on Climate Normals 1971-2000 for Burwash, Mayo, Watson Lake, and Whitehorse (Environment Canada website)

(c) based on snow depth survey data at Minto and mean month-end snow data at Mayo (Climate Normals 1971-2000, Environment Canada website)

(d) based on Climatic Normals 1951-1980 at Norman Wells and Whitehorse (Environment Canada, 1982)

4.0 CALIBRATION THERMAL ANALYSIS

A thermistor cable was installed on July 7, 1996 to a depth of 10 m in borehole BH 96-G08 within the footprint of the proposed "dry" stacked tailings placement area at the Minto site. One-dimensional thermal analysis was conducted to calibrate the thermal model with the measured ground temperatures at BH 96-G08. The modelled soil profile consists of a thin (0.1 m) organics layer overlying 4.5 m organic silt/sand, 1.4 m sand/gravel, and 39 m sand/silt over granite bedrock.

The soil index properties were estimated from the borehole log for BH 96-G08 and past experience. Thermal properties of the soils were determined indirectly from well-established correlations with soil index properties (Farouki, 1986; Johnston, 1981). Table 2 summarizes the material properties used in the calibration thermal analysis.

TABLE 2: MATERIAL PROPERTIES USED IN CALIBRATION THERMAL ANALYSIS

Material	Water Content (%)	Bulk Density (Mg/m^3)	Thermal Conductivity (W/m-^{o}C)		Specific Heat (kJ/kg^{o}C)		Latent Heat (MJ/m^3)
			Frozen	Unfrozen	Frozen	Unfrozen	
Moss/Organics	100	1.00	0.81	0.47	1.89	2.94	167
Organic Silt/Sand	60	1.60	2.36	1.02	1.24	2.03	200
Sand/Gravel	8	2.35	2.61	2.12	0.83	0.99	58
Sand/Silt	28	1.96	2.40	1.34	1.03	1.49	143
Bedrock	1	2.68	3.00	3.00	0.75	0.77	9

Table 3 compares the calibrated ground temperatures with those measured on September 9, 1996 at BH 96-G08.

TABLE 3: MEASURED AND PREDICTED GROUND TEMPERATURES AT BH 96-G08

Depth below Ground Surface (m)	Measured (^{o}C)	Predicted (^{o}C)
1	0.1	0.1
2	-0.5	-0.2
3	-0.7	-0.4
4	-0.8	-0.5
5	-0.8	-0.6
7.5	-0.8	-0.8
10	-0.8	-0.8

Table 3 indicates that there is a good agreement between the measured and predicted ground temperatures. The predicted mean active layer thickness is approximately 1.2 m. The results of the calibration thermal analysis indicate that the input data used in the thermal model are reasonable and can be used to predict the thermal regime of the stacked tailings area.

5.0 THERMAL ANALYSES OF STACKED TAILINGS AREA

5.1 CASES SIMULATED

The planned construction schedules and activities for the stacked tailings placement area at the Minto site include the following:

- removing trees in the tailings placement area during January 2007;
- placing 1.5 m sandy gravel drainage blanket over the area in February 2007; and
- placing tailings in engineered lifts overlying the sandy gravel drainage blanket beginning in May 2007 and continuing through the mine life.

The purposes of the thermal evaluations in the current study are to predict thermal performance of the stacked tailings and to evaluate thermal impacts of the tailings placement on the original ground. Various cases with different assumed tailings placement rates and final heights were simulated. Parametric and sensitivity studies for some cases were also conducted. A total of 15 cases were analyzed and are summarized in Table 4.

TABLE 4: CASES SIMULATED BY THERMAL MODELLING

Case	Ground Conditions Prior to Placing Tailings	Simulated Placement Rate and Schedule of "Dry" Stacked Tailings	Assumed Final Height of Total Tailings Placed (m)	Assumed Percentage of Monthly Average Snow Depth over Long-term Monthly Mean Snow Depth
1	1.5 m sandy gravel drainage blanket placed over the original ground in February 2007 after trees removed in January 2007	No tailings placed	0	15% from February 2007 to September 2007 and 100% after September 2007
2		1.5 m/year: placing the first 0.5 m thick lift of tailings in May 2007, the second 0.5 m lift in September 2007 (after four months), the third 0.5 m lift in January 2008, and so on.	5	65% during the period of placing the tailings and 100% after the final height of the tailings is reached
3			7.5	
4			10	
5		3.0 m/year: placing the first 0.5 m thick lift in May 2007, the second 0.5 m lift in July 2007 (after two months), the third 0.5 m lift in September 2007, and so on.	5	15% during the period of placing the tailings and 100% after the final height of the tailings is reached
6			7.5	
7			10	
8		6.0 m/year: placing a 0.5 m thick lift in each month starting in May 2007.	5	5% during the period of placing the tailings and 100% after the final height of the tailings is reached
9			7.5	
10			10	
11		3.0 m/year: placing the first 0.5 m thick lift in September 2007, the second 0.5 m lift in November 2007 (after two months), the third 0.5 m lift in January 2008, and so on.	10	15% during the period of placing the tailings and 100% after the final height of the tailings is reached
12	Original ground with trees removed in January 2007 but without the sandy gravel drainage blanket	1.5 m/year: placing the first 0.5 m thick lift in May 2007, the second 0.5 m lift in September 2007 (after four months), the third 0.5 m lift in January 2008, and so on.	5	65% during the period of placing the tailings and 100% after the final height of the tailings is reached
13		3.0 m/year: placing the first 0.5 m thick lift in September 2007, the second 0.5 m lift in November 2007 (after two months), the third 0.5 m lift in January 2008, and so on.	10	15% during the period of placing the tailings and 100% after the final height of the tailings is reached
14	Same as Case 1 but with assumed increased snow depth after September 2007			15% from February 2007 to September 2007 and 200% after September 2007
15	Original ground without trees	No tailings placed	0	100 % prior to May 1, 2007 and 200% after May 1, 2007

Case 1 evaluates the long-term thermal conditions of the original ground covered with the 1.5 m thick sandy gravel drainage blanket but without placing any tailings. Cases 2 to 10 simulate various tailings placement rates and tailings final heights. Case 11 is the same case as Case 7 but assumes that tailings are first placed in September 2007 instead of May 2007, which evaluates the sensitivity of the thermal analysis results to the initial tailings placement time. Cases 12 and 13 are sensitivity cases that evaluate the thermal impacts of tailings placed directly over the original ground instead of over the 1.5 m thick sandy gravel drainage blanket as for Cases 2 to 11. Cases 14 and 15 are parametric cases that evaluate the effects of assumed snow depth on the predicted maximum thaw penetration for cases without tailings.

In the thermal analyses, placement of the 1.5 m sandy gravel drainage blanket was modelled as 0.5 m thick three lifts being placed on February 8, 15, and 22, 2007, respectively. The 0.5 m thick lift of the tailings placed in a given month was modelled as four sub-lifts, 0.125 m thick each, being placed on the 7th, 15th, 22nd, and 30th of the month, respectively.

The initial ground temperatures on February 1, 2007 for Cases 1 and 14 and on May 1, 2007 for Cases 12, 13 and 15 were estimated from the calibrated thermal analysis for BH 96-G08. The initial ground temperatures on May 1, 2007 (Cases 2 to 10) and on September 1, 2007 (Case 11) were estimated from the thermal analysis results for Case 1.

The assumed initial temperatures were -4°C for the sandy gravel drainage blanket placed in February 2007, 5°C for the tailings placed in October through May, and 20°C for the tailings placed in June through September.

5.2 SOIL INDEX AND THERMAL PROPERTIES

The soil index and thermal properties for the original ground for the thermal analyses were assumed to be the same as those listed in Table 2 for the calibration thermal analysis for BH 96-G08, except for the moss/organics layer, which was assumed to be compressed after thaw consolidation under loading of the drainage blanket or/and tailings. The assumed soil index and thermal properties for the compressed moss/organics layer are presented in Table 5.

The index properties for the sandy gravel drainage blanket and stacked tailings have been estimated from limited available information and past experience. Thermal properties of the materials were determined indirectly from well-established correlations with their index properties. Table 5 summarizes the material properties used in the thermal analyses.

TABLE 5: MATERIAL PROPERTIES USED IN THERMAL ANALYSES

Material	Water Content (%)	Bulk Density (Mg/m³)	Thermal Conductivity (W/m-°C)		Specific Heat (kJ/kg°C)		Latent Heat (MJ/m³)
			Frozen	Unfrozen	Frozen	Unfrozen	
Compressed moss/ organics after thaw consolidation	60	1.60	2.36	1.02	1.24	2.03	200
Sandy gravel placed in winter	3	2.06	1.22	1.42	0.77	0.83	20
Sandy gravel placed in winter after initial thaw	3	2.11	1.38	1.54	0.77	0.83	21
Sandy gravel after thaw consolidation under loadings from tailings	5	2.20	1.89	1.84	0.80	0.90	35
Stacked tailings	20	1.90	2.07	1.39	0.96	1.31	106

5.3 RESULTS AND DISCUSSION

One-dimensional thermal analyses were conducted for all 15 cases listed in Table 4. The predicted maximum thaw penetration into the original ground and associated time during the mine life for each of the 15 cases are summarized in Table 6. The following observations can be made from the results:

- The predicted maximum thaw depth of 1.3 m for Case 1 (placing only the 1.5 m sandy gravel drainage blanket in Feb 2007) is slightly greater than the estimated active layer thickness of 1.2 m for the original ground for BH 96-G08.
- The predicted maximum thaw depths for Cases 2 to 11 are generally similar and have limited sensitivity to the tailings placement rates and final stack heights.
- The predicted maximum thaw depths are greater for the cases where the tailings are placed directly on the original ground instead of the 1.5 m thick sandy gravel drainage blanket.
- The predicted maximum thaw depths greatly increase with increasing snow depth for the cases that simulated the ground conditions without placed tailings.

TABLE 6: PREDICTED MAXIMUM THAW PENETRATION INTO ORIGINAL GROUND FOR 15 CASES

Case	Predicted Maximum Thaw Depth below Original Ground Surface during Life of Minto Mine (2007 to 2014) (m)	Time Associated with Maximum Thaw	Comments Based on Thermal Analysis Results
1	1.3	Summer 2014	The predicted thaw depth is 0.8 m below the original ground surface in summer 2008 and increases to 1.3 m in summer 2014.
2 to 7 and 9 to 10	0.7	Summer 2007	The predicted depth of the unfrozen original overburden soils after summer 2007 is either equal to or less than that in summer 2007.
8	0.9	Summer 2014	The predicted thaw depth is 0.7 m below the original ground surface in summer 2007 and increases to 0.9 m in summer 2014.
11	0.8	Summer 2007	The thawed original overburden soils are frozen back after 2008.
12 and 13	1.4	Summer 2007 and after	The predicted depth of the unfrozen original overburden soils after summer 2007 remains the same as that in summer 2007.
14	2.2	Summer 2014	The predicted thaw depth is 1.0 m below the original ground surface in summer 2008 and increases to 2.2 m in summer 2014.
15	2.1	Summer 2014	The predicted thaw depth is 1.5 m below the original ground surface in summer 2008 and increases to 2.1 m in summer 2014.

It is noted that tailings placement warms up the original ground. The results indicate that the original ground has warmed from approaching -0.8°C to between -0.3°C and 0°C. Figures 1 to 3 present the predicted September 2014 tailings/ground temperature profiles for Cases 2 to 4, 5 to 7, and 8 to 10, respectively. Figures 1 to 3 indicate that the tailings is either unfrozen or marginally frozen with temperatures warmer than -0.3°C. The predicted tailings temperatures for the tailings placement rates of 1.5 m/year (Cases 2 to 4) and 3.0 m/year (Cases 5 to 7) are generally colder than those for the tailings placement rate of 6.0 m/year (Cases 8 to 10).

Figure 4 compares the predicted September 2014 tailings/ground temperature profiles for Cases 7 and 11. Case 11 is the same case as Case 7 but assumes that tailings are first placed in September 2007 instead of May 2007. Figure 4 shows that the predicted tailings/ground temperatures for Case 11 are colder than those for Case 7. This is attributed to the fact that the tailings placed during the summer of 2007 for Case 11 is 1.0 m thinner than that for Case 7, such that the thin 0.5 m thick tailings layer, underlying fill, and original ground for Case 11 are predicted to completely freeze back by the following winter. On the contrary, the portion of the thawed original ground beneath the tailings placed during the summer of 2007 for Case 7 is predicted to remain unfrozen after the following winter. This suggests that a thin initial summer-placed tailings layer will result in colder tailings/ground temperatures during the later stage of the mine life.

Both the thermal analysis results and past experience suggest that ground with thick snow cover would be warmer since snow serves as good thermal insulation. Snow on the surface of the active tailings placement area will likely be cleared, melted, or compressed during tailings placement. Therefore, thin lifts of tailings placed over the large area would result in thin average snow cover on the tailings surface, which, in turn, would result in colder tailings stack temperatures.

6.0 SENSITIVITY EVALUATION OF ESTIMATED MEAN AIR TEMPERATURES

6.1 UNCERTAINTY OF ESTIMATED MEAN AIR TEMPERATURES

The measured monthly mean air temperatures at the Minto site were available for the period from October 2005 to June 2006, as listed in Table 7. The measured air temperatures at Carmacks during the same period are also presented in Table 7 for comparison. However, no measured air temperatures at Pelly Ranch are available for the same period. The data in Table 7 show no clear trend between the measured air temperatures at the two sites. The average temperature during this period is 1.1°C warmer at the Minto site than at Carmacks. This observation is based on the data for a very short period and may not represent the long-term correlation between the two sites. To address the potential uncertainty associated with the estimated long-term air temperatures, another set of long-term mean air temperatures for the Minto site were estimated by interpolating the long-term mean monthly air temperatures at Pelly Ranch and Carmacks based on the distances to the Minto site but without adjusting for the elevation difference. Accordingly, the mean annual air temperature at the Minto site was estimated to be -3.5°C, which is 1.6°C warmer than that for the estimated long-term monthly air temperatures used in the previous thermal analyses. The estimated monthly long-term mean air temperatures at the Minto site for both the following sensitivity studies and the previous thermal analyses are listed in Table 7 for comparison.

TABLE 7: MEASURED AND ESTIMATED AIR TEMPERATURES AT MINTO AND CARMACKS

Month	Measured Monthly Air Temperature from October 2005 to June 2006 at Minto Site[(a)] (°C)	Measured Monthly Air Temperature from October 2005 to June 2006 at Carmacks[(b)] (°C)	Estimated Monthly Mean Air Temperature at Minto for Sensitivity Thermal Analyses in Section 6.2[(c)] (°C)	Estimated Monthly Mean Air Temperature at Minto for Previous Thermal Analyses in Sections 4 and 5[(d)] (°C)
January	-19.3	-24.1	-26.6	-28.2
February	-11.8	-15.6	-20.2	-21.8
March	-12.0	-13.3	-10.8	-12.4
April	-0.9	0.7	0.5	-1.1
May	7.3	7.4	7.9	6.3
June	13.6	13.3	13.3	11.7
July			15.4	13.8
August			12.8	11.2
September			6.6	5.0
October	-0.9	0.2	-2.4	-4.0
November	-12.7	-11.9	-15.4	-17.1
December	-10.2	-13.3	-23.4	-25.0
Average	-5.2	-6.3	-3.5	-5.1

Notes:

(a) measured at the Minto Camp climate station from October 2005 to June 2006 (Access Consulting Group, 2006)

(b) measured at Carmacks from October 2005 to June 2006 (Environment Canada website)

(c) based on Climate Normals 1971-2000 at Pelly Ranch (Environment Canada website), measured mean air temperatures at Carmacks and Pelly Ranch for the period of 1963 to 2004 (Environment Canada website)

(d) based on Climate Normals 1971-2000 at Pelly Ranch (Environment Canada website), measured mean air temperatures at Carmacks and Pelly Ranch for the period of 1963 to 2004 (Environment Canada website), and Johnston (1981)

6.2 AIR TEMPERATURE SENSITIVITY STUDIES

To evaluate the effects of the uncertainty associated with the estimated long-term air temperatures at the Minto site, a set of sensitivity thermal analyses were conducted using the warmer long-term air temperatures listed in Table 7.

Calibration thermal analyses for BH 96-G08 were repeated using the warmer long-term air temperatures. The soil profile and properties remained the same. Input data such as snow properties and ground surface conditions were adjusted. Table 8 compares the calibrated ground temperatures with those measured on September 9, 1996 at BH 96-G08. The calibrated ground temperatures are almost identical to those listed in Table 3. The predicted active layer thickness under the warmer long-term air temperatures remains approximately 1.2 m.

TABLE 8: MEASURED AND MODELLED GROUND TEMPERATURES AT BH 96-G08

Depth below Ground Surface (m)	Measured (ºC)	Modelled (ºC)
1	0.1	0.1
2	-0.5	-0.2
3	-0.7	-0.4
4	-0.8	-0.6
5	-0.8	-0.7
7.5	-0.8	-0.8
10	-0.8	-0.8

Cases 1, 2, and 7 listed in Table 4 were re-run with the warmer long-term air temperatures and calibrated snow properties. Other climatic data and ground surface properties were assumed to be the same as for the earlier analyses. The initial February 1, 2007 ground temperatures for Case 1 were estimated based on the new calibration thermal analysis for BH 96-G08. The initial May 1, 2007 ground temperatures for Cases 2 and 7 were estimated based on the revised results for Case 1.

Table 9 presents the predicted maximum thaw penetration into the original ground using the estimated warmer long-term air temperatures. The results indicate that the predicted maximum thaw depths for the current sensitivity studies are 0.1 m to 0.4 m deeper than those for the corresponding cases simulated in Section 5.

TABLE 9: PREDICTED MAXIMUM THAW PENETRATION INTO ORIGINAL GROUND FOR AIR TEMPERATURE SENSITIVITY STUDIES

Case	Predicted Maximum Thaw Depth below Original Ground Surface during Life of Minto Mine (2007 to 2014) (m)	Time Associated with Maximum Thaw	Comments Based on Thermal Analysis Results
1	1.4	Summer 2014	The predicted thaw depth is 1.0 m below the original ground surface in summer 2008 and increases to 1.4 m in summer 2014.
2	1.1	Summer 2014	The predicted thaw depth is 0.8 m below the original ground surface in summer 2007 and increases to 1.1 m in summer 2014.
7	0.8	Summer 2007	The predicted thaw depth remains the same during the life of the mine.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations can be drawn from the thermal analysis results:

- The 1.5 m thick sandy gravel drainage blanket proposed to be placed over the original ground to drain potential excess pore water in the original ground and tailings can also provide benefit in limiting thaw penetration into the original ground due to tailings placement.
- The predicted long-term tailings temperatures for tailings placement rates of 1.5 m/year and 3.0 m/year are colder than those for a tailings placement rate of 6.0 m/year. Therefore, it is recommended to limit the tailings placement rate to less than 3.0 m/year to promote freeze-back of the summer-placed tailings.
- A thin initial summer-placed tailings layer would promote freeze-back of the tailings, underlying sandy gravel fill, and original ground during the following winter and result in colder tailings/ground temperatures during the later stage of the mine life. The initial summer-placed tailings should be spread over a large area and in thin lifts to promote freeze-back of the tailings, underlying sandy gravel fill, and original ground during the following winter.
- Reduced snow cover would result in colder tailings/ground temperatures. It is recommended that snow be regularly cleared off the tailings surface.
- Snow tends to accumulate on the lower area along the toe of the tailings perimeter slopes due to both natural snow-drifting and intentional snow-clearing off the tailings top surface. It is understood that a haul road will be constructed around the toe of the lower portion of the tailings perimeter slopes. It is recommended that snow be regularly cleared off both the slope toe area and the road surface to limit thaw penetration into the original ground within the area.
- The long-term air temperatures at the Minto site could be warmer than the estimated. Sensitivity thermal analyses assuming warmer mean air temperatures indicate that the predicted maximum thaw penetration into the original ground will be 0.1 m to 0.4 m deeper than those for the corresponding cases presented in Table 6. It is recommended that the long-term mean air temperatures at the Minto site be reviewed when more data become available and the results of the thermal analyses be re-evaluated.

In addition, it is recommended that tailings/ground temperatures in the tailings placement area be regularly monitored to confirm the ground/tailings thermal conditions and to provide additional information for future mine closure design. The results from this study cannot be directly used for the closure design for the following reasons:

- The actual thermal conditions in the tailings placement area may be different from the predicted in this study due to actual different tailings placement rate, different construction schedule, and other factors. Actual tailings/ground temperature monitoring data would provide a better basis for the closure design.
- Long-term global warming effects were not considered in this study due to the relatively short mine life; however, they should be considered for the closure design.

- It is understood that climatic data will be collected at the Minto site during the mine life. The climatic data used for the current study can then be reviewed and updated for the closure design.

8.0 LIMITATIONS

The thermal evaluations in this study were based on limited available site-specific information and engineering judgement. A number of assumptions were applied in the thermal evaluations. The thermal analyses were solely based on the soil profile at BH 96-G08 under estimated long-term climatic conditions. It is expected that the soil profiles and properties will be different from one location to another over the tailings placement area, and climatic conditions over the mine life could be different from those estimated. Therefore, the actual thermal conditions may differ from those predicted in this study.

REFERENCES

Access Consulting Group, 2006. An electronic mail with four attached files from Mr. Scott Keesey of Access Consulting Group to Mr. Jason Berkers of EBA on November 17, 2006.

Environment Canada, 1982. Canadian Climate Normals, Volume 1, Solar Radiation, 1951 - 1980, 57p.

Farouki, O.T., 1986. Thermal Properties of Soils. TransTech Publications, Germany, 136p.

Johnston, G.H. (Editor), 1981. Permafrost, Engineering Design and Construction. Wiley & Sons Toronto, 540p.

FIGURES

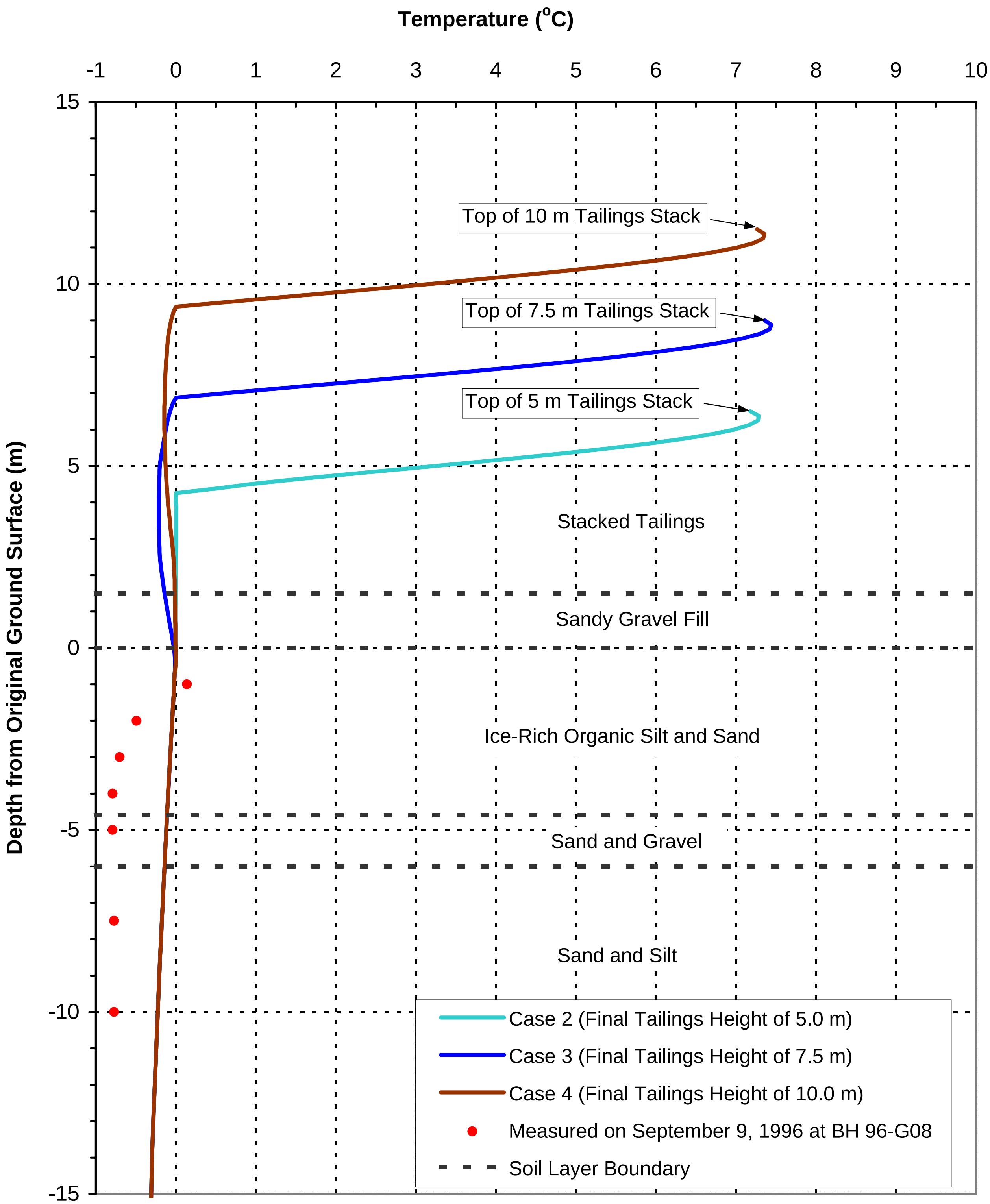


Figure 1

Predicted Tailings/Ground Temperature Profiles in Mid-September 2014 for Cases with Tailings Placement Rate of 1.5 m/year and Various Tailings Final Heights

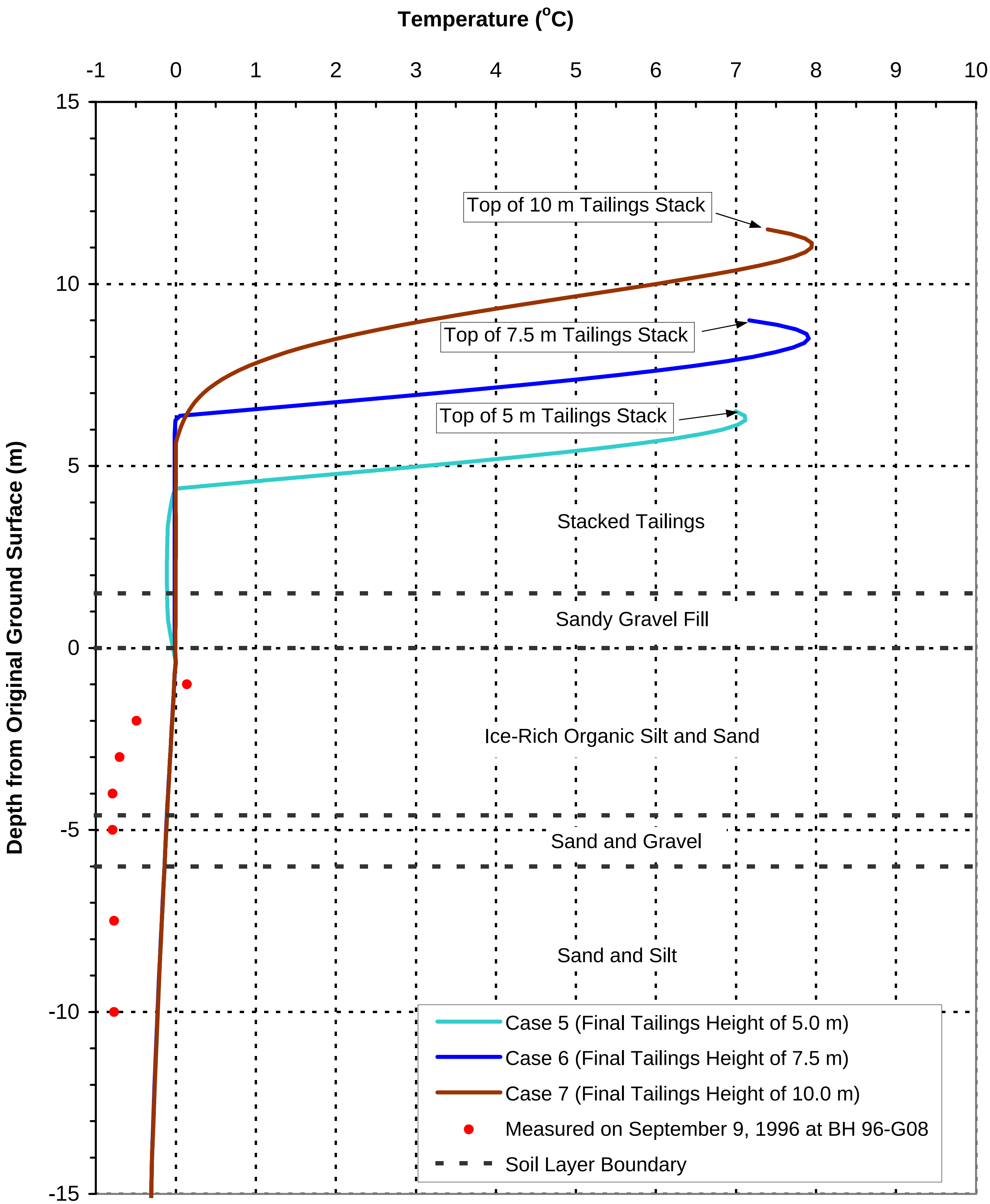


Figure 2

Predicted Tailings/Ground Temperature Profiles in Mid-September 2014 for Cases with Tailings Placement Rate of 3.0 m/year and Various Tailings Final Heights

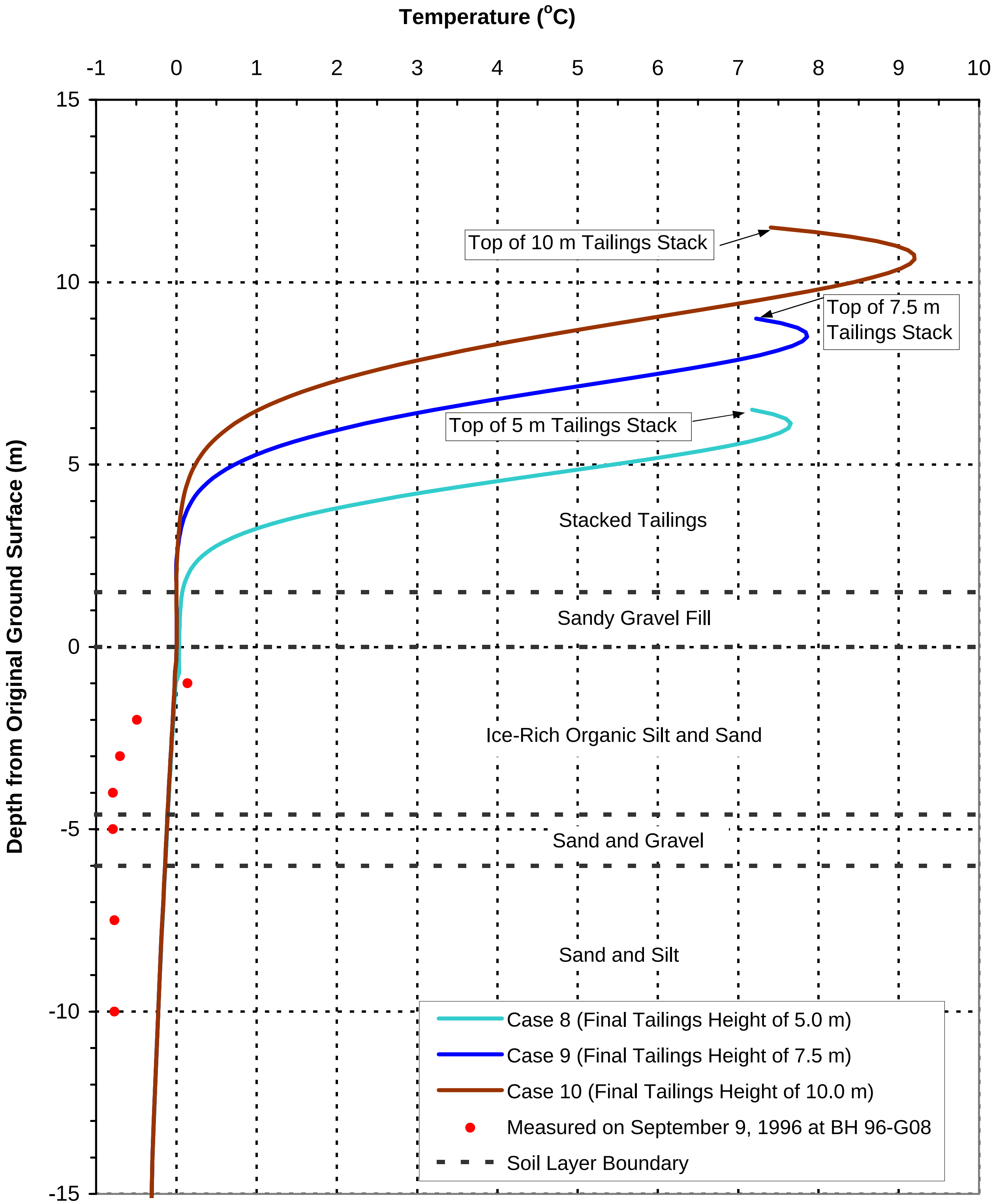


Figure 3

Predicted Tailings/Ground Temperature Profiles in Mid-September 2014 for Cases with Tailings Placement Rate of 6.0 m/year and Various Tailings Final Heights

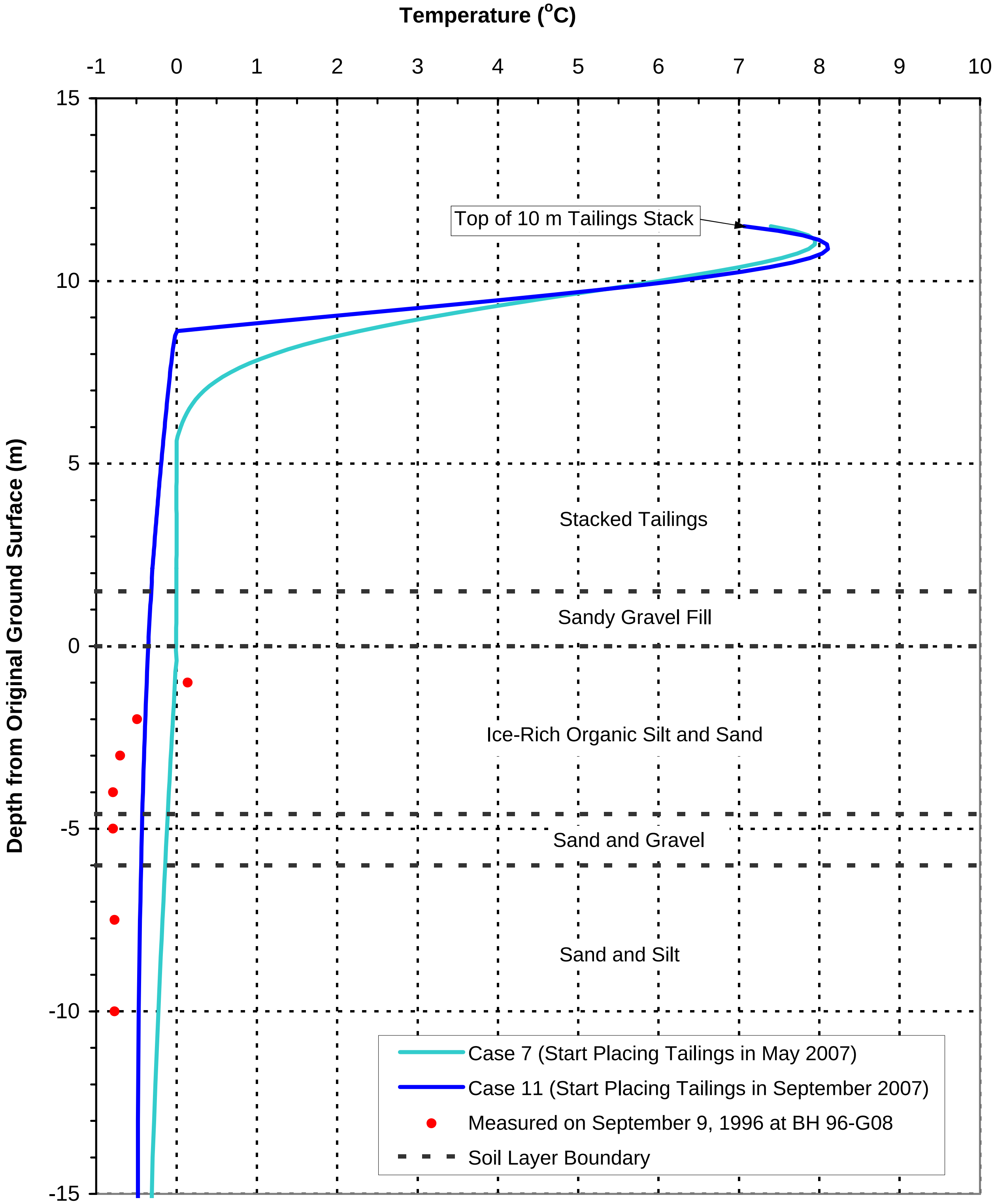


Figure 4

Comparison of Predicted Tailings/Ground Temperature Profiles in Mid-September 2014 for Cases 7 and 11 (Same Tailings Placement Rate of 3.0 m/year and Final Height of 10 m)

MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

APPENDIX B

Area 1 Open Pit – Southern and Western Permafrost Overburden Slope Stability Monitoring

---

EBA, A Tetra Tech Company
Calcite Business Centre, Unit 6, 151 Industrial Road
Whitehorse, YT Y1A 2V3 CANADA
p. 867.668.3068 f. 867.668.4349

TECHNICAL MEMO

ISSUED FOR USE

TO:	Mr. Jason Nickel Mine Manager Minto Exploration Ltd.	**DATE:**	March 23, 2011
C:	John Knapp, Daniel Avar, Tyrone Monteith	**MEMO NO.:**	5
FROM:	Chad Cowan	**EBA FILE:**	W14101068.012

SUBJECT: Area 1 Open Pit – Southern and Western Permafrost Overburden Slope Stability Monitoring
Minto Mine, YT

1.0 INTRODUCTION

EBA, A Tetra Tech Company was retained by Minto Exploration Ltd. to develop a decision matrix associated with the daily movements being observed from the monitoring instrumentation located in the permafrost overburden along the southern and western perimeters of the Area 1 Open Pit. This matrix lists both triggers and responses that Minto staff should consider during further development and completion of the Area 1 Open Pit.

Minto is presently mining the bottom of the Area 1 Open Pit with completion scheduled for the first week of April. Upon completion of the Area 1 Open Pit, a proposed rock buttress is to be placed along the exposed southern and western permafrost overburden slopes to help reduce the current movement and reduce the risk of slope failure into the open pit.

2.0 MONITORING INSTRUMENTATION

A summary of the instrumentation installed to date can be found in Table 1. The location of each instrument can be seen on Figure 1.

Table 1: Area 1 Open Pit Instrumentation Installed to Date

Instruments	Instrument Type	Date Installed	Still Functional?
10-MDI-1, -2	Inclinometer	February 2010	Yes
10-SDI-1	Inclinometer	February 2010	Yes
10-SWFI-5	Inclinometer	February 2010	No
10-SWFI-6, -7	Inclinometer	February 2010	Yes
M63, M64, M65	Survey Hub	October 2010	Yes
10-SWFI-8, -11	Inclinometer	November 2010	Yes
10-SWFI-9, -10	Inclinometer	November 2010	No
M66, M67	Survey Hub	January 2011	Yes
11-SWFE-1, -2, -3	Extensometer	March 2011	Yes

In late February 2011 EBA recommended that extensometers (two pieces of rebar securely placed into the ground on either side of the larger tension cracks) be installed at various locations determined by Minto staff. In early March Minto installed extensometers at three different locations. Measurements of these extensometers are to be taken daily.

3.0 DECISION MATRIX

Table 2 shows the decision matrix detailing various stages of open pit development, the possible triggers and responses.

Table 2: Decision Matrix – Triggers and Responses

Development Stage	Triggers - Instrumentation (Inclinometers, extensometers & survey hubs).	Possible Responses
Area 1 Open Pit Mining	Constant or decreased movement rate of monitoring instrumentation.	Collect data from all monitoring instrumentation daily.
	10% increase in movement rate of monitoring instrumentation.	Collect data from all monitoring instrumentation daily.
	25% increase in movement rate of monitoring instrumentation.	Collect data from inclinometers daily and data from extensometers and survey hubs twice per day.
	50% increase in movement rate of monitoring instrumentation.	Keep all traffic away from toe of slope. Collect data twice daily from survey hubs and extensometers.
	100% increase in movement rate of monitoring instrumentation.	Keep all traffic away from toe of slope and away from the 810 bench. Collect data twice daily from survey hubs and extensometers.
Reduce driving force by Excavation and Relocation of Existing Haul Road (assuming minimal impact to the permafrost overburden slopes)	Constant or decreased movement rate of monitoring instrumentation.	Collect data from all monitoring instrumentation weekly.
	10% increase in movement rate of monitoring instrumentation.	Collect data from all monitoring instrumentation bi-weekly.
	25% increase in movement rate of monitoring instrumentation.	Collect data from all monitoring instrumentation daily.
	50% increase in movement rate of monitoring instrumentation.	Keep all traffic away from toe of slope. Collect data twice daily from survey hubs and extensometers.
	100% increase in movement rate of monitoring instrumentation.	Keep all traffic away from toe of slope and away from the 810 bench. Collect data twice daily from survey hubs and extensometers.
Excavation of Overburden Prior to placement of Waste Rock Support Located at Edge of Pit Wall	Constant or decreased movement rate of monitoring instrumentation.	Collect data from all monitoring instrumentation daily.
	10% increase in movement rate of monitoring instrumentation.	Collect data from all monitoring instrumentation daily.
	25% increase in movement rate of monitoring instrumentation.	Collect data from inclinometers daily and data from extensometers and survey hubs twice per day.
	50% increase in movement rate of monitoring instrumentation.	Keep all traffic away from toe of slope. Collect data twice daily from survey hubs and extensometers.
	100% increase in movement rate of monitoring instrumentation.	Keep all traffic away from toe of slope and away from the 810 bench. Collect data twice daily from survey hubs and extensometers.

Table 2: Decision Matrix – Triggers and Responses Cont'd

Development Stage	Triggers - Instrumentation (Inclinometers, extensometers & survey hubs).	Possible Responses
During Construction of Buttress	Constant or decreased movement rate of monitoring instrumentation.	Collect data from all monitoring instrumentation daily.
	10% increase in movement rate of monitoring instrumentation.	Collect data from all monitoring instrumentation daily.
	25% increase in movement rate of monitoring instrumentation.	Collect data from inclinometers daily and data from extensometers and survey hubs twice per day.
	50% increase in movement rate of monitoring instrumentation.	Keep all traffic away from toe of slope. Only collect data from survey hubs and extensometers on 810 Bench.
	100% increase in movement rate of monitoring instrumentation.	Keep all traffic away from toe of slope and away from the 810 bench.

The percent increase in movement rate refers to the percentage difference between the measured daily movement rate and the average daily movement rate over a specified time period. Review of the data collected to date indicates that changes in movement rates of 25% can occur on a daily basis, however typically these movement rates decrease the day following the spike. All readings with an increase in daily lateral displacement rate of 25% or greater should not be ignored. Even though it is assumed to be possible equipment error, a second reading might be required later that same day or first thing the following morning to verify the increase in movement rate at which time mining personnel should be prepared to take the appropriate action as outlined in Table 2.

4.0 MONITORING DATA

Data from the inclinometers is summarized in Table 3. This data presents the change in location from initial reading. Regarding the movement of the inclinometers, Minto staff should give special attention to inclinometer locations that indicate the greatest average daily lateral displacement rate.

Table 3: Inclinometer Summary – Change in Location from Initial Reading

Instrument	Average Daily Lateral Displacement Rate (mm/d)	Increase in Daily Lateral Displacement Rate (Average Daily Rate plus Increase in Daily Rate)			
		10%	25%	50%	100%
10-MDI-1	1	1.1	1.25	1.5	2
10-MDI-2	1	1.1	1.25	1.5	2
10-SDI-1	1	1.1	1.25	1.5	2
10-SWFI-6	0	0.2	0.5	1	2
10-SWFI-7	0	0.2	0.5	1	2
10-SWFI-8	0	0.2	0.5	1	2
10-SWFI-11	4	4.8	5	6	8

Data from the survey hubs is summarized in Table 4. This data presents the change in location from initial reading. Regarding the movement of the survey hubs, Minto staff should give special attention to survey hub locations that indicate the greatest average daily lateral displacement rate.

Table 4: Survey Hub Summary – Change in Location from Initial Reading

Instrument	Average Daily Lateral Displacement Rate (mm/d)	Increase in Daily Lateral Displacement Rate (Average Daily Rate plus Increase in Daily Rate)			
		10%	25%	50%	100%
M63	2	2.2	2.5	3	4
M64	No movement	0.2	0.5	1	2
M65	2	2.2	2.5	3	4
M66	15	16.5	18.75	22.5	30
M67	5	5.5	6.25	7.5	10
M68	11	12.1	13.7	16.5	22
M69	4	4.8	5	6	8

Data from the extensometers is summarized in Table 5. This data will present the change in location from initial reading. Regarding the movement of the extensometers, Minto staff should give special attention to extensometer locations that indicate the greatest average daily lateral displacement rate.

Table 5: Extensometer Summary – Change in Location from Initial Reading

Instrument	Average Daily Lateral Displacement Rate (mm/d)	Increase in Daily Lateral Displacement Rate			
		10%	25%	50%	100%
10-SWFE-A	Minto just started collecting data				
10-SWFE-B	Minto just started collecting data				
10-SWFE-C	Minto just started collecting data				

5.0 CONCLUSIONS AND RECOMMENDATIONS

Section 3.0 of this memo details the recommended frequency of instrumentation readings. These readings should be forwarded on to EBA on a daily basis. EBA should also be notified of any other observations that indicate that the pit wall is heading towards possible slope failure. These observations can include increased bulging of the slope toe, unravelling of the slope's surface, or development of new tension cracks near the slope's crest. Any observations of slope instability should be forwarded to EBA immediately.

EBA is prepared to send senior personnel to site at short notice should Minto require assistance interpreting these measures or additional observations indicating that the slope is heading towards possible slope failure are observed.

6.0 CLOSURE

We trust this memo meets your present requirements regarding the monitoring of the movement of the southern and western overburden slopes. Should you have any questions or comments, please contact the undersigned at your convenience.

Sincerely,
EBA, A Tetra Tech Company

Chad Cowan

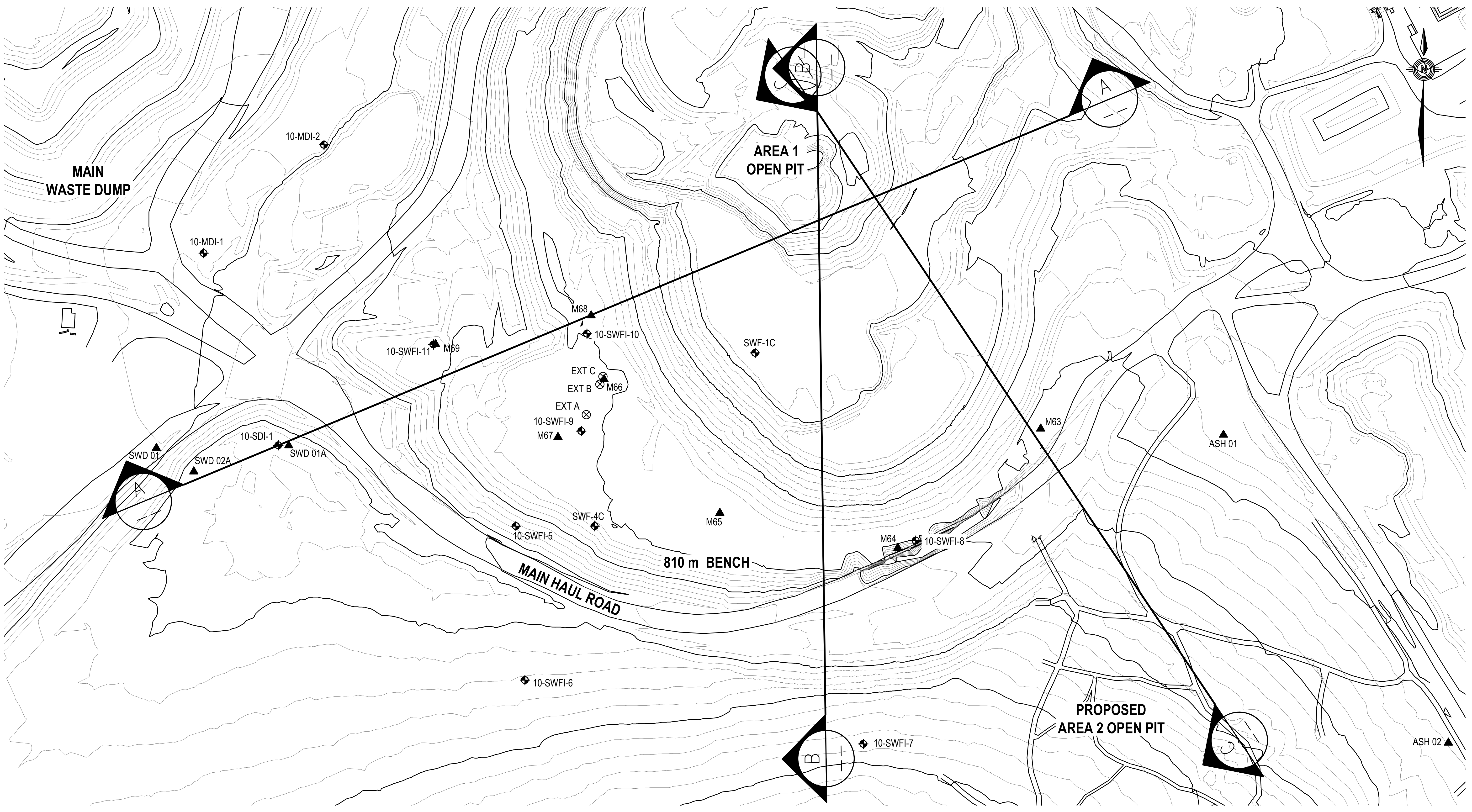
Brian Cutts

Prepared by:
Chad Cowan, P.Eng.
Project Director – Yukon, Arctic Region
Direct Line: 867.668.2071x229
ccowan@eba.ca

Reviewed by:
Brian Cutts, P.Eng.
Senior Geotechnical Engineer
Direct Line: 250.505.4467
bcutts@eba.ca

FIGURES

Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 012 Area 1 Open Pit\Open Pit Instrumentation March 2011.dwg [FIGURE 1] March 18, 2011 - 5:57:05 pm (BY: BUCHAN, CAMERON)



LEGEND

▲ SURVEY HUB (SH)

⌖ SRK/EBA INCLINOMETER

⊗ EXTENSOMETER

— SECTION LINES USED FOR FLAC ANALYSIS

NOTES :

1. Site infrastructure and Facilities provided by Minto Explorations Ltd. April 2009.
2. Base plan generated from information provided by Minto Explorations Ltd. January 2011.

0 100

Scale: 1: 3 000 (metres)

CLIENT

MINTO EXPLORATIONS LTD.

A TETRA TECH COMPANY

AREA 1 OPEN PIT
MINTO MINE, YUKON

SITE PLAN SHOWING INSTRUMENTATION

PROJECT NO.	DWN	CKD	REV
W14101068.012	CB	CPC	0

OFFICE	DATE
EBA-WHSE	March 10, 2011

Figure 1

MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

APPENDIX C

Geotechnical Design Proposed Southwest Dump

Minto Explorations Ltd.
Whitehorse, Yukon

ISSUED FOR USE

GEOTECHNICAL DESIGN
PROPOSED SOUTHWEST WASTE DUMP
MINTO MINE, YUKON

W14101068.005

September 2008

EBA Engineering Consultants Ltd.
p. 867.668.3068 • f. 867.668.4349
Calcite Business Centre • Unit 6, 151 Industrial Road • Whitehorse, Yukon Y1A 2V3 • CANADA

TABLE OF CONTENTS

TABLE OF CONTENTS

PAGE

TABLE OF CONTENTS

FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 GENERAL

The Minto Mine is a copper-gold mine located about 240 km north of Whitehorse, Yukon and is owned and operated by Minto Explorations Ltd. (Minto). The general location of the Minto Mine, along with its specific structures, is shown in Figure 1. The mine is being developed as an open pit mining operation and has been in production since June 2007. Development of the Area 1 Open Pit commenced with stripping in April 2006, and currently operates on an ongoing basis with either ore being stockpiled for processing and/or waste materials being disposed of at one of the waste dumps. There are currently three waste dumps permitted at the Minto Mine - the Main Waste Dump (MWD), the Reclamation Overburden Dump (ROD), and the Ice-Rich Overburden Dump (IROD). The MWD is used to store both non ice-rich overburden and waste rock materials while the ROD is used to store non ice-rich overburden for possible use in future reclamation. The IROD is to be used for storing ice-rich overburden. To date, Minto has only used the MWD and ROD for waste from the open pit.

To facilitate future reclamation and optimize current operations, Minto has proposed the design and construction of a fourth waste dump for the storage of non ice-rich overburden and waste rock materials. Consequently, EBA Engineering Consultants Ltd. (EBA) was retained by Minto to undertake the geotechnical design of this fourth waste dump, the Southwest Waste Dump (SWD).

This report presents the detailed geotechnical design of the proposed SWD and supersedes the Preliminary Design report dated May 2008. Background information involving the proposed SWD, findings of several geotechnical characterization programs, which were conducted in 1996, 1997, 2005, and 2008, the layout and geometry of the proposed SWD, and analytical work associated with the geotechnical design of the SWD will be summarized within this detailed design report. Furthermore, construction and monitoring recommendations for the SWD are also included.

EBA received approval from Minto to proceed with the geotechnical design of the SWD in May 2008.

This report is subject to the General Conditions provided in Appendix A.

1.2 SCOPE OF WORK

EBA's scope of work for this report was specifically the geotechnical design of the proposed SWD, and did not include detailed waste deposition planning or evaluating waste rock geochemical testwork and characterization data.

1.3 REPORT FORMAT

This geotechnical design report is contained in one volume and presents the main text together with the figures and appendices.

2.0 BACKGROUND INFORMATION

2.1 DESIGN INFORMATION

EBA developed the geotechnical design for the proposed SWD from the following background information.

- A drawing supplied by Minto on May 12, 2008 that detailed the Stage 1 dump layout and geometry.
- A drawing supplied by Minto on May 21, 2008 that detailed the proposed footprint limit.
- An email by Minto on May 29, 2008 that stipulated the proposed 2008 waste volumes to be excavated from the Area 1 Open Pit.
- A 2008 report (SRK, 2008) entitled “Waste Dump Overburden Drilling, Minto Mine, Yukon” detailing the 2008 geotechnical investigation.
- An email by Minto on August 22, 2008 that presented the proposed 2009 to 2011 waste volumes to be excavated from the Area 1 Open Pit.
- Several conversations, meetings, and site visits with Minto involving the SWD’s construction and intended use.

In addition, EBA also used the following information from EBA’s files.

- A 1997 report (EBA, 1997) entitled “1996 Geotechnical Drilling Program” detailing the 1996 geotechnical investigation.
- A 1998 report (EBA, 1998a) entitled “1997 Geotechnical Program and Construction Inspection Reports” detailing the 1997 geotechnical investigations.
- A 1998 report (EBA, 1998b) entitled “Geotechnical Evaluation, Proposed Main Waste Dump” summarizing the geotechnical design of the MWD.
- A 2006 report (EBA, 2006) entitled “Geotechnical Design, Ice-Rich Overburden Dump” summarizing the geotechnical design of the IROD.
- A 2007 report (EBA, 2007) entitled “Geotechnical Design Report, “Dry” Stack Tailings Storage Facility” summarizing the geotechnical design of the DSTSF.
- A 2008 report (EBA, 2008a) entitled “Geotechnical Design, Proposed Reclamation Overburden Dump” summarizing the geotechnical design of the ROD.

- A 2008 letter report (EBA, 2008b) entitled "Dry Stack Tailings Storage Facility – 2007/2008 Annual Review" summarizing the construction quality assurance data collected between May 1, 2007 and April 30, 2008 for the DSTSF.

3.0 SITE CHARACTERIZATION

3.1 SITE CHARACTERIZATION PROGRAMS

Four separate site characterization programs have been completed within the proposed SWD footprint. The first three programs were completed by EBA while the fourth was completed by SRK Consulting Inc. (SRK). The first program was completed in July 1996 (EBA, 1997) and was comprised of investigating various areas of the mine site to evaluate future development. The second was completed in September and October 1997 (EBA, 1998a) and formed part of the geotechnical evaluation of the MWD (EBA, 1998b). The third program was completed in October 2005 and formed part of the geotechnical evaluation of the IROD (EBA, 2006). The fourth program was completed in March and April 2008 to conduct condemnation drilling within the proposed area and supplement the data required for the SWD design (SRK, 2008).

3.1.1 1996 Site Characterization Program

The 1996 site characterization program included three boreholes drilled within the vicinity of the proposed SWD location. Only one (96-G05) of the three boreholes is located within the proposed SWD footprint while one (96-G04) is located north and the another (96-G06) is located east of the footprint. Figure 2 shows the location of these three boreholes. Borehole logs summarizing the soil and ground ice descriptions, as well as the laboratory index testing (moisture content and particle size distribution tests) are presented in Appendix B. Individual particle size distribution results are also presented in Appendix B with the associated borehole log.

3.1.2 1997 Site Characterization Program

The 1997 site characterization program included thirteen boreholes drilled within the vicinity of the proposed SWD location. Nine of the thirteen boreholes are located within the proposed SWD footprint while the remaining four (97-G09, -G18, -G19, and –G23) are located north of the footprint. Figure 2 shows the location of these thirteen boreholes, 97-G09 through –G19, -G23 and –G24. Borehole logs summarizing the soil and ground ice descriptions, as well as the laboratory index testing (moisture content and particle size distribution tests) are presented in Appendix B. Individual particle size distribution results are also presented in Appendix B with the associated borehole log.

3.1.3 2005 Site Characterization Program

The 2005 site characterization program included ten testpits excavated within the proposed SWD location along the design toe of the IROD. Figure 2 shows the location of these testpits, 1200179-TP100 through –TP109. Testpit logs summarizing the soil descriptions, as well as the laboratory index testing (moisture content and particle size distribution tests) are presented in Appendix B. Individual particle size distribution results are also presented in Appendix B with the associated testpit log.

3.1.4 2008 Site Characterization Program

The 2008 site characterization program was completed to conduct condemnation drilling and provide additional subsurface information within the vicinity of the proposed SWD. The program included nine boreholes, three of the nine are located within the proposed SWD footprint while the remaining six are located east of the footprint. Figure 2 shows the location of these nine boreholes, 08SWC270 through -280, excluding -276 and -279. Borehole logs summarizing the soil descriptions, as well as the laboratory index testing (moisture content and Atterberg limits tests) are presented in Appendix B. Individual particle size distribution and Atterberg limits results are also presented in Appendix B.

4.0 SITE CONDITIONS

4.1 SURFACE FEATURES

The proposed SWD site is located over gently sloping terrain in the upper portion of a valley, and is directly south of the MWD and east of the IROD. The proposed footprint limit, presented in Figure 2, is enclosed by the main MWD haul road, the IROD and Dyno access road, the IROD and a 30 m offset from the main drainage of this valley that forms part of the upper extent of Minto Creek.

The proposed footprint is located on an east facing slope on the west side of the upper valley. The terrain steepens to the east, south and west of the proposed SWD site. Topographic information indicates the presence of several small ephemeral creeks that converge to the middle of this upper valley into the main drainage. A few small ephemeral creeks enter the proposed footprint from the northwest between the IROD and Pelly laydown pad. These also converge to the middle of this upper valley into the main drainage. These creeks collect the surface run-off water and route it down the mountain side.

The site and adjacent area has sparse to locally dense tree cover. The area was subject to a forest fire in 1995 that has resulted in areas of fallen trees with deciduous species regrowth.

4.2 SUBSURFACE CONDITIONS

The geotechnical site characterizations indicate that the subsurface conditions within the majority of the proposed SWD footprint generally comprise a thin veneer of peat and vegetation overlying a silty sand to sandy silt colluvium overlying residual soil (residuum), which in turn overlies weathered bedrock (granodiorite).

Within the direct vicinity of the IROD, the subsurface conditions generally comprise a thin veneer of peat and vegetation overlying residual soil (residuum), which in turn overlies weathered bedrock (granodiorite).

4.2.1 Groundwater

Groundwater was noted at a depth of 0.5 m at 97-G12 and 2.4 m at 97-G16 during the site characterization. No other borehole or testpit completed within the vicinity of the proposed SWD site during the 1996, 1997, or 2005 characterizations identified groundwater.

Shallow groundwater was noted in SRK, 2008 (up to 2.6 m deep based on short-term data) for each borehole; however, this could be the result of the drilling and soil conditions. Additional monitoring of these instruments is required to better define groundwater conditions at these locations.

4.2.2 Permafrost

Permafrost was encountered in the majority of boreholes drilled during the 1996 and 1997 site characterization programs that are located within the proposed SWD footprint. The observed ice contents in these boreholes were logged as Nbe (Ice not visible – well bonded, excess ice) to Vx (Visible ice – individual ice crystals or inclusions) 5% to 20%. The active layer at the time of drilling varied between 0.3 m and 3.1 m.

Permafrost was not encountered in any of the testpits completed during the 2005 program and is not present beneath or upgradient of the IROD.

Permafrost was encountered in the majority of boreholes drilled during the 2008 site characterization program. The observed ice contents in these boreholes were logged as Nbn (Ice not visible – well bonded) to Ice and Soil. SRK, 2008 noted that distinct permafrost layers were difficult to delineate during the program as not all of the core was recovered in a frozen state. Recent readings from ground temperature cables installed during the program indicate near surface permafrost conditions similar to those observed in the 1996 and 1997 programs. These readings indicate ground temperatures ranging between -0.5 °C and -1.3 °C.

4.2.3 Bedrock

Depth to competent bedrock (granodiorite) at the design toe of the IROD was determined to range between 2.0 m and 3.1 m during the 2005 site characterization program. Weathered bedrock outcrops are present upgradient of the IROD.

All boreholes completed during the 2008 program were terminated within bedrock. Table 1 presents depths to bedrock in these boreholes.

TABLE 1: DEPTH TO BEDROCK – 2008 SITE CHARACTERIZATION

Borehole	Depth to Bedrock (m)
08SWC270	10.7
08SWC271	39.6
08SWC272	42.7
08SWC273	51.8
08SWC274	45.7
08SWC275	26.2
08SWC277	22.3
08SWC278	45.7
08SWC280	19.8

5.0 WASTE SOURCING AND CHARACTERIZATION

5.1 WASTE SOURCING AND CHARACTERIZATION

Waste will be sourced from the Area 1 Open Pit and consist of predominately waste rock; however, some non ice-rich overburden will also require storage within the SWD. This waste material is currently scheduled to be stored at the MWD and is consistent with the material placed to date within the MWD.

The volume of waste to be sourced from the Area 1 Open Pit and ultimately stored within the SWD and/or MWD has been forecasted by Minto as listed in Table 2. These volumes include a 30% swell factor (recommended by Minto based on historic data).

TABLE 2: FORECASTED VOLUMES OF WASTE

Year	Waste Rock Volume (m^3)	Non Ice-Rich Overburden Volume (m^3)
2008	1,027,000(1)	
2009 1st Quarter	888,680	151,115
2009 2nd Quarter	1,054,025	81,055
2009 3rd Quarter	1,269,725	75,420
2009 4th Quarter	1,283,200	126,365
2010 1st Quarter	784,410	105,300
2010 2nd Quarter	195,880	824,890
2010 3rd Quarter	308,820	1,100,055
2010 4th Quarter	746,105	181,015
2011 1st Quarter	238,235	0
TOTAL	7,796,080	2,645,215

Note: (1) Volume for September to December only

6.0 SOUTHWEST WASTE DUMP DESIGN

6.1 DESIGN CONSIDERATIONS

The design considerations for the proposed SWD are summarized below.

- The proposed dump must be geotechnically stable at all stages of construction, with particular attention required to evaluate the effects of permafrost foundation conditions.
- It is Minto's intent to construct the dump in the same manner as the MWD, with a series of setbacks and benches to allow for continued progressive reclamation.
- Surface water management and control of both run-on and run-off water must be incorporated into the design.
- The proposed SWD footprint has been offset 30 m from the main ephemeral creek southeast of the dump.
- Field observation and performance monitoring must be incorporated into the design.
- A design capacity of 12,450,000 m^3 has been assumed for the SWD. This capacity is reduced by approximately 135,000 m^3 because of material already located at the toe of the IROD. This material was stripped from the IROD footprint during its construction and has remained in its current location. This resulting design capacity is roughly 15% larger than the forecasted waste volume from Table 2.

6.2 LAYOUT AND GEOMETRY

The proposed SWD footprint limit is presented in Figure 2 while the overall layout and geometry is shown in Figure 3 and 4. It is Minto's intent to construct the dump by placing the waste material at its angle of repose (approximately 1.5H:1V) with 15 m benches or setbacks at 10 m (vertical) intervals. The only deviation to the 1.5H:1V sideslopes is the bottom bench of the dump, which has been stipulated at 2.5H:1V at all locations around the dump. The ultimate ramp will have 3H:1V sideslopes.

Figure 5 shows the SWD at several stages of construction. Stage 1 consists of the ramp from the haul road and the portion of the SWD directly east of the IROD. Stage 2 fills in the remainder of the north portion of the footprint while Stage 3 fills in the remainder of the south. During construction of Stage 3, Minto will need to address the required protocol of working adjacent to the Dyno site.

6.3 THERMAL EVALUATION

6.3.1 Analysis Methodology

Thermal analyses were carried out using EBA's proprietary two-dimensional finite element computer model, GEOTHERM. The model simulates transient, two-dimensional heat conduction with change of phase for a variety of boundary conditions. The heat exchange at the ground surface is modelled with an energy balance equation considering air temperatures, wind velocity, snow depth, and solar radiation. The model facilitates the inclusion of temperature phase change relationships for soils, such that any freezing depression and unfrozen water content variations can be explicitly modelled. The model has been verified by comparing its results with closed-form analytical solutions and many different field observations. The model has successfully formed the basis for thermal evaluations and designs of tailings dykes, dams, foundations, pipelines, utilidor systems, landfills, and ground freezing systems in arctic and sub-arctic regions.

6.3.2 Analyzed Profile

The purpose of the thermal analyses was to evaluate the impacts of the proposed waste rock placement on the thermal regime of the underlying foundation soils. The foundation soils used in the analyses were inferred to be silt and sand with varying percentages of gravel, grading into residuum and weathered granodiorite bedrock at depth.

The analysis considered waste rock placement to three final heights, 10 m, 20 m and 30 m. The 10 m lifts were assumed to be placed in two month intervals starting at the beginning of July 2008. In addition, waste rock placement to a final height of 10 m was analyzed assuming a January 2009 start date.

6.3.3 Climatic Data for Analyses

Climatic data required for the thermal analyses includes monthly air temperature, wind speed, solar radiation, and snow cover. Minto Mine's meteorological station collects monthly air temperatures, wind speed, and solar radiation at the site; however, the data is limited to the time period between October 2005 and May 2008. Mine specific snow surveys are limited to 6 years, 1994, 1995, 1998 and 2006 through 2008.

Long term data is required for the analyses; therefore, climatic data from relevant meteorological stations were also used.

Table 3 summarizes the climatic data estimated for the Minto site for the base case model.

TABLE 3: MEAN CLIMATIC CONDITIONS AT MINTO USED IN BASE CASE THERMAL ANALYSES

Month	Estimated Mean Air Temperatures at Minto [a] (°C)	Monthly Wind Speed[b] (km/h)	Month-End Snow Cover[c] (m)	Daily Solar Radiation[d] (W/m2)
January	-21.3	7.5	0.40	10.2
February	-15.6	8.9	0.44	39.0
March	-10.6	10.0	0.48	102.0
April	0.5	11.7	0.08	180.7
May	8.0	11.8	0.00	229.9
June	14.7	10.8	0.00	255.4
July	16.3	9.5	0.00	225.8
August	13.4	9.6	0.00	170.1
September	6.7	10.7	0.00	99.1
October	-2.3	11.9	0.10	41.5
November	-13.5	8.9	0.23	14.2
December	-18.4	7.8	0.31	5.3

Notes:

(a) Based on Climate Normals 1973-2003 for Carmacks and Pelly Ranch (Environment Canada website) and estimated air temperature changes between 1988-2008. Values presented consider the change observed temperature rate change and are prorated to reflect the temperatures at 2008.

(b) Based on Climate Normals 1971-2000 for Burwash, Mayo, Watson Lake, and Whitehorse (Environment Canada website) and measured data at Minto.

(c) Based on Climate Normals 1971-2000 mean month-end snow data for Mayo (Environment Canada website) and snow depth survey data at Minto.

(d) Based on Climatic Normals 1951-1980 at Norman Wells and Whitehorse (Environment Canada, 1982) and measured data at Minto.

6.3.3.1 Future Climate Change (Global Warming) Conditions

Climate change, global warming conditions, have been incorporated into the analyses to consider potential long-term global warming of the air temperatures at the Minto site area. These climate changes were predicted by Global Circulation Models (GCMs).

GCMs, are mathematical representation of the atmosphere, land surfaces, and oceans that have been developed to predict future climate behaviour in response to changes in the composition of the atmosphere. Several scenarios have been developed to estimate the likely range of future emissions that may affect climate (IPCC, 2000). Different GCMs have been developed, resulting in different degrees of projected global warming. In this study, using results from the Canadian Climate Impact Scenario project (http://www.cics.uvic.ca/scenarios/index.cgi), seasonal temperature changes for the mine site area were estimated from four GCMs: a) CGCM2 (Canadian Centre for Climate Modelling and Analysis, Canada); b) GFDL-R30 (Geophysical Fluid Dynamics Laboratory, United States); c) ECHAM4 (Max-Planck Institute of Meteorology, Germany), and d) HadCM3 (Hadley Centre for Climate Prediction and Research, United Kingdom).

The average seasonal changes in temperature over 110 years estimated from the four GCM models for the Minto site area are summarized in Table 4. The thermal analyses considering the long-term global warming conditions were conducted for some of the cases in this study.

TABLE 4: MEAN AIR TEMPERATURE CHANGE (°C) OVER 110 YEARS PREDICTED BY GCMS

	December January February	March April May	June July August	September October November	Annual
Average of Four GCM Models	4.2	2.6	3.3	3.1	3.3

6.3.3.2 Air Temperatures for Sensitivity Analyses

Measured air temperatures at Minto differ from the estimated mean air temperatures. A sensitivity analysis was conducted using recent site specific mean monthly air temperatures at Minto Mine to determine the impact on the thermal regime. The estimated air temperatures for the sensitivity analysis are listed in Table 5.

TABLE 5: MINTO 2008 TEMPERATURES USED FOR SENSITIVITY THERMAL ANALYSIS

Month	Difference between Estimated Mean Air Temperatures and Measured 2008 Site Temperatures for the Sensitivity Case and for Base Cases (°C)	Air Temperatures for the Sensitivity Analysis (°C)
January	4.3 (warmer)	-17.0
February	4.0 (warmer)	-11.6
March	1.5 (warmer)	-9.1
April	0.8(colder)	-0.3
May	0.6 (coder)	7.4
June	0.3 (colder)	14.4
July	0.9 (colder)	15.4
August	0.6 (warmer)	14.0
September	1.4 (colder)	5.3
October	1.4 (colder)	-3.7
November	3.8 (warmer)	-9.7
December	2.9 (warmer)	-15.5
Average	1.0 (warmer)	-0.9

6.3.4 Soil Index and Thermal Properties

Soil index and thermal properties chosen for the waste rock and foundation material in the thermal analyses are presented in Table 6. These properties were selected based on data from the DSTSF geotechnical design and the 2008 site characterization. Thermal properties of the soils were determined indirectly from well-established correlations with soil index properties (Farouki, 1986; Johnston, 1981).

It was assumed that the top moss layer under the waste rock would be compressed by the waste rock placement.

TABLE 6: MATERIAL PROPERTIES USED IN WASTE ROCK THERMAL ANALYSIS

Material	Water Content (%)	Bulk Density (Mg/m³)	Thermal Conductivity (W/m-°C)		Specific Heat (kJ/kg°C)		Latent Heat (MJ/m³)
			Frozen	Unfrozen	Frozen	Unfrozen	
Waste Rock	3	2.06	1.22	1.42	0.77	0.83	20
Moss/Organics (for cases without waste rock placement)	100	1.00	0.81	0.47	1.89	2.94	167
Compressed Moss/Organics (for cases with waste rock placement)	60	1.60	2.36	1.02	1.24	2.03	200
Organic Silt/Sand	60	1.60	2.36	1.02	1.24	2.03	200
Sand/Gravel	8	2.35	2.61	2.12	0.83	0.99	58
Sand/Silt	28	1.96	2.40	1.34	1.03	1.49	143
Bedrock	1	2.68	3.00	3.00	0.75	0.77	9

6.3.5 Thermal Calibration Analysis

Thermal calibration analysis was performed to calibrate the thermal model and then establish initial ground temperature profiles for each case of the thermal analyses. Borehole 96-G08, located within the DSTSF, was selected for the calibration because of the consistent soil conditions with the SWD area and that it had recent ground temperature measurements.

Results of the calibration, as listed in Table 7, show a good agreement between the modelled and measured ground temperatures in Borehole 96-G08 on September 7, 2007. The predicted active layer thickness is 1.2 m in 2007.

TABLE 7: MEASURED AND PREDICTED GROUND TEMPERATURES AT BH 96-G08

Depth below Ground Surface (m)	Measured on Sep 7, 2007 (°C)	Predicted on Sep 7, 2007 (°C)
1	2.3	0.2
2	-0.4	-0.5
3	-0.9	-0.7
4	-1.2	-0.9
5	-1.2	-1.0
7.5	-1.1	-1.2
10	-1.0	-0.9

6.3.6 Thermal Analyses

One-dimensional thermal analyses were conducted for two original ground cases (without waste rock placement) and six waste rock placement cases. The detailed climatic data and waste rock placement assumptions for each of the eight cases are summarized in Table 8.

TABLE 8: THERMAL ANALYSIS CASES SIMULATED

Case	Snow	Time of First 10 m Waste Rock Lift	Time of Second 10 m Waste Rock Lift	Time of Third 10 m Waste Rock Lift	Air Temperatures at Placement	Air Temperatures after Placement
1 (original ground without waste rock placement)	Mean	No waste rock			Mean (1)	Mean (1)
2 (original ground without waste rock placement, snow sensitivity)	Three times mean	No waste rock			Mean (1)	Mean (1)
3 (10 m waste rock placed in summer)	Mean	Jul 1 2008			Mean (1)	Mean (1)
4 (10 m waste rock placed in summer, GW)	Mean	Jul 1 2008			Mean (1)	Mean (1) plus Global Warming
5 (10 m waste rock placed in summer, air temperature sensitivity, GW)	Mean	Jul 1 2008			Sensitivity (2)	Sensitivity (2) plus Global Warming

TABLE 8: THERMAL ANALYSIS CASES SIMULATED CONT'D

6 (10 m waste rock placed in winter)	Mean	Jan 1 2009			Mean (1)	Mean (1)
7 (20 m (two 10 m lifts) waste rock placed in summer, GW)	Mean	Jul 1 2008	Sep 1 2008		Mean (1)	Mean (1) plus Global Warming
8 (30 m (three 10 m lifts) waste rock placed in summer, GW)	Mean	Jul 1 2008	Sep 1 2008	Nov 1 2008	Mean (1)	Mean (1) plus Global Warming

Note: (1) Mean temperatures from Table 3
(2) Sensitivity temperatures from Table 5

Cases 1 and 2 simulated the original ground adjacent to the toe of the waste rock dump slopes. Case 1 assumed the mean snow thicknesses estimated for the Minto site. Case 2 tripled the Minto mean snow thicknesses to simulate potential snow accumulation at the toe of the waste rock dump slope after waste rock placement.

Cases 3, 4 and 5 assumed summer placement, July 1, 2008, of only one 10 m lift of waste rock during the mine life. The three cases differ with respect to air temperatures assumed. Case 3 assumed the estimated Minto 2008 mean air temperatures (as listed in Table 3). Case 4 assumed the estimated Minto 2008 mean air temperatures plus potential air temperature changes with time, following long-term GCM's global warming trends. Case 5 considered the estimated Minto 2008 sensitivity air temperatures (as listed in Table 5) plus potential air temperature changes following the long-term GCM's global warming trends. The snow conditions were consistent for each case.

Cases 6 assumed winter placement, January 1, 2009, of only one 10 m lift of waste rock for the duration of the mine life. The air temperature and snow conditions for Case 6 were assumed to be the same as Case 3.

Cases 7 and 8 assume summer placement of multiple 10 m lifts of waste rock with Case 7 modelled a final height of 20 m and Case 8 a final height of 30 m. The air temperature and snow conditions for these cases were consistent with Case 3.

6.3.7 Results and Discussions

Table 9 summarizes the predicted maximum thaw depth below the original ground surface after five and ten years for each of the cases analyzed.

TABLE 10: PREDICTED MAXIMUM THAW PENETRATION INTO ORIGINAL GROUND FOR CASES SIMULATED

Case	Predicted Maximum Thaw Depth Penetration into the Original Ground (m)		Comments Based on Thermal Analysis Results
	After Five Years	After Ten Years	
1 (original ground without waste rock placement)	1.6	2.0	Predicted active layer thickness under mean snow conditions
2 (original ground without waste rock placement, snow sensitivity)	2.4	3.6	Thaw depth increased under tripled mean snow conditions (Case 2 vs. 1)
3 (10 m waste rock placed in summer)	1.0	1.3	Thaw depth into original ground increases from initial 0.7 to 1 m after five years
4 (10 m waste rock placed in summer, GW)(1)	1.0	1.3	Effects of global warming on the predicted thaw depth are negligible for time period (Case 4 vs. 3)
5 (10 m waste rock placed in summer, air temperature sensitivity, GW) (1)	1.1	1.6	Effects of air temperature sensitivity on the predicted thaw depth indicates a deeper thaw (Case 5 vs. 3)
6 (10 m waste rock placed in winter)	1.3	1.3	Effects of initial winter placement show slightly deeper thaw within five years (Case 6 vs. 3)
7 (20 m (two 10 m lifts) waste rock placed in summer, GW) (1)	1.3	1.6	Similar to Case 5
8 (30 m (three 10 m lifts) waste rock placed in summer, GW) (1)	1.3	1.3	Similar to Case 6

Note: (1) Considers GCM's global warming

In general terms, the thermal analyses results indicate that the original ground temperatures of the foundation soils would warm up with time for all cases analyzed and the original ground surface which experienced seasonal freezing and thawing would no longer do so with the placement of the waste rock fill. This seasonal frost depth will be maintained within the waste rock once the dump is constructed. Waste rock fill located below the seasonal frost depth would remain unfrozen year round for all the summer waste rock placement cases (Case 3, 4, 5, 7, and 8). A frozen waste rock zone, sandwiched between the top seasonal frozen/thaw waste rock zone and the top unfrozen foundation soil prior to waste rock placement, would exist in waste rock placed in winter in the initial several years before it thawed entirely later.

Snow depth significantly affects the thaw depth of the original ground (Case 1 vs. 2). If three times the mean snow cover is assumed over the original ground surface, the predicted thaw depth increases 0.8 m after five years and 1.6 m after ten years.

In five years, the predicted maximum thaw depth into the original ground ranges from 1 m to 1.3 m for all waste rock placement cases. In ten years, the maximum thaw depth is predicted to be either the same or increase by 0.3 m. The exception to this is Case 5 that indicated a maximum thaw depth increase of 0.5 m.

The effects of global warming on the predicted thaw depth are negligible for the 5 year and 10 year study periods (Case 3 vs. 4).

The effects of the air temperature sensitivity on the predicted thaw depth indicates an increase of 0.1 m and 0.3 m for 5 years and 10 years, respectively (Case 3 vs. 5).

Comparing Case 3 and Case 6, the results indicate that starting construction in January 2009 as oppose to July 2008 would result in a slight increase of thaw depth by Year 5 but similar effect by Year 10.

The effects of placing additional 10 m lifts of waste rock (Cases 7 and 8 vs. 4) on the predicted thaw depth indicates an increase of 0.3 m after 5 years and negligible to 0.3 m after 10 years.

6.3.8 Limitations

The thermal analyses in this study were based on limited available site-specific climatic data and estimated long-term climatic conditions and a number of assumptions were applied. It is expected that the soil profiles and properties will be different from one location to another over the SWD footprint, and climatic conditions over the mine life could be different from those estimated. Therefore, although reasonable assumptions and estimates have been made, the actual thermal conditions may differ from those predicted in this study.

Additional analyses must be completed during final closure design of the dump. The results from this study cannot be directly used for the closure design for the following reasons:

- Long term climatic data, specifically mean air temperatures, at the Minto Mine are still unknown. The future climatic data collected at the Minto site will be used to complete the closure design.
- The actual thermal conditions in the SWD may be different from those predicted in this study due to differences in actual waste rock placement rates and construction schedules. Actual waste rock/ground temperature monitoring data should be regularly monitored to confirm the predicted ground/waste rock thermal conditions and to provide additional information for future mine closure design.

- The design criteria for the long-term closure design would be different from those for the current dump design, the latter mainly focuses on the short term during the remaining mine life and several years after the mine closure. Long-term closure design must take into consideration the performance of the dump and final configuration of the mine and related components (open pits, dumps, etc.).

6.4 STABILITY EVALUATION

6.4.1 Analysis Methodology

Limit equilibrium analyses were conducted to determine the factor of safety against slope failure during construction of the dump. All analyses were conducted using the commercially available two-dimensional, limit equilibrium software, SLOPE/W (Geo-Slope International Ltd., GeoStudio 2007 (Version 7.03)). The principles underlying the method of limit equilibrium analyses of slope stability are as follows:

- A slip mechanism is postulated;
- The shear resistance required to equilibrate the assumed slip mechanism is calculated by means of statics;
- The calculated shear resistance required for equilibrium is compared with the available shear strength in terms of factor of safety; and
- The slip surface with the lowest factor of safety is determined through iteration.

A factor of safety is used to account for the uncertainty and variability in the strength and porewater pressure parameters, and to limit deformations.

Earthquake loading has been modeled using pseudostatic peak horizontal ground acceleration.

6.4.2 Analyzed Profile

Stability analyses were carried out for a typical profile, shown in Figure 6, of the proposed SWD. The foundation soils at this location were inferred to be silt and sand with varying percentages of gravel, grading into residuum and weathered granodiorite bedrock at depth. The presence of permafrost was incorporated into the stability evaluation. The depth to permafrost was assumed to be 1.6 m based on the thermal analyses and 2008 site characterization data.

6.4.3 Failure Scenario

It has been postulated for the stability analyses that some thaw at the base of the current active layer will occur and that the shear strength acting along the thawed frozen interface will be a controlling factor in the overall dump design; although it is the design intent to retain the permafrost within the foundation. A slow thaw rate would allow dissipation of pore pressure resulting from thaw.

The failure scenario assessed for overall dump stability was based on a deeper failure plane cutting through the dump to the permafrost interface in the foundation soil. The failure would then follow the permafrost interface and exit below the toe of the slope.

The underlying permafrost is considered much stronger than the unfrozen soil; therefore, the risk of shear failure through the frozen ground was not analysed.

The potential for creep displacements occurring deep within the permafrost has not been specifically analysed. Creep displacements, if they were to occur would be identified in the deformation monitoring system and by manifestation of cracking in the slope. These movements are slow, seldom resulting in substantial earth movement and there would be adequate time for mitigative measures.

6.4.4 Design Criteria

The guidelines for minimum design factor of safety have been adopted from the British Columbia Interim Guidelines for Investigation and Design of Mine Dumps (Waste Rock Design Manual).

The design criteria adopted from the guidelines are included in Table 11.

TABLE 11: DESIGN FACTORS OF SAFETY

Stability Condition	Minimum Design Factor of Safety
Long Term Stability	1.3
Seismic (Pseudostatic) Stability	1.1

The Waste Rock Design Manual recommends that seismic stability should be evaluated using pseudostatic horizontal accelerations that correspond to a 10% probability of exceedance in 50 years. When work was originally undertaken on the MWD in the mid 1990's, the Canadian Geological Survey Pacific Geosciences Centre provided a value for the peak horizontal acceleration for the project site of 0.15 g. An updated value for the site has been provided by the Pacific Geosciences Centre and the current peak horizontal acceleration that corresponds to a 10% probability of exceedance in 50 years is 0.055 g. The reasoning for the decrease in the peak ground acceleration provided by the Pacific Geosciences Centre is that seismic data collection has increased substantially in the Yukon in recent years. A better understanding of ground motion and improved modelling has resulted in revised predictions, which are considered to be more accurate and representative for the project area.

6.4.5 Material Properties

The material properties chosen for the waste rock and foundation materials in the stability analyses are presented in Table 12. The properties for the materials were selected based on the completed laboratory testing, and properties used in the design of the existing facilities on the site as detailed below.

TABLE 12: MATERIAL PROPERTIES USED IN STABILITY ANALYSES

Material	Angle of Internal Friction (º)	Cohesion (kPa)	Unit Weight (kN/m³)
Waste Rock	35	--	20.0
Unfrozen Foundation Soils	28	--	18.4
Permafrost	--	--	--

6.4.5.1 Waste Rock

It is anticipated that the majority of the waste rock from the open pit will be "rock like" with a friction angle of 37º to 38º; however, some of the waste rock excavated may not be as competent. Therefore, the waste rock parameters have been treated as "soil like" waste rock with a friction angle of 35˚.

6.4.5.2 Unfrozen Foundation Soils

The active layer soils are typically a silty sand or silt and sand with trace to some gravel. This material is believed to be representative of the colluvium found at Testpit 97-TP01 (location shown in Figure 2). Direct shear testing of a silty sand colluvium sample from Testpit 97-TP01 indicates this material could exhibit strain-softening behaviour with a peak friction angle of 35º and a residual friction angle of 28º. Based on these results, strength parameters of θ´ = 28º and c´ = 0 kPa were used for the stability analyses.

6.4.5.3 Permafrost

For the purpose of these analyses, the frozen foundation soil has been modelled to behave as bedrock. This forces the critical failure surface to the contact of the thawed and frozen material.

6.4.6 Porewater Pressure Conditions

6.4.6.1 Natural Stratigraphy

The geotechnical drilling and testpitting at this site suggests that the existing active layer was relatively dry; however, free flowing water was noted at two locations. Therefore, it is possible that a shallow perched groundwater table may exist for short periods of the year.

A groundwater table at the original ground surface was used for the stability analyses.

6.4.6.2 Waste Rock

The potential for a phreatic surface developing within the dump slope was not considered due to the coarse gradation of the material will allow for any free water within the dump or its foundation to drain away from the facility. Should non ice-rich overburden be stored within the dump it will be located away from the overall slope of the dump.

6.4.7 Stability Analyses

The static and pseudostatic analyses have been evaluated assuming that a thin layer at the top of the existing permafrost will thaw with some porewater liberated, resulting in reduced shear strength. To analyse this reduction in shear strength, the unfrozen foundation soils (0-1.6 m) have been assigned a pore pressure parameter (Ru) from zero for a fully drained condition up to 0.2 to account for the possibility of porewater pressure build-up within the thawed foundation soil.

As expected, the stability of the dump is governed by the case where Ru = 0.2. Based on the thermal analyses predictions, the expected actual site conditions will be closer to Ru = 0 due to the slow rate of thaw, if any.

6.4.7.1 Static Cases

The results of the minimum factors of safety calculated during the static stability analyses are summarized in Table 13. Figure 6 presents the typical profile used for the analyses and the resulting critical slip surfaces.

TABLE 13: SUMMARY OF STATIC STABILITY ANALYSES RESULTS		
Case		Minimum Factor of Safety of the ROD
	Bench 1 Failure	
1	Static, groundwater table at original grade, Ru=0	1.60
2	Static, groundwater table at original grade, Ru=0.2	1.36
	Bench 2 Failure	
3	Static, groundwater table at original grade, Ru=0	2.03
4	Static, groundwater table at original grade, Ru=0.2	1.71
	Bench 5 Failure	
5	Static, groundwater table at original grade, Ru=0	2.43
6	Static, groundwater table at original grade, Ru=0.2	2.16

6.4.7.2 Pseudostatic (Earthquake) Cases

The results of the minimum factors of safety calculated during the pseudostatic stability analyses are summarized in Table 14. Figure 6 presents the typical profile used for the analyses and the resulting critical slip surfaces.

TABLE 14: SUMMARY OF PSEUDOSTATIC STABILITY ANALYSES RESULTS		
Case		Minimum Factor of Safety of the ROD
	Bench 1 Failure	
7	Pseudostatic (0.055g), groundwater table at original grade, Ru=0	1.32
8	Pseudostatic (0.055g), groundwater table at original grade, Ru=0.2	1.14
	Bench 2 Failure	
9	Pseudostatic (0.055g), groundwater table at original grade, Ru=0	1.70
10	Pseudostatic (0.055g), groundwater table at original grade, Ru=0.2	1.42
	Bench 5 Failure	
11	Pseudostatic (0.055g), groundwater table at original grade, Ru=0	1.98
12	Pseudostatic (0.055g), groundwater table at original grade, Ru=0.2	1.74

6.4.7.3 Results and Discussion

A porewater pressure parameter of Ru=0 is expected for the unfrozen foundation soils. For Ru=0, static cases 1, 3, and 5 indicate a factor of safety of 1.60 for Bench 1, 2.03 for Bench 2, to 2.43 for Bench 5. Pseudostatic cases 7, 9, 11 indicate a factor of safety of 1.32 for Bench 1, 1.70 for Bench 2, to 1.98 for Bench 5. These results indicate that the factor of safety for the overall dump stability exceed the design criteria in both the static and pseudostatic condition based on the expected porewater pressure parameter.

The sensitivity analyses assessing the effects of a porewater pressure parameter of Ru was utilized to account for the potential of excessive porewater pressure build up in the unfrozen foundation soils. Static cases 2, 4, and 6 assume a porewater pressure parameter of Ru=0.2 and had factor of safety ranges from 1.36 for Bench 1, 1.71 for Bench 2, to 2.16 for Bench 5. Pseudostatic cases 8, 10, 12 had a factor of safety of 1.14 for Bench 1, 1.42 for Bench 2, to 1.74 for Bench 5 assuming Ru=0.2. These results indicate that the factor of safety for the overall dump stability exceed the design criteria in both the static and pseudostatic condition for Ru=0.2.

A critical zone for slope stability within the placed waste material is the overall slope of the dump. This zone has been analyzed assuming waste rock material without a phreatic surface. Ensuring that pore pressures do not build-up in this area is critical to the overall stability of the dump; therefore, it is recommended that only free-draining waste rock be placed within this zone. This zone should extent from the design toe to a 30 m offset from the ultimate design crest. Finer grained waste rock and non ice-rich overburden must be placed upslope of this zone.

7.0 SURFACE WATER MANAGEMENT

There are several small ephemeral creeks that converge to the middle of this upper valley into the main drainage as shown in Figures 2 and 5. The majority of these ephemeral creeks originate with the proposed SWD footprint; however, a few enter the proposed footprint from the northwest between the IROD and Pelly laydown area. These also converge to the middle of this upper valley into the main drainage. These creeks collect the surface run-off water and route it down to and through the main haul road and into the Area 1 Open Pit area.

Surface water management has been considered for the following conditions; the main drainage that forms part of upper Minto creek, small ephemeral creeks that originate within the dump perimeter, and run-on water from ephemeral creeks entering the proposed footprint from the northwest.

To account for the main ephemeral drainage that forms a part of upper Minto creek, the SWD footprint limit includes a 30 m setback from this drainage. This will allow unaffected areas, specifically those east of the footprint, to continue to report to this drainage and minimize the impact of the proposed dump.

The ephemeral creeks originating within the dump will not pose any significant issues within the dump as they will be covered with waste material (Stage 1 and 3). Direct precipitation will then filter through the waste and report to the main drainage in the similar fashion it previously did. The construction of the overall dump slope with free draining waste rock (design toe to 30 m set back from design crest) will allow for this runoff water to flow through this portion of the dump relatively freely. Short term management of non ice-rich overburden slopes within the dump should include the construction of a waste rock shell cover immediately following the completion of overburden placed in the given area to reduce the potential for erosion to occur.

The few small ephemeral creeks entering the proposed footprint from the northwest between the IROD and Pelly laydown will be addressed with the staged construction. The Stage 1 dump footprint does not infringe on these water courses with the exception of the ramp. To enable run-on water to pass through the ramp and not pond within or in the vicinity of the dump, the waste rock used for construction must be coarse graded. This coarse material will act similar to a French drain through the ramp and allow for water flow. This practice was utilized during the construction of the main haul road.

During the 2009 freshet event, or any other high precipitation event, the effectiveness of the ramp material must be evaluated prior to the construction of Stage 2. Once it is confirmed that the ramp material is able to pass the run-on water effectively, the Pelly laydown extension can be infilled with coarse waster rock along with the remainder of the Stage 2 dump.

8.0 CONSTRUCTION RECOMMENDATIONS

Construction recommendations for the SWD are summarized below.

- Subgrade preparation for the proposed SWD is not required. The organic mat should remain undisturbed.
- Only coarse waste rock material sourced during pit development should be used within the exterior slope of the dump (design toe to 30 m setback from ultimate design crest). Finer grained waste rock and non ice-rich overburden must be placed within the interior of the dump.
- Minto must monitor the overburden material to determine whether it should be stored within the SWD (non ice-rich) or IROD (ice-rich).
- Regular visual inspections by Minto and EBA should be completed to note potential areas of instability.
- A monitoring program must be incorporated to provide photographs and record (as built) information of the construction progress. This information should include the division of waste rock and non ice-rich overburden material.
- Placement planning must account for the storage of non ice-rich overburden specifically in the 2nd and 3rd quarter of 2010 when a large volume will be excavated compared to the waste rock. A waste rock shell should be placed on the overburden slope immediately after its completion. Alternatively, an interior waste rock berm could be constructed prior to the placement of the overburden.
- The base of the ramp must be constructed with coarse waste rock along the zone of the ultimate side slope of the dump to allow for water movement away from the facility. The effectiveness of the ramp to allow for surface water runoff must be evaluated by EBA prior to the construction of Stage 2.
- Stage 3 construction can be completed in conjunction with Stage 1 and prior to Stage 2.

9.0 PERFORMANCE MONITORING

Performance monitoring is an integral part of the design, construction, and operation of the SWD. This section describes a recommended minimum monitoring program for the construction and operation phases of the dump.

The results of the monitoring program can be the basis of an adaptive management process that continually reviews the operation of the dump and will provide data for the final closure plan.

9.1 OVERBURDEN MATERIAL MONITORING

Monitoring of the overburden waste soils should be completed during open pit development to ensure only non ice-rich overburden waste is placed in the proposed SWD. Ice-rich waste should be placed in the IROD.

9.2 VISUAL MONITORING

Visual monitoring should be completed by Minto personnel daily and include the following:

- Inspection of the external slopes for any signs of distress;
- Inspection of the crest of the dump for any signs of transverse cracking;
- Inspection of the dump toe for any signs of seepage from the base: and
- Inspection of the dump toe for any signs of distress resulting from snow accumulation during the winter months. Snow accumulation depth at the dump toe should be noted with respect to surrounding area.

9.3 DEFORMATION SURVEYS

The breaklines (crest and toes) of the SWD should be surveyed at the completion of each main construction phase to determine the record (as built) geometry and to establish a basis for determining future deformations. These same breaklines should be resurveyed and reviewed in the summer of each year, or periodically at the discretion of the Geotechnical Engineer, to monitor deformation movements.

9.4 EXISTING INSTRUMENTATION MONITORING

During the 2008 site characterization program, four ground temperature cables and six Casagrande piezometers were installed. The location of these instruments is presented in Figure 7. One of the ground temperature cables and three of the piezometers are located within the proposed footprint will the remaining instruments are located east of the SWD.

These instruments should be monitored on a monthly basis or periodically at the discretion of the Geotechnical Engineer.

9.5 PROPOSED INSTRUMENTATION MONITORING

The installation of five instrumentation locations is recommended for additional monitoring of the SWD. Each location is to be installed through Bench 1 of the given area. Three locations are situated within Stage 1 while the remaining two are scheduled for Stage 3. Each location will have a vibrating wire piezometer, ground temperature cable and survey hub installed.

9.5.1 Vibrating Wire Piezometers

Vibrating wire piezometers are to be installed to confirm the assumed phreatic surfaces used for the stability analyses and monitor any build up of porewater pressure.

The piezometers shall have a 19 mm diameter steel housing with high air entry filter and integrated thermistor. The pressure rating for the piezometers will range from 0 - 170 kPa and 0 - 350 kPa. The electrical cable shall be PVC jacketed and rated for direct burial. The electrical cable shall be of sufficient length to reduce the need for field splicing.

9.5.2 Ground Temperature Cables

Ground temperature cables are to be installed to monitor the thermal regime of the foundation soils and waste rock fill.

The ground temperature cables will be prefabricated by EBA using 10 mm diameter, 20 conductor cable with a water block component included within the insulating sheath. The thermistor beads will be located along the cable and surrounded by a polyurethane protective moulding. The thermistor beads will be calibrated prior to installation.

9.5.3 Survey Hubs

The survey hubs will be constructed into the waste rock fill to monitor horizontal and vertical displacement within the instrumentation location.

The hubs will be comprised of a piece of rebar grouted into drill steel installed into the waste rock fill.

9.5.4 Monitoring Plan

Table 15 summarizes the minimum monitoring requirements for the proposed instrumentation.

TABLE 15: SCHEDULE FOR MONITORING

Item	Frequency
Vibrating Wire Piezometer	Biweekly (May through October) Monthly (November through April)
Ground Temperature Cable	Monthly
Survey Hubs	Monthly

9.5.5 Threshold Warning Levels

Threshold warning levels (triggers for action) for each type of instrumentation are specified in Table 16.

TABLE 16: THRESHOLD WARNING LEVELS

Item	Threshold Warning Level
Vibrating Wire Piezometer P1, P2, P3, P4, P5	Porewater pressure parameter (Ru) exceeds 0.2
Ground Temperature Cable T1, T2, T3, T4, T5	Temperatures greater than 0ºC for thermistor beads at depths greater than 1.5 m below original ground. (1)
Survey Hub SH1, SH2, SH3, SH4, SH5	Displacements greater than 150 mm in any given direction.

Note: (1) Assumes all beads below 1.5 m are located in permafrost at time of installation

9.5.6 Adaptive Management Approaches

Adaptive management approaches may be required should the threshold warning levels be exceeded. Each situation will vary depending on the severity and rate of the exceedance. Table 17 summarizes adaptive management approaches given a specific exceedance for a given monitoring function.

TABLE 17: ADAPTIVE MANAGEMENT APPROACHES

Item	Adaptive Management Approaches (1)
Vibrating Wire Piezometer	
Porewater pressure parameter (Ru) exceeds 0.2	- EBA will review existing piezometer, temperature, and survey data. - Monitoring and review will be increased to semi-weekly until determined unnecessary.
Porewater pressure parameter (Ru) exceeds 0.4	- EBA will review of existing piezometer, temperature, and survey data. - EBA will conduct a site visit and determine if waste placement and/or construction plan requires modification. - Monitoring and review will be increased to daily until determined unnecessary. - EBA will determine if additional instrumentation is required. - EBA will complete analysis of mitigative measures should exceedance continue.
Ground Temperature Cable	
Thaw at 1.5 m depth	- EBA will review existing piezometer, temperature, and survey data.
Thaw at 2.0 m depth and greater	- EBA will review existing piezometer, temperature, and survey data. - EBA will conduct a site visit and determine if waste placement and/or construction plan requires modification. - EBA will determine requirement for increased monitoring and review. - EBA will determine if additional instrumentation or analysis is required. - EBA will complete analysis of mitigative measures should exceedance continue. - Minto to complete survey of area of interest to monitor any future displacement, if any.

TABLE 17: ADAPTIVE MANAGEMENT APPROACHES (CONT'D)

Survey Hub	
Displacements between 150 mm and 500 mm	- EBA will review existing piezometer, temperature, and survey data. - Monitoring and review will be increased to bi-weekly until determined unnecessary. - Minto to complete survey of area of interest to monitor any future displacement, if any. - EBA will determine if waste placement and/or construction plan requires modification. - EBA will determine if additional instrumentation is required.
Displacements greater than 500 mm	- EBA will review existing piezometer, temperature, and survey data. - EBA will conduct a site visit and determine if waste placement and/or construction plan requires modification. - Monitoring and review will be increased to semi-weekly until determined unnecessary. - Minto to complete survey of area of interest to monitor any future displacement, if any - EBA will determine if additional instrumentation is required. - EBA will complete analysis of mitigative measures should exceedance continue.

Note: (1) Adaptive management approaches are subject to change depending on the severity and rate of the exceedance

10.0 ANNUAL INSPECTION

It is recommended that an annual site inspection be conducted by the Geotechnical Engineer during the operational period to document the performance of the SWD. The specific tasks of these visits include:

- Inspection of the external slopes for any signs of distress;
- Inspection of the crest of the dump for any signs of transverse cracking;
- Inspection of the dump for any signs of seepage from the base;
- Review of survey data to confirm conformance with design assumptions; and
- Preparation of an annual report that summarizes the data and provides recommendations for maintenance or modification to the dump.

11.0 LIMITATIONS

Geological conditions are innately variable and are seldom spatially uniform. At the time of this report, information on stratigraphy at the project was at identified borehole locations from past studies. In order to develop recommendations from this information, it is necessary to make some assumptions concerning conditions other than at the specifically tested locations. Adequate monitoring should be provided during construction to check that these assumptions are reasonable.

The recommendations prepared and presented in this report are based on the geotechnical data gathered by EBA from previous reports and site characterization programs and SRK in 2008. The provided data, in the form of geotechnical boreholes and associated laboratory index property test results, has been supplemented by EBA's direct observations of the site.

This report and the recommendations contained in it are intended for the sole use of Minto Explorations Ltd. EBA does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report if the information presented in this report is used or relied upon by any party other than that specified above for the proposed SWD. Any such unauthorized use of this report is at the sole risk of the user. Additional information regarding the use of this report is presented in the attached General Conditions, which form a part of this report.

12.0 CLOSURE

EBA trusts that this report satisfies your requirements. Please do not hesitate to contact the undersigned should you have any questions or comments.

Respectfully Submitted,
EBA Engineering Consultants Ltd.

J.P.W. BERKERS

Sept 22/08

J. RICHARD TRIMBLE

Sept 22/08

prepared by:
Jason P.W. Berkers, P.Eng.
Project Engineer
Direct Line: 867.668.2071 x233
jberkers@eba.ca

reviewed by:
J. Richard Trimble, M.Sc. (Eng.), P.Eng.
Project Director, Yukon Region
Direct Line: 867.668.2071 x222
rtrimble@eba.ca

PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
SIGNATURE
Date Sept 22/08
PERMIT NUMBER PP003
Association of Professional Engineers of Yukon

W J Horne

reviewed by:
William Horne, M.Sc. (Eng), P.Eng. (Alberta, NWT)
Principal Consultant, Arctic Region
Direct Line: 780.451.2130 x276
bhorne@eba.ca

REFERENCES

EBA, 1997. "1996 Geotechnical Drilling Program". Minto Explorations Ltd. Minto Mine Property, Yukon. (EBA Project No. 0201-11509, dated January 1997).

EBA, 1998a. "1997 Geotechnical Program and Construction Inspection Reports". Minto Explorations Ltd. Minto Mine, Yukon. (EBA Project No. 0201-11509, dated February 1998).

EBA, 1998b. "Geotechnical Evaluation, Proposed Main Waste Dump". Minto Explorations Ltd. Minto Mine, Yukon. (EBA Project No. 0201-11509, dated April 1998).

EBA, 2006. "Geotechnical Design, Ice-Rich Overburden Dump". Minto Explorations Ltd. Minto Mine, Yukon. (EBA Project No. 1200173, dated January 2006).

EBA, 2007. "Geotechnical Design Report, "Dry" Stack Tailings Storage Facility". Minto Explorations Ltd. Minto Mine, Yukon. (EBA Project No. 1200173, dated January 2007).

EBA, 2008a. "Proposed Reclamation Overburden Dump". Minto Explorations Ltd. Minto Mine, Yukon. (EBA Project No. W14101068.004, dated February 2008).

EBA, 2008b. "Dry Stack Tailings Storage Facility – Construction Quality Assurance Data". Minto Explorations Ltd. Minto Mine, Yukon. (EBA Project No. W14101068.001, dated April 10, 2008).

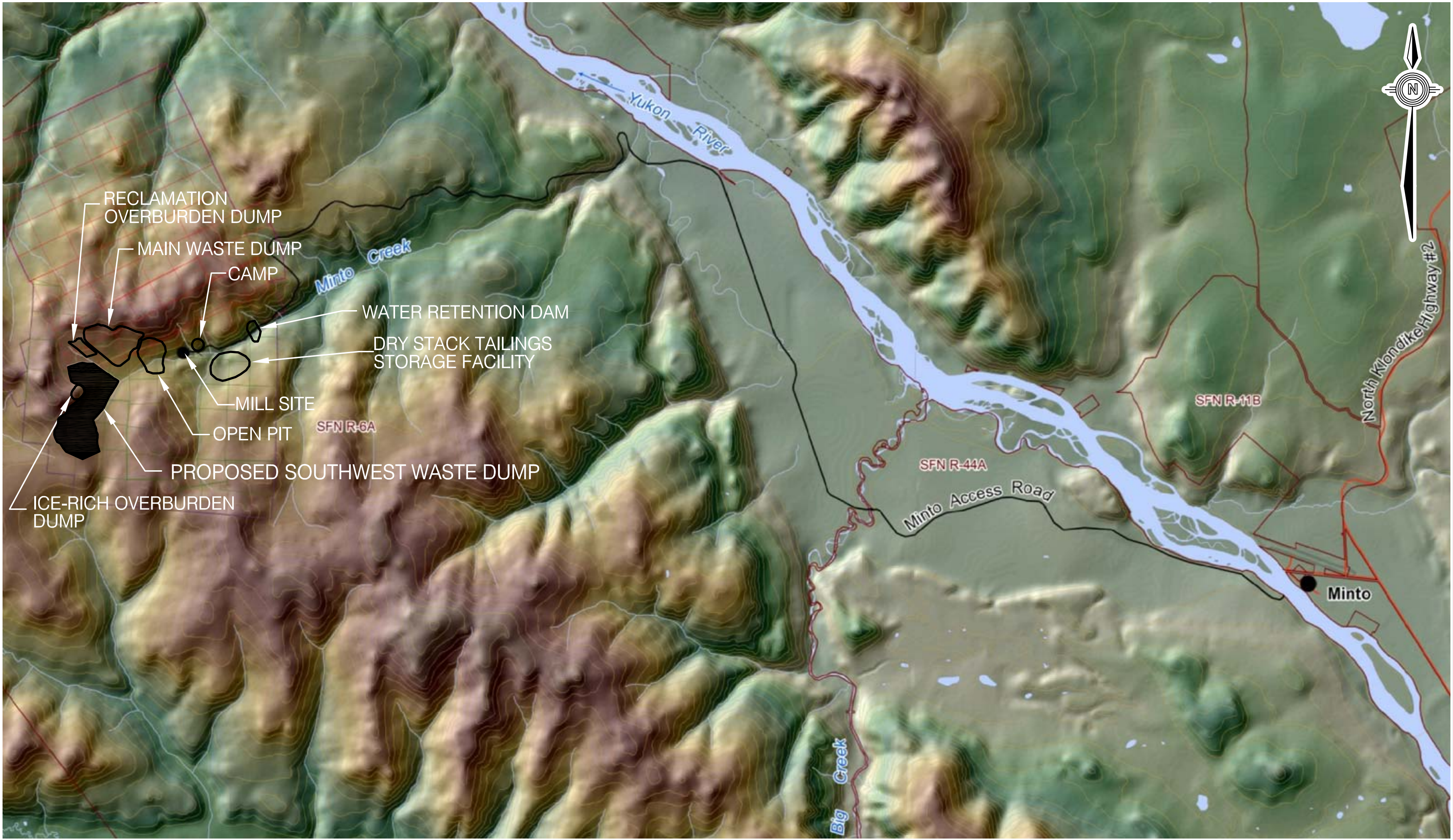
Farouki, 1986. "Thermal Properties of Soils". TransTech Publications, Germany, 136p.

Johnston (Editor), 1981. "Permafrost, Engineering Design and Construction". Wiley & Sons, Toronto, 540p.

SRK, 2008. "Waste Dump Overburden Drilling". Minto Explorations Ltd. Minto Mine, Yukon. (SRK Project No. 2CM022.003, dated May 2008).

FIGURES

Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 005 Valley Waste Dump\Geo Design Rpt\W14101068005 Geo Rpt Figure 1.dwg [FIG 1 8.5X11L] September 05, 2008 - 1:49:16 pm (BY: KEN TOMCZYK)



1000m 0 1000m 2000m 3000m 4000m

BAR SCALE

CLIENT

MINTO EXPLORATIONS LTD.

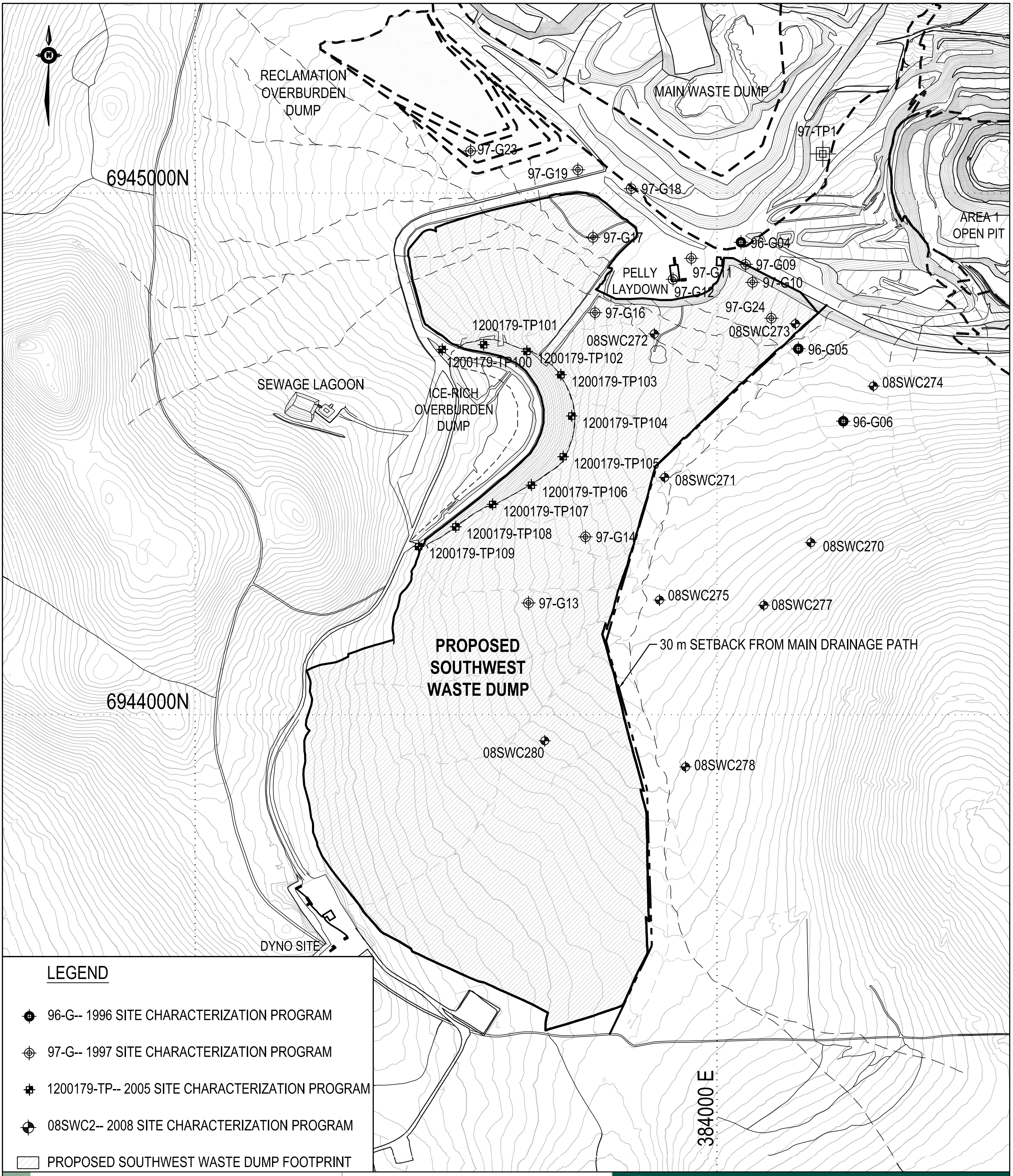
EBA Engineering Consultants Ltd.

PROPOSED SOUTHWEST WASTE DUMP MINTO MINE, YT

LOCATION PLAN

PROJECT NO.	DWN	CKD	REV
W14101068.005	KJT	JSB	0
OFFICE	DATE		
EBA-WHSE	AUGUST 22, 2008		

Figure 1



Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 005 Valley Waste Dump\Geo Design Rpt\W14101068005 Geo Rpt Figure 2.dwg [FIGURE 2] September 19, 2008 - 2:35:28 pm (BY: KEN TOMCZYK)

CLIENT

MINTO EXPLORATIONS LTD.

EBA Engineering Consultants Ltd.

PROPOSED SOUTHWEST WASTE DUMP
MINTO MINE, YT

PROPOSED FOOTPRINT LIMIT AND EXISTING GEOTECHNICAL INFORMATION

PROJECT NO.	DWN	CKD	REV
	KJT	JPB	0

OFFICE
EBA-WHSE

DATE
AUGUST 22, 2008

Figure 2

0 500

Scale: 1: 10 000 (metres)

CLIENT

MINTO EXPLORATIONS LTD.

EBA Engineering Consultants Ltd.

PROPOSED SOUTHWEST WASTE DUMP
MINTO MINE, YT

SITE PLAN

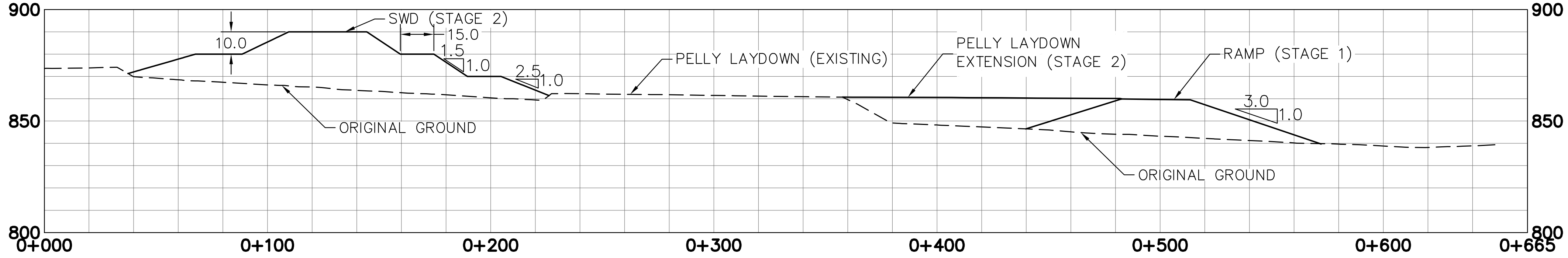
PROJECT NO.	DWN	CKD	REV
W14101068.005	KJT	JPB	0

OFFICE
WHSE

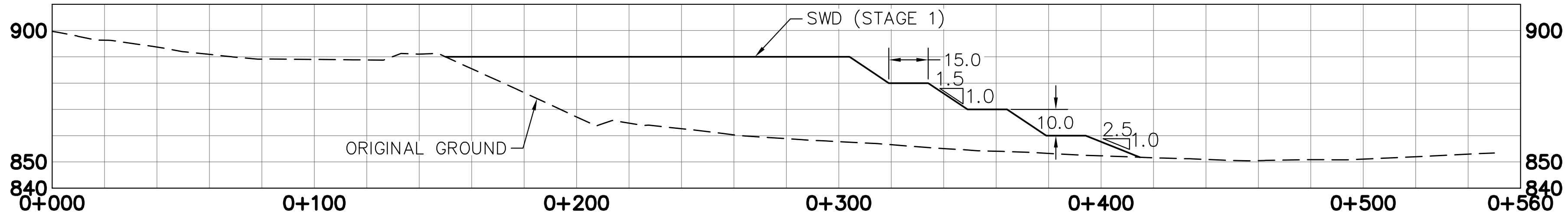
DATE
AUGUST 22, 2008

Figure 3

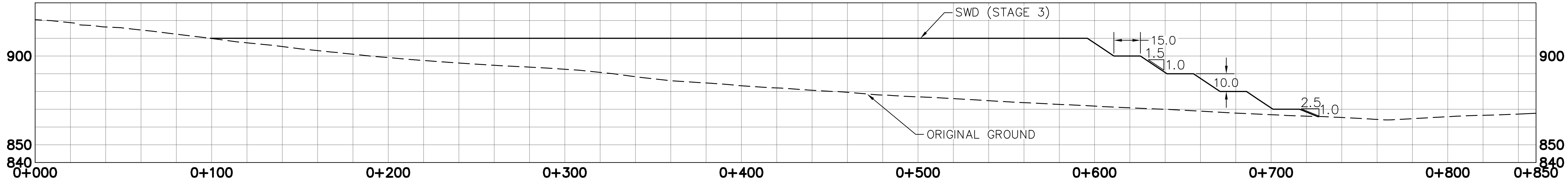
Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 005 Valley Waste Dump\Geo Design Rpt\W14101068005 Geo Rpt figure 3-5.dwg [FIGURE 3] September 16, 2008 - 11:04:16 am (BY: KEN TOMCZYK)



A
3
NORTH SECTION
SCALE 1:2,500



B
3
CENTRAL SECTION
SCALE 1:2,500



C
3
SOUTH SECTION
SCALE 1:2,500

CLIENT

MINTO EXPLORATIONS LTD.

EBA Engineering
Consultants Ltd.

PROPOSED SOUTHWEST WASTE DUMP
MINTO MINE, YT

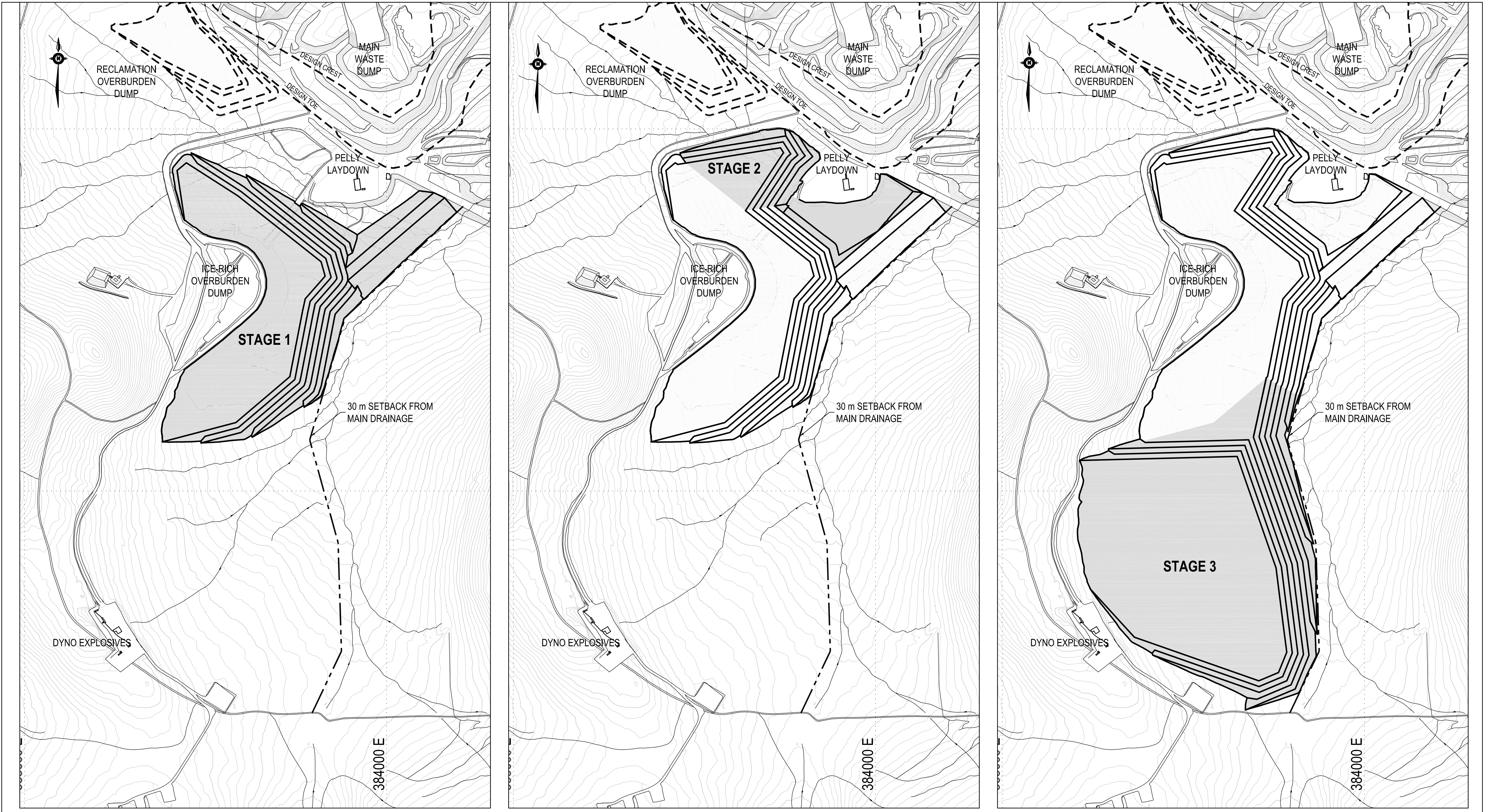
SECTIONS

PROJECT NO.	DWN	CKD	REV
W14101068.005	KJT	JPB	0

OFFICE	DATE
WHSE	AUGUST 22, 2008

Figure 4

Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 005 Valley Waste Dump\Geo Design Rpt\W14101068005 Geo Rpt figure 3-5.dwg [FIGURE 4] September 16, 2008 - 11:05:39 am (BY: KEN TOMCZYK)



CLIENT

MINTO EXPLORATIONS LTD.

EBA Engineering Consultants Ltd.

PROPOSED SOUTHWEST WASTE DUMP MINTO MINE, YT

STAGING PLAN

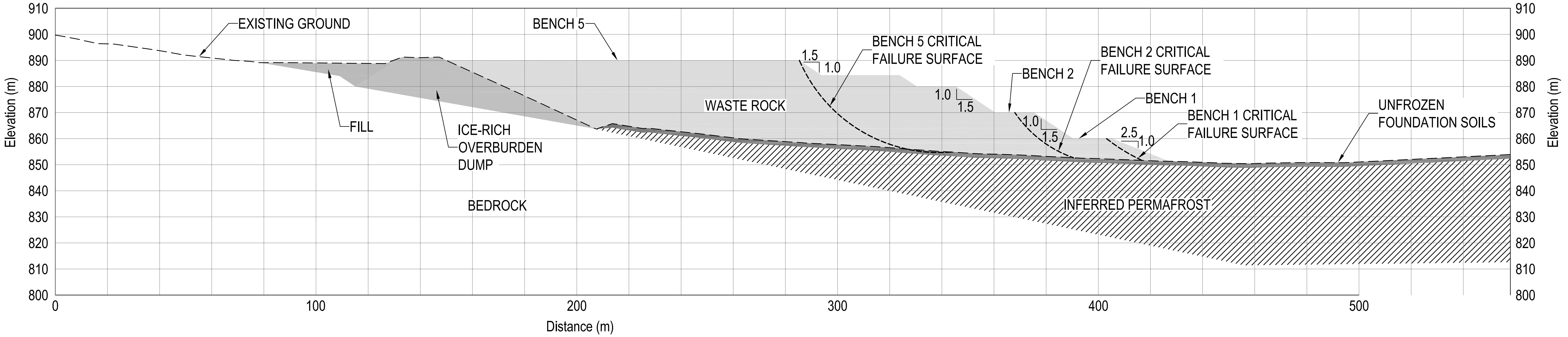
PROJECT NO.	DWN	CKD	REV
W14101068.005	KJT	JPB	0
OFFICE	DATE		
WHSE	AUGUST 22, 2008		

Figure 5

Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 005 Valley Waste Dump\Geo Design Rpt\W14101068005 Geo Rpt figure 3-5.dwg [FIGURE 5] September 16, 2008 - 11:08:24 am (BY: KEN TOMCZYK)

SOIL PARAMETERS

MATERIAL	BULK DENSITY (kN/m³)	FRICTION ANGLE (DEGREES)	COHESION (kPa)
WASTE ROCK	20.0	35	0
UNFROZEN FOUNDATION SOILS	18.4	28	0
PERMAFROST	--	--	--



ANALYZED SECTION
SCALE 1: 1500

CLIENT
MINTO EXPLORATIONS LTD.

PROPOSED SOUTHWEST WASTE DUMP
MINTO MINE, YT

TYPICAL CROSS SECTION
FOR STABILITY ANALYSIS

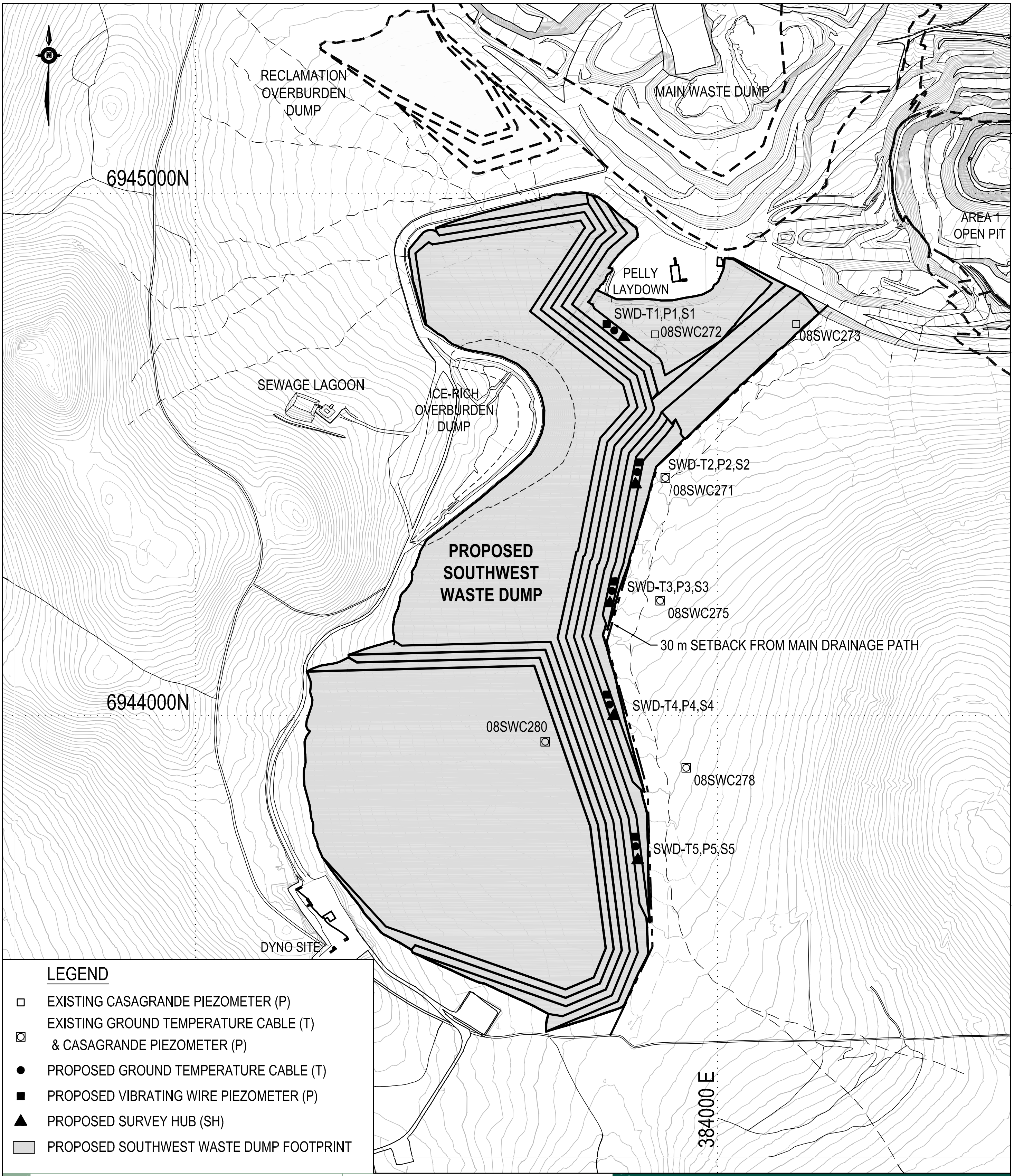
EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
W14101068.005	KJT	JPB	0

OFFICE: WHSE
DATE: SEPTEMBER 4, 2008

Figure 6

Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 005 Valley Waste Dump\Geo Design Rpt\W14101068005 Geo Rpt Figure 6.dwg [FIGURE 6] September 16, 2008 - 11:11:52 am (BY: KEN TOMCZYK)



Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 005 Valley Waste Dump\Geo Design Rpt\W14101068005 Geo Rpt Figure 7.dwg [FIGURE 7] September 16, 2008 - 11:15:49 am (BY: KEN TOMCZYK)

0 500
Scale: 1: 10 000 (metres)

CLIENT

MINTO EXPLORATIONS LTD.

EBA Engineering Consultants Ltd.

PROPOSED SOUTHWEST WASTE DUMP
MINTO MINE, YT

PROPOSED AND EXISTING INSTRUMENTATION

PROJECT NO.	DWN	CKD	REV
W14101068.005	KJT	JPB	0

OFFICE	DATE
EBA-WHSE	SEPTEMBER 5, 2008

Figure 7

APPENDIX

APPENDIX A GENERAL CONDITIONS

PROJECT DESIGN REPORT – GENERAL CONDITIONS

This Design Report incorporates and is subject to these "General Conditions".

1.0 PURPOSE

These General Conditions apply to this Design Report that EBA has prepared in fulfillment of certain project specific requirements that have been previously agreed to by EBA and its Client. The Design Report may include plans, drawings, profiles and other support documents that collectively constitute the Design Report.

2.0 USE OF REPORT

This Design Report pertains to a specific site, a specific development, and a specific scope of work. The Report and all supporting documents are intended for the sole use of EBA's client. EBA does not accept any responsibility for the accuracy of any of the data, analyses or other contents of the Design Report when it is used or relied upon by any party other than EBA's Client, unless authorized in writing by EBA. Any unauthorized use of the Design Report is at the sole risk of the user.

3.0 CALCULATIONS AND DESIGNS

EBA has undertaken design calculations and has prepared project specific designs in accordance with terms of reference that were previously set out in consultation with, and agreement of, EBA's client. These designs have been prepared to a standard that is consistent with industry practice. Notwithstanding, if any error or omission is detected by EBA's client or any party that is authorized to use the Design Report, the error or omission should be immediately drawn to the attention of EBA.

4.0 GEOTECHNICAL CONDITIONS

A Geotechnical Report is commonly the basis upon which the specific project design has been completed. It is incumbent upon EBA's Client, and any other authorized party, to be knowledgeable of the level of risk that has been incorporated into the project design, in consideration of the level of the geotechnical information that was reasonably acquired to facilitate completion of the design.

If the Geotechnical Report for the project was prepared by EBA, it would have been included in the Project Design Report. That Report contains General Conditions that should be read in conjunction with these General Conditions.

5.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless so stipulated in the Project Design Report, EBA was not retained to investigate, address or consider, and has not investigated, addressed or considered any environmental or regulatory issues associated with the project specific design.

6.0 STANDARD OF CARE

Services that EBA provided to complete this Design Report have been undertaken in a manner that is consistent with the approach ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services were provided. Engineering judgement has been applied in developing design elements that are integral to this Project Design Report. No other warranty or guarantee, expressed or implied, is made concerning the content of this Project Design Report.

6.0 ALTERNATIVE 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), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by EBA shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancies, the hard copy versions shall govern over the electronic versions. Furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed version archived by EBA shall be deemed to be the overall original for the Project.

The Client agrees that 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. The Client warrants that EBA's instruments of professional service will be used only and exactly as submitted by EBA.

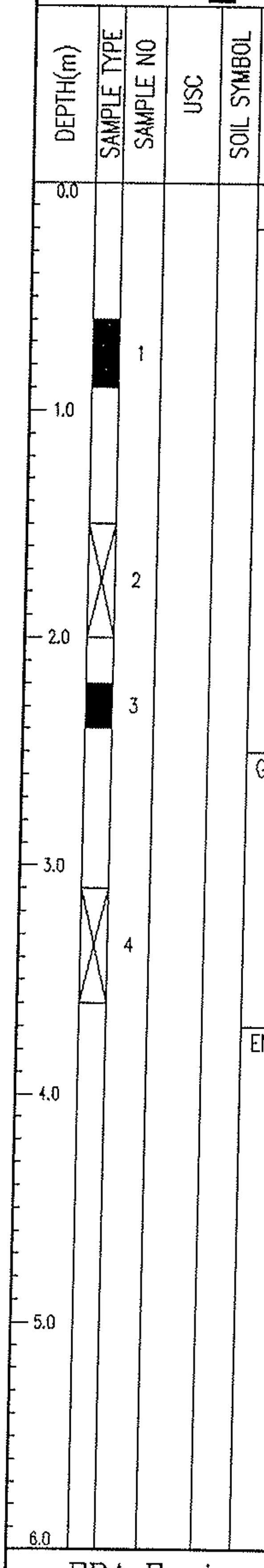
The Client recognizes and agrees that electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

APPENDIX

APPENDIX B SITE CHARACTERIZATION PROGRAMS - BOREHOLE AND TESTPIT LOGS

MINTO CREEK MINE DEVELOPMENT	CLIENT: MINTO EXPLORATIONS LTD.	TEST PIT NO: 96-G04
GEOTECHNICAL EVALUATION—WEST WASTE DUMP	DRILL: CME-75 C/W SOLID SHAFT AUGERS	PROJECT NO: 0201-11509
MINTO CREEK, YUKON	UTM ZONE: 8 N6944726.8 E384145.3	ELEVATION: 2787.30 (m)

SAMPLE TYPE ■ GRAB SAMPLE ◱ NO RECOVERY ☒ STANDARD PEN. ▤ 75 mm SPOON ▥ CRREL BARREL



SOIL DESCRIPTION

MOSS, ORGANIC SILT

SAND AND SILT – some gravel; fine to coarse angular sand; fine to medium angular gravel; frozen, Nbe; brown

– more gravel and sand with depth; grading into residuum

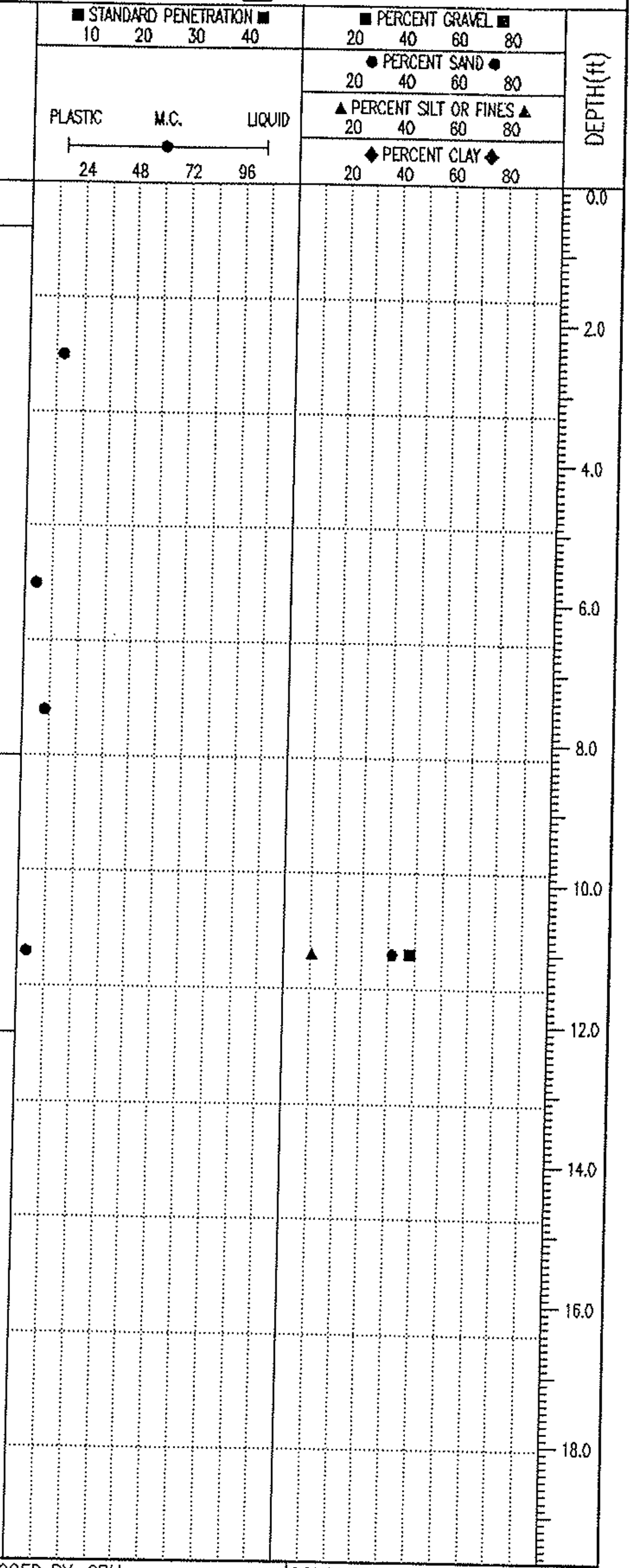
– occasional zones of SILT – some sand throughout

GRAVEL AND SAND (residuum) – trace to some silt; occasional silt inclusions; fine angular gravel, some coarse; sand is angular to subangular; unfrozen; damp; dense; light brown

– slow, rough drilling

– drilling refusal @ 3.7 m

END OF BOREHOLE @ 3.7 m

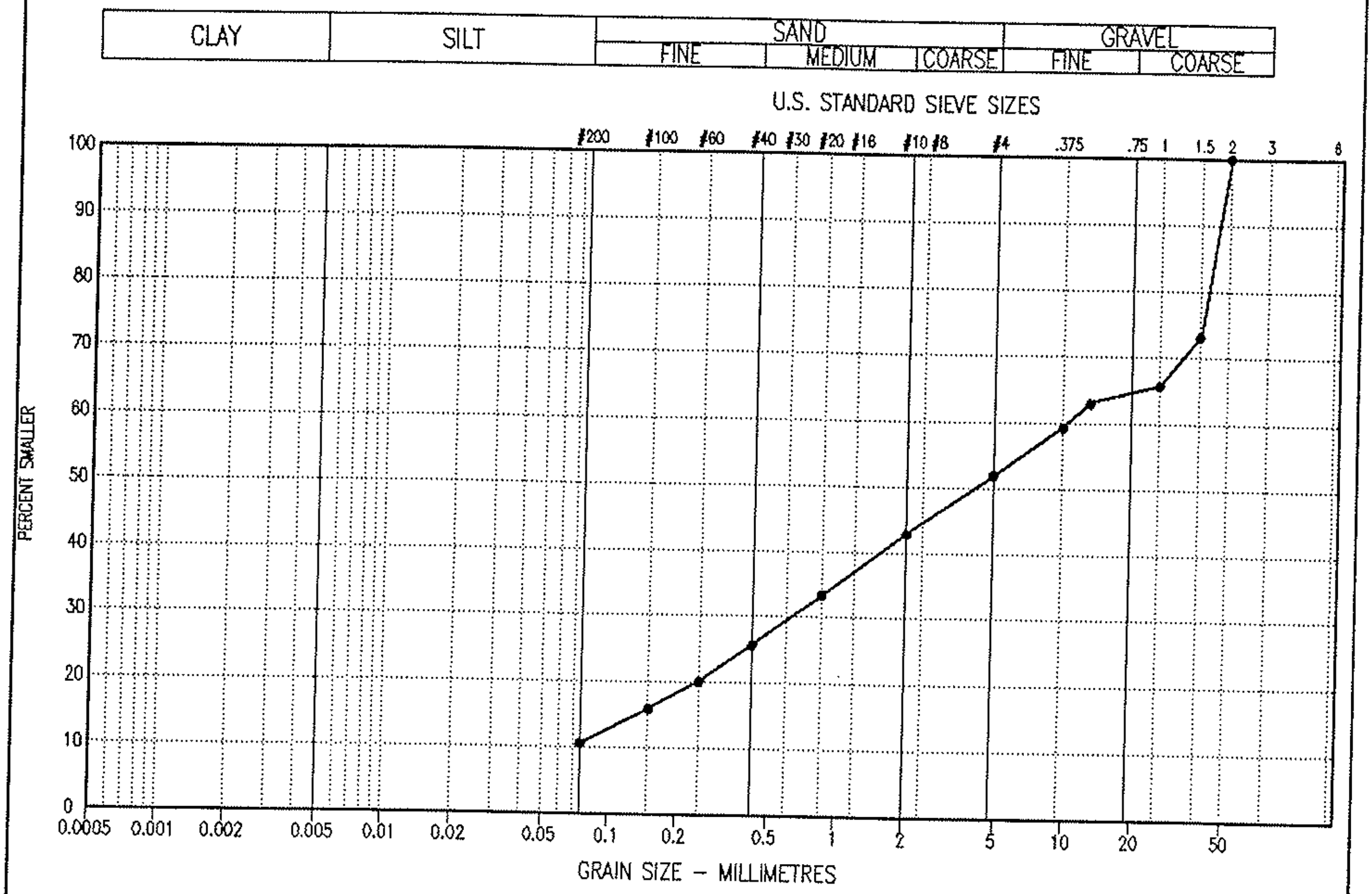


EBA Engineering Consultants Ltd.
Whitehorse, Yukon

LOGGED BY: CRH	COMPLETION DEPTH: 3.7 m
REVIEWED BY: CRH	COMPLETE: 96/07/05
Fig. No:	Page 1 of 1

96/08/13 03:42PM (YUKON-6)

PARTICLE SIZE - ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION			Cu	Cc	U.S.C
			CLAY & SILT %	SAND %	GRAVEL %			
●—●	96-G04	3.10 - 3.60	10.6	41.4	48.0	143.3	0.6	GP-GM

Project: 0201-11509

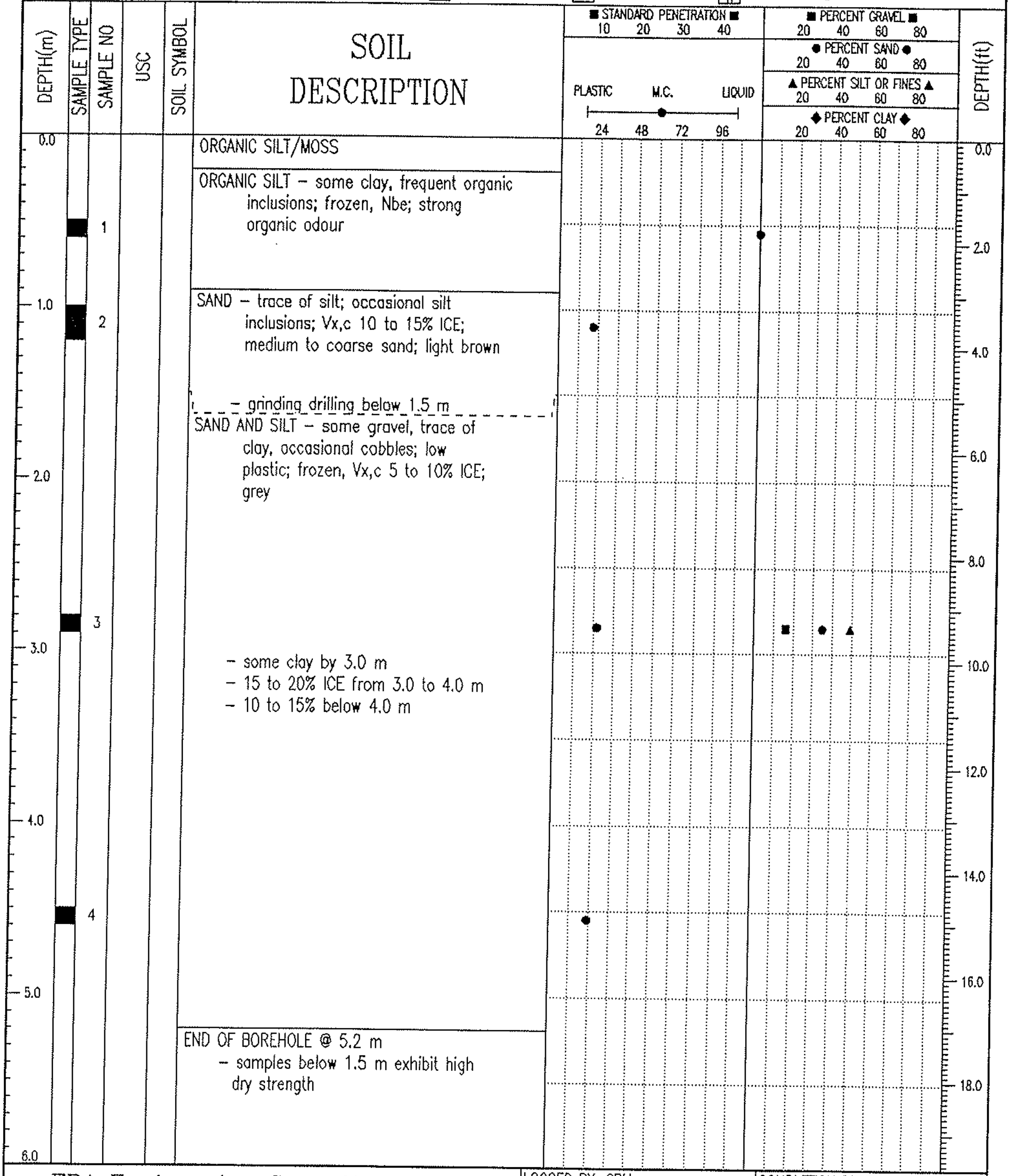
Date Tested: 96/07/11

BY: AA

Tested in accordance with ASTM D422 unless otherwise noted.

MINTO CREEK MINE DEVELOPMENT	CLIENT: MINTO EXPLORATIONS LTD.	TEST PIT NO: 96-G05
GEOTECHNICAL EVALUATION-WEST WASTE DUMP	DRILL: CME-75 C/W SOLID SHAFT AUGERS	PROJECT NO: 0201-11509
MINTO CREEK, YUKON	UTM ZONE: 8 N6944522.9 E384254.8	ELEVATION: 2739.30 (m)

SAMPLE TYPE ■ GRAB SAMPLE ▨ NO RECOVERY ☒ STANDARD PEN. ☰ 75 mm SPOON ▯ CRREL BARREL



ORGANIC SILT/MOSS

ORGANIC SILT – some clay, frequent organic inclusions; frozen, Nbe; strong organic odour

SAND – trace of silt; occasional silt inclusions; Vx,c 10 to 15% ICE; medium to coarse sand; light brown

– grinding drilling below 1.5 m

SAND AND SILT – some gravel, trace of clay, occasional cobbles; low plastic; frozen, Vx,c 5 to 10% ICE; grey

- some clay by 3.0 m
- 15 to 20% ICE from 3.0 to 4.0 m
- 10 to 15% below 4.0 m

END OF BOREHOLE @ 5.2 m

– samples below 1.5 m exhibit high dry strength

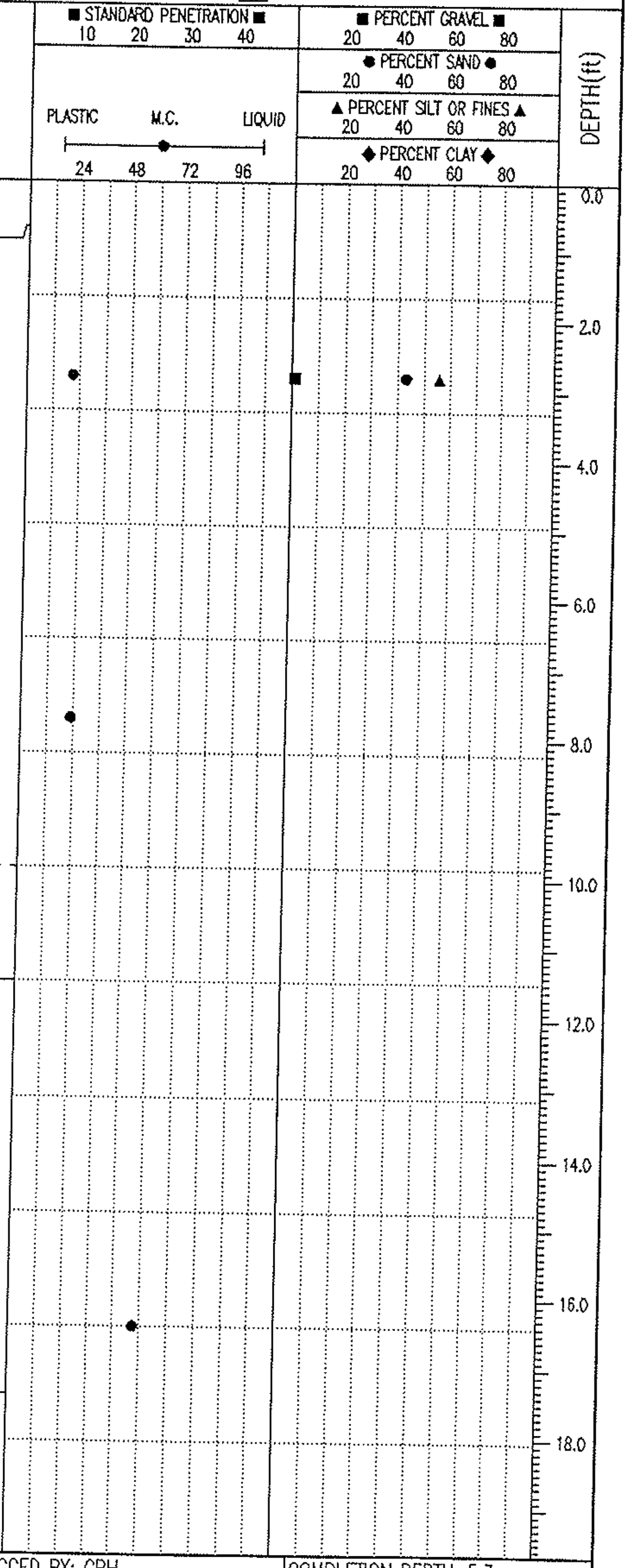
EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: CRH	COMPLETION DEPTH: 5.2 m
	REVIEWED BY: CRH	COMPLETE: 96/07/04
	Fig. No:	Page 1 of 1

96/08/13 03:43PM (YUKON-6)

MINTO CREEK MINE DEVELOPMENT	CLIENT: MINTO EXPLORATIONS LTD.	TEST PIT NO: 96-G06
GEOTECHNICAL EVALUATION-WEST WASTE DUMP	DRILL: CME-75 C/W SOLID SHAFT AUGERS	PROJECT NO: 0201-11509
MINTO CREEK, YUKON	UTM ZONE: 8 N6944384.2 E384340.8	ELEVATION: 2798.60 (m)

SAMPLE TYPE ■ GRAB SAMPLE ▨ NO RECOVERY ☒ STANDARD PEN. ☰ 75 mm SPOON ▯ CRREL BARREL

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL	SOIL DESCRIPTION
0.0					ORGANIC SILT – frequent roots; soft; wet; black
					SAND AND SILT – trace of clay, occasional fine gravel; mica platelets dissemented throughout; fine to medium sand; low plastic; frozen, Nbe; brown
	■	1			
1.0					– more sand below 1.2 m
2.0	■	2			
3.0					ICE INCLUSION, 0.5 m in thickness
					SILT – trace to some fine sand; Vx; 15 to 20% ICE; brown; mild to strong organic odour
4.0					– some zones of ash
5.0	■	3			
					END OF BOREHOLE @ 5.3 m
6.0					

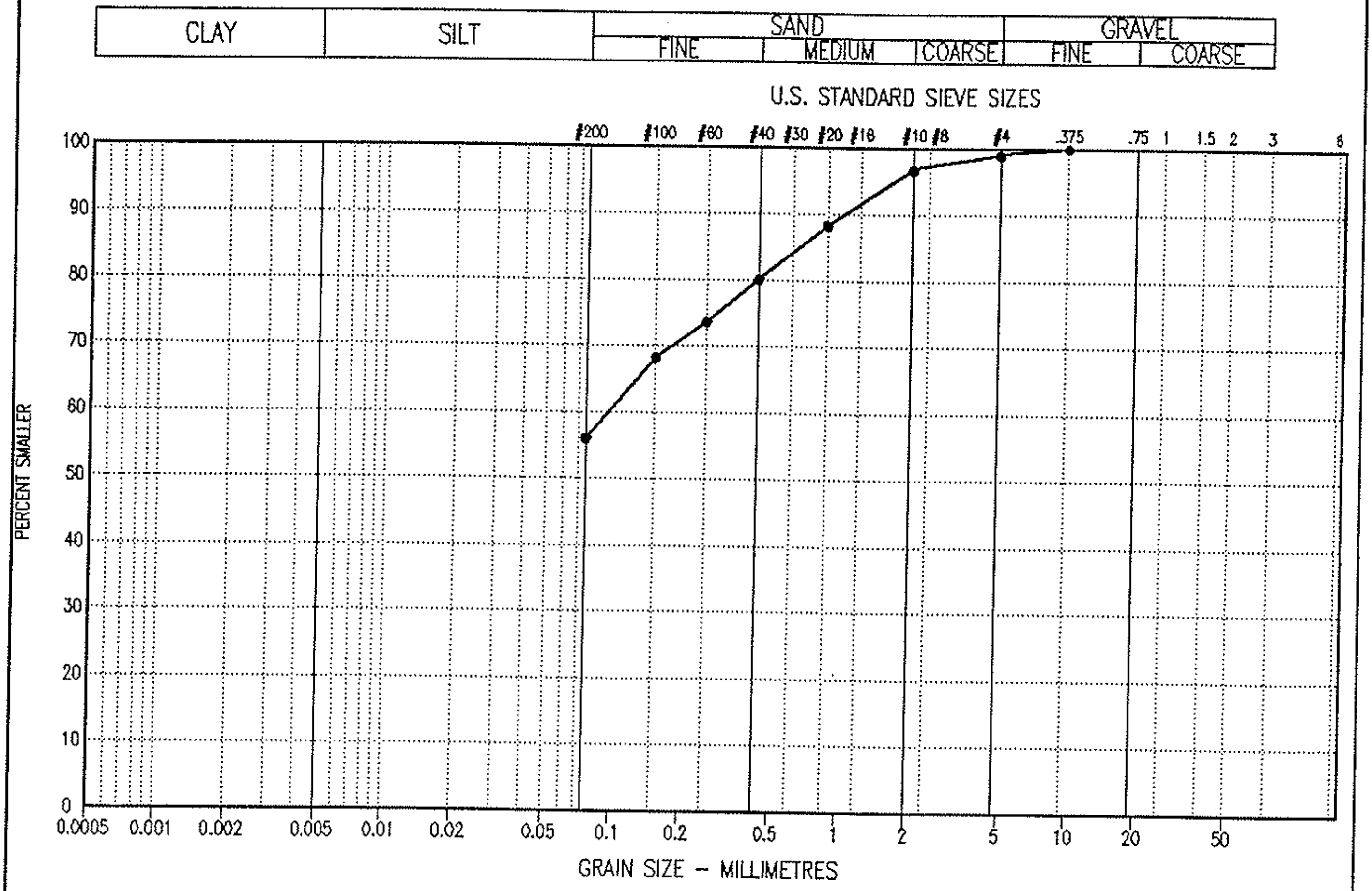


EBA Engineering Consultants Ltd.
Whitehorse, Yukon

LOGGED BY: CRH	COMPLETION DEPTH: 5.3 m
REVIEWED BY: CRH	COMPLETE: 96/07/04
Fig. No:	Page 1 of 1

96/08/14 10:36AM (YUKON-6)

PARTICLE SIZE – ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION			Cu	Cc	U.S.C
			CLAY & SILT %	SAND %	GRAVEL %			
●——●	96-G06	0.70 - 1.00	55.9	43.0	1.1	7.4	1.2	

Project: 0201-11509

Date Tested: 96/07/11

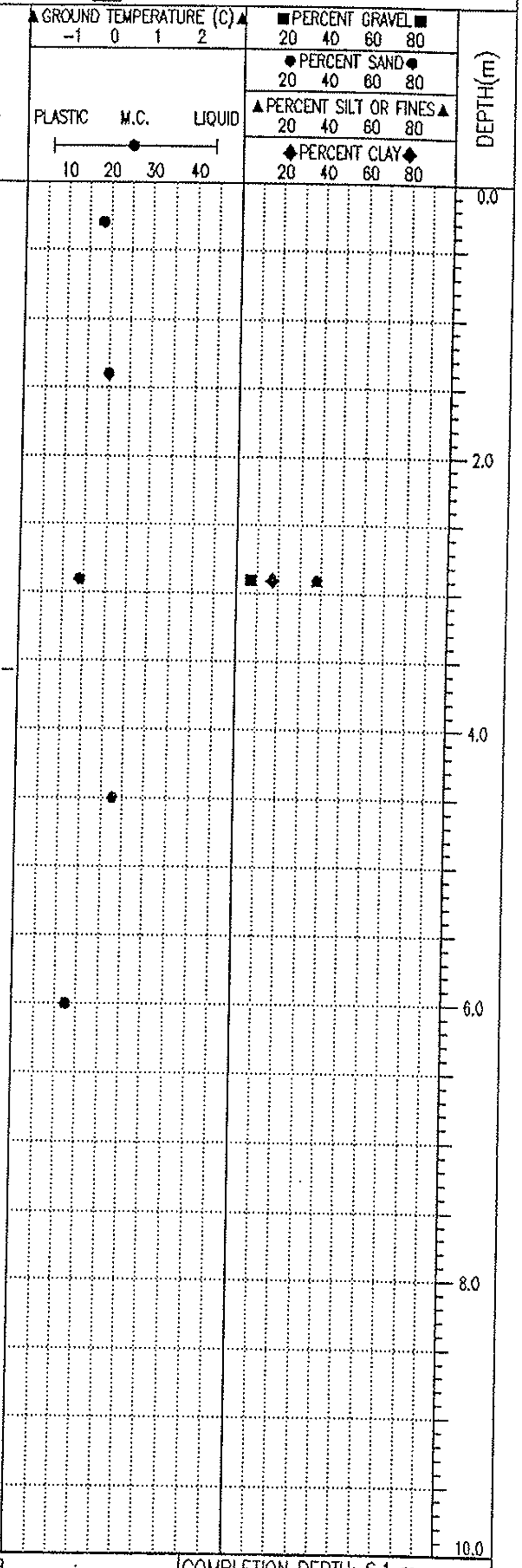
BY: AA

Tested in accordance with ASTM D422 unless otherwise noted.

THE MINTO PROJECT	CLIENT: MINTO EXPLORATIONS LTD	BOREHOLE NO: 97-G09
GEOTECHNICAL EVAL. - WASTE DUMP AREA	DRILL: CME-75 c/w SOLID SHAFT AUGERS	PROJECT NO: 0201-97-11509
MINTO CREEK, YUKON	UTM ZONE: - N - E -	ELEVATION: 2776.3 '

SAMPLE TYPE ■ GRAB SAMPLE ◺ NO RECOVERY ☒ STANDARD PEN. ☰ 75 mm SPOON ▯ CRREL BARREL

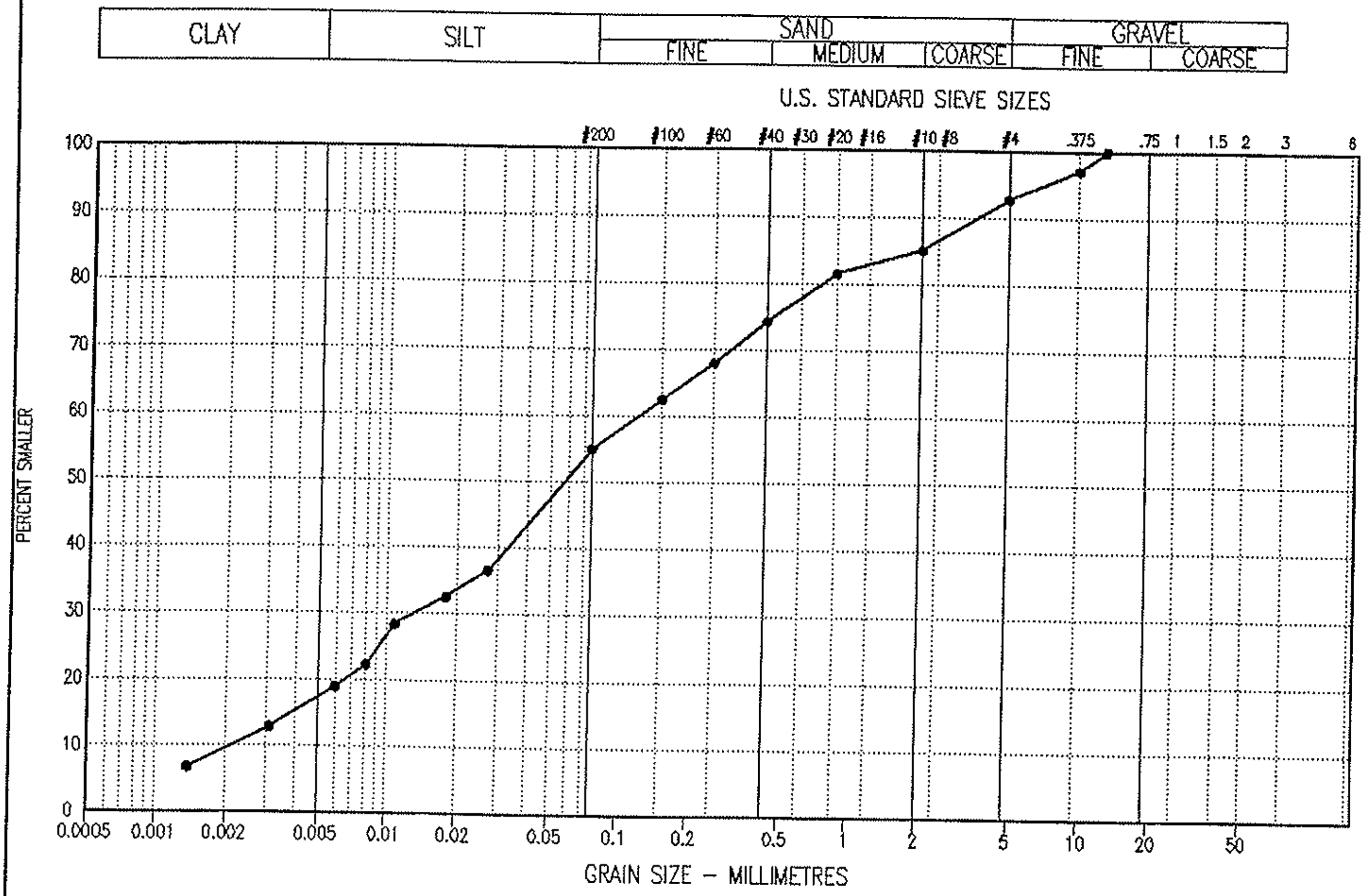
DEPTH(m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL	SOIL DESCRIPTION	GROUND ICE DESCRIPTION
0.0	■	57			MOSS AND ROOT MAT SILT & SAND - some clay, trace of gravel, fine grained sand, low to non-plastic, soft, very moist, olive brown	UNFROZEN
1.0	■	58			- hole sloughing	
2.0					- becomes some gravel to gravelly fine to med. grained sub-rounded below 1.8 m - damp to moist below 1.8 m - silt content decreases below 1.8 m - sand content increases below 1.8 m	
3.0	■	59				
4.0					- grinding and hard drilling below 3.4 to 3.7 m - coarse grained sand, some silt, some gravel fine to med. grained 3.4 m to 3.7 m	PERMAFROST Nf
5.0	■	60			- some sand below 3.7 m - silt content increases, trace of clay below 3.7 m - no gravel below 3.7 m - grinding below 5.2 m	-0.8 degree C.
6.0	■	61			SAND - gravelly, some silt, coarse grained sand, fine to med. grained sub-rounded gravel, compact, moist, brownish grey	
7.0					END OF BOREHOLE @ 6.1 m (REFUSAL) - sloughing from top of hole NOTE: Mine Coordinates N 10280.00 E 8310.00	0.0 degree C.
8.0						
9.0						
10.0						



EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: JSB	COMPLETION DEPTH: 6.1 m
	REVIEWED BY: CRH	COMPLETE: 97/09/11
	Fig. No:	Page 1 of 1

98/02/17 11:47AM (YUK-PT10)

PARTICLE SIZE - ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C
			CLAY %	SILT %	SAND %	GRAVEL %			
●—●	97-G09	2.80 - 3.00	16.8	38.0	38.0	7.2	54.9	0.7	

Project: 0201-97-11509

Date Tested: 97/10/21

BY: JSB

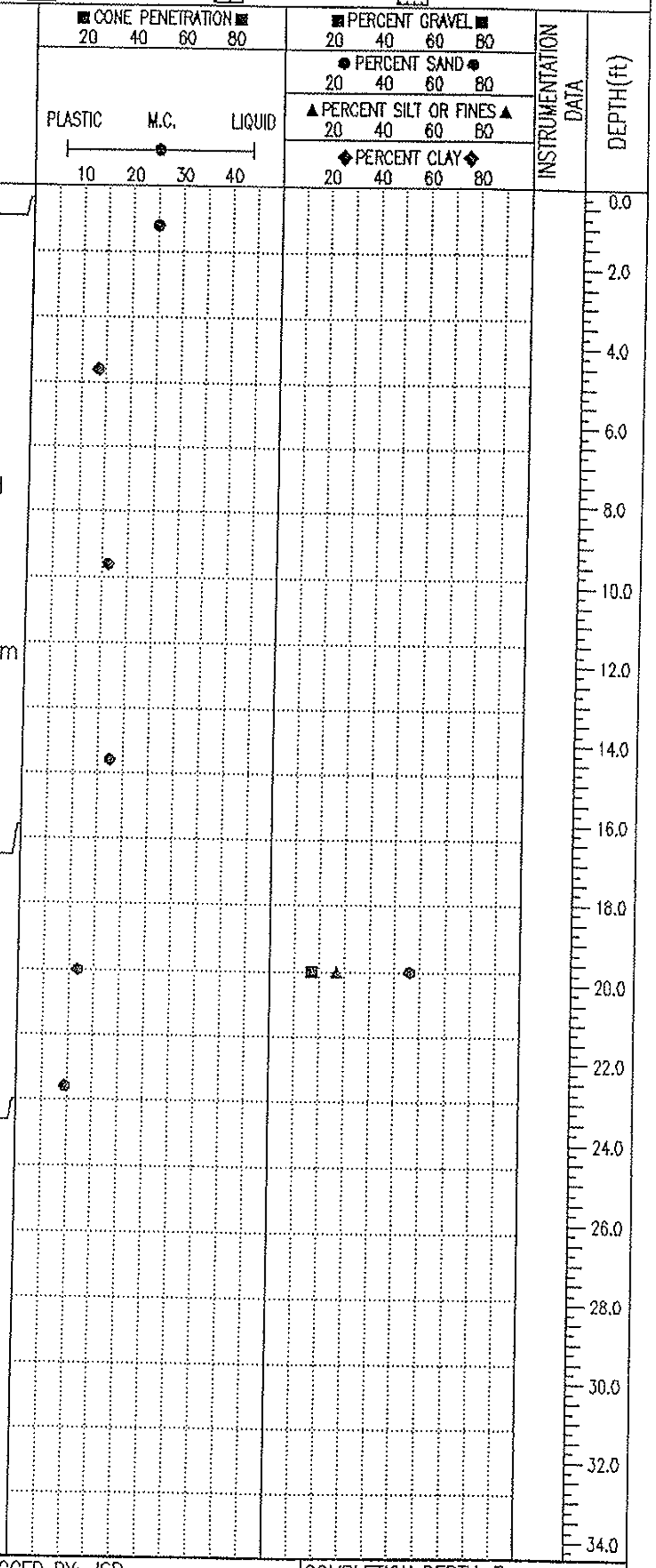
Tested in accordance with ASTM D422 unless otherwise noted.

THE MINTO PROJECT	CLIENT: MINTO EXPLORATIONS LTD	BOREHOLE NO: 97-G10
GEOTECHNICAL EVAL. - WASTE DUMP AREA	DRILL: CME-75 c/w SOLID SHAFT AUGERS	PROJECT NO: 0201-97-11509
MINTO CREEK, YUKON	UTM ZONE: - N - E -	ELEVATION: 2768.8'

SAMPLE TYPE ▩ GRAB SAMPLE ▱ NO RECOVERY ☒ STANDARD PEN. ☰ 75 mm SPOON ▥ CRREL BARREL

BACKFILL TYPE ▩ BENTONITE ▒ PEA GRAVEL ▥ SLOUGH ▒ GROUT ▨ DRILL CUTTINGS ▒ SAND

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION
0.0						MOSS AND ROOT MAT
	▩	62				SILT - sandy, well graded sand, low plastic, soft, very moist, olive brown - trace of fine grained gravel below 0.5 m - color changes to light greyish brown around 0.9 m
1.0	▩	63				
2.0						- becomes gravelly, fine to med. grained below 2.2 m
3.0	▩	64				- 0.0 degree C. at 3.0 m - some visable ice inclusion Vr > 10% various depths from 3.2 m - 4.5 m
4.0	▩	65				
5.0						- dense hard driling below 4.9 m
						SAND - silty, some gravel, coarse grained sand, fine to med. grained sub-angular gravel, moist, dense, light greyish brown
6.0	▩	66		SM	▒	
7.0	▩	67				- grinding and hard drilling below 6.7 m - broke off fish tail bit, lost in hole
						END OF BOREHOLE @ 7.0 m (REFUSAL) - major slough throughout NOTE: Mine Coordinates N 10169.00 E 8357.00
8.0						
9.0						
10.0						



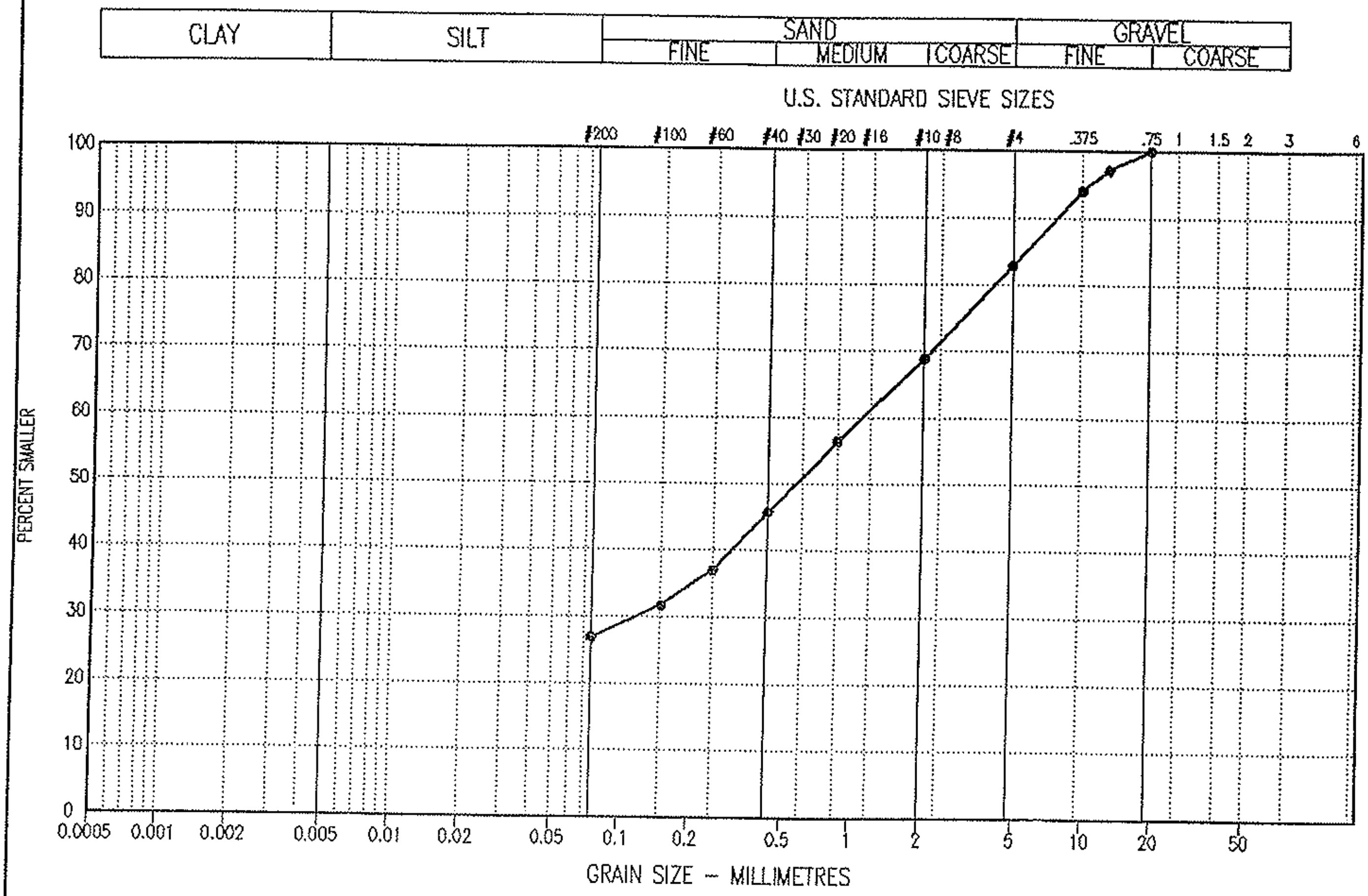
EBA Engineering Consultants Ltd.
Whitehorse, Yukon

LOGGED BY: JSB	COMPLETION DEPTH: 7 m
REVIEWED BY: CRH	COMPLETE: 97/09/11
Fig. No:	Page 1 of 1

98/01/14 09:54AM (YUKON-10)

EBA Engineering

PARTICLE SIZE – ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION			Cu	Cc	U.S.C
			CLAY & SILT %	SAND %	GRAVEL %			
●—●	97-G10	5.90 – 6.10	26.9	55.9	17.2	42.4	0.5	SM

Project: 0201-97-11509

Date Tested: 97/10/20

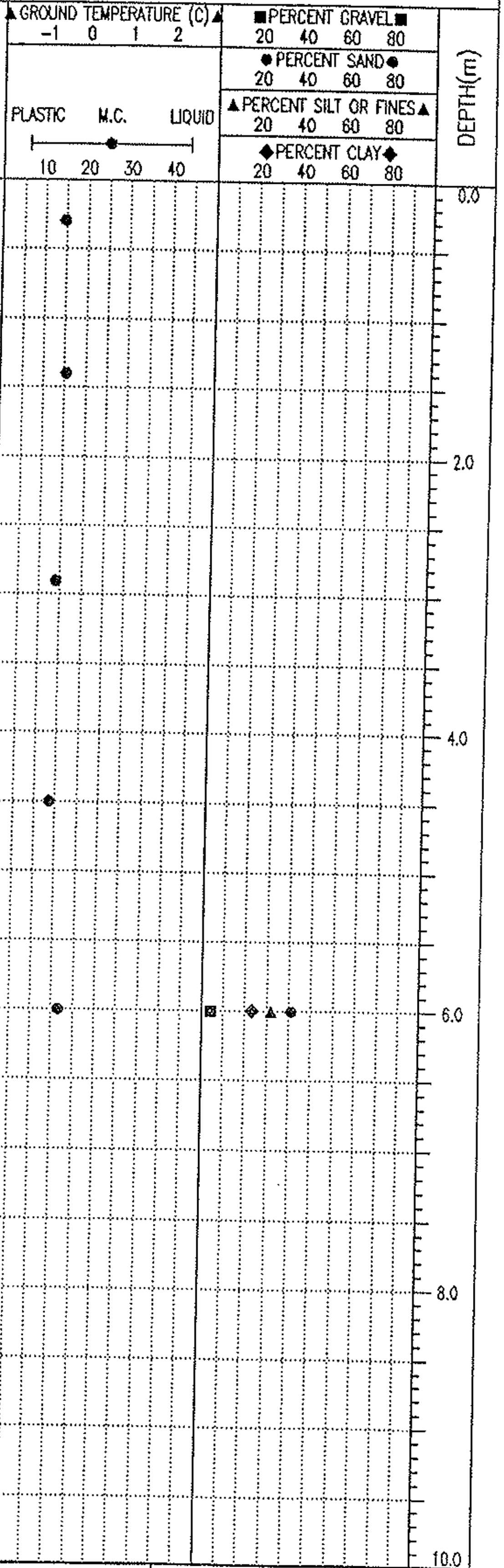
BY: RS

Tested in accordance with ASTM D422 unless otherwise noted.

THE MINTO PROJECT	CLIENT: MINTO EXPLORATIONS LTD	BOREHOLE NO: 97-G11
GEOTECHNICAL EVAL. – WASTE DUMP AREA	DRILL: CME-75 c/w SOLID SHAFT AUGERS	PROJECT NO: 0201-97-11509
MINTO CREEK, YUKON	UTM ZONE: – N – E –	ELEVATION: 2798.7'

SAMPLE TYPE ▓ GRAB SAMPLE ▨ NO RECOVERY ☒ STANDARD PEN. ☰ 75 mm SPOON ▯ CRREL BARREL

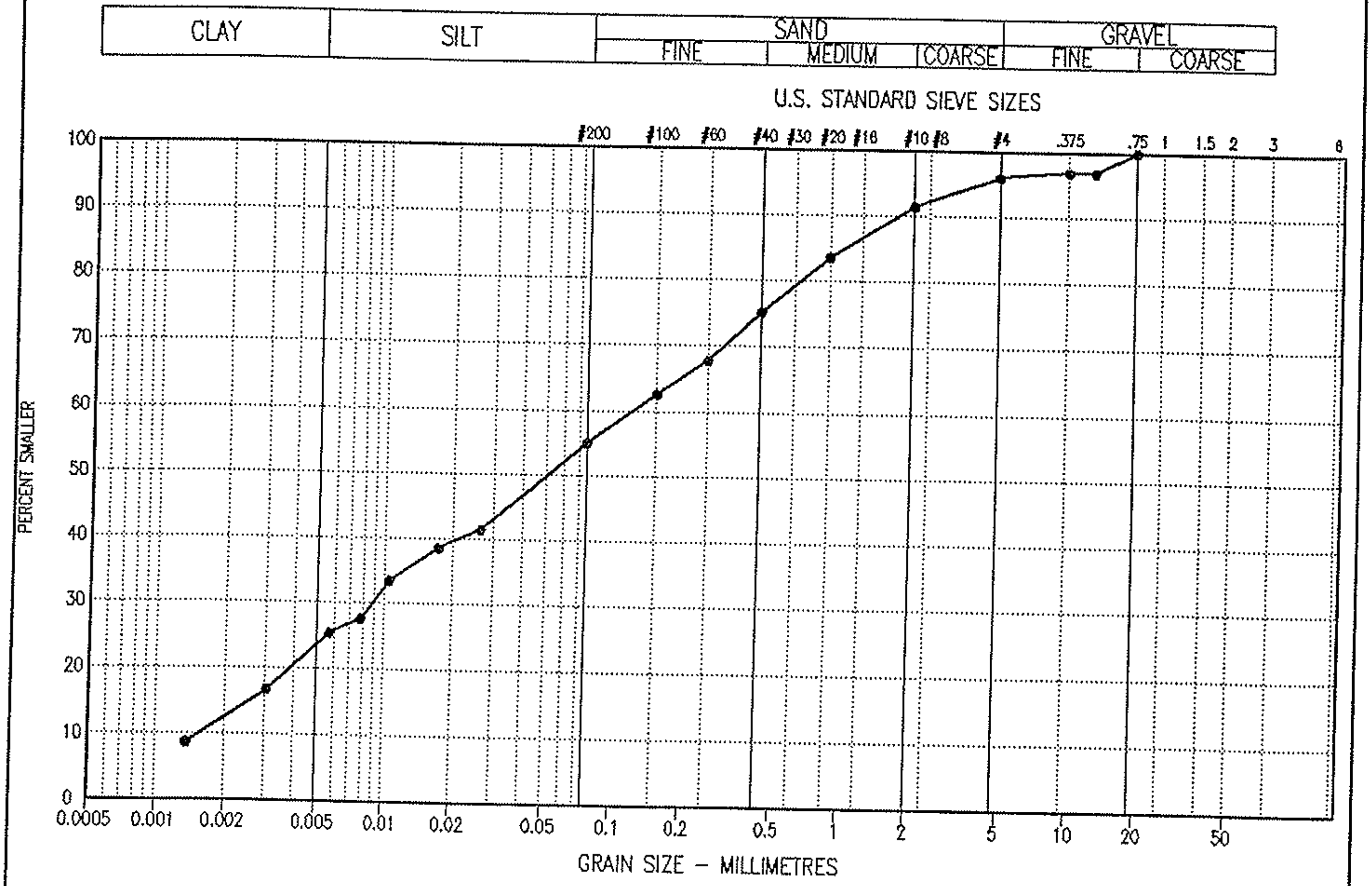
DEPTH(m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL	SOIL DESCRIPTION	GROUND ICE DESCRIPTION
0.0					MOSS AND ROOT MAT	UNFROZEN
	▓	68			SILT & SAND – some clay, fine to med. grained sand, very moist, greyish brown	
1.0					– trace of fine grained sub-rounded gravel below 0.4 m	
	▓	69			– sand content increases slightly below 0.4m	
2.0						
	▓	70				
3.0						PERMAFROST –0.6 degree C. Nf
4.0					– moisture content decreases around 3.7 m – coarse grained sand below 3.7 m	
	▓	71				
5.0					– silt content decreases to some silt below 4.8 m	
6.0	▓	72			– becomes silty, clayey below 5.9 m	
					END OF BOREHOLE @ 6.1 m (REFUSAL) – major slough throughout – no water table encountered NOTE: Mine Coordinates N 10306.00 E 7968.00	
7.0						
8.0						
9.0						
10.0						



EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: JSB	COMPLETION DEPTH: 6.1 m
	REVIEWED BY: CRH	COMPLETE: 97/09/12
	Fig. No:	Page 1 of 1

98/02/17 11:48AM (YUK-PT10)

PARTICLE SIZE – ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C
			CLAY %	SILT %	SAND %	GRAVEL %			
●——●	97-G11	5.90 – 6.10	23.1	31.9	41.0	4.0	76.4	0.4	

Project: 0201-97-11509

Date Tested: 97/10/21

BY: JSB

Tested in accordance with ASTM D422 unless otherwise noted.

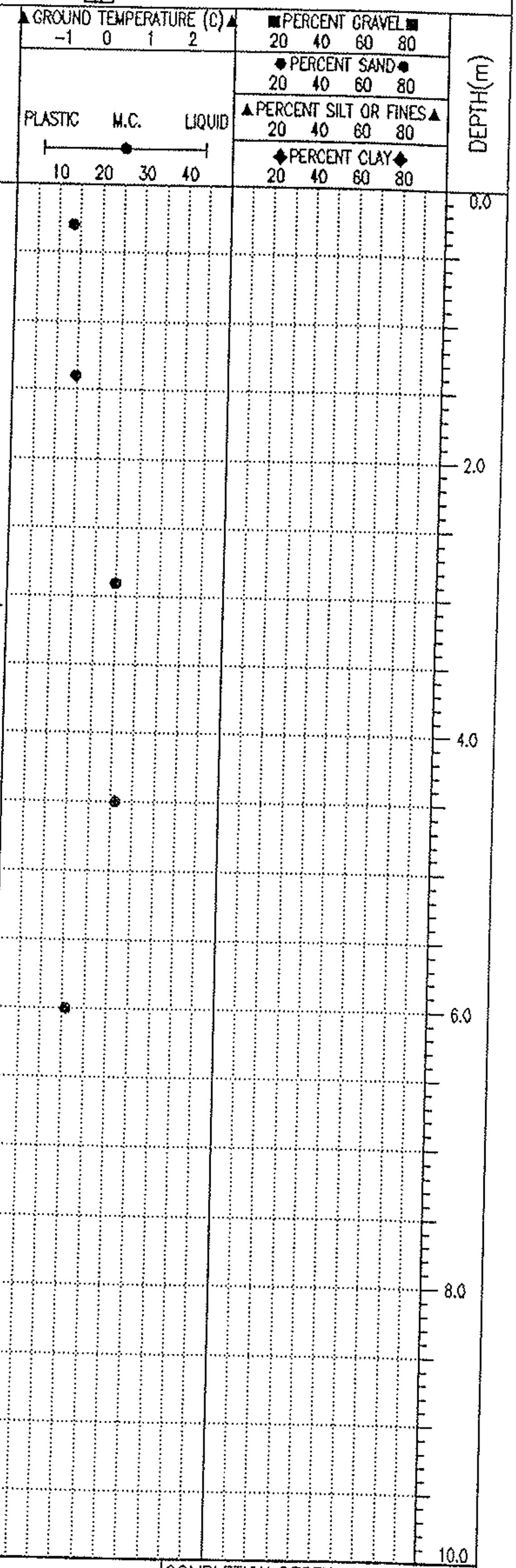
THE MINTO PROJECT
GEOTECHNICAL EVAL. – WASTE DUMP AREA
MINTO CREEK, YUKON

CLIENT: MINTO EXPLORATIONS LTD
DRILL: CME–75 c/w SOLID SHAFT AUGERS
UTM ZONE: – N – E –

BOREHOLE NO: 97–G12
PROJECT NO: 0201-97-11509
ELEVATION: 2793.9 '

SAMPLE TYPE ■ GRAB SAMPLE ◿ NO RECOVERY ☒ STANDARD PEN. ☰ 75 mm SPOON ▯ CRREL BARREL

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL	SOIL DESCRIPTION	GROUND ICE DESCRIPTION
0.0					MOSS AND ROOTMAT	UNFROZEN
	■	73			SILT & SAND – fine to med. grained sand, low plastic, soft, moist, greyish brown – water at 0.5 m – trace of fine grained gravel below 0.5 m	
1.0	■	74				
2.0					SAND – some silt, med. grained uniform sand, soft, wet, light greyish brown	
3.0	■	75				PERMAFROST –0.8 degree C. Nf Vx, <5%
4.0					– drill slightly firmer below 3.7 m	
	■	76				–0.9 degree C.
5.0					– trace of some gravel fine to med. grained below 4.9 m – unfrozen below 5.2 m	UNFROZEN
6.0	■	77				
					END OF BOREHOLE @ 6.1 m – major slough throughout – water at 0.5 m NOTE: Mine Coordinate N 10170 E 7858	
7.0						
8.0						
9.0						
10.0						



EBA Engineering Consultants Ltd.
Whitehorse, Yukon

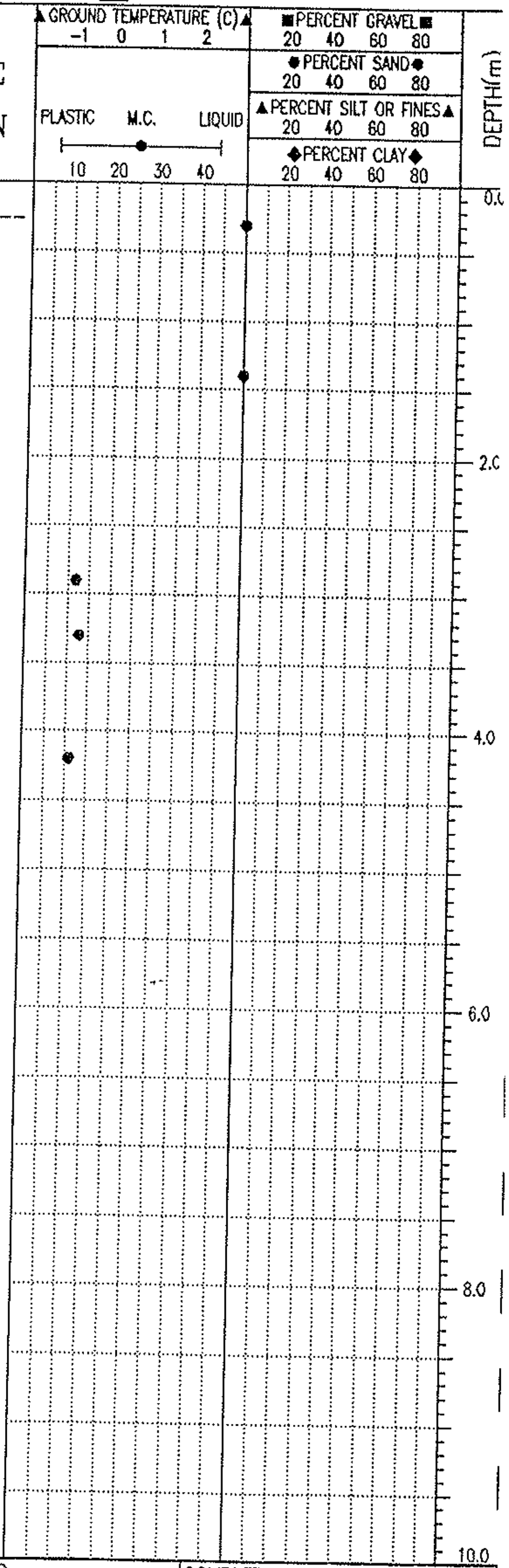
LOGGED BY: JSB
REVIEWED BY: CRH
Fig. No:

COMPLETION DEPTH: 6.1 m
COMPLETE: 97/09/12

THE MINTO PROJECT	CLIENT: MINTO EXPLORATIONS LTD	BOREHOLE NO: 97-G13
GEOTECHNICAL EVAL. - WASTE DUMP AREA	DRILL: CME-75 c/w SOLID SHAFT AUGERS	PROJECT NO: 0201-97-11509
MINTO CREEK, YUKON	UTM ZONE: - N - E -	ELEVATION: 2851.7'

SAMPLE TYPE ▇ GRAB SAMPLE ◪ NO RECOVERY ☒ STANDARD PEN. ▤ 75 mm SPOON ▥ CRREL BARREL

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL	SOIL DESCRIPTION	GROUND ICE DESCRIPTION
0.0					MOSS AND ROOTMAT	UNFROZEN
0.0 – 1.0	▇ ▇	78 79			SILT & SAND - well graded sand, low plastic, wet, brownish black - trace of fine to med. grained gravel below 0.4 m	PERMAFROST Vx, 10 - 15% -1.8 degree C.
2.0 – 4.0	▇ ▇ ▇	80 81 82			SAND (RESIDUM) - gravelly, some silt, well graded sand, fine to med. grained angular gravel, moist brownish grey, no visable ice, poorly, bonded, Nf - grinding and hard drilling below 3.1 m - fish tail replaced with button bit at 3.15 m - slow hard drilling continues - easier drilling below 3.5 m - grinding at 4.0 t0 4.3 m Note: sample silty with ground up gravel, unable to determine temp at depth	-0.8 degree C.
6.0					END OF BOREHOLE @ 5.8 m (REFUSAL) - some sloughing - no water table encountered NOTE: Mine Coordinates N 8108.00 E 7022.00	
7.0						
8.0						
9.0						
10.0						



EBA Engineering Consultants Ltd.
Whitehorse, Yukon

LOGGED BY: JSB	COMPLETION DEPTH: 5.8 m
REVIEWED BY: CRH	COMPLETE: 97/09/12
Fig. No:	Page 1 of 1

98/02/17 11:51AM (YUK-PT10)

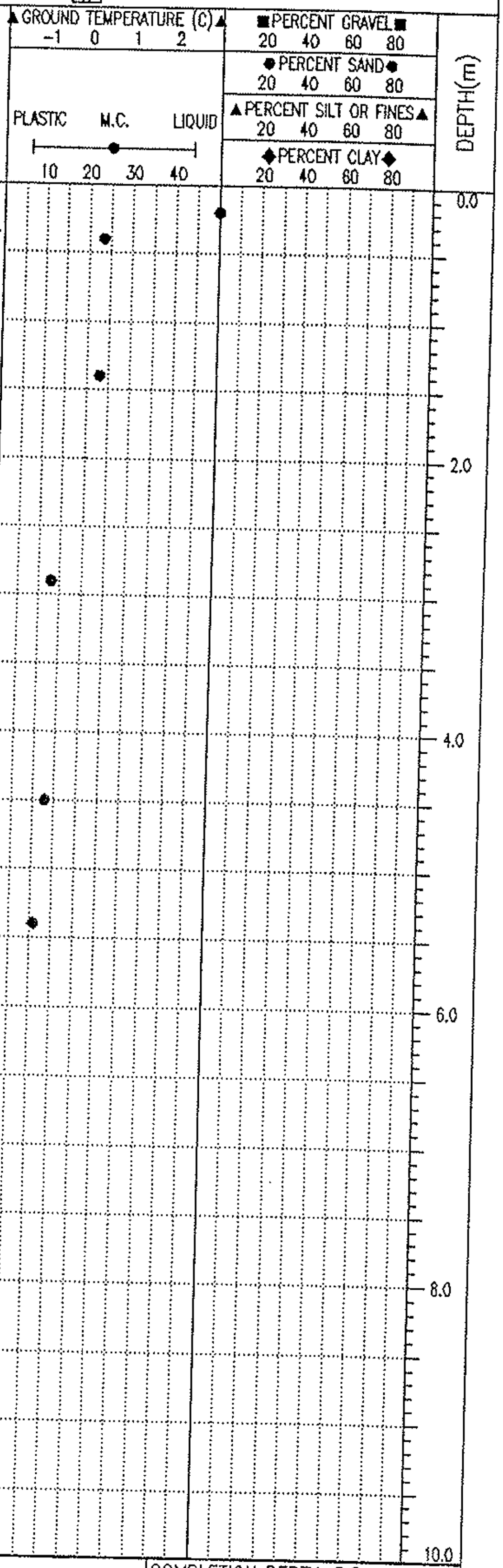
THE MINTO PROJECT	CLIENT: MINTO EXPLORATIONS LTD	BOREHOLE NO: 97-G14
GEOTECHNICAL EVAL. – WASTE DUMP AREA	DRILL: CME-75 c/w SOLID SHAFT AUGERS	PROJECT NO: 0201-97-11509
MINTO CREEK, YUKON	UTM ZONE: – N – E –	ELEVATION: 2824.5 '

SAMPLE TYPE ■ GRAB SAMPLE ▨ NO RECOVERY ☒ STANDARD PEN. ▤ 75 mm SPOON ▥ CRREL BARREL

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL
	■	83		
	■	84		
	■	85		
	■	86		
	▥	87		
	▥	88		

DEPTH(m): 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

SOIL DESCRIPTION	GROUND ICE DESCRIPTION
MOSS AND ROOT MAT	UNFROZEN
SILT & SAND – well graded sand, low plastic, wet, brownish brown – color changes to greyish brown at 0.3 m – trace of fine to med. grained sub-angular gravels – grinding below 1.8 m	PERMAFROST Vx, 10 – 15% Vx, 10 –15%, Nf Vx, <5% poorly bonded
SAND (RESIDUUM) – some gravel, some silt, med. to coarse grained sand, fine to med. grained angular gravels, moist, greyish brown – change fish tail bit to CRREL barrel – grinding and hard drilling below 4.9 m – large cobble in CRREL barrel	
END OF BOREHOLE @ 5.5 m (REFUSAL) – little to no slough – no water table encountered NOTE: Mine Coordinates N 8535.00 E 7365.00	



EBA Engineering Consultants Ltd.
Whitehorse, Yukon

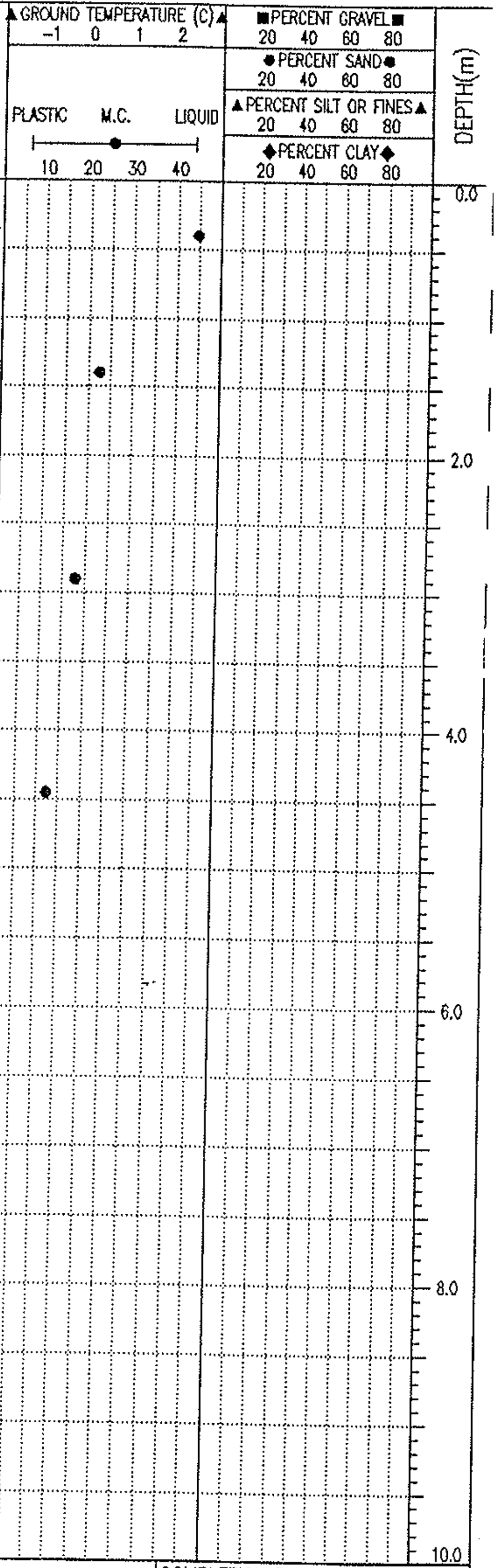
LOGGED BY: JSB	COMPLETION DEPTH: 5.5 m
REVIEWED BY: CRH	COMPLETE: 97/09/12
Fig. No:	Page 1 of 1

98/02/17 11:52AM (YUK-PT10)

THE MINTO PROJECT	CLIENT: MINTO EXPLORATIONS LTD	BOREHOLE NO: 97-G15
GEOTECHNICAL EVAL. – WASTE DUMP AREA	DRILL: CME-75 c/w SOLID SHAFT AUGERS	PROJECT NO: 0201-97-11509
MINTO CREEK, YUKON	UTM ZONE: – N – E –	ELEVATION: 2795'

SAMPLE TYPE ■ GRAB SAMPLE ▨ NO RECOVERY ☒ STANDARD PEN. ☰ 75 mm SPOON ‖ CRREL BARREL

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL	SOIL DESCRIPTION	GROUND ICE DESCRIPTION
0.0					MOSS AND ROOT MAT	UNFROZEN
	■	89			SILT – sandy, fine to med. grained sand, very moist, greyish brown	PERMAFROST
					SAND – some silt, trace of gravel, med. to coarse grained sand, fine grained angular gravel, soft, moist, grey	
1.0						Vx, <5%
	■	90				−0.3 degree C. Vx, 15 – 20%
2.0						Vx, 10 – 15%
	■	91				
3.0						−0.2 degree C.
4.0						
	■	92				
					– hard drilling at 4.6 m – 4.9 m	
5.0					END OF BOREHOLE @ 4.9 m – some slough – no water table encountered NOTE: Mine Coordinates N 9147.00 E 7550.00	
6.0						
7.0						
8.0						
9.0						
10.0						



EBA Engineering Consultants Ltd.
Whitehorse, Yukon

LOGGED BY: JSB	COMPLETION DEPTH: *.*
REVIEWED BY: CRH	COMPLETE: 97/09/12
Fig. No:	Page 1 of 1

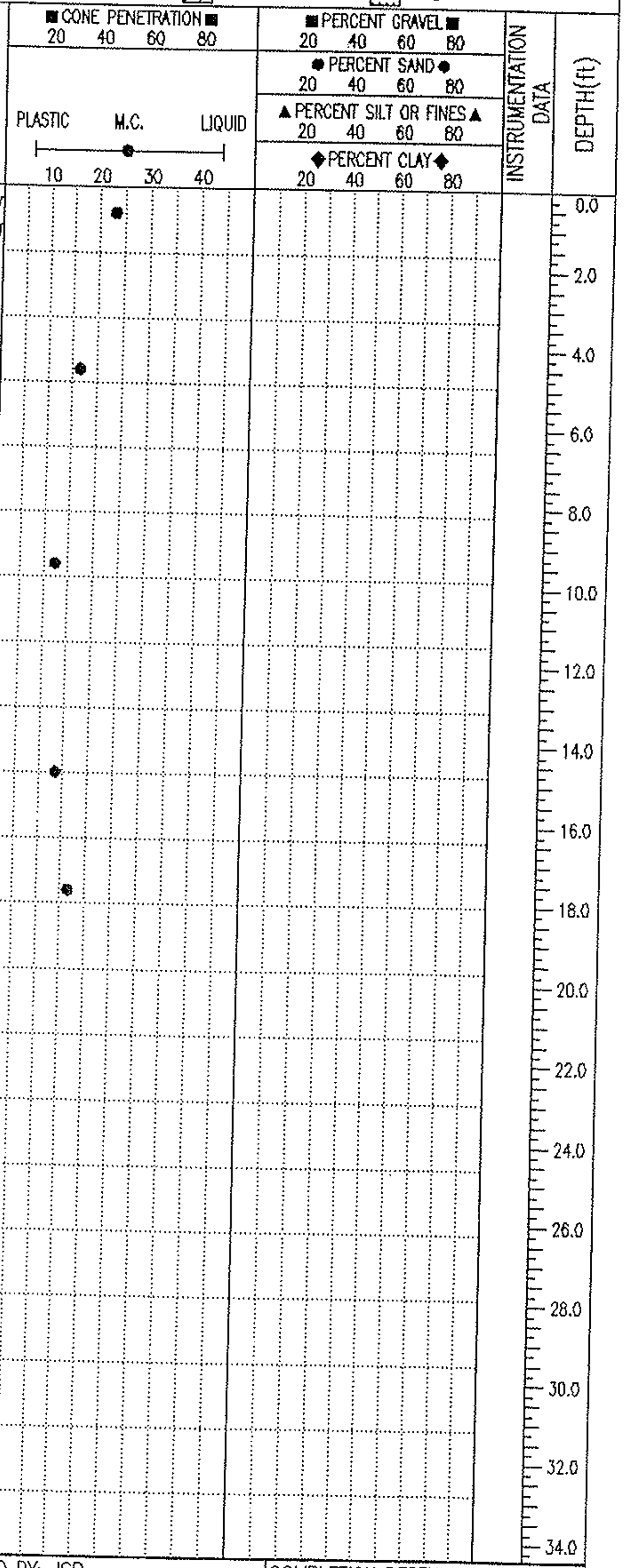
98/02/17 11:53AM (YUK-PT10)

THE MINTO PROJECT	CLIENT: MINTO EXPLORATIONS LTD	BOREHOLE NO: 97-G16
GEOTECHNICAL EVAL. – WASTE DUMP AREA	DRILL: CME-75 c/w SOLID SHAFT AUGERS	PROJECT NO: 0201-97-11509
MINTO CREEK, YUKON	UTM ZONE: – N – E –	ELEVATION: 2814.3 '

SAMPLE TYPE ▩ GRAB SAMPLE ▨ NO RECOVERY ☒ STANDARD PEN. ☰ 75 mm SPOON ▥ CRREL BARREL

BACKFILL TYPE ▩ BENTONITE ⁚ PEA GRAVEL ▥ SLOUGH ▦ GROUT ▨ DRILL CUTTINGS ⁙ SAND

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION
0.0	▩	93				MOSS AND ROOT MAT SILT & SAND – well graded sand, low plastic, wet, dark olive bown SAND – silty, fine grained uniform sand, non-plastic, soft, moist, light greyish brown
1.0						
	▩	94				
2.0						– trace of fine grained angular gravel below 2.4 m – sand becomes well graded below 2.4 m – moisture content increases to very moist below 2.7 m
	▩	95				
3.0						– + 3.9 degree C. at 3.0 m – possible water table around 3.5 m
4.0						
	▩	96				
5.0						
	▩	97				
						END OF BOREHOLE @ 5.5 m (REFUSAL) – major slough throughout – possible water table at 2.4 m NOTE: Mine Coorindates N 9944.00 E 7376.00
6.0						
7.0						
8.0						
9.0						
10.0						



EBA Engineering Consultants Ltd.
Whitehorse, Yukon

LOGGED BY: JSB	COMPLETION DEPTH: *.*
REVIEWED BY: CRH	COMPLETE: 97/09/16
Fig. No:	Page 1 of 1

98/01/14 10:09AM (YUKON-10)

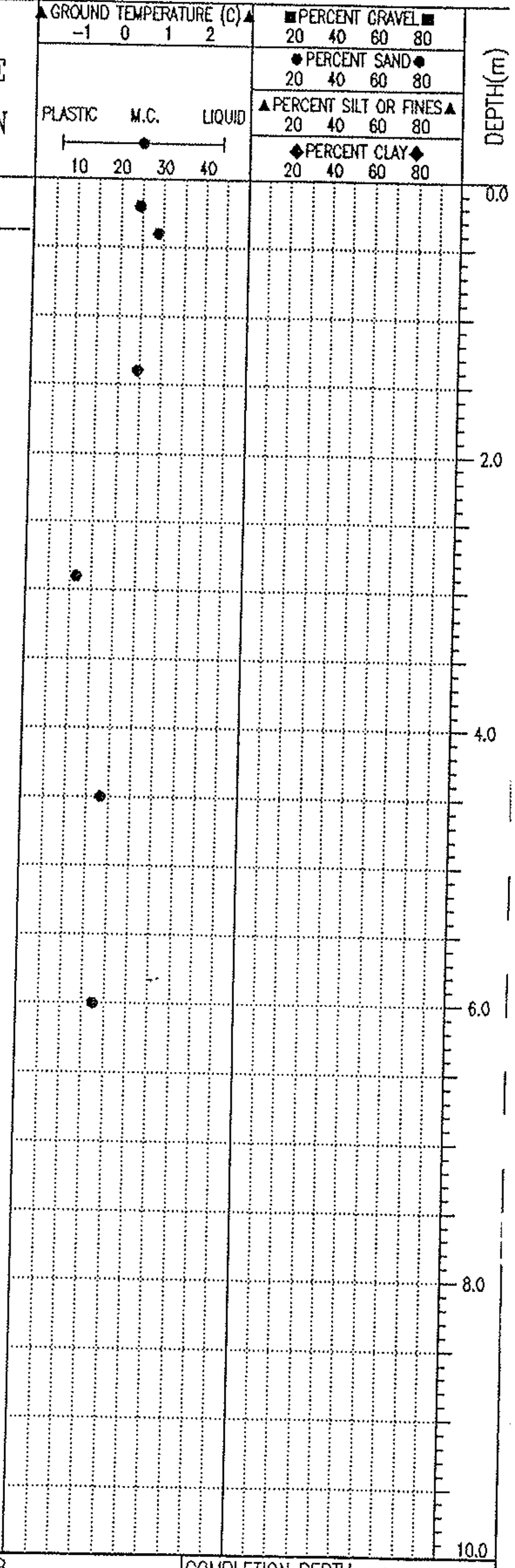
THE MINTO PROJECT
GEOTECHNICAL EVAL. - WASTE SUMP AREA
MINTO CREEK,YUKON

CLIENT: MINTO EXPLORATIONS LTD.
DRILL: CME-75 c/w SOLID SHAFT AUGERS
UTM ZONE: - N - E -

BOREHOLE NO: 97-G17
PROJECT NO: 0201-97-11509
ELEVATION: 2827.2 '

SAMPLE TYPE ▩ GRAB SAMPLE ◩ NO RECOVERY ☒ STANDARD PEN. ☰ 75 mm SPOON ▥ CRREL BARREL

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL	SOIL DESCRIPTION	GROUND ICE DESCRIPTION
0.0					MOSS AND ROOT MAT	UNFROZEN
	▩	98			SAND & SILT - trace of fine grained gravel, well graded sand, brownish grey	
	▩	99			- become some silt to silty below 0.3 m	PERMAFROST Vx, <5%
1.0						
	▩	100				Vx, 15 to 20%
					- silt content increases to silty below 1.6 m - trace of clay below 1.6 m - gravel becomes fine to med grained below 1.6 m - color becomes grey below 1.6 m	
2.0						
3.0	▩	101			- some gravel below 3.0 m	Vx, <5%
4.0						
	▩	102				
5.0						
6.0	▩	103				
					END OF BOREHOLE @ 6.1 m - no water table encountered - some slough throughout NOTE: Mine Coordinates N 10416.00 E 7347.00	
7.0						
8.0						
9.0						
10.0						



EBA Engineering Consultants Ltd.
Whitehorse, Yukon

LOGGED BY: JSB
REVIEWED BY: CRH
Fig. No:
COMPLETION DEPTH: *.*
COMPLETE: 97/09/12
Page 1 of 1

98/02/17 11:54AM (YUK-PT10)

THE MINTO PROJECT	CLIENT: MINTO EXPLORATIONS LTD	BOREHOLE NO: 97-G18
GEOTECHNICAL EVAL. - WASTE DUMP AREA	DRILL: CME-75 c/w SOLID SHAFT AUGERS	PROJECT NO: 0201-97-11509
MINTO CREEK, YUKON	UTM ZONE: - N - E -	ELEVATION: 2841.5'

SAMPLE TYPE ▩ GRAB SAMPLE ▨ NO RECOVERY ☒ STANDARD PEN. ▤ 75 mm SPOON ▥ CRREL BARREL

BACKFILL TYPE ▩ BENTONITE ⁖ PEA GRAVEL ▥ SLOUGH ⁖ GROUT ▨ DRILL CUTTINGS ⁖ SAND

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL
0.0	▩	104			
1.0	▩	105			
2.6	▩	106		SP-SM	
4.2	▩	107			
5.7	▩	108			
7.2	▩	109		SM	

SOIL DESCRIPTION

MOSS AND ROOT MAT

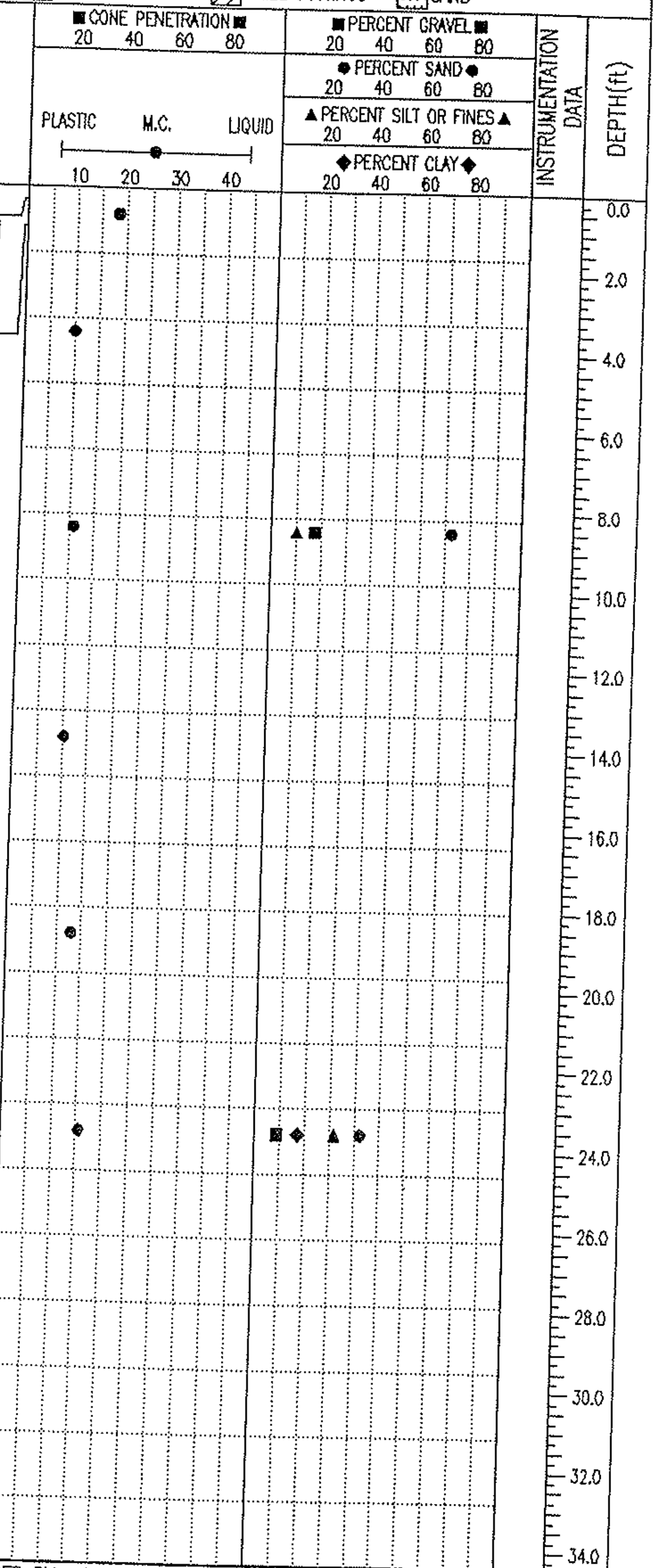
SILT & SAND - trace of gravel, well graded sand, fine to med. grained angular and sub-rounded gravels, moist, loose, mottled brown and grey

SAND - silty, some gravel, well graded sand, fine to med. grained angular and sub-rounded gravel, loose, moist, light greyish brown

- sand becomes coarse grained below 2.1 m
- some silt below 2.1 m
- some fine grained gravel below 2.1 m
- trace of silt below 2.1 m
- very wet below 2.1 m, possible water table
- sand becomes fine to med. grained below 4.3 m
- trace of fine grained gravel below 4.3 m
- silty, some clay below 7.1 m

END OF BOREHOLE @ 7.3 m
- major sloughing

NOTE: Mine Coordinates N 10730.00
E 7575.00



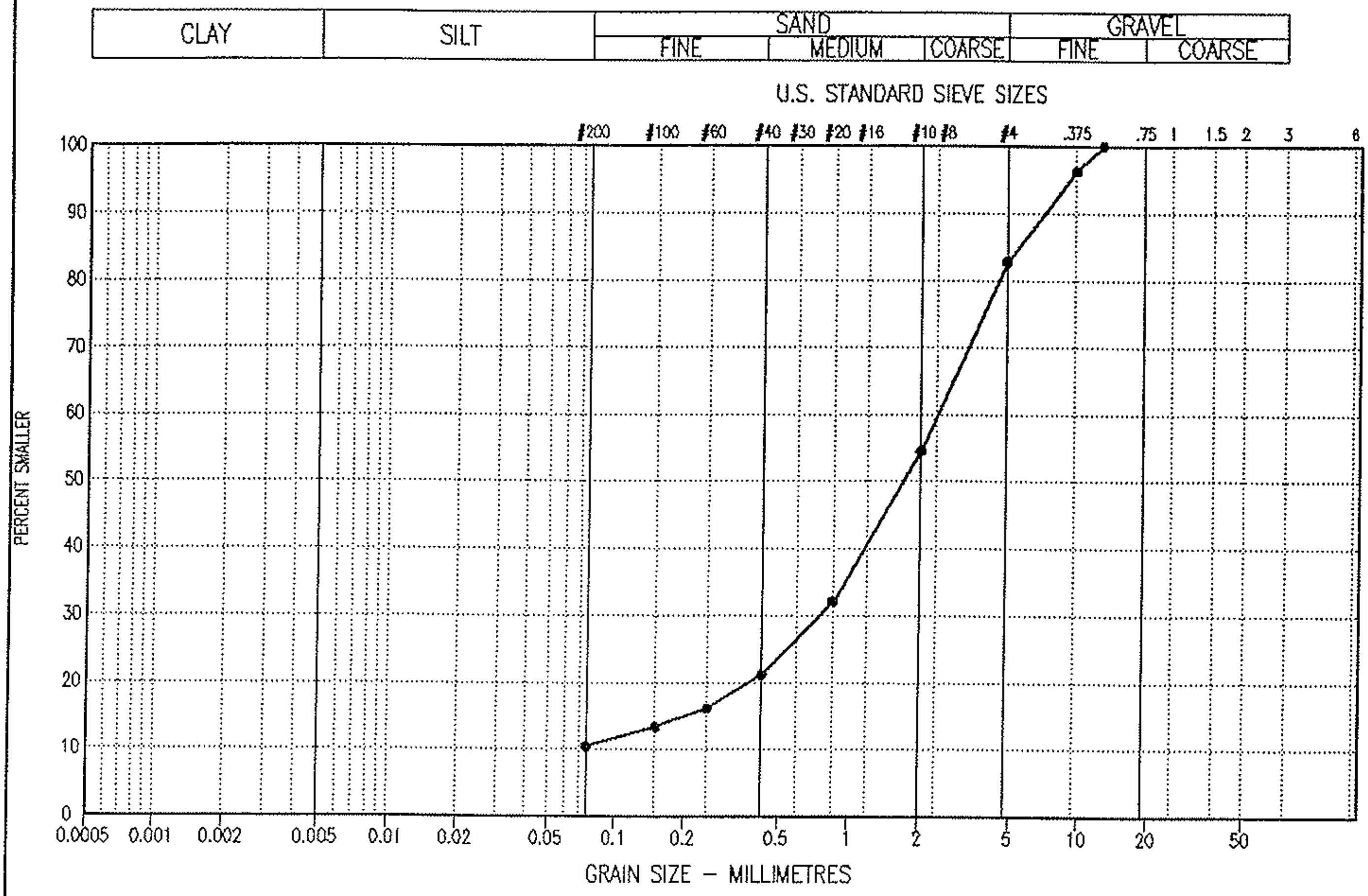
EBA Engineering Consultants Ltd.
Whitehorse, Yukon

LOGGED BY: JSB	COMPLETION DEPTH: *.*
REVIEWED BY: CRH	COMPLETE: 97/09/13
Fig. No:	Page 1 of 1

98/01/14 10:15AM (YUKON-10)

EBA Engineering

PARTICLE SIZE – ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION			Cu	Cc	U.S.C
			CLAY & SILT %	SAND %	GRAVEL %			
●—●	97-G18	2.50 – 2.70	10.3	72.4	17.3	35.0	3.2	SP-SM

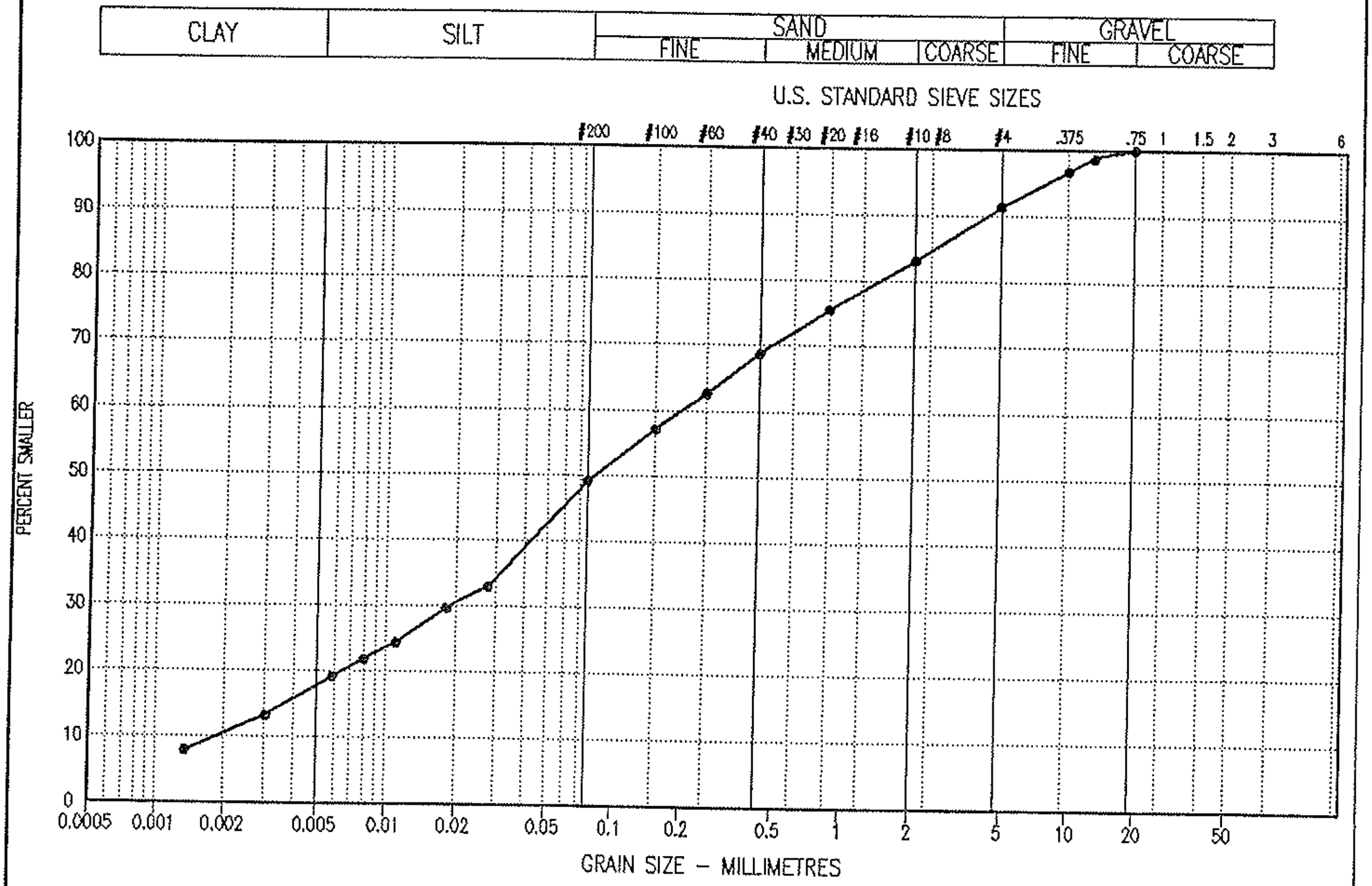
Project: 0201-97-11509

Date Tested: 97/10/20

BY: RS

Tested in accordance with ASTM D422 unless otherwise noted.

PARTICLE SIZE – ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C
			CLAY %	SILT %	SAND %	GRAVEL %			
o——o	97-G18	7.10 – 7.30	17.3	31.8	42.2	8.7	100.5	0.9	SM

Project: 0201-97-11509

Date Tested: 97/10/27

BY: JSB

Tested in accordance with ASTM D422 unless otherwise noted.

THE MINTO PROJECT	CLIENT: MINTO EXPLORATIONS LTD	BOREHOLE NO: 97-G19
GEOTECHNICAL EVAL. – WASTE DUMP AREA	DRILL: CME-75 c/w SOLID SHAFT AUGERS	PROJECT NO: 0201-97-11509
MINTO CREEK, YUKON	UTM ZONE: – N – E –	ELEVATION: 2857.7'

SAMPLE TYPE ■ GRAB SAMPLE ▨ NO RECOVERY ☒ STANDARD PEN. ☰ 75 mm SPOON ▯ CRREL BARREL

BACKFILL TYPE ■ BENTONITE ⁚ PEA GRAVEL ▥ SLOUGH ⁚ GROUT ▨ DRILL CUTTINGS ⁚ SAND

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL
0.0	■	110			
1.0	■	111			
2.0	■	112			
	■	113			
4.0	■	114		SM	
	■	115			
7.0	■	116			
	■	117			

SOIL DESCRIPTION

MOSS AND ROOTMAT

SILT & SAND – trace of gravel, well graded sand, fine to med. grained sub-rounded gravel, soft, moist, dark olive brown

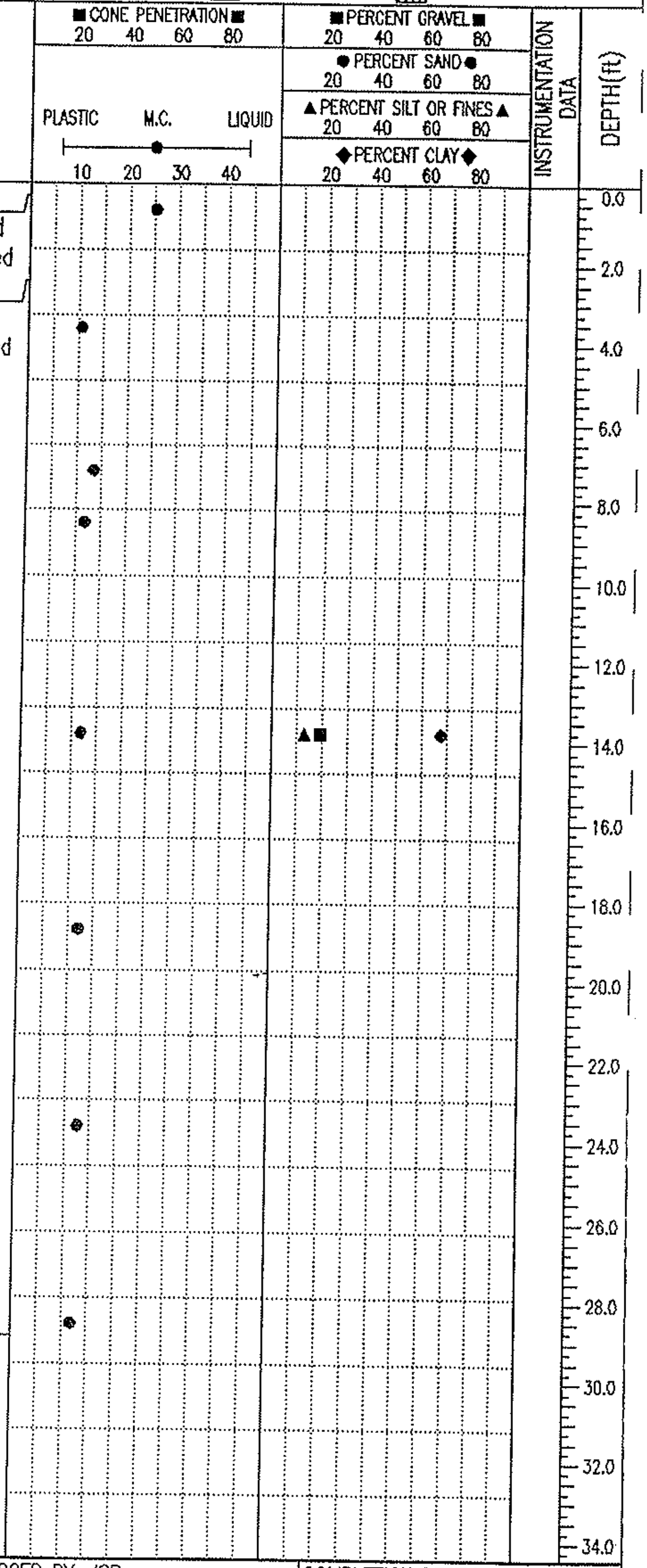
SAND – silty, trace of gravel, well graded sand, fine to med. grained sub-rounded gravel, loose, moist, greyish brown

- water table at 1.2 m possibly lower at sand seam below 2.1 m
- 0.3 m thick layer of med. to coarse grained sand, trace of silt, loose, very wet, grey
- sand becomes med to coarse grained below 3.7 m
- some silt below 3.7 m
- trace of fine grained sub-rounded gravels
- gravel content increases below 4.1 m
- becomes silty below 4.4 m
- drilling slightly harder below 6.1 m

END OF BOREHOLE @ 8.8 m

- borehole sloughing
- water around 1.2 m

NOTE: Mine Coordinates N 10837.00
E 7237.00



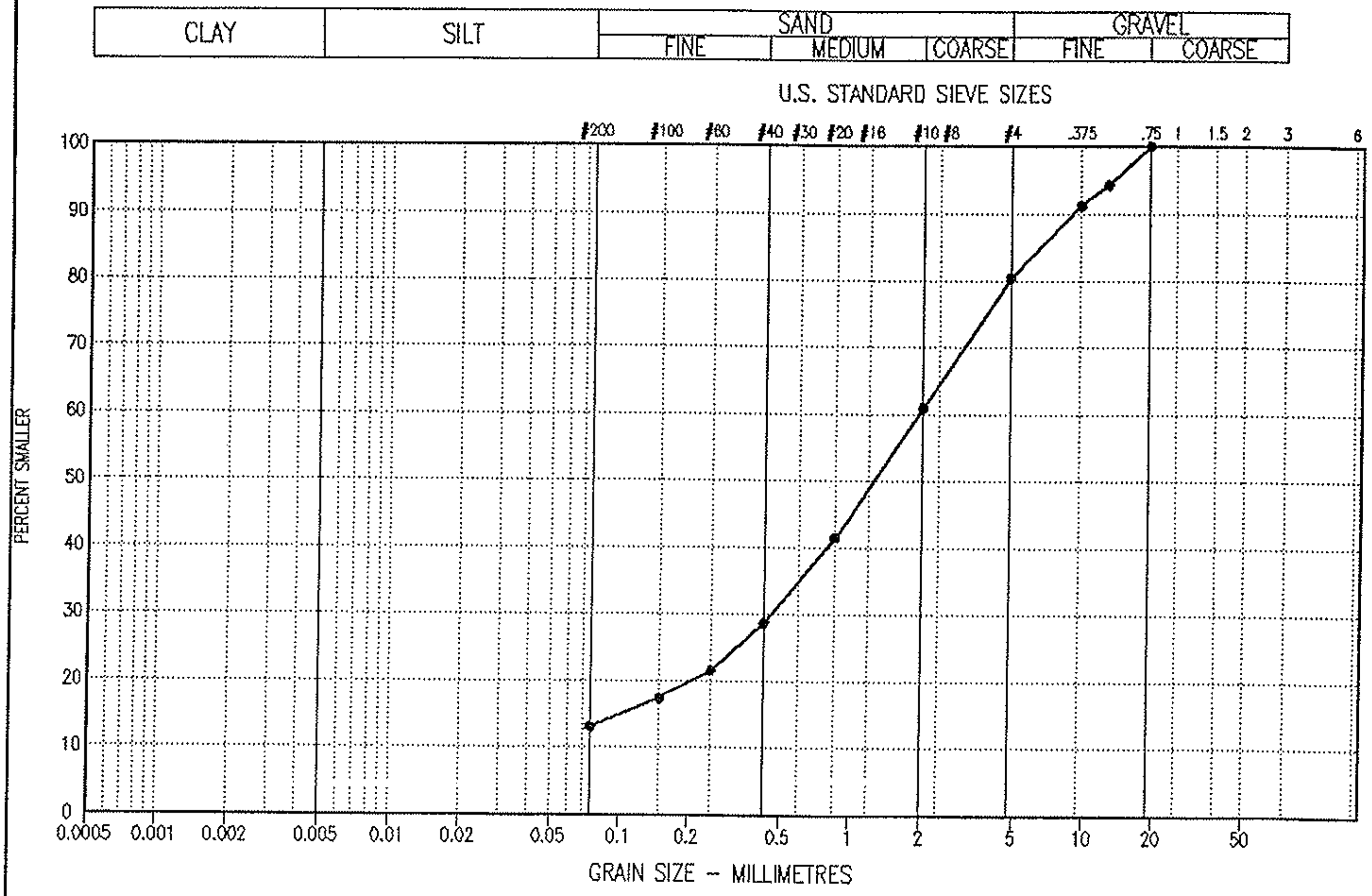
EBA Engineering Consultants Ltd.
Whitehorse, Yukon

LOGGED BY: JSB	COMPLETION DEPTH: *.*
REVIEWED BY: CRH	COMPLETE: 97/09/13
Fig. No:	Page 1 of 1

98/01/14 10:46AM (YUKON-10)

EBA Engineering

PARTICLE SIZE - ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION			Cu	Cc	U.S.C
			CLAY & SILT %	SAND %	GRAVEL %			
●—●	97-G19	4.10 - 4.30	13.0	67.5	19.5	33.7	2.0	SM

Project: 0201-97-11509

Date Tested: 97/10/20

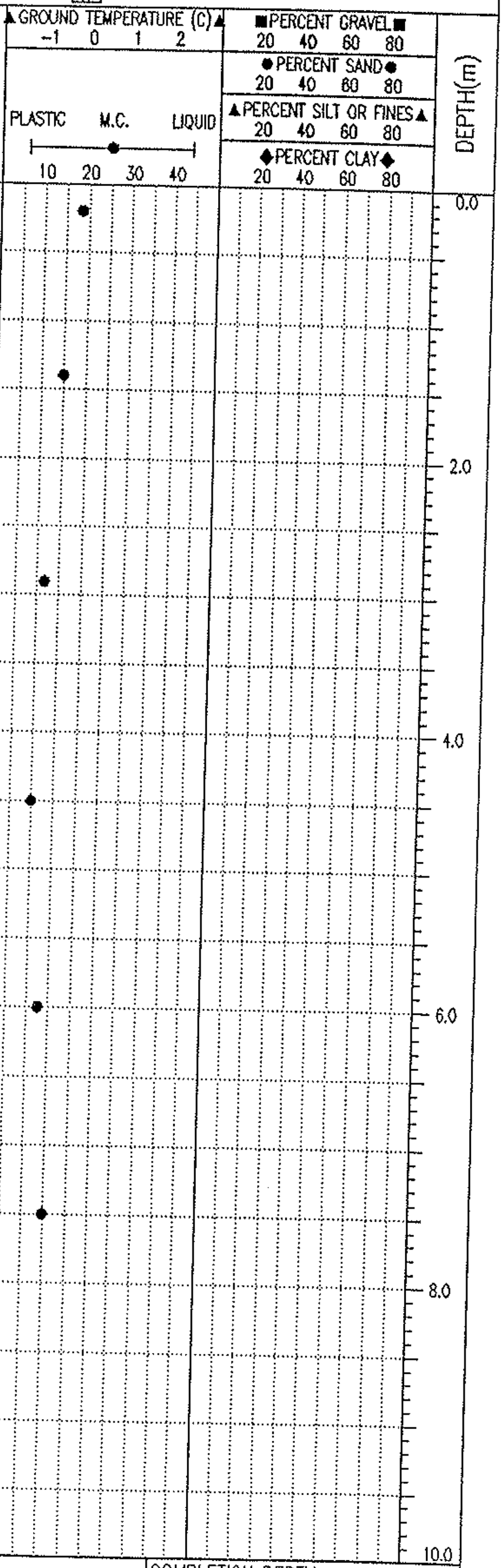
BY: RS

Tested in accordance with ASTM D422 unless otherwise noted.

THE MINTO PROJECT	CLIENT: MINTO EXPLORATIONS LTD	BOREHOLE NO: 97-G23
GEOTECHNICAL EVAL. – WASTE DUMP AREA	DRILL: CME-75 c/w SOLID SHAFT AUGERS	PROJECT NO: 0201-97-11509
MINTO CREEK, YUKON	UTM ZONE: – N – E –	ELEVATION: 2885'

SAMPLE TYPE ■ GRAB SAMPLE ▨ NO RECOVERY ☒ STANDARD PEN. ☰ 75 mm SPOON ▯ CRREL BARREL

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL	SOIL DESCRIPTION	GROUND ICE DESCRIPTION
0.0	■	141			MOSS AND ROOT MAT SAND – some silt, trace of gravel, med. to coarse grained sand, fine grained sub-rounded gravel, dense, moist, light greyish brown – harder drilling below 0.3 m	UNFROZEN
1.0	■	142			– gravel content increases slightly and becomes fine to med. grained below 1.6 m	
2.0						
3.0	■	143				
4.0	■	144				
5.0						PERMAFROST
6.0	■	145				–0.09 degree C. Nf
7.0	■	146			– very hard drilling and grinding below 7.7 m	
8.0					END OF BOREHOLE 7.9 m (REFUSAL) – very little slough – no water table encountered NOTE: Mine Coordinates N 10932.00 E 6560.00	
9.0						
10.0						



EBA Engineering Consultants Ltd.
Whitehorse, Yukon

LOGGED BY: JSB	COMPLETION DEPTH: *.*
REVIEWED BY: CRH	COMPLETE: 97/09/14
Fig. No:	Page 1 of 1

98/02/17 11:55AM (YUK-PT10)

THE MINTO PROJECT	CLIENT: MINTO EXPLORATIONS LTD	BOREHOLE NO: 97-G24
GEOTECHNICAL EVAL. - WASTE DUMP AREA	DRILL: CME-75 c/w SOLID SHAFT AUGERS	PROJECT NO: 0201-97-11509
MINTO CREEK, YUKON	UTM ZONE: - N - E -	ELEVATION: 2752.8'

SAMPLE TYPE ■ GRAB SAMPLE ▨ NO RECOVERY ☒ STANDARD PEN. ☰ 75 mm SPOON ▥ CRREL BARREL

BACKFILL TYPE ■ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▨ DRILL CUTTINGS ⁘ SAND

SOIL DESCRIPTION

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL
0.0	■	147			
1.0	■	148			
2.5	■	149			
4.2	■	150			
5.6	■	151			
7.2	■	152			

MOSS AND ROOT MAT

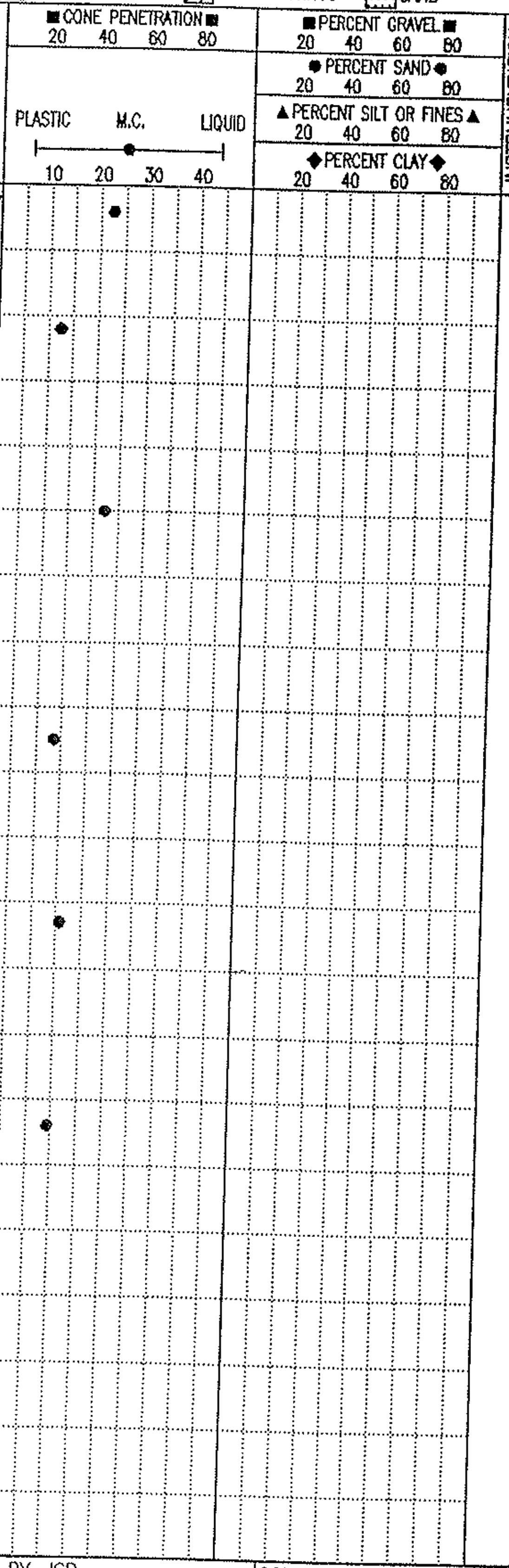
SILT - sandy, trace of gravel, well graded sand, fine grained sub-rounded gravel, moist, soft, dark olive brown

SAND & SILT - trace of gravel, well graded sand, fine grained sub-rounded gravel, soft, moist, brownish grey

- trace of clay below 1.5 m
- becomes sandy, silt, trace of clay, trace fine grained gravel below 2.0 m
- clay content decreases below 2.8m
- gravel becomes well graded below 2.8 m
- hard drilling, some grinding below 3.9 m

END OF BOREHOLE 7.6 m (REFUSAL)
- no water table encountered
- some minor sloughing

NOTE: Mine Coordinates N 9948.00
E 8483.00



INSTRUMENTATION DATA

DEPTH(ft): 0.0, 2.0, 4.0, 6.0, 8.0, 10.0, 12.0, 14.0, 16.0, 18.0, 20.0, 22.0, 24.0, 26.0, 28.0, 30.0, 32.0, 34.0

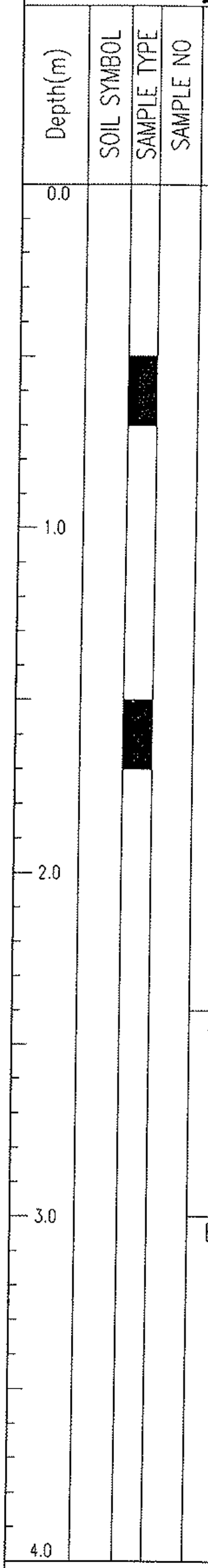
DEPTH(m): 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: JSB	COMPLETION DEPTH: *.*
	REVIEWED BY: CRH	COMPLETE: 97/09/14
	Fig. No:	Page 1 of 1

98/01/14 10:23AM (YUKON-10)

Minto Mine Development 2005	Client: Sherwood Mining Corp.	TEST PIT NO: 1200173-TP100
Minto Copper Mine	Excavator: CAT 416 C Rubber Tire	PROJECT NO: 1200173
Proposed Overburden Dump	6944700 N, 383473.6 E, Z 8	ELEVATION: 0 m

SAMPLE TYPE ▨ GRAB



SOIL DESCRIPTION

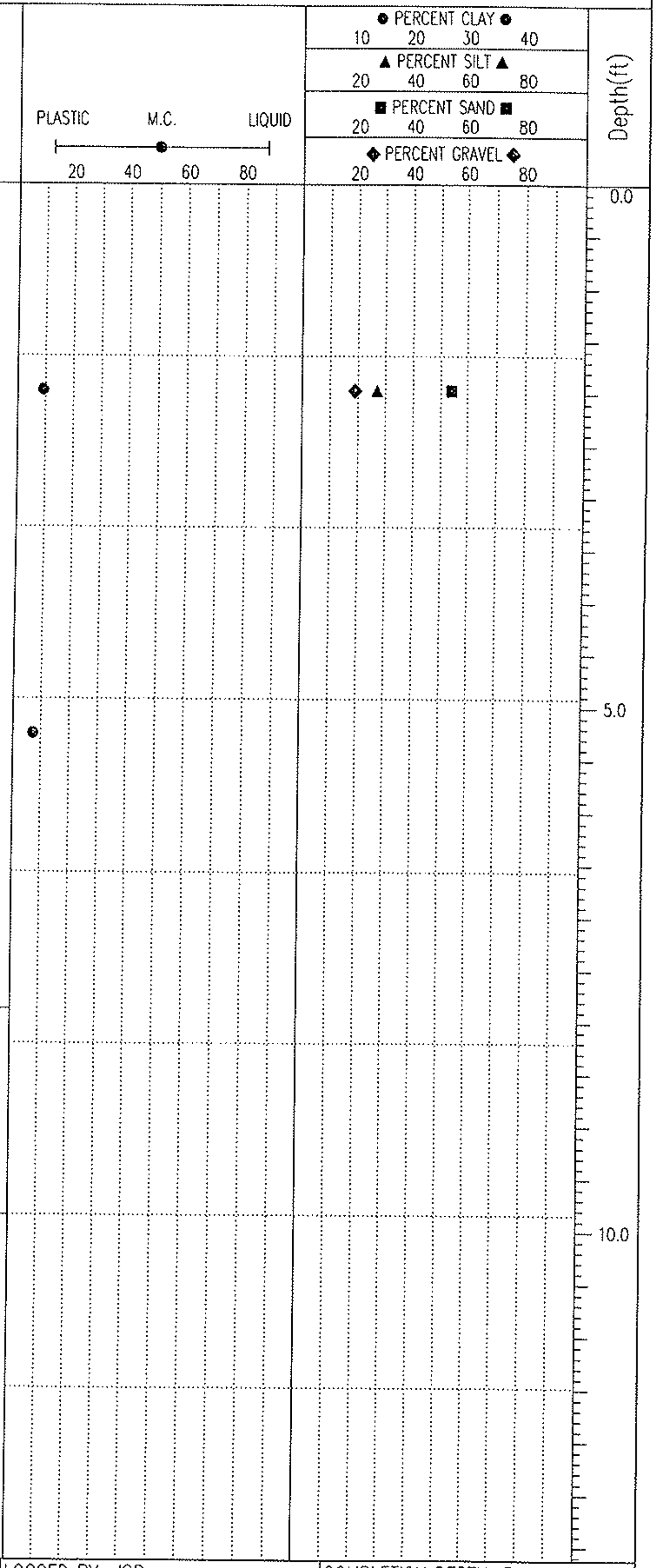
SAND (RESIDIUUM) – silty, trace of gravel

- becomes some gravel, fine to medium grained, angular 0.5 m
- trace to some silt below 1.0 m

BEDROCK (GRANITE) – poor quality, friable

- becomes more competent with depth

END OF TESTPIT 3.0 m (REFUSAL)

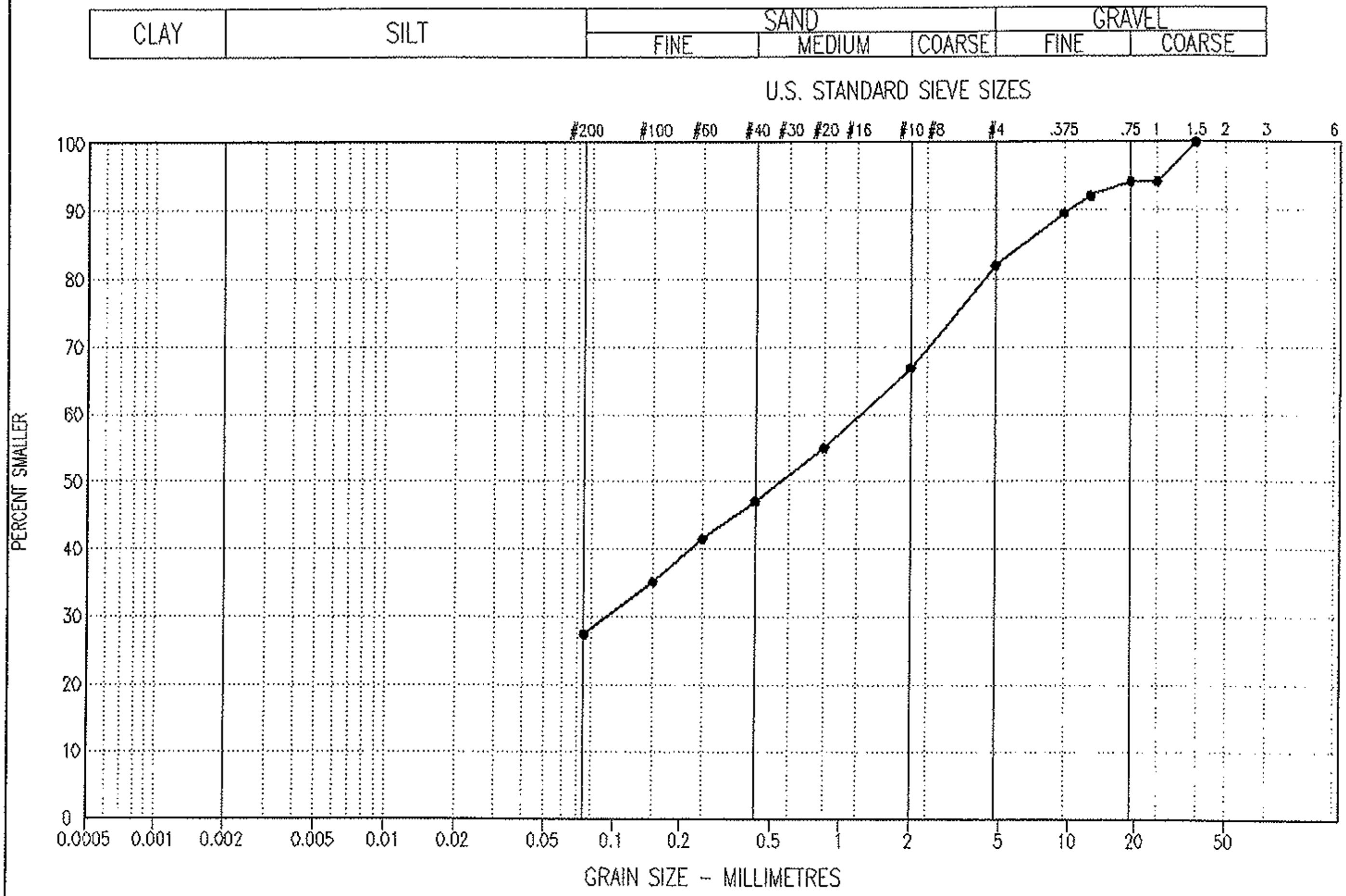


EBA Engineering Consultants Ltd.	LOGGED BY: JSB	COMPLETION DEPTH: 3 m
	REVIEWED BY: JRT	COMPLETE: 05/10/16
	Fig. No:	Page 1 of 1

05/11/28 02:57PM (YUK-TP4)

EBA Engineering

PARTICLE SIZE – ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C
			CLAY %	SILT %	SAND %	GRAVEL %			
●——●	1200173-100	0.50 – 0.70	--- 27 ---		54	19	–	–	

Project: 0201-1200173

Date Tested: 05/11/02

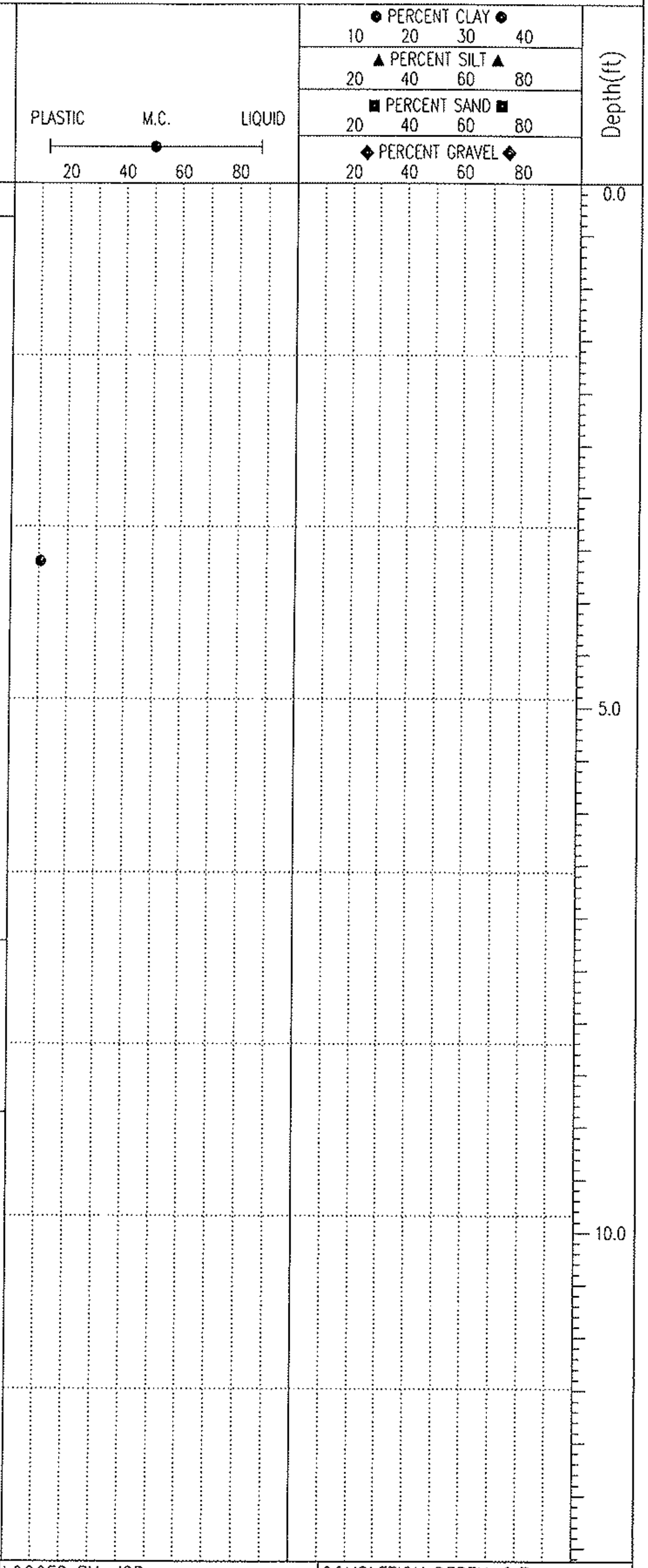
BY: JP

Tested in accordance with ASTM D422 unless otherwise noted.

Minto Mine Development 2005	Client: Sherwood Mining Corp.	TEST PIT NO: 1200173-TP101
Minto Copper Mine	Excavator: CAT 416C Rubber Tire	PROJECT NO: 1200173
Proposed Overburden Dump	6944709 N, 383553.1 E, Z 8	ELEVATION: 0 m

SAMPLE TYPE ■ GRAB

Depth(m)	SOIL SYMBOL	SAMPLE TYPE	SAMPLE NO	SOIL DESCRIPTION
0.0				ORGANIC ROOT MAT
				SAND (RESIDIUUM) – silty, trace of gravel
				– trace to some silt below 0.3 m
1.0		■		
				– coarser gravels, some cobbles present below 1.8 m
2.0				
				BEDROCK (GRANITE) – poor quality, friable
				– more competent with depth
				END OF TESTPIT 2.7 m (REFUSAL)
3.0				
4.0				



EBA Engineering Consultants Ltd.

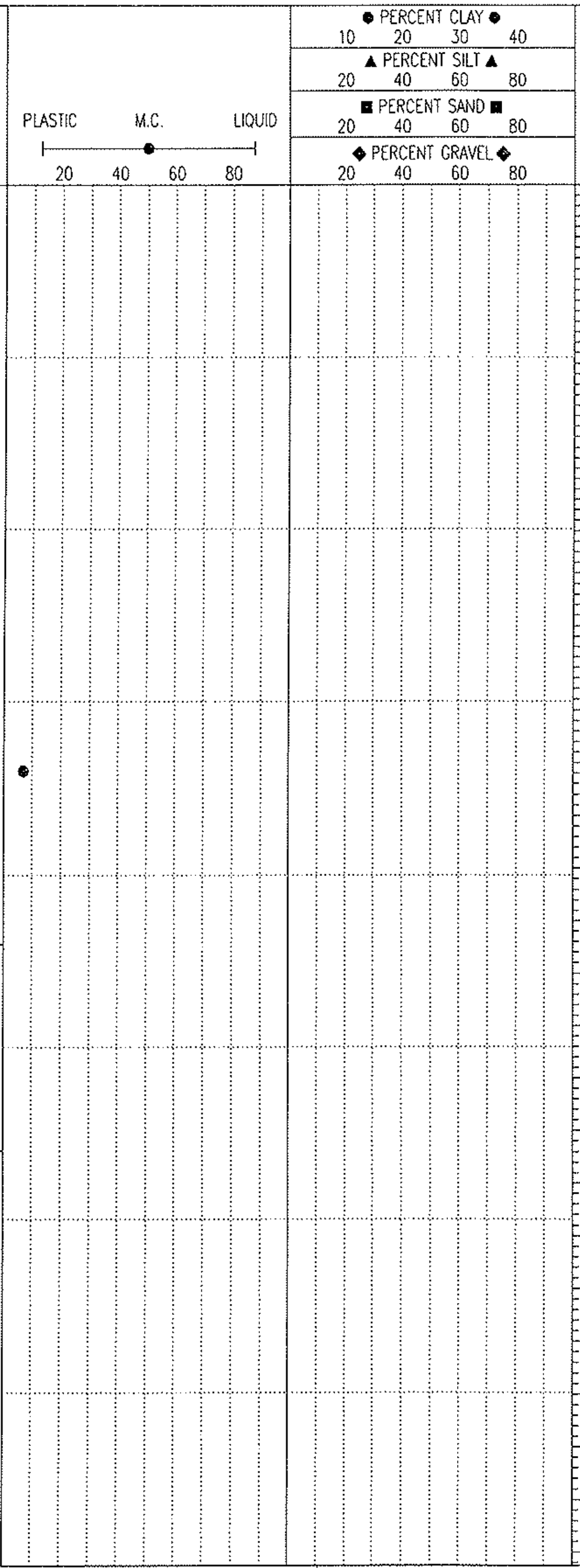
LOGGED BY: JSB	COMPLETION DEPTH: 2.7 m
REVIEWED BY: JRT	COMPLETE: 05/10/16
Fig. No:	Page 1 of 1

05/11/28 02:57PM (YUK-TP4)

Minto Mine Development 2005	Client: Sherwood Mining Corp.	TEST PIT NO: 1200173-TP102
Minto Copper Mine	Excavator: CAT 416C Rubber Tire	PROJECT NO: 1200173
NW of Minto, YT	6944697 N, 383635.9 E, Z 8	ELEVATION: 0 m

SAMPLE TYPE ■ GRAB

Depth(m)	SOIL SYMBOL	SAMPLE TYPE	SAMPLE NO	SOIL DESCRIPTION
0.0				SAND (RESIDIUUM) - silty, trace of gravel - trace to some silt below 0.4 m - some gravel, fine to medium grained, angular to 0.4 m
1.0				
		■		
2.0				
				BEDROCK (GRANITE) - poor quality, friable
				END OF TESTPIT 2.8 m (REFUSAL)
3.0				
4.0				



Depth(ft)
0.0
5.0
10.0

EBA Engineering Consultants Ltd.

LOGGED BY: JSB	COMPLETION DEPTH: 2.8 m
REVIEWED BY: JRT	COMPLETE: 05/10/16
Fig. No:	Page 1 of 1

05/11/28 02:57PM (YUK-TP4)

Minto Mine Development 2005

Minto Copper Mine

Proposed Overburden Dump

Client: Sherwood Mining Corp.

Excavator: CAT 416C Rubber Tire

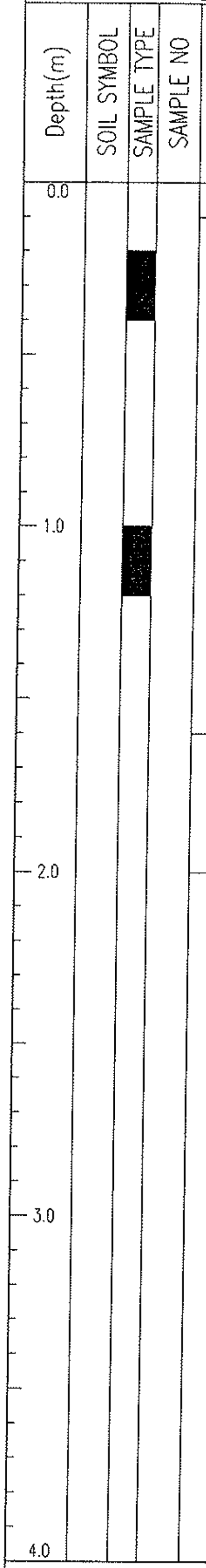
6944651 N, 383701.1 E, Z 8

TEST PIT NO: 1200173-TP103

PROJECT NO: 1200173

ELEVATION: 0 m

SAMPLE TYPE ■ GRAB



SOIL DESCRIPTION

ORGANIC ROOT MAT

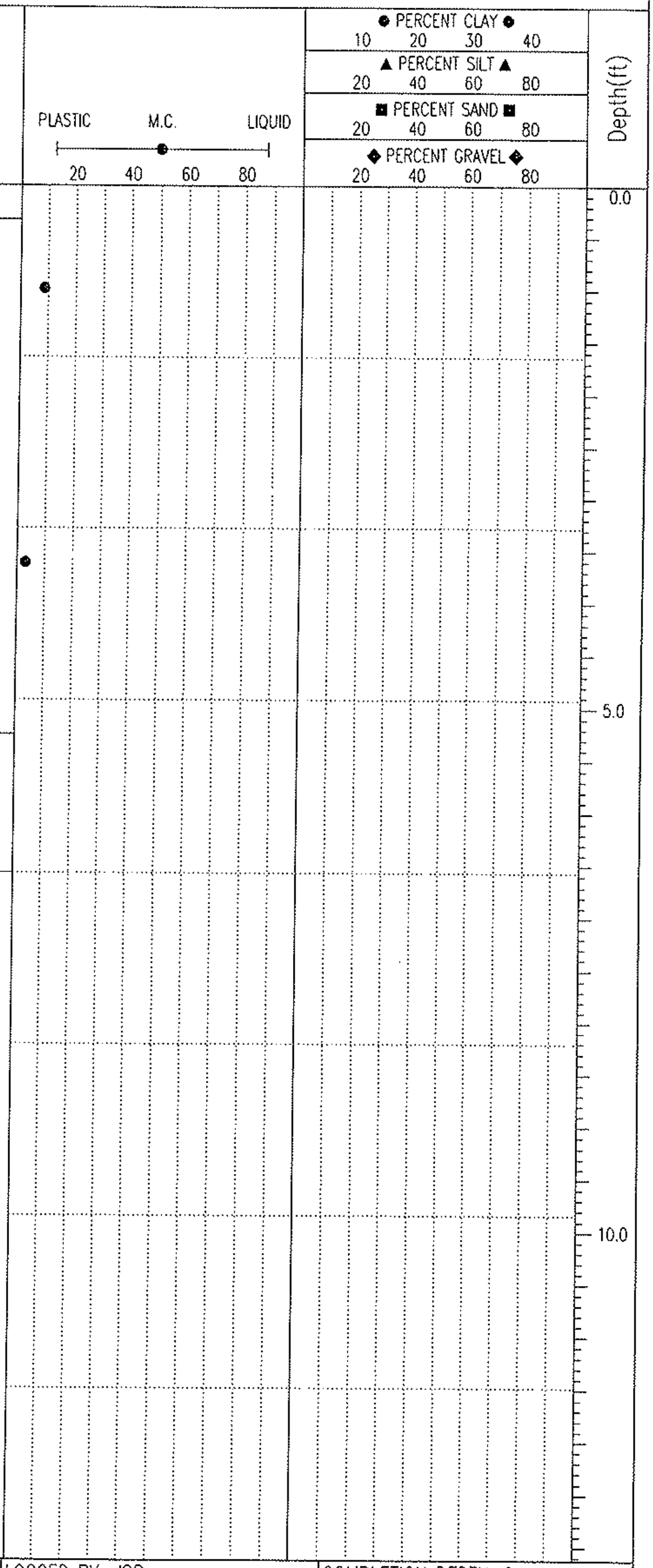
SAND (RESIDIUUM) - silty, trace of gravel

- trace to some silt below 0.4 m
- becomes gravelly, well graded, angular below 0.4 m

- cobbles encountered below 1.0 m
- some boulders present below 1.0 m

BEDROCK (GRANITE) - poor quality, friable around 1.6 m

END OF TESTPIT 2.0 m (REFUSAL)



EBA Engineering Consultants Ltd.

LOGGED BY: JSB

REVIEWED BY: JRT

Fig. No:

COMPLETION DEPTH: 2 m

COMPLETE: 05/10/16

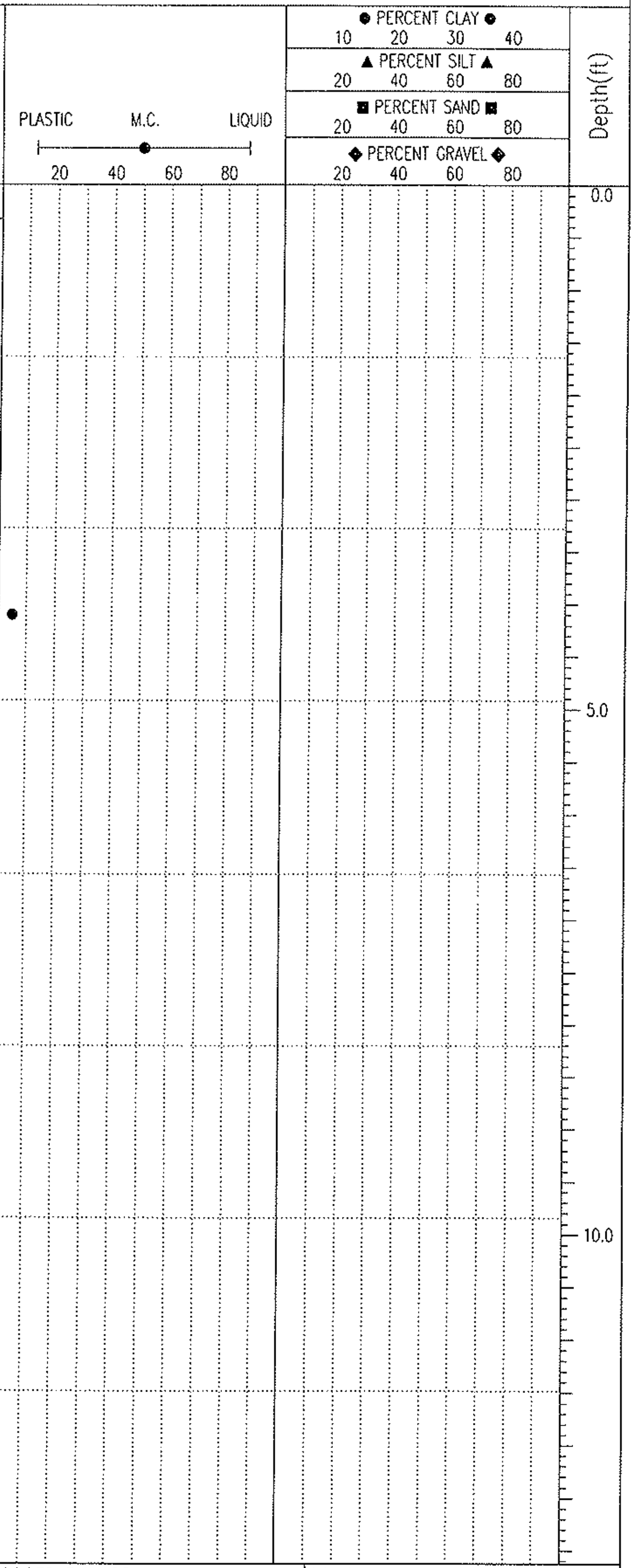
Page 1 of 1

05/11/28 02:57PM (YUK-TP4)

Minto Mine Development 2005	Client: Sherwood Mining Corp.	TEST PIT NO: 1200173-TP104
Minto Copper Mine	Excavator: CAT 416C Rubber Tire	PROJECT NO: 1200173
NW of Minto, YT	6944573 N, 383721.6 E, Z 8	ELEVATION: 0 m

SAMPLE TYPE ■ GRAB

Depth(m)	SOIL SYMBOL	SAMPLE TYPE	SAMPLE NO	SOIL DESCRIPTION
0.0				ORGANIC ROOT MAT
				SAND (RESIDIUUM) – silty, trace of gravel, well graded sand, fine to medium grained angular gravel, compact, damp, reddish brown – trace to some silt below 0.4 m – becomes gravelly, well graded, angular below 0.4 m – cobbles below 0.7 m
1.0				
		■		
2.0				
				BEDROCK (GRANITE) – poor quality, friable – more competent with depth
3.0				
				END OF TESTPIT 3.1 m (REFUSAL)
4.0				



EBA Engineering Consultants Ltd.

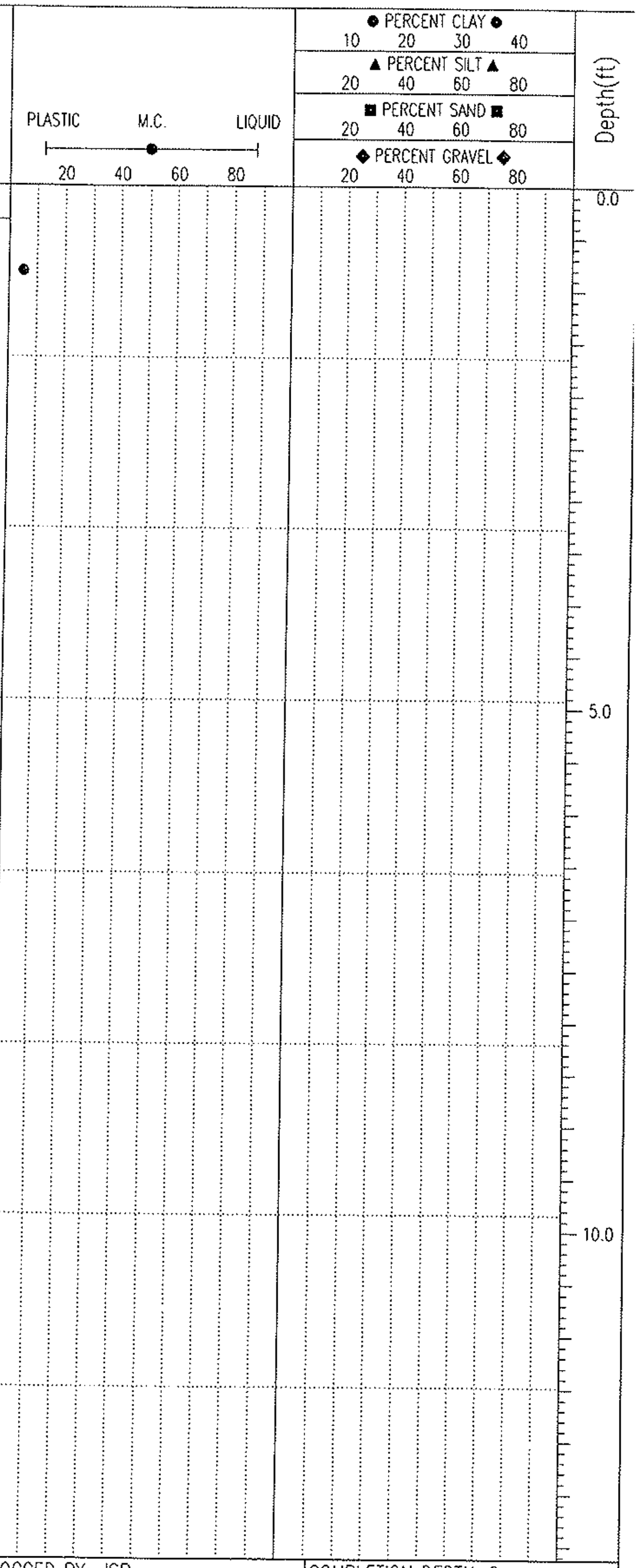
LOGGED BY: JSB	COMPLETION DEPTH: 3.1 m
REVIEWED BY: JRT	COMPLETE: 05/10/16
Fig. No:	Page 1 of 1

05/11/28 02:57PM (YUK-TP4)

Minto Mine Development 2005	Client: Sherwood Mining Corp.	TEST PIT NO: 1200173-TP105
Minto Copper Mine	Excavator: CAT 416C Rubber Tire	PROJECT NO: 1200173
NW of Minto, YT	6944494 N, 383705.1 E, Z 8	ELEVATION: 0 m

SAMPLE TYPE ■ GRAB

Depth(m)	SOIL SYMBOL	SAMPLE TYPE	SAMPLE NO	SOIL DESCRIPTION
0.0				ORGANIC ROOT MAT
		■		SAND (RESIDIUUM) - trace to some gravel, well graded sand, fine angular gravel, compact, damp, medium grey - trace to some silt below 0.4 m - becomes gravelly, well graded, angular below 0.4 m - cobbles encountered below 0.6 m
1.0				BEDROCK (GRANITE) - poor quality, friable
2.0				END OF TESTPIT 2.0 m (REFUSAL)
3.0				
4.0				



EBA Engineering Consultants Ltd.

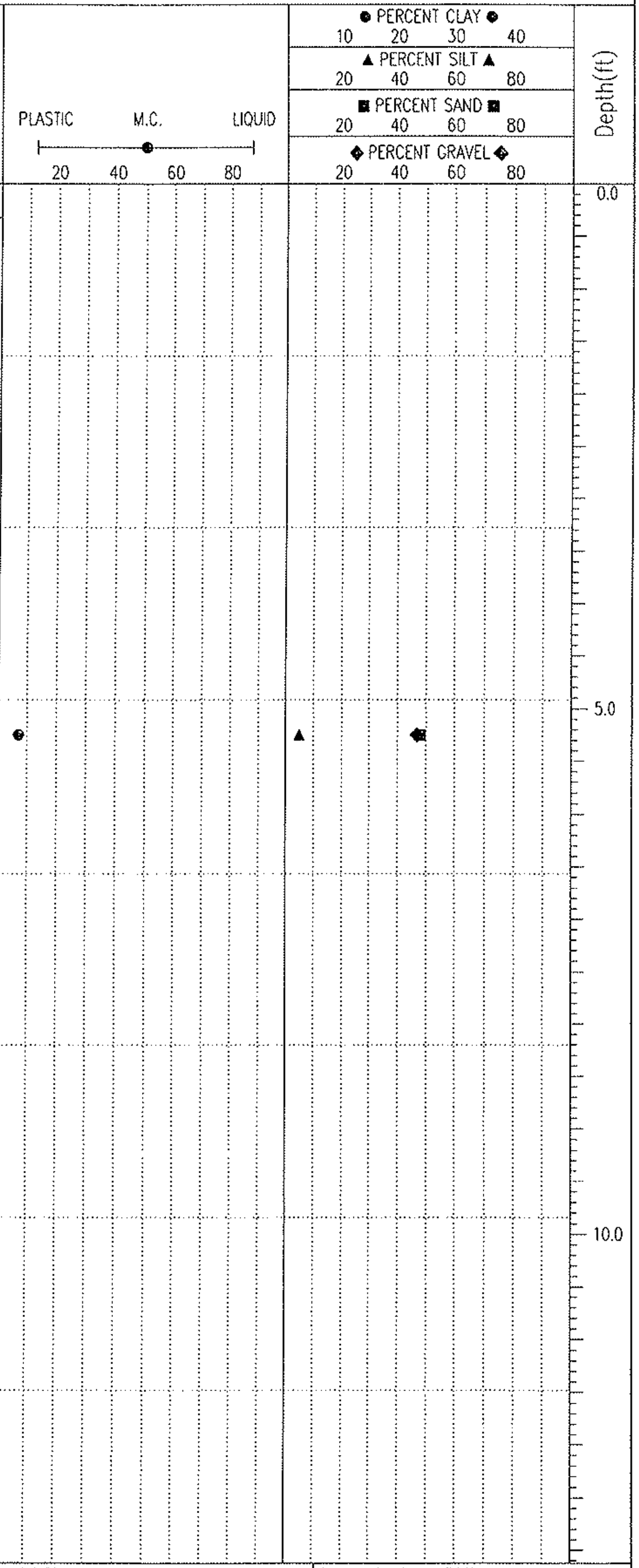
LOGGED BY: JSB	COMPLETION DEPTH: 2 m
REVIEWED BY: JRT	COMPLETE: 05/10/16
Fig. No:	Page 1 of 1

05/11/28 02:57PM (YUK-TP4)

Minto Mine Development 2005	Client: Sherwood Mining Corp.	TEST PIT NO: 1200173-TP106
Minto Copper Mine	Excovotor: CAT 416C Rubber Tire	PROJECT NO: 1200173
Proposed Overburden Dump	6944439 N, 383645 E, Z 8	ELEVATION: 0 m

SAMPLE TYPE ■ GRAB

Depth(m)	SOIL SYMBOL	SAMPLE TYPE	SAMPLE NO	SOIL DESCRIPTION
0.0				ORGANIC ROOTMAT
				SAND (RESIDIUUM) – silty, trace of gravel – trace to some silt below 0.5 m below 0.5 m – becomes gravelly, well graded, angular
1.0				– gravel content increases with depth around 1.0 m
		■		– cobble sized pieces encountered around 1.5 m
				BEDROCK (GRANITE) – poor quality, friable
2.0				
				END OF TESTPIT 2.7 m (REFUSAL)
3.0				
4.0				



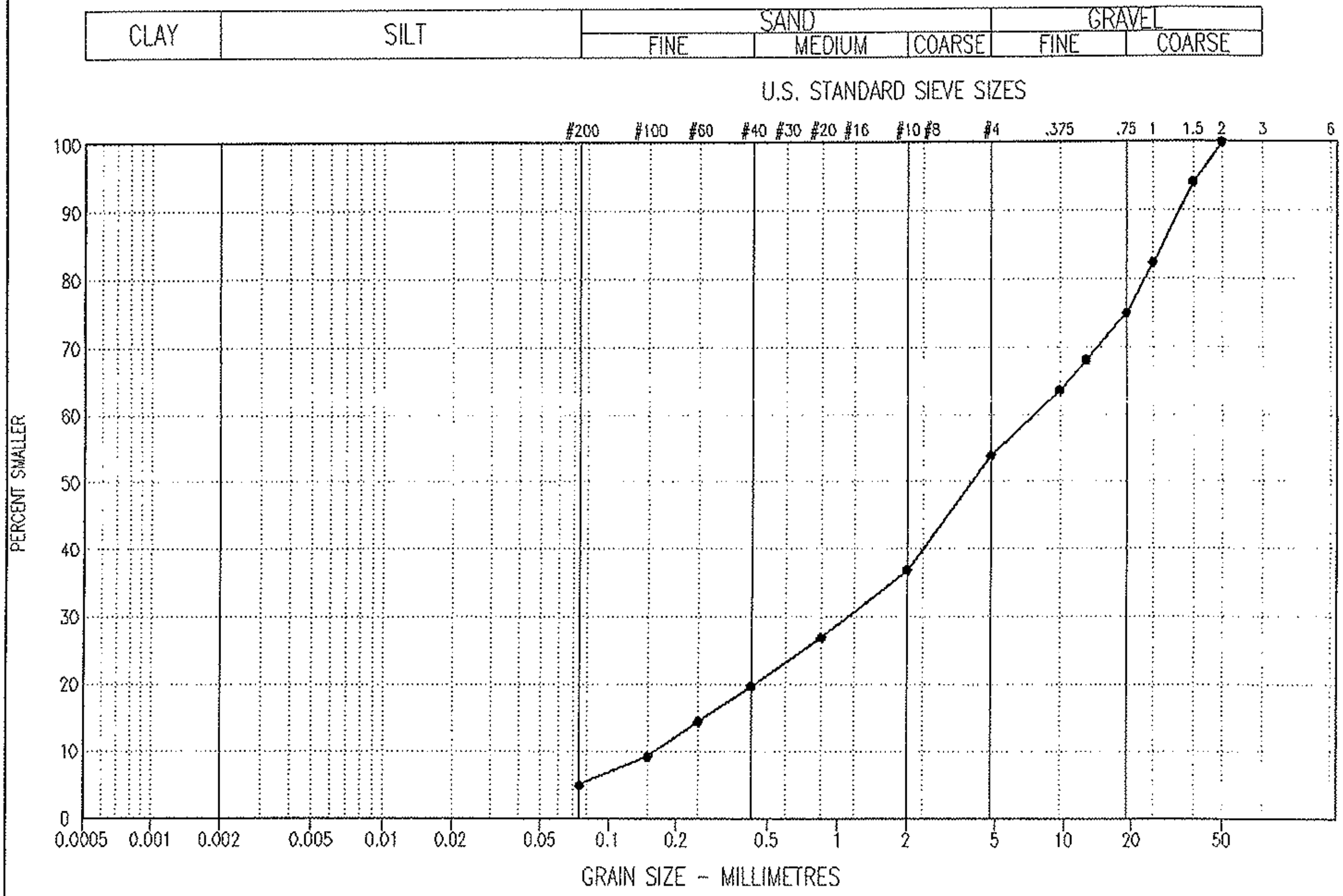
EBA Engineering Consultants Ltd.

LOGGED BY: JSB	COMPLETION DEPTH: 2.7 m
REVIEWED BY: JRT	COMPLETE: 05/10/16
Fig. No:	Page 1 of 1

05/11/28 02:57PM (YUK-TP4)

EBA Engineering

PARTICLE SIZE - ANALYSIS OF SOILS



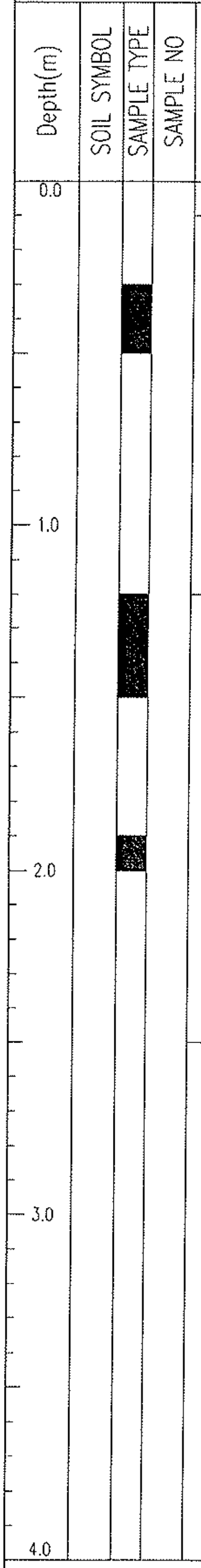
SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C
			CLAY %	SILT %	SAND %	GRAVEL %			
●——●	1200173-106	1.50 - 1.70	---	5 ---	48	47	46.7	1.1	SW

Project: 0201-1200173 Date Tested: 11/02/05 BY: JP

Tested in accordance with ASTM D422 unless otherwise noted.

Minto Mine Development 2005	Client: Sherwood Mining Corp.	TEST PIT NO: 1200173-TP107
Minto Copper Mine	Excavator: CAT 416C Rubber Tire	PROJECT NO: 1200173
Proposed Overburden Dump	6944403 N, 383570 E, Z 8	ELEVATION: 0 m

SAMPLE TYPE ■ GRAB



SOIL DESCRIPTION

ORGANIC ROOTMAT

SAND – silty, gravelly, well graded sand, well graded angular gravels, compact, damp, reddish brown

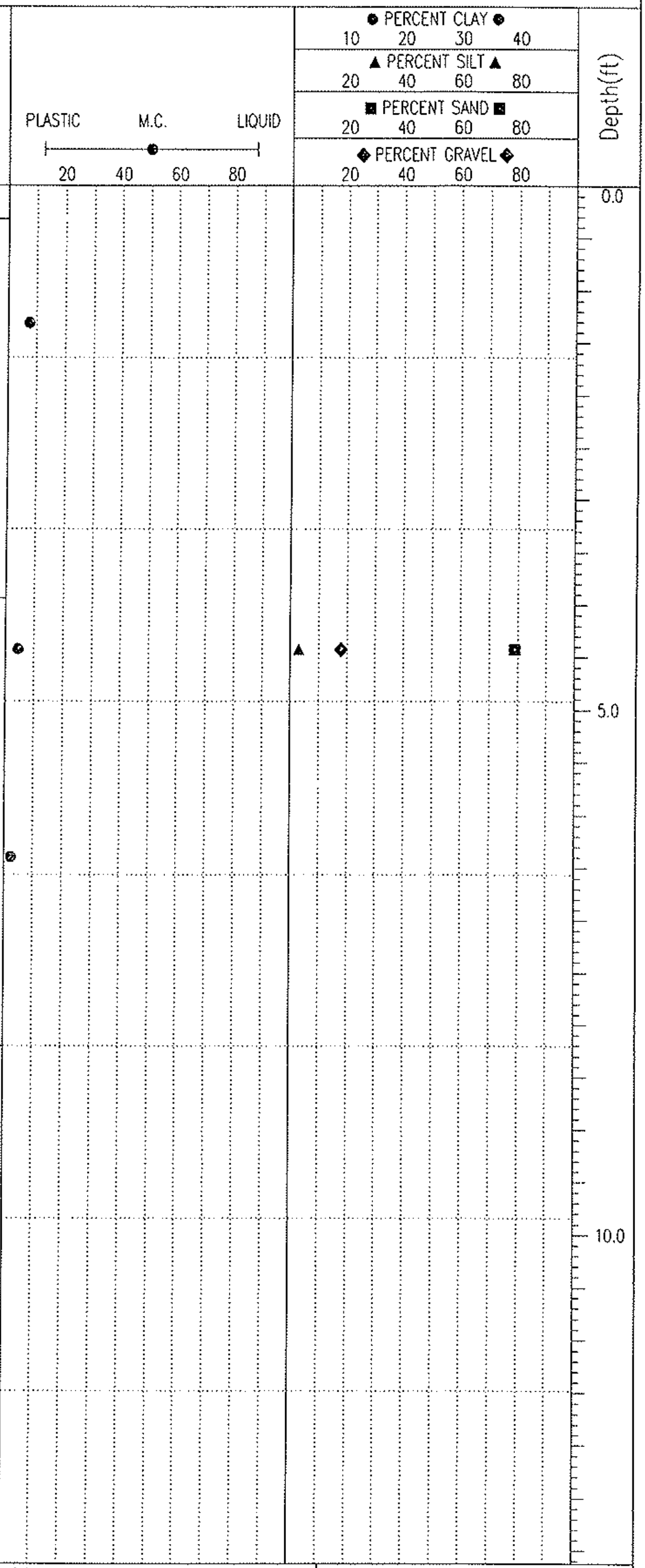
- trace of silt around 0.5 m

- becomes trace to some fine to medium grained angular gravels around 0.7 m

BEDROCK (GRANITE) – poor quality, friable

- becomes more competent with depth

END OF TESTPIT 2.5 m (REFUSAL)



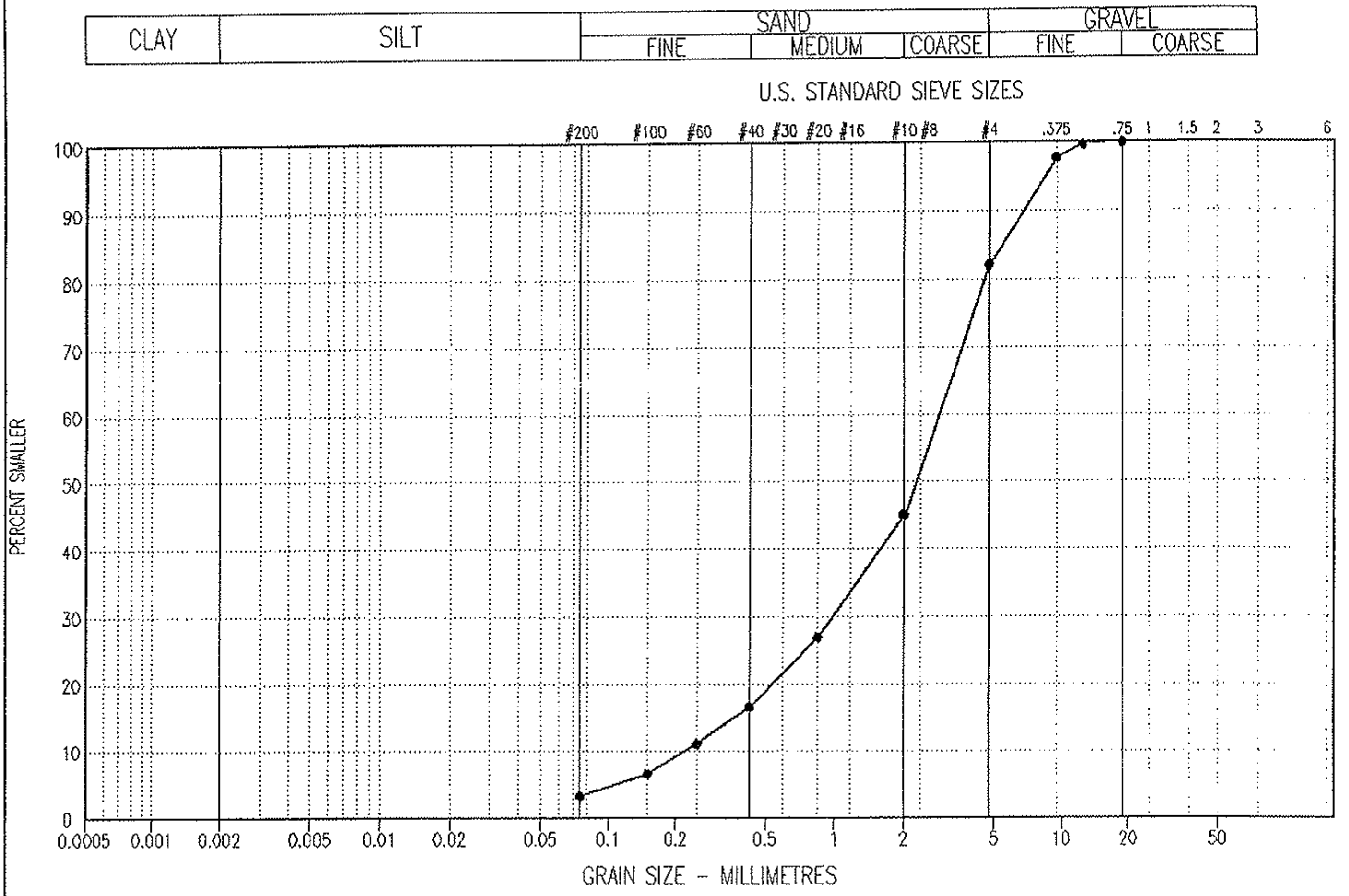
EBA Engineering Consultants Ltd.

LOGGED BY: JSB	COMPLETION DEPTH: 2.5 m
REVIEWED BY: JRT	COMPLETE: 05/10/16
Fig. No:	Page 1 of 1

05/11/28 02:58PM (YUK-TP4)

EBA Engineering

PARTICLE SIZE - ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C
			CLAY %	SILT %	SAND %	GRAVEL %			
●——●	1200173-107	1.20 - 1.50	---	3 ---	79	18	13.6	1.5	SW

Project: 0201-1200173

Date Tested: 11/02/05

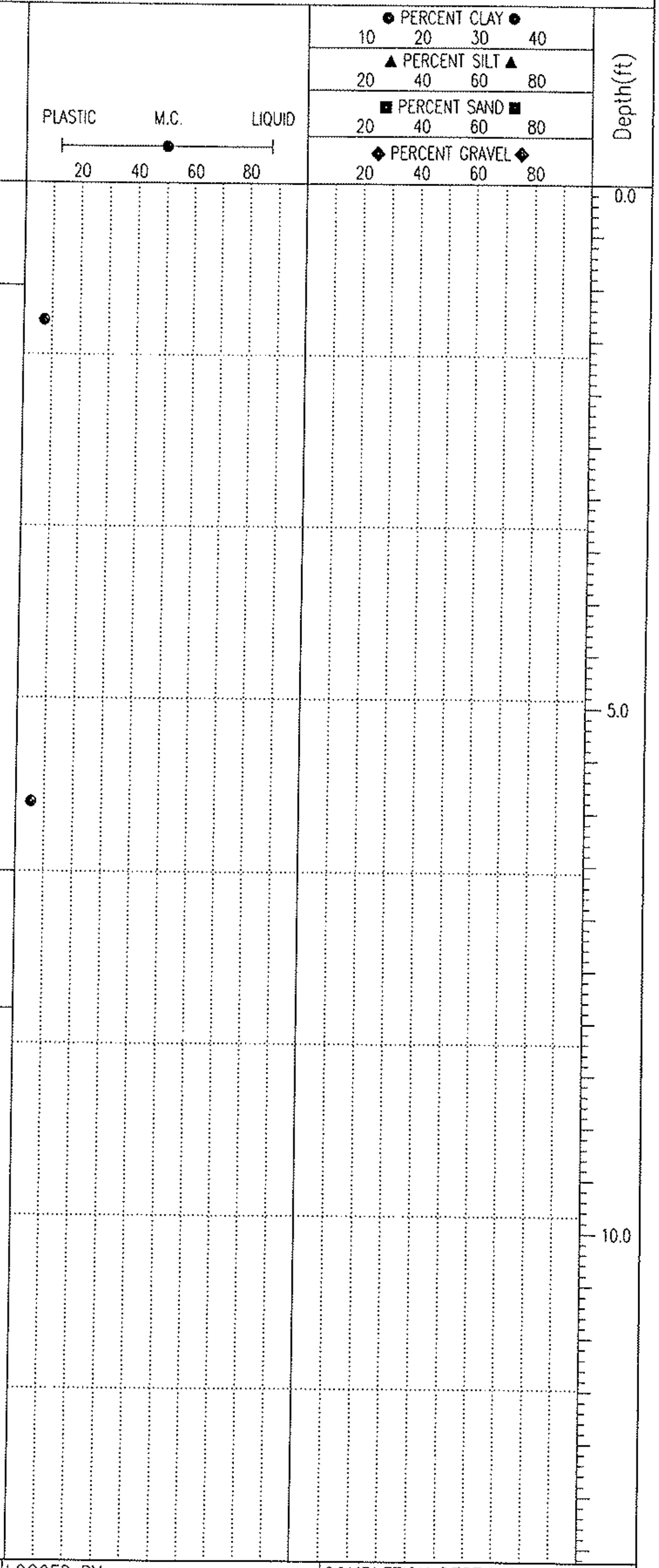
BY: JP

Tested in accordance with ASTM D422 unless otherwise noted.

Minto Mine Development 2005	Client: Sherwood Mining Corp.	TEST PIT NO: 1200173-TP108
Minto Copper Mine	Excavator: CAT 416C Rubber Tire	PROJECT NO: 1200173
Proposed Overburden Dump	6944360 N, ~~6944322~~ 383500 E, Z 8	ELEVATION: 0 m

SAMPLE TYPE ■ GRAB

Depth(m)	SOIL SYMBOL	SAMPLE TYPE	SAMPLE NO	SOIL DESCRIPTION
0.0				ORGANIC ROOT MAT
		■		SAND (RESIDIUUM) – silty, trace of gravel, well graded sand, fine to medium grained angular gravels, reddish brown – trace to some silt below 0.5 m
1.0				– some gravel to gravelly around 1.0 m – 1.5 m
		■		
2.0				BEDROCK (GRANITE) – poor quality, friable below 2.0 m
				END OF TESTPIT 2.4 m (REFUSAL)
3.0				
4.0				



EBA Engineering Consultants Ltd.

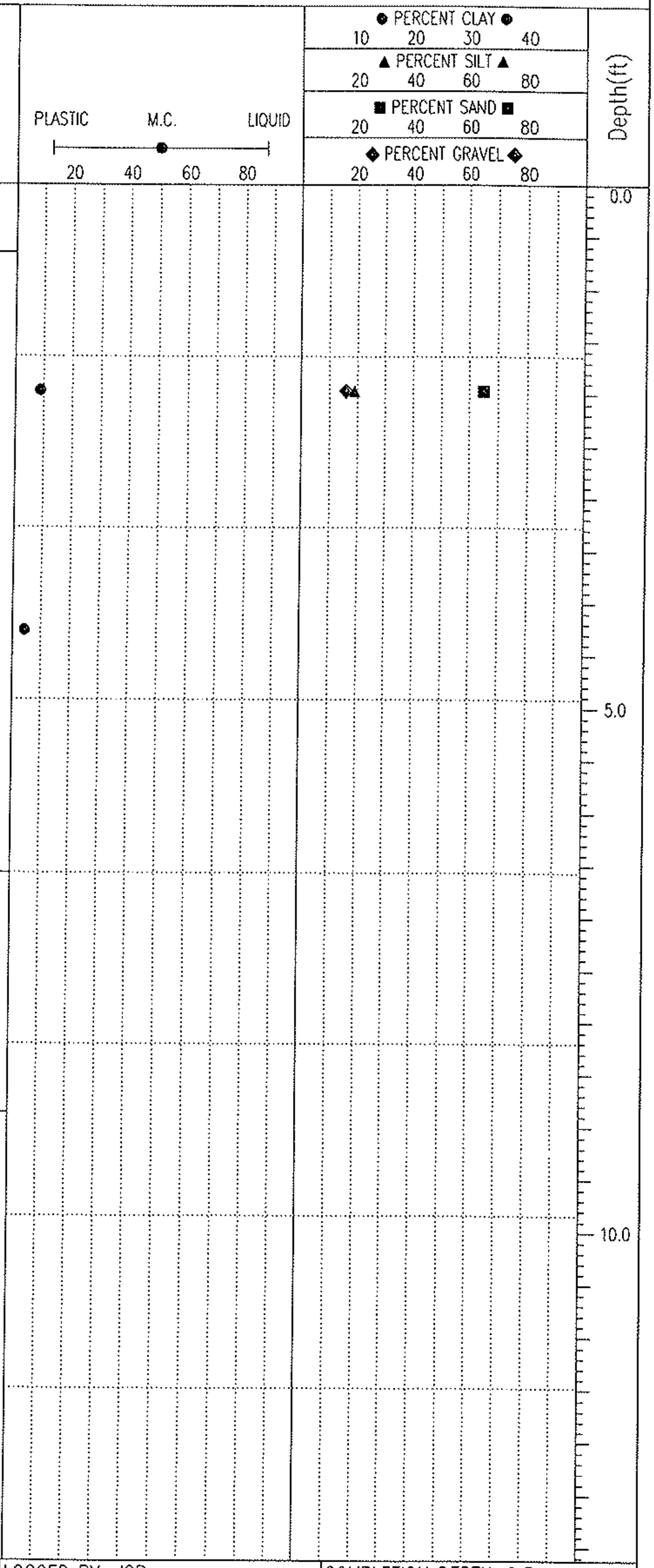
LOGGED BY:	COMPLETION DEPTH: 2 m
REVIEWED BY:	COMPLETE: 05/10/16
Fig. No:	Page 1 of 1

05/11/28 02:58PM (YUK-TP4)

Minto Mine Development 2005	Client: Sherwood Mining Corp.	TEST PIT NO: 1200173-TP109
Minto Copper Mine	Excavator: CAT 416C Rubber Tire	PROJECT NO: 1200173
Proposed Overburden Dump	6944322 N, 383427.8 E, Z 8	ELEVATION: 0 m

SAMPLE TYPE ■ GRAB

Depth(m)	SOIL SYMBOL	SAMPLE TYPE	SAMPLE NO	SOIL DESCRIPTION
0.0				ORGANIC ROOT MAT
				SAND (RESIDUUM) - silty, trace to some fine gravel, well graded sand, reddish brown
		■		- less silt with depth around 0.5 m
1.0				
		■		- becomes gravelly, coarser grained around 1.2 m
2.0				BEDROCK (GRANITE) - HIGHLY FRACTURED - cobble sized pieces, coarser with depth
				END OF TESTPIT 2.7 m (REFUSAL)
3.0				
4.0				

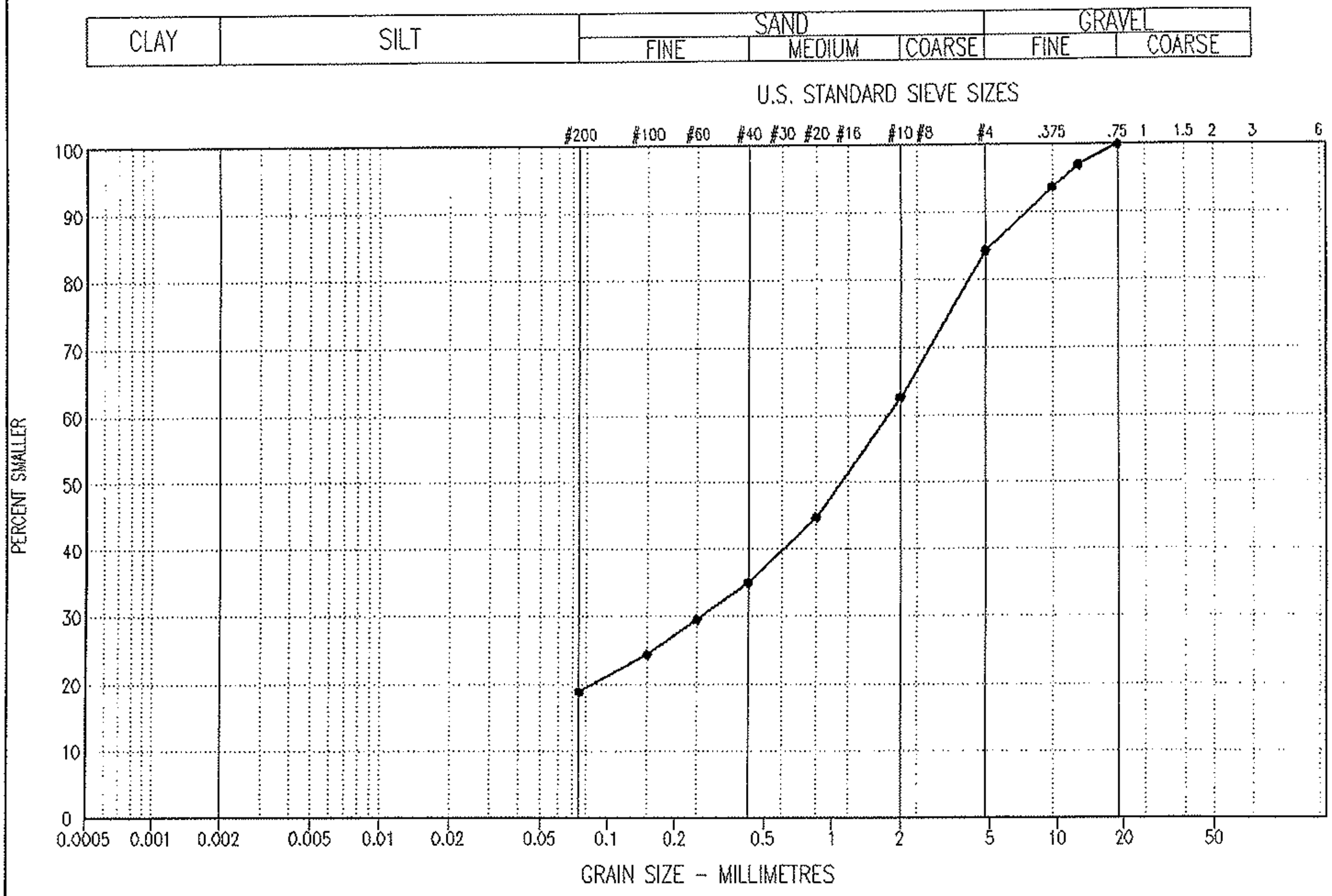


EBA Engineering Consultants Ltd.

LOGGED BY: JSB	COMPLETION DEPTH: 2.7 m
REVIEWED BY: JRT	COMPLETE: 05/10/16
Fig. No:	Page 1 of 1

05/11/28 02:58PM (YUK-TP4)

PARTICLE SIZE - ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C
			CLAY %	SILT %	SAND %	GRAVEL %			
●—●	1200173-109	0.50 - 0.70	--- 19 ---		65	16	-	-	

Project: 0201-1200173 Date Tested: 05/11/02 BY: JP

Tested in accordance with ASTM D422 unless otherwise noted.

SRK Consulting
Engineers and Scientists

BORING LOG

PROJECT : Minto Overburden Drilling Program 2008
SITE : Minto Mine Yukon Canada
FILE NO : MINTO (2CM022 003)
BORING DATE : 2008-02-27 TO 2008-03-06
DATUM : NAD83 Zone 8V
COORDINATES : 6944333 00 N 384181 00 E

BOREHOLE : *08SWC270*
PAGE : 1 OF 1
DRILL : Air Rotary
CORE BARREL : Triple tube (HQ)

SAMPLE CONDITION	TYPE OF SAMPLER	LABORATORY AND IN SITU TEST
▨ Remoulded	SS Split spoon	PS Particle size analysis
☐ Undisturbed	ST Thin walled shelby tube	w Water content
Lost	PS Piston sampler	D Unit weight (kN/m³)
■ Soil core	CT Core tube sample	k Permeability (cm/s)

Torvane (Su) : intact
(Sur) ◆ remoulded
Ground Temperature

STRATIGRAPHY

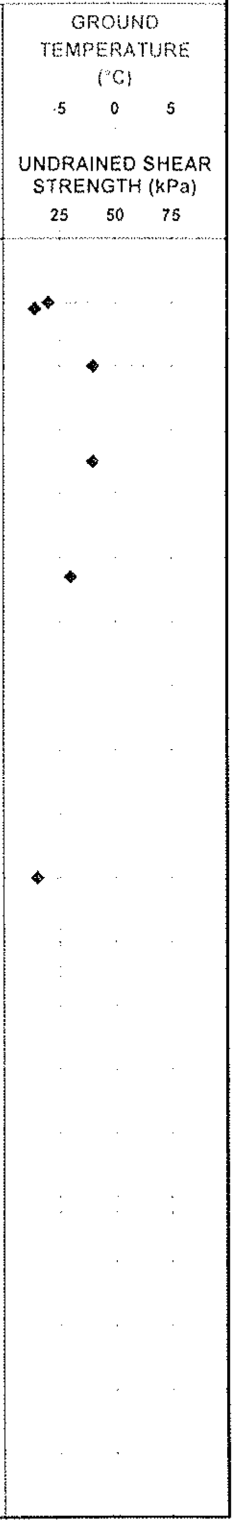
ELEVATION - m DEPTH - m	DESCRIPTION
865 40 0 00	dark brown, damp stiff, organic sandy SILT with gravel topsoil non-plastic
863 88 1 52	brown, damp, very stiff sandy SILT with gravel and weathered bedrock, non-plastic
862 35 3 05	brown, moist, soft to moderetley stiff sandy SILT with weathered bedrock particles non-plastic
860 83 4 57	gray saturated stiff, sandy SILT with gravel non-plastic
859 30 6 10	gray saturated very soft sandy SILT non-plastic with a 2" thick weathered granite cobble
857 78 7 62	brown saturated very soft sandy SILT with gravel, non plastic, with some cobbles
856 26 9 14	brown moist soft, loose silty SAND with gravel non-plastic
854 73 10 67	bedrock (switched to NQ)
853 21 12 19	bedrock
850 16 15 24	END OF LOGGING at 15 24m (Borehole depth = 359 66m)

WATER LEVEL - m: *Frozen 0.12m below ground surface*

SAMPLES

TYPE AND NUMBER	CONDITION	RECOVERY %	N or RQD	LABORATORY and IN SITU TESTS
CT-1	■	9	*0*	
CT-2	■	16	*0*	
CT-3	■	25	*0*	w = 17 8% PS (42 5% < 0 08mm)
CT-4	■	33	*0*	
CT-5	■	42	*0*	
CT-6	■	50	*0*	
CT-7	■	58	*0*	PS (7 5% < 0 08mm) w = 17 1%
CT-8	■	100	*0*	
CT-9	■	100	*0*	
CT-10	■	100	*0*	

WATER CONTENT and LIMITS (%)
W_P W W_L
20 40 60 80



SRK Consulting
Engineers and Scientists

BORING LOG

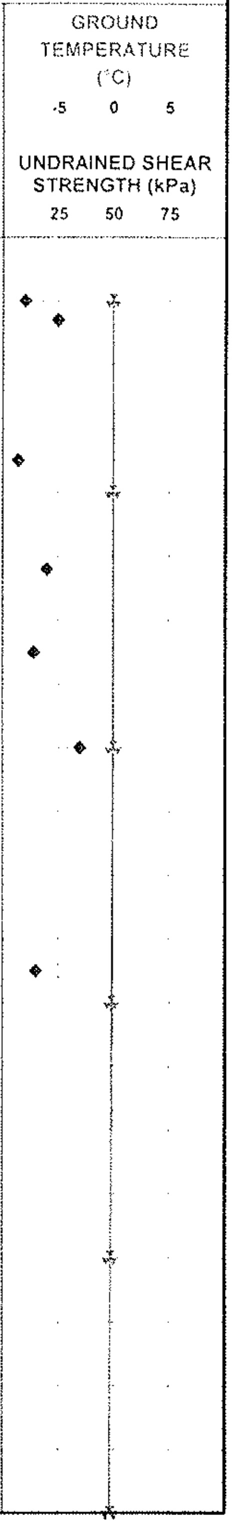
PROJECT : Minto Overburden Drilling Program 2008
SITE : Minto Mine Yukon Canada
FILE NO : MINTO (2CM022 003)
BORING DATE : 2008-03-06 TO 2008-03-10
DATUM : NAD83 Zone 8V
COORDINATES : 6944455.00 N 383901 00 E

BOREHOLE : *08SWC271*
PAGE : 1 OF 3
DRILL : Air Rotary
CORE BARREL : Triple tube (HQ)

SAMPLE CONDITION		TYPE OF SAMPLER		LABORATORY AND IN SITU TEST	
▨	Remoulded	SS	Split spoon	PS	Particle size analysis
▨	Undisturbed	ST	Thin walled shelby tube	w	Water content
	Lost	PS	Piston sampler	D	Unit weight (kN/m³)
■	Soil core	CT	Core tube sample	k	Permeability (cm/s)

Torvane (Su) intact
(Sur) ◆ remoulded
Ground Temperature ✣———✣

DEPTH - m	ELEVATION - m DEPTH - m	DESCRIPTION	SYMBOL	WATER LEVEL - m	TYPE AND NUMBER	CONDITION	RECOVERY %	N or RQD	WATER CONTENT and LIMITS (%) Wp W WL 20 40 60 80	LABORATORY and IN SITU TESTS
	849 20									
	0 00	very dark brown saturated soft organic sandy SILT non-plastic (topsoil)		frozen from top of pipe	CT-1	■	97			PS (83 0% < 0 08mm) w = 121%
1	848 01 1 19	very dark gray moist dense silty SAND with gravel non-plastic								
2	847 68 1 52	very dark gray moist, stiff silty SAND with gravel, non-plastic			CT-2	■	6			
	847 58 1 62	Not Recovered								
3	846 15 3 05	very dark gray staurated soft clayey SILT low-plasticity			CT-3	■	94			
4	845 09 4 11	dark gray moist loose silty SAND with sub-angular gravel non-plastic								
5	844 63 4 57	very dark gray saturated firm clayey SILT with sub-angular gravel low plasticity			CT-4	■	88			PS (38 0% < 0 08mm) w = 10 1%
	844 23 4 97	drak brown saturated soft clayey SILT with sub-angular gravel low plasticity								
6	843 10 6 10	very dark gray moist soft sandy SILT with sub-angular gravel and cobbles non-plastic with an 8' rock core								
7	842 22 6 98	dark brown saturated soft clayey SILT with sub-angular gravel and cobbles low plasticity			CT 5	■	100			
8					CT 6	■	92			
9										
10					CT-7	■	92			
11	838 53 10 67	dark brown, moist to saturated soft clayey SILT with sub-angular gravel and cobbles low plasticity			CT-8	■	96			
12										
13					CT-9	■	96			
14	835 48 13 72	Dark grey moist dense silty CLAY with subangular gravel and cobbles			CT-10	■	100			
15	833 96 15 24	Not Recovered								
16					CT-11	■	0			
17	832 44 16 76	Dark grey moist dense silty SAND with traces subangular gravel and clay Very low plasicity Nbn < 5%			CT-12	■	100			
18										
19					CT-13	■	100			
	829 39									



F:\06 REFERENCE MATERIAL\[illegible]\MINTO [illegible] PLOTTED 2008-05-27 11:53AM

SRK Consulting
Engineers and Scientists

BORING LOG

PROJECT : Minto Overburden Drilling Program 2008
SITE : Minto Mine Yukon, Canada
FILE NO : MINTO (2CM022 003)
BORING DATE : 2008-03-06 TO 2008-03-10
DATUM : NAD83 Zone 8V
BOREHOLE : *08SWC271*
PAGE : 2 OF 3
DRILL : Air Rotary
CORE BARREL : Triple tube (HQ)
COORDINATES : 6944455 00 N 383901 00 E

SAMPLE CONDITION	TYPE OF SAMPLER	LABORATORY AND IN SITU TEST	
▨ Remoulded	SS Split spoon	PS Particle size analysis	Torvane (Su) · intact
▨ Undisturbed	ST Thin walled shelby tube	w Water content	(Sur) ◆ remoulded
Lost	PS Piston sampler	D Unit weight (kN/m³)	
■ Soil core	CT Core tube sample	k Permeability (cm/s)	Ground Temperature

DEPTH - m	STRATIGRAPHY ELEVATION - m DEPTH - m	DESCRIPTION	SYMBOL	WATER LEVEL - m	SAMPLES TYPE AND NUMBER	CONDITION	RECOVERY %	N or RQD	WATER CONTENT and LIMITS (%) W_P W W_L 20 40 60 80	LABORATORY and IN SITU TESTS	GROUND TEMPERATURE (°C) -5 0 5 UNDRAINED SHEAR STRENGTH (kPa) 25 50 75
21		Dark grey moist dense clayey SILT with traces of sand and subangular gravel Very low plasicity Nbn <5%			CT-14	■	100				
22					CT-15	■	100				
23	826 34 22 86	Dark grey moist dense clayey SILT with traces of sand and subangular gravel Very low plasicity No ice content observed			CT-16	■	100				
24	824 82 24 38	Dark grey moist dense sandy SILT with clay and subangular gravel Very low plasicity No ice content observed									
25					CT-17	■	100			w = 13% PS (46 5% < 0 08mm)	
26											
27					CT-18	■	100				
28	821 77 27 43	Dark grey moist dense clayey SILT with traces of sand and subangular gravel Low plasicity			CT-19	■	100				
	820 55 28 65	ICE and SOIL 50% clear ice									
29	820 24 28 96	Dark grey moist dense clayey SILT with traces of sand and subangular gravel Low plasicity ICE and SOIL 10% clear ice									
30					CT-20	■	100				
31	818 72 30 48	Dark grey moist dense clayey SILT with traces of sand and subangular gravel Low plasicity			CT-21	■	100				
	817 65 31 55	Dark grey moist dense clayey SILT with traces of sand and subangular gravel									
32	817 20 32 00	Low plasicity Vs 10%									
33	816 89 32 31	Dark grey moist dense clayey SILT with traces of sand and subangular gravel Low plasicity			CT-22	■	100				
34	815 67 33 53	Dark grey moist dense silty CLAY Medium plasicity ICE and SOIL 15% clear ice			CT-23	■	100				
35	814 15 35 05	Dark grey moist dense sandy SILT with clay and subangular gravel Non plasic No ice content observed									
36	813 23 35 97	Grey moist dense SAND and GRAVEL with silt and traces of clay			CT-24	■	100				
37	812 62 36 58	Dark grey moist dense fine SAND with traces gravel and silt No visible ice content			CT-25	■	100				
38	811 10 38 10	Grey moist dense SAND and GRAVEL with silt and traces of silt No visible ice content									
39	810 34 38 86	Grey moist firm SAND and GRAVEL No visible ice content			CT-26	■	100				
	809 58 39 62	Broken Bedrock Bedrock									

F 06 REFERENCE MATERIAL [illegible] MINTO [illegible] 2008 [illegible]

SRK Consulting
Engineers and Scientists

BORING LOG

PROJECT : Minto Overburden Drilling Program 2008
BOREHOLE : *08SWC271*
SITE : Minto Mine Yukon, Canada
PAGE : 3 OF 3
FILE NO : MINTO (2CM022.003)
DRILL : Air Rotary
BORING DATE : 2008-03-06 TO 2008-03-10
CORE BARREL : Triple tube (HQ)
DATUM : NAD83 Zone 8V
COORDINATES : 6944455.00 N 383901.00 E

SAMPLE CONDITION	TYPE OF SAMPLER	LABORATORY AND IN SITU TEST	
Remoulded	SS Split spoon	PS Particle size analysis	Torvane (Su) intact
Undisturbed	ST Thin walled shelby tube	w Water content	(Sur) ◆ remoulded
Lost	PS Piston sampler	D Unit weight (kN/m³)	Ground Temperature
▓ Soil core	CT Core tube sample	k Permeability (cm/s)	

DEPTH - m	STRATIGRAPHY ELEVATION - m DEPTH - m	DESCRIPTION	SYMBOL	WATER LEVEL - m	SAMPLES TYPE AND NUMBER	CONDITION	RECOVERY %	N or RQD	WATER CONTENT and LIMITS (%) W$_P$ W W$_L$ 20 40 60 80	LABORATORY and IN SITU TESTS	GROUND TEMPERATURE (°C) -5 0 5 UNDRAINED SHEAR STRENGTH (kPa) 25 50 75
					CT-27	▓	100				
41	808.05 41.15	END OF LOGGING at 41.15m (Borehole Depth = 242.30m)									
42											
43											
44											
45											
46											
47											
48											
49											
50											
51											
52											
53											
54											
55											
56											
57											
58											
59											

SRK Consulting
Engineers and Scientists

BORING LOG

PROJECT : Minto Overburden Drilling Program 2008
SITE : Minto Mine Yukon, Canada
FILE NO : MINTO (2CM022 003)
BORING DATE : 2008-03-10 TO 2008-03-14
DATUM : NAD83 Zone 8V
BOREHOLE : *08SWC272*
PAGE : 1 OF 3
DRILL : Air Rotary
CORE BARREL : Triple tube (HQ)
COORDINATES : 6944730 00 N 383681 00 E

SAMPLE CONDITION	TYPE OF SAMPLER	LABORATORY AND IN SITU TEST	
Remoulded	SS Split spoon	PS Particle size analysis	Torvane (Su) · intact
Undisturbed	ST Thin walled shelby tube	w Water content	(Sur) ◆ remoulded
Lost	PS Piston sampler	D Unit weight (kN/m³)	
■ Soil core	CT Core tube sample	k Permeability (cm/s)	Ground Temperature

STRATIGRAPHY

DEPTH - m	ELEVATION - m DEPTH - m	DESCRIPTION
	849 90	
	0 00	very dark brown saturated soft, organic
	849 72	sandy SILT non-plastic (topsoil)
	0 18	brownish red saturated.soft. silty SAND
1	849 66	non-plastic
	0.24	
	849 35	dark drown to black, saturated soft
	0 55	organic sandy SILT with traces of roots
2	849 21	reddish brown saturated. soft SAND
	0 69	with silt, non-plastic
	848 38	Not Recovered
3	1 52	
	848 07	dark brown, wet soft SAND with silt
	1 83	non-plastic
4	847 95	dark grey moist unconsolidated silty
	1 95	SAND
	847 64	
	2 26	dark grey, moist soft clayey SILT with
5	846 85	subrounded cobbles, non-plastic
	3 05	Not Recovered
	845 33	Not Recovered
6	4 57	dark grey moist firm clayey SILT with
	844 54	
	5 36	subrounded coarse gravel, low plasticity
	843 80	Not Recovered
7	6 10	same as above Ice in corecatcher Nbe
	842 28	<3%
	7 62	dark grey wet. soft. sandy gravelly SILT
8	841 67	with subrounded cobbles no ice
	8 23	observed
9	840 76	dark grey wet soft silty CLAY with fine
	9 14	sand higly plastic No visible ice
	840 15	dark grey wet soft gravelly silty SAND
10	9 75	with clay, non-plastic No visible ice
	839 72	dark grey mist. soft gravelly silty SAND
	10 18	
	839 23	with subrounded pebbles, non-plastic No
11	10 67	visible ice
	838 87	dark grey moist stiff clayey silty SAND
	11 03	with subrounded coarse gravel plastic
12	837 71	No visible ice
	12 19	pinkish white boulder
		dark grey moist firm silty CLAY with
13	836 79	subrounded coarse gravel, medium
	13 11	
	836 49	plasitcity Nbn
	13 41	dark grey wet, firm, silty SAND with
14	836 18	subangular large gravel non-plastic, Nbn
	13 72	dark grey moist firm sandy GRAVEL
	835 96	
15	13 94	non-plastic, Nbn
	834 66	dark grey moist firm silty SAND
	15 24	non-plastic, Vs 10%
16		dark grey moist hard consolidated
		sandy silty GRAVEL, rounded
	833 14	non-plastic, Nbn
17	16 76	dark grey moist stiff silty SAND with
		<5% subangular gravel, non-plastic Vx
	832 13	50%
18	17 77	
	831 61	dark grey moist stiff, sandy SILT with
	18 29	subrounded gravel Nbn 80% Vs20%
19	830 85	dark grey moist stiff, silty SAND with
	19 05	subangular cobbles non-plastic Vbn
	830 09	dark grey moist firm sandy SILT with

WATER LEVEL - m: Frozen at ground surface

SAMPLES

TYPE AND NUMBER	CONDITION	RECOVERY %	N or RQD	WATER CONTENT and LIMITS (%) W_p W W_L 20 40 60 80	LABORATORY and IN SITU TESTS
CT-1	■	65			
CT-2	■	28			PS (23 5% < 0 08mm) w = 23 2%
CT-3	■	0			
CT-4	■	55			
CT-5	■	75			
CT-6	■	90			
CT-7	■	80			
CT-8	■	100			PS (65 5% < 0 08mm) w = 13 7% PI = 5%
CT-9	■	97			w = 15 1% PS (27 5% < 0 08mm)
CT-10	■	100			
CT-11	■	100			
CT-12	■	90			
CT-13	■	95			

GROUND TEMPERATURE (°C) -5 0 5

UNDRAINED SHEAR STRENGTH (kPa) 25 50 75

F 06 REFERENCE MATERIAL\Graphic [illegible]\MINTO [illegible] PLOTTED 2008-05-27 11:53m

SRK Consulting
Engineers and Scientists

BORING LOG

PROJECT : Minto Overburden Drilling Program 2008
SITE : Minto Mine Yukon Canada
FILE NO : MINTO (2CM022 003)
BORING DATE : 2008-03-10 TO 2008-03 14
DATUM : NAD83 Zone 8V
COORDINATES : 6944730 00 N 383881 00 E
BOREHOLE : *08SWC272*
PAGE : 2 OF 3
DRILL : Air Rotary
CORE BARREL : Triple tube (HQ)

SAMPLE CONDITION	TYPE OF SAMPLER	LABORATORY AND IN SITU TEST	
Remoulded	SS Split spoon	PS Particle size analysis	Torvane (Su) intact
Undisturbed	ST Thin walled shelby tube	w Water content	(Su) ◆ remoulded
Lost	PS Piston sampler	D Unit weight (kN/m³)	
▮ Soil core	CT Core tube sample	k Permeability (cm/s)	Ground Temperature

DEPTH - m	ELEVATION - m DEPTH - m	DESCRIPTION	SYMBOL	WATER LEVEL - m	TYPE AND NUMBER	CONDITION	RECOVERY %	N or RQD	WATER CONTENT and LIMITS (%) Wp W WL 20 40 60 80	LABORATORY and IN SITU TESTS	GROUND TEMPERATURE (°C) -5 0 5 UNDRAINED SHEAR STRENGTH (kPa) 25 50 75
21		dark grey moist stiff sandy clayey SILT non-plastic 50% clear ice			CT-14		95				
22	828 56 21 34	dark grey, moist firm clayey SILT with sand weakly plastic Vs 25%			CT-15		100			w = 24 6% PI = 7% PS (89 0% < 0 08mm)	
23	827 04 22 86	same as above									
24	826 43 23 47	dark grey moist sandy clayey SILT with subangular gravel weakly plastic Nbn			CT-16		95				
25	825 52 24 38	dark grey moist firm sandy SILT with subangular gravel Nbn									
	824 75 25 15	dark grey moist stiff sandy SILT with subrounded gravel, non-plastic Nbn			CT-17		100			PS (41 5% < 0 08mm) w = 13 4% PI = 4%	
26	824 30 25.60	rock core									
27	823 99 25 91	Not Recovered			CT-18		0				
28	822 47 27 43	dark grey moist firm, sandy gravelly SILT, non-plastic, Nbn			CT-19		85				
	821 98 27 92	same as above									
29	821 55 28 35	subrounded and subangular coarse gravel and cobbles, no fines									
30	820 94 28 96	dark grey, moist firm silty CLAY with sand and subangular gravel medium plasticity Nbn			CT-20		95				
	819 72 30 18	same as above 10% Vx									
31 32	819 42 30 48	same as above Nbn			CT-21		85				
	817 90 32 00	dark grey moist very hard silty CLAY with sand non-plastic, Nbn									
33	817 59 32 31	dark grey moist very hard gravelly silty CLAY 15% gravel non-plastic Nbn			CT-22		100				
34	816 98 32 92 816 37 33 53	dark grey moist, firm sandy silty CLAY medium plasticity not frozen									
	816 07 33 83	dark grey moist hard clayey SILT non-plastic			CT-23		100				
35	815 76 34 14	dark grey moist very hard gravelly SILT with 15% gravel non-plastic									◆
36	815 15 34 75 814 85 35 05	dark grey moist very hard sandy SILT with subangular large gravel non-plastic			CT-24		100				◆
	814 36 35 54	dark grey moist stiff, sandy SILT with clay, 10% sand, medium plasticity									
37	813 63 36 27	dark grey moist hard sandy SILT 10% sand, medium plasticity			CT-25		100				
38	813 32 36 58	dark grey moist stiff sandy SILT with clay, 10% sand, medium plasticity									
39	811 80 38 10 811 19 38 71	dark grey moist hard sandy SILT 10% sand medium plasticity			CT-26		100				
	810 28 39 62	dark grey moist very hard sandy SILT (5 to 10% sand) with occasional									

SRK Consulting
Engineers and Scientists

BORING LOG

PROJECT : Minto Overburden Drilling Program 2008
SITE : Minto Mine Yukon Canada
FILE NO : MINTO (2CM022 003)
BORING DATE : 2008-03-10 TO 2008-03-14
DATUM : NAD83 Zone 8V
COORDINATES : 6944730.00 N 383881 00 E

BOREHOLE : *08SWC272*
PAGE : 3 OF 3
DRILL : Air Rotary
CORE BARREL : Triple tube (HQ)

SAMPLE CONDITION	TYPE OF SAMPLER	LABORATORY AND IN SITU TEST
▨ Remoulded	SS Split spoon	PS Particle size analysis
▨ Undisturbed	ST Thin walled shelby tube	w Water content
Lost	PS Piston sampler	D Unit weight (kN/m³)
▮ Soil core	CT Core tube sample	k Permeability (cm/s)

Torvane (Su) intact
(Sur) ◆ remoulded

Ground Temperature

DEPTH - m	ELEVATION - m DEPTH - m	DESCRIPTION	SYMBOL	WATER LEVEL - m	SAMPLES: TYPE AND NUMBER	SAMPLES: CONDITION	SAMPLES: RECOVERY %	SAMPLES: N or RQD	WATER CONTENT and LIMITS (%) W_P W W_L 20 40 60 80	LABORATORY and IN SITU TESTS	GROUND TEMPERATURE (°C) -5 0 5 / UNDRAINED SHEAR STRENGTH (kPa) 25 50 75
		5% gravel non-plastic				▮					
	40.23 809 36	dark grey wet unconsolidated gravelly			CT-27	▮	100				
41	40 54 808 75	SAND with subangular cobbles 10% gravel 25% cobbles				▮					
	41 15	weathered bedrock				▮					
42	807 84	weathered bedrock			CT-28	▮	100				
	42 06 807 23	black wet consolidated SAND				▮					
43	42 67	weathered bedrock 1" of clear ice				▮					
					CT-29	▮	100				
44	805 70 44 20	END OF LOGGING at 44 20m (Borehole Depth = 249 94m)									
45											
46											
47											
48											
49											
50											
51											
52											
53											
54											
55											
56											
57											
58											
59											

SRK Consulting
Engineers and Scientists

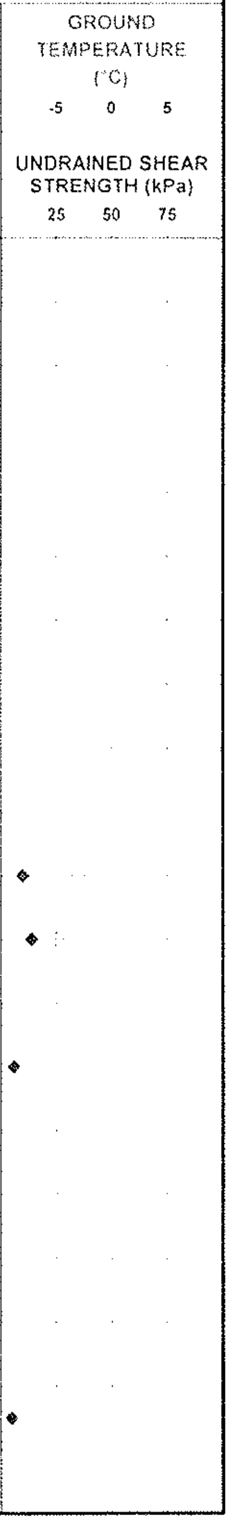
BORING LOG

PROJECT : Minto Overburden Drilling Program 2008
SITE : Minto Mine, Yukon, Canada
FILE NO : MINTO (2CM022 003)
BORING DATE : 2008-03-14 TO 2008-03-18
DATUM : NAD83 Zone 8V
COORDINATES : 6944750 00 N 384150 00 E
BOREHOLE : *08SWC273*
PAGE : 1 OF 3
DRILL : Air Rotary
CORE BARREL : Triple tube (HQ)

SAMPLE CONDITION	TYPE OF SAMPLER	LABORATORY AND IN SITU TEST	
⁚ Remoulded	SS Split spoon	PS Particle size analysis	Torvane (Su) intact
▨ Undisturbed	ST Thin walled shelby tube	w Water content	(Sur) ◆ remoulded
Lost	PS Piston sampler	D Unit weight (kN/m³)	Ground Temperature
■ Soil core	CT Core tube sample	k Permeability (cm/s)	

DEPTH - m	ELEVATION - m DEPTH - m	DESCRIPTION	WATER LEVEL - m	TYPE AND NUMBER	CONDITION	RECOVERY %	N or RQD	LABORATORY and IN SITU TESTS
	835 80							
	0 00	dark brown saturated stiff organic	Frozen 0 12m above ground surface		■			
		sandy SILT non-plastic temp -1 deg C						
				CT-1		50		PS (56 5% <
1								0 08mm)
	834 28							w = 27 2%
	1 52	Same as above						
2	833 97	brown wet stiff gravelly silty SAND						
	1 83	non-plastic		CT-2		70		
3	832 75							
	3 05	not recoverable						
				CT-3		0		
4								
	831 23							
	4 57	not recoverable						
5								
				CT-4		0		
6	829 70							
	6 10	not recoverable						
7				CT-5		0		
	828 18							
	7 62	not recoverable						
8								
				CT-6		0		
9	826 66							
	9 14	dark grey wet firm sandy clayey SILT						
		weakly plastic temp 8 to 12 deg C						
10				CT-7		30		
	825 13							
11	10 67	dark grey wet soft gravelly sandy SILT						
		10% gravel moderately plastic temp 8 to						
		12 deg C		CT-8		60		
12	823 61							
	12 19	Same as above temp 2 to 6 deg C						
13				CT-9		38		
	822 08							
14	13 72	dark grey stiff moist gravelly sandy						
		SILT 15-20 % subangular medium						
	821 17	gravel, non-plastic		CT 10		50		
	14 63							PS (63 5% <
15	820 56	dark grey moist hard sandy SILT						
	15 24	non-plastic, temp 2-4 deg C						0 08mm)
	820 41	gray sub-rounded cobbles						w = 16 6%
16	15 39	Not Recovered		CT 11		10		
	819 04							
17	16 76	gray brown sub-rounded cobbles						
	818 58							
	17 22	dark gray moist stiff sandy SILT with						
	818 12	sub-rounded gravel and cobbles		CT-12		60		
18	17 68	non-plastic						
	817 51	Not Recovered						
	18 29	gray moist soft sand SILT with						
19	816 84			CT-13		64		
	18 96	sub-rounded gravel and cobbles						
	816 54	non-plastic						
	19 26	dark gray moist very hard clayey SILT						

WATER CONTENT and LIMITS (%)
W_P W W_L
20 40 60 80



SRK Consulting
Engineers and Scientists

BORING LOG

PROJECT : Minto Overburden Drilling Program 2008
SITE : Minto Mine, Yukon Canada
FILE NO : MINTO (2CM022 003)
BORING DATE : 2008-03-14 TO 2008-03-18
DATUM : NAD83 Zone 8V
COORDINATES : 6944750 00 N 384150 00 E

BOREHOLE : *08SWC273*
PAGE : 2 OF 3
DRILL : Air Rotary
CORE BARREL : Triple tube (HQ)

SAMPLE CONDITION
- Remoulded
- Undisturbed
- Lost
- ▨ Soil core

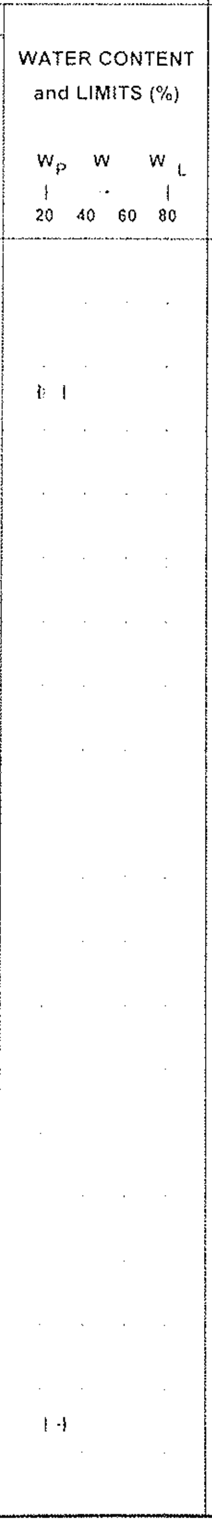
TYPE OF SAMPLER
- SS Split spoon
- ST Thin walled shelby tube
- PS Piston sampler
- CT Core tube sample

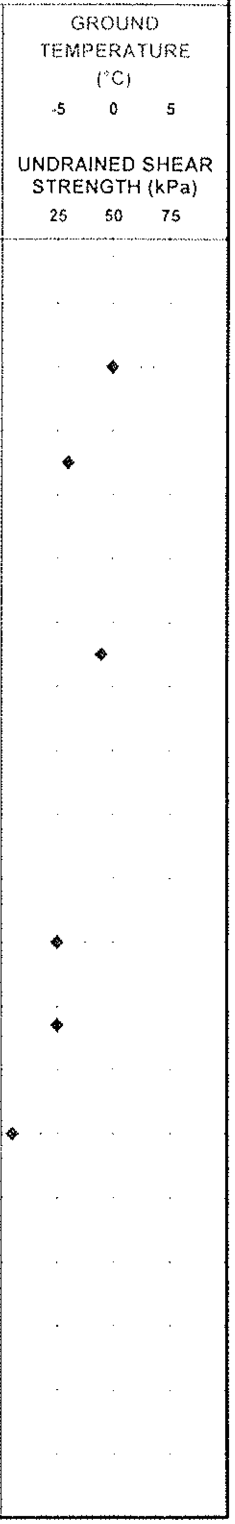
LABORATORY AND IN SITU TEST
- PS Particle size analysis
- w Water content
- D Unit weight (kN/m³)
- k Permeability (cm/s)

Torvane (Su) · intact
(Sur) ◆ remoulded

Ground Temperature

DEPTH - m	ELEVATION - m DEPTH - m	DESCRIPTION	SYMBOL	WATER LEVEL - m	TYPE AND NUMBER	CONDITION	RECOVERY %	N or RQD	LABORATORY and IN SITU TESTS
	19 81	dark gray moist hard clayey SILT with sub-rounded gravel and trace cobbles and sand, low-plasticity frozen Nbn			CT-14		94		
21	814 56 21 24	Not Recovered							
22	814 46 21 34	dark gray moist stiff clayey SILT with sub-rounded gravel low plasticity Clear ice at 73 5' 3% Vx			CT 15		100		w = 17 5% PI = 12% PS (65 5% < 0 08mm)
23	812 94 22 86	same as above 2% Vs Temp range in run=-0 2 -2.2 degrees celcius			CT-16		90		
24	811 57 24 23	Not Recovered							
25	811 42 24 38	same as 75'-79 5' frozen, Nbn no visible ice, temp range= 0 6 -2 4 degrees celcius			CT-17		90		
	810 04 25 76	Not Recovered							
26	809 89 25 91	dark brown moist, very hard clayey SILT with sub-rounded cobbles and gravel and trace sand Nbn			CT-18		95		
27	808 44 27 36	Not Recovered							
28	808 37 27 43	same as 85'-89 75'			CT-19		100		
29	806 84 28 96	same as 85'-89 75' 3" elongated smoky ice at 97 5'			CT-20		96		
30	805 38 30 42	Not Recovered							
31	805 32 30 48	dark gray moist very hard clayey SILT with sand and sub rounded gravel non-plastic. Nbn no visible ice			CT-21		100		
32	803 80 32 00	Same as above							
33	803 19 32 61	Not Recovered			CT-22		40		
	802 27 33 53	dark gray saturated loose silty SAND with sub-rounded cobbles and gravel, non-plastic, no visible ice, Nbn							
34	801 51 34 29	dark gray moist very hard sandy SILT with sub-rounded cobbles and gravel, no visible ice. Nbn			CT-23		100		
35	800 75 35 05	dark grey moist, stiff, silty CLAY with 10-15% coarse sand ocasional subrounded fine gravel							
36	800 14 35 66	dark grey moist stiff, SILT with 5% subangular coarse sand, non-plastic. Nbn			CT-24		100		
37	799 22 36 58	same as above			CT-25		80		
38	797 70 38 10	dark grey wet soft, silty CLAY with sand (<3%) weakly plastic Nbn			CT-26		80		PS (62 0% < 0 08mm) w = 29 4% PI = 9%
39	796 18 39 62	same as above							





SRK Consulting
Engineers and Scientists

BORING LOG

PROJECT : Minto Overburden Drilling Program 2008
SITE : Minto Mine Yukon, Canada
FILE NO : MINTO (2CM022.003)
BORING DATE : 2008-03-14 TO 2008-03-18
DATUM : NAD83 Zone 8V
BOREHOLE : *08SWC273*
PAGE : 3 OF 3
DRILL : Air Rotary
CORE BARREL : Triple tube (HQ)
COORDINATES : 6944750.00 N 384150.00 E

SAMPLE CONDITION	TYPE OF SAMPLER	LABORATORY AND IN SITU TEST	
▨ Remoulded	SS Split spoon	PS Particle size analysis	Torvane (Su) intact
▨ Undisturbed	ST Thin walled shelby tube	w Water content	(Sur) ◆ remoulded
Lost	PS Piston sampler	D Unit weight (kN/m³)	Ground Temperature
■ Soil core	CT Core tube sample	k Permeability (cm/s)	

STRATIGRAPHY

DEPTH - m	ELEVATION - m DEPTH - m	DESCRIPTION
	795.26 40.54	dark grey moist stiff clayey sandy SILT 10% sand with subangular coarse gravel mostly Nbn 1% Vs
41	794.65 41.15	dark grey moist firm silty CLAY with sand (<3%) ocasional subangular coarse gravel weakly plastic. Nbn
42		
	793.13 42.67	same as above
43		
	792.21 43.59	dark grey moist firm silty CLAY with 10% coarse sand ocasional subangular cobbles non-plastic Nbn
44	791.60 44.20	rock core
45	791.36 44.44	dark grey moist firm silty CLAY with 10% coarse sand ocasional subangular cobbles, non-plastic mostly Nbn 1% Vs
	790.99 44.81	dark grey moist stiff silty CLAY with sand, weakly plastic ocasional subangular cobbles
46	790.08 45.72	dark grey moist firm silty sandy CLAY with ocasional subangular medium gravel medium plasticity. Nbn
47	788.56 47.24	same as above
48		
49	787.03 48.77	dark grey wet firm silty clayey SAND with subangular cobbles and 5% subangular coarse gravel non-plastic
50	785.51 50.29	same as above
51	785.05 50.75	brownish grey saturated very soft SAND with subangular medium gravel
52	783.98 51.82	weathered bedrock subangular cobbles
53	782.46 53.34	weathered bedrock
54		
55	780.94 54.86	weathered bedrock
56	779.41 56.39	END OF LOGGING at 56.39m (Borehole Depth = 255.42m)
57		
58		
59		

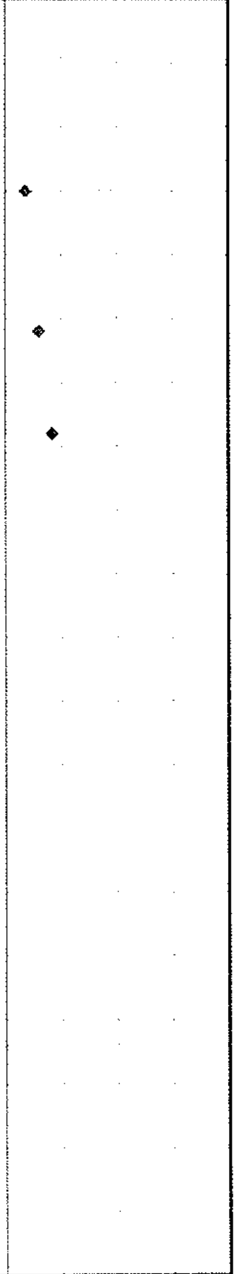
SAMPLES

TYPE AND NUMBER	CONDITION	RECOVERY %	N or RQD
CT-27	■	100	
CT-28	■	100	
CT-29	■	95	
CT-30	■	100	
CT-31	■	100	
CT-32	■	70	
CT-33	■	50	
CT-34	■	40	
CT-35	■	40	
CT-36	■	50	
CT-37	■	70	

WATER LEVEL - m

WATER CONTENT and LIMITS (%)
W_P W W_L
20 40 60 80

LABORATORY and IN SITU TESTS
PS (7.3% < 0.08mm)
w = 17.8%


GROUND TEMPERATURE (°C)
-5 0 5
UNDRAINED SHEAR STRENGTH (kPa)
25 50 75

SRK Consulting
Engineers and Scientists

BORING LOG

PROJECT : Minto Overburden Drilling Program 2008
SITE : Minto Mine, Yukon, Canada
FILE NO : MINTO (2CM022 003)
BORING DATE : 2008-03-18 TO 2008-03-23
DATUM : NAD83 Zone 8V
COORDINATES : 6944630 00 N 384300 00 E
BOREHOLE : 08SWC274
PAGE : 1 OF 3
DRILL : Air Rotary
CORE BARREL : Triple tube (HQ)

SAMPLE CONDITION	TYPE OF SAMPLER	LABORATORY AND IN SITU TEST
Remoulded	SS Split spoon	PS Particle size analysis
Undisturbed	ST Thin walled shelby tube	w Water content
Lost	PS Piston sampler	D Unit weight (kN/m³)
▮ Soil core	CT Core tube sample	k Permeability (cm/s)

Torvane (Su) intact; (Sur) ◆ remoulded
Ground Temperature

DEPTH - m	ELEVATION - m / DEPTH - m	DESCRIPTION	WATER LEVEL - m
	838 20 0 00	dark brown saturated very soft organic sandy SILT non-plastic Nbe	Frozen 0.12m below ground surface
1	836 68 1 52	Not Recovered	
2, 3	835 15 3 05	brownish grey moist very soft sandy (10%) clayey SILT non-plastic Nbn	
4	834 39 3 81	dark grey moist soft SILT with fine sand <5% Nbe	
	833 63 4 57	same as above only 4 inches recovered in the core-catcher	
5, 6	832 10 6 10	dark grey wet soft gravelly sandy SILT non-plastic, Nbn	
	831 80 6 40	Not Recovered	
7	830 58 7 62	dark grey wet soft silty sandy subangular GRAVEL with subangular cobbles	
8	830 28 7 92	Not Recovered	
9	829 06 9 14	dark grey wet soft silty gravelly SAND with subangular cobbles non-plastic, Nbn	
10	828 14 10 06	dark grey moist soft, sandy SILT non-plastic, Nbn	
	828 07 10 13	Not Recovered	
11	827 53 10 67	dark grey moist soft sandy (3 to 5%) clayey SILT with subangular gravel and occasional subangular cobbles, weakly plastic Nbn	
12	826 01 12 19	same as above + Vx 3 inches Vs 5 inches	
13	824 48 13 72	Not Recovered	
14	823 87 14 33	dark grey moist, soft, sandy (3 to 5%) clayey SILT with subangular gravel and occasional subangular cobbles weakly plastic Nbn	
15	822 96 15 24	dark grey moist, soft (when thawed) clayey SILT with 3 to 5% medium sand Nbn 3mm of clear ice	
16, 17	821 44 16 76	same as above + occasional subangular cobbles Nbn	
18	819 91 18 29	same as above + Nbn Vr = 3 inches	
19	818 39		

TYPE AND NUMBER	CONDITION	RECOVERY %	N or RQD	LABORATORY and IN SITU TESTS
CT 1	▮	18		
CT-2	▮	0		
CT 3	▮	90		PS (52 0% < 0 08mm) w = 31 4%
CT-4	▮	6		
CT-5	▮	20		
CT-6	▮	20		
CT 7	▮	70		
CT 8	▮	100		
CT-9	▮	95		
CT-10	▮	60		
CT-11	▮	86		
CT-12	▮	90		
CT 13	▮	90		

WATER CONTENT and LIMITS (%)
W_p W W_L
20 40 60 80

GROUND TEMPERATURE (°C)
-5 0 5

UNDRAINED SHEAR STRENGTH (kPa)
25 50 75

SRK Consulting
Engineers and Scientists

BORING LOG

PROJECT :	Minto Overburden Drilling Program 2008	BOREHOLE :	08SWC274
SITE :	Minto Mine, Yukon, Canada	PAGE :	2 OF 3
FILE NO :	MINTO (2CM022.003)	DRILL :	Air Rotary
BORING DATE :	2008-03-18 TO 2008-03-23	CORE BARREL :	Triple tube (HQ)
DATUM :	NAD83 Zone 8V	COORDINATES :	6944630.00 N 384300.00 E

SAMPLE CONDITION	TYPE OF SAMPLER	LABORATORY AND IN SITU TEST	
▨ Remoulded	SS Split spoon	PS Particle size analysis	Torvane (Su) intact
▨ Undisturbed	ST Thin walled shelby tube	w Water content	(Sur) ◆ remoulded
Lost	PS Piston sampler	D Unit weight (kN/m³)	
■ Soil core	CT Core tube sample	k Permeability (cm/s)	Ground Temperature ⩚——⩚

DEPTH - m	ELEVATION - m DEPTH - m	DESCRIPTION	SYMBOL	WATER LEVEL - m	TYPE AND NUMBER	CONDITION	RECOVERY %	N or RQD	WATER CONTENT and LIMITS (%) W_P W W_L 20 40 60 80	LABORATORY and IN SITU TESTS	GROUND TEMPERATURE (°C) -5 0 5 UNDRAINED SHEAR STRENGTH (kPa) 25 50 75
		same as above Nbn			CT-14	■	100				
21 22	816.86 21.34	same as above + occasional subrounded coarse gravel Nbn			CT-15	■	100		⊢⊣	w = 14.8% PI = 7% PS (48.0% < 0.08mm)	
23 24	815.34 22.86	same as above Nbn			CT-16	■	50				
25	813.82 24.38	same as above Nbn			CT-17	■	72				
26 27	812.29 25.91	dark grey moist soft (when thawed) SILT interbedded with 5 inch thick layers of sand ocasional sub-angular coarse gravel Nbn			CT-18	■	75				
28	810.77 27.43	dark grey SILT with an occasional cobble (up to 1.5 in long) firm low moisture content no vis Ice Nbn			CT-19	■	100				
29 30	809.24 28.96	dark grey SILT with occasional small gravel (up to 1 in long) firm crumbles Nbn less than 5% Vx			CT-20	■	93				◆
31	807.72 30.48	same as above Nbn coarser grained with depth			CT-21	■	98				◆
32 33	806.20 32.00	dark grey (browner with depth) sandy SILT crumbles with pick Nbn			CT-22	■	83				◆
34	804.67 33.53	dark brown and grey with some light brown banding soft clayey SILT Vx <5% Nbn			CT-23	■	96				◆
35 36	803.15 35.05	dark grey soft SILT with increasing sand with depth some sand layers, pieces of granitic rock (up to 2 in long) no vis ice Nbn			CT-24	■	95		·	w = 17.6% PS (24.5% < 0.08mm)	◆
37	801.62 36.58	dark grey SILT with sand soft no vis ice pieces of granitic rock (up to 4 in long) Nbn			CT-25	■	77		·		
38 39	800.10 38.10	dark grey with brown sections browner at depth silty SAND pieces of rock (up to 1 in long) no vis ice Nbn			CT-26	■	83			w = 16.8% PS (37.0% < 0.08mm)	
	798.58 39.62	med brown to light grey with some darker				■					

SRK Consulting
Engineers and Scientists

BORING LOG

PROJECT : Minto Overburden Drilling Program 2008
SITE : Minto Mine Yukon Canada
FILE NO : MINTO (2CM022 003)
BORING DATE : 2008-03-18 TO 2008-03-23
DATUM : NAD83 Zone 8V
BOREHOLE : *08SWC274*
PAGE : 3 OF 3
DRILL : Air Rotary
CORE BARREL : Triple tube (HQ)
COORDINATES : 6944630 00 N 384300 00 E

SAMPLE CONDITION		TYPE OF SAMPLER		LABORATORY AND IN SITU TEST	
▨	Remoulded	SS	Split spoon	PS	Particle size analysis
▨	Undisturbed	ST	Thin walled shelby tube	w	Water content
	Lost	PS	Piston sampler	D	Unit weight (kN/m³)
■	Soil core	CT	Core tube sample	k	Permeability (cm/s)

Torvane (Su) intact
(Sur) ◆ remoulded

Ground Temperature ☆——☆

	STRATIGRAPHY				SAMPLES						
DEPTH - m	ELEVATION - m DEPTH - m	DESCRIPTION	SYMBOL	WATER LEVEL - m	TYPE AND NUMBER	CONDITION	RECOVERY %	N or RQD	WATER CONTENT and LIMITS (%) W_P W W_L 20 40 60 80	LABORATORY and IN SITU TESTS	GROUND TEMPERATURE (°C) -5 0 5 UNDRAINED SHEAR STRENGTH (kPa) 25 50 75
		areas, sandy SILT pieces of rock (up to 1 5 in long) no vis ice Nbn			CT-27	■	95				
41	797 05 41 15	same as above with smaller rock pieces									
42					CT-28	■	90				
	795 53 42 67	same as above									
43											
					CT-29	■	80				
44	794 00 44 20	highly fractured granitic rock SAND with silt and gravel (up to 1 in long)									
45					CT-30	■	98				
	792 48 45 72	fractured granitic rock veining and staining dark in colour									
46											
					CT-31	■	100				
47	790 96 47 24	same as above									
48					CT-32	■	100				
	789 43 48 77	END OF LOGGING at 48 77m (Borehole Depth = 368 81m)									
49											
50											
51											
52											
53											
54											
55											
56											
57											
58											
59											

FILE REFERENCE: MATERIAL Systems [illegible] MINTO [illegible] PLOTTED: 2008-06-23 11:04

SRK Consulting
Engineers and Scientists

BORING LOG

PROJECT : Minto Overburden Drilling Program 2008
SITE : Minto Mine Yukon Canada
FILE NO : MINTO (2CM022 003)
BORING DATE : 2008-03-20 TO 2008-03-22
DATUM : NAD83 Zone 8V
BOREHOLE : *08SWC275*
PAGE : 1 OF 2
DRILL : Air Rotary
CORE BARREL : Triple tube (HQ)
COORDINATES : 6944220.00 N 383890 00 E

SAMPLE CONDITION	TYPE OF SAMPLER	LABORATORY AND IN SITU TEST	
Remoulded	SS Split spoon	PS Particle size analysis	Torvane (Su) intact
Undisturbed	ST Thin walled shelby tube	w Water content	(Sur) ◆ remoulded
Lost	PS Piston sampler	D Unit weight (kN/m³)	Ground Temperature
▨ Soil core	CT Core tube sample	k Permeability (cm/s)	

STRATIGRAPHY

DEPTH - m	ELEVATION - m DEPTH - m	DESCRIPTION
	856 60 0 00	dark brown organic sandy SILT Vx (50%) with some Vr (up to 1 in long) lots of visible ice roots present pebbles in last 1 ft of run
2	854 42 2 18	driller feels it is SAND that has washed away
4	852 33 4 27	GRAVEL (subangular to subround 0 25 x 0 5 in to 1 75 x 0 75 in rocks) one 0 5 x 0 5 in piece of ice
6	850 81 5 79	grey moist firm sandy SILT with gravel non-plastic Nbn
	850 50 6 10	same as above
7	848 98 7 62	Not Recovered
9	847 46 9 14	Not Recovered
10	845 93 10 67	sub-rounded large GRAVEL and small cobbles no fines
11	845 63 10 97	dark grey moist soft sandy SILT with ocasional boulders non-plastic Nbn
12	844 41 12 19	dark grey sandy SILT with gravel (subround to subang up to 0 5 in long with one 2 in long) no vis ice Nbe
13	842 88 13 72	same as above - decreasing sand content with depth
15	841 36 15 24	dark grey sandy SILT some small pebbles (up to 0 25 in long) no vis ice Nbn
16	839 84 16 76	same as above
18	838 31 18 29	dark grey clayey SILT with some sandy and gravel layers (3-4 in run)
	836 79	

WATER LEVEL - m: *Frozen at ground surface*

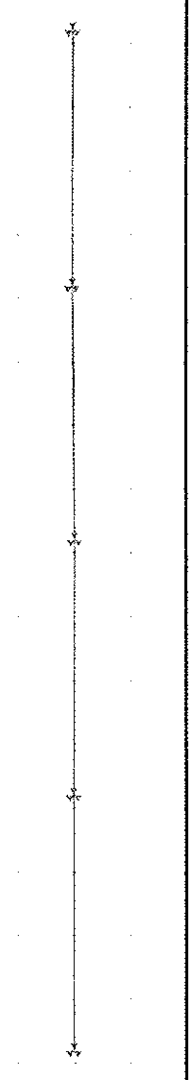
SAMPLES

TYPE AND NUMBER	CONDITION	RECOVERY %	N or RQD	LABORATORY and IN SITU TESTS
CT-1	▨	100		
CT-2	▨	43		PS (68 0% < 0 08mm) w = 189 7%
CT-3	▨	0		
CT-4	▨	5		
CT-5	▨	90		
CT-6	▨	0		
CT-7	▨	0		
CT-8	▨	90		
CT-9	▨	90		
CT-10	▨	98		w = 10 1% PS (33 5% < 0 08mm)
CT-11	▨	82		
CT-12	▨	88		
CT-13	▨	100		w = 15 4% PI = 10%

WATER CONTENT and LIMITS (%)

W_P W W_L

20 40 60 80



SRK Consulting
Engineers and Scientists

BORING LOG

PROJECT : Minto Overburden Drilling Program 2008
SITE : Minto Mine Yukon Canada
FILE NO : MINTO (2CM022 003)
BORING DATE : 2008-03-20 TO 2008-03-22
DATUM : NAD83 Zone 8V
BOREHOLE : *08SWC275*
PAGE : 2 OF 2
DRILL : Air Rotary
CORE BARREL : Triple tube (HQ)
COORDINATES : 6944220 00 N 383890 00 E

SAMPLE CONDITION	TYPE OF SAMPLER	LABORATORY AND IN SITU TEST
Remoulded	SS Split spoon	PS Particle size analysis
Undisturbed	ST Thin walled shelby tube	w Water content
Lost	PS Piston sampler	D Unit weight (kN/m³)
█ Soil core	CT Core tube sample	k Permeability (cm/s)

Torvane (Su) intact
(Sur) ◆ remoulded

Ground Temperature

DEPTH - m	ELEVATION - m DEPTH - m	STRATIGRAPHY DESCRIPTION	SYMBOL	WATER LEVEL - m	SAMPLES TYPE AND NUMBER	CONDITION	RECOVERY %	N or RQD	WATER CONTENT and LIMITS (%) W_P W W_L 20 40 60 80	LABORATORY and IN SITU TESTS	GROUND TEMPERATURE (°C) -5 0 5 UNDRAINED SHEAR STRENGTH (kPa) 25 50 75
		same as above with bigger gravel pieces			CT-14	█	83				
21	835 26 21 34	dark grey moist firm sandy SILT with ocasional sub-angular coarse gravel non-plastic				█					
22					CT-15	█	60				
23	833 74 22 86	dark grey moist firm sandy SILT with subangular gravel non-plastic			CT-16	█	100				
24	832 22 24 38	same as previous				█					
25					CT 17	█	100		•	PS (56 0% < 0 08mm) w = 9 6%	
26	830 69 25 91 830 45 26 15	angular to subrounded medium to coarse gravel no fines dark grey firm moist silty SAND			CT-18	█	22				
27	829 17 27 43	END OF BOREHOLE at 27 43m									
28											
29											
30											
31											
32											
33											
34											
35											
36											
37											
38											
39											

F 06 REFERENCE MATERIAL Systems [illegible] MINTO [illegible] PLOTTED 2008-05-27 11 04hrs

SRK Consulting
Engineers and Scientists

BORING LOG

PROJECT : Minto Overburden Drilling Program 2008
SITE : Minto Mine, Yukon, Canada
FILE NO : MINTO (2CM022 003)
BORING DATE : 2008-03-23 TO 2008-03-26
DATUM : NAD 83 Zone 8V
BOREHOLE : 08SWC277
PAGE : 1 OF 2
DRILL : Air Rotary
CORE BARREL : Triple tube (HQ)
COORDINATES : 6944211 00 N 384090 00 E

SAMPLE CONDITION	TYPE OF SAMPLER	LABORATORY AND IN SITU TEST	
Remoulded	SS Split spoon	PS Particle size analysis	Torvane (Su) intact
Undisturbed	ST Thin walled shelby tube	w Water content	(Sur) ◆ remoulded
Lost	PS Piston sampler	D Unit weight (kN/m³)	
▨ Soil core	CT Core tube sample	k Permeability (cm/s)	Ground Temperature

STRATIGRAPHY

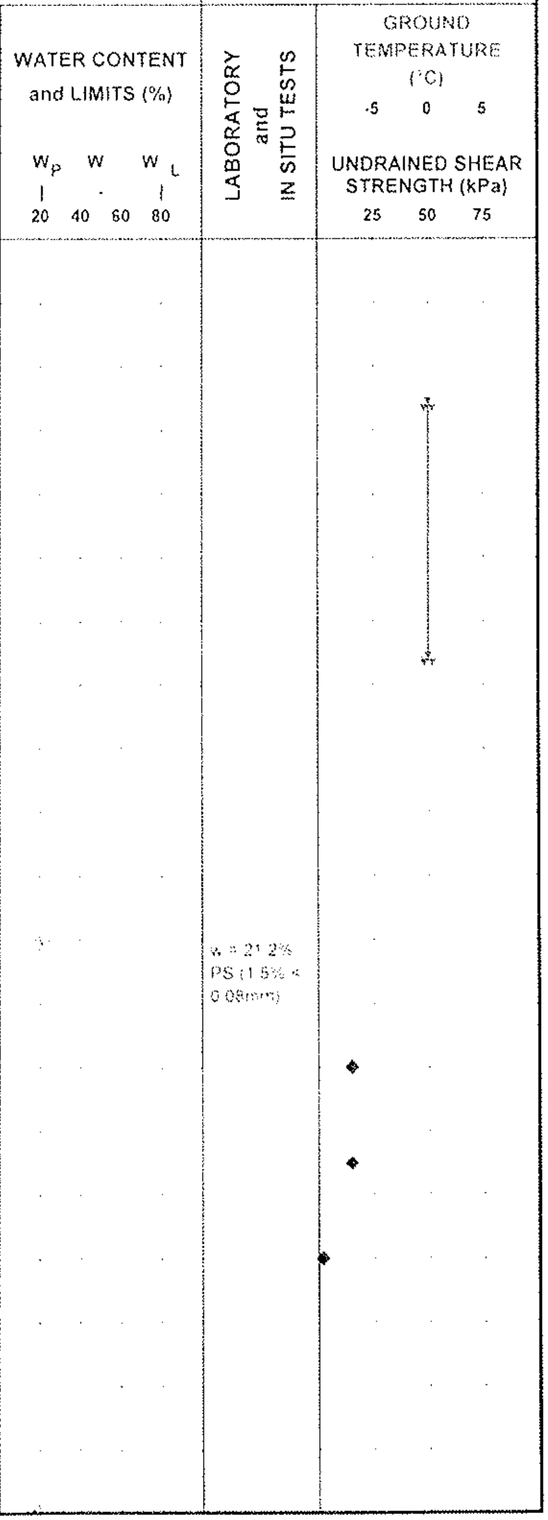
DEPTH - m	ELEVATION - m DEPTH - m	DESCRIPTION
	869 00 0 00	Brown, wet very soft organic sandy SILT non-plastic
1	867 48 1 52	subangular to subrounded coarse to medium gravel no fines
2		
3	865 95 3 05	Not Recovered
4	864 43 4 57	Not Recovered
5		
6	862 90 6 10	Not Recovered
7	861 38 7 62	Not Recovered
8		
9	859 86 9 14	subangular to subrounded coarse gravel no fines
	859 70 9.30	brownish grey wet soft sandy SILT with coarse gravel and subangular cobbles
10	859 09 9 91	Not Recovered
11	858 33 10 67	subangular to subrounded fine gravel no fines ocasional subangular large gravel
	858 03 10 97	dark grey moist firm sandy SILT with subangular gravel and ocasional subangular boulder
12	857 42 11 58	Not Recovered
	856 81 12 19	dark grey, moist, soft to firm sandy gravelly SILT with subangular cobbles non-plastic, not frozen
13	855 68 13 32	Not Recovered
14	855.28 13 72	dark grey moist, firm with narrow soft zones, SILT with 10% sand non-plastic not frozen
15	853 76 15 24	same as above + ocasional subangular cobbles
16		
17	852 24 16 76	dark grey moist stiff sandy SILT with 3-5% fine gravel interbedded with clean subangular poorly graded gravel and fine brownish grey sand
18	850 71 18 29	grey wet soft to stiff silty SAND with angular gravel and cobbles non-plastic not frozen
19	850 10 18 90	Not Recovered
	849 19	

WATER LEVEL - m: *Water 2.1m below ground surface*

SAMPLES

TYPE AND NUMBER	CONDITION	RECOVERY %	N or RQD	LABORATORY and IN SITU TESTS
CT-1	▨	37		
CT-2	▨	20		
CT-3	▨	0		
CT-4	▨	0		
CT-5	▨	0		
CT-6	▨	0		
CT-7	▨	50		
CT-8	▨	60		w = 21 2% PS (1 5% < 0 08mm)
CT-9	▨	73		
CT 10	▨	90		
CT-11	▨	90		
CT-12	▨	73		
CT-13	▨	37		

WATER CONTENT and LIMITS (%)



SRK Consulting
Engineers and Scientists

BORING LOG

PROJECT : Minto Overburden Drilling Program 2008
SITE : Minto Mine Yukon Canada
FILE NO : MINTO (2CM022 003)
BORING DATE : 2008-03-23 TO 2008-03-26
DATUM : NAD 83 Zone 8V
COORDINATES : 6944211 00 N 384090 00 E

BOREHOLE : *08SWC277*
PAGE : 2 OF 2
DRILL : Air Rotary
CORE BARREL : Triple tube (HQ)

SAMPLE CONDITION	TYPE OF SAMPLER	LABORATORY AND IN SITU TEST
▨ Remoulded	SS Split spoon	PS Particle size analysis
▨ Undisturbed	ST Thin walled shelby tube	w Water content
Lost	PS Piston sampler	D Unit weight (kN/m³)
■ Soil core	CT Core tube sample	k Permeability (cm/s)

Torvane (Su) · intact
(Sur) ◆ remoulded

Ground Temperature ☆——☆

DEPTH - m	STRATIGRAPHY: ELEVATION - m DEPTH - m	STRATIGRAPHY: DESCRIPTION	STRATIGRAPHY: SYMBOL	WATER LEVEL - m	SAMPLES: TYPE AND NUMBER	SAMPLES: CONDITION	SAMPLES: RECOVERY %	SAMPLES: N or RQD	WATER CONTENT and LIMITS (%) W_P W W_L 20 40 60 80	LABORATORY and IN SITU TESTS	GROUND TEMPERATURE (°C) -5 0 5 UNDRAINED SHEAR STRENGTH (kPa) 25 50 75
		orange wet, angular gravelly SAND non-cohesive			CT-14	■	48			w = 17 3% PS (9 5% < 0 08mm)	
	848 43 20 57	Not Recovered									
21	847 66 21 34	orange wet weakly cemented angular gravelly coarse SAND				■					
22	846 75 22 25	Not Recovered			CT-15	■	60			w = 11 9% PS (7 0% < 0 08mm)	
23	846 14 22 86	orange weathered bedrock				■					
24					CT-16	■	100				
	844 62 24 38	bedrock				■					
25					CT-17	■	100				
26	843 09 25 91	END OF LOGGING at 25 91m (Borehole Depth = 252 98m)									
27											
28											
29											
30											
31											
32											
33											
34											
35											
36											
37											
38											
39											

SRK Consulting
Engineers and Scientists

BORING LOG

PROJECT :	Minto Overburden Drilling Program 2008	BOREHOLE :	*08SWC278*
SITE :	Minto Mine Yukon Canada	PAGE :	1 OF 3
FILE NO :	MINTO (2CM022 003)	DRILL :	Air Rotary
BORING DATE :	2008-03-26 TO 2008-03-29	CORE BARREL :	Triple tube (HQ)
DATUM :	NAD83 Zone 8V	COORDINATES :	6943900 00 N 383940 00 E

SAMPLE CONDITION	TYPE OF SAMPLER	LABORATORY AND IN SITU TEST	
▨ Remoulded	SS Split spoon	PS Particle size analysis	Torvane (Su) · intact
░ Undisturbed	ST Thin walled shelby tube	w Water content	(Sur) ◆ remoulded
Lost	PS Piston sampler	D Unit weight (kN/m³)	Ground Temperature
▓ Soil core	CT Core tube sample	k Permeability (cm/s)	

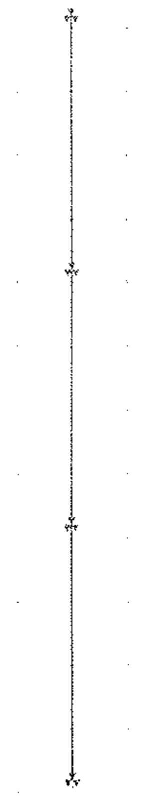
DEPTH - m	ELEVATION - m DEPTH - m	DESCRIPTION	TYPE AND NUMBER	RECOVERY %	LABORATORY and IN SITU TESTS
	870 10				
	0 00	orange-brown to brown wet, soft			PS (55 0% <
	869 80	organic sandy SILT non-plastic Nbn			0 08mm)
	0 30	Not Recovered	CT-1	20	w = 24 9%
1					PI = 5%
	868 58				
	1 52	brownish grey wet soft silty SAND with			
2	868 27	inclusions of orange sandy silt			
	1 83	non-plastic Nbe	CT-2	20	
		Not Recovered			
3	867 05				
	3 05	Not Recovered			
4			CT-3	0	
	865 53				
	4 57	grey wet soft sandy SILT inclusions of			
5		poorly graded medium sand and			
		ocasional subangular medium gravel	CT-4	68	
		non-plastic Nbn			
6	864 00				
	6 10	grey wet, soft silty fine SAND			
	863 70	non-plastic. Nbn			
	6 40	subangular coarse GRAVEL with less	CT-5	40	
7	863 39				
	6 71	than 3% fines			
	862 48	Not Recovered			
8	7 62	brownish-orange poorly graded medium			
	862 16	sand. wash-out from hole (no recovery)			PS (0 4% <
	7 92	grey wet. angular to subrounded well	CT-6	50	0 08mm)
	861 57				w = 1 3%
9	8 53	graded GRAVEL (30% coarse, 40 %			
	860 96	medium 30 % fine) with traces of sand			
	9 14	no fines not frozen			
10	860 19		CT-7	50	
	9 91	Not Recovered			
	859 43	grey moist loose well graded SAND			
	10 67	with traces of silt ad subangular gravel			
11	859 31	not frozen			
	10 79	Not Recovered	CT-8	100	
	859 19	grey wet, soft SILT with fine sand			
12	10 91				
	857 91	weakly plastic. not frozen			
	12 19	grey moist firm fine SAND with 10 %			
13		coarse sand and traces of gravel	CT-9	86	
		grey moist medium dense SAND with			
	856 38	gravel and ocasional cobbles not frozen			
14	13 72	same as above			
		dark grey moist stiff silty SAND with 5 to	CT-10	100	
		10% subangular gravel non-plastic no			
15	854 86	ice observed			
	15 24	same as above			
16			CT 11	100	
	853 34				PS (36 0% <
17	16 76	same as above + traces of Vs			0 08mm)
					w = 7 2%
			CT-12	100	
	852 27				
18	17 83	dark grey moist stiff SILT with sand and			
	851 81	subangular gravel non-plastic, mainly			
	18 29	Nbn, traces of Vs			
19		same as above + traces of Vs	CT-13	100	
	850 29				

WATER LEVEL - m: Water 0 6m below ground surface

WATER CONTENT and LIMITS (%): W_P W W_L — 20 40 60 80

GROUND TEMPERATURE (°C) -5 0 5

UNDRAINED SHEAR STRENGTH (kPa) 25 50 75



SRK Consulting
Engineers and Scientists

BORING LOG

PROJECT : Minto Overburden Drilling Program 2008
SITE : Minto Mine Yukon Canada
FILE NO : MINTO (2CM022 003)
BORING DATE : 2008-03-26 TO 2008-03-29
DATUM : NAD83 Zone 8V
BOREHOLE : *08SWC278*
PAGE : 2 OF 3
DRILL : Air Rotary
CORE BARREL : Triple tube (HQ)
COORDINATES : 6943900 00 N 383940 00 E

SAMPLE CONDITION	TYPE OF SAMPLER	LABORATORY AND IN SITU TEST	
Remoulded	SS Split spoon	PS Particle size analysis	Torvane (Su) intact
Undisturbed	ST Thin walled shelby tube	w Water content	(Sur) ◆ remoulded
Lost	PS Piston sampler	D Unit weight (kN/m³)	Ground Temperature
■ Soil core	CT Core tube sample	k Permeability (cm/s)	

DEPTH - m	STRATIGRAPHY: ELEVATION - m DEPTH - m	STRATIGRAPHY: DESCRIPTION	STRATIGRAPHY: SYMBOL	WATER LEVEL - m	SAMPLES: TYPE AND NUMBER	SAMPLES: CONDITION	SAMPLES: RECOVERY %	SAMPLES: N or RQD	WATER CONTENT and LIMITS (%) W	LABORATORY and IN SITU TESTS	GROUND TEMPERATURE (°C) -5 0 5 / UNDRAINED SHEAR STRENGTH (kPa) 25 50 75
21		same as above + traces of Vs			CT-14	■	100				
22	848 76 21 34	same as above			CT-15	■	100				
	847 85 22 25	dark grey moist stiff sandy SILT with 5 to 10% subangular gravel non-plastic Nbn traces of Vs									
23 24	847 24 22 86	same as above + traces of Vs			CT-16	■	100				
25	845 72 24 38	same as above + traces of Vs			CT-17	■	100				
26 27	844 19 25 91	dark grey clayey SILT some rocks (subrounded up to 2 in long) no vis ice Nbn?? - int temp 10C			CT 18	■	28				
28	842 67 27 43	dark grey SILT with sand and gravel 1 piece granitic rock (~3 in long), 1 25 in ice lens no vis ice Nbn?? - int temp 3C			CT-19	■	100			w = 8 5% PS (24 0% < 0 08mm)	◆
29 30	841 14 28 96	same as above - less rock, 1 piece granitic rock (~ 1 5 in long) no vis ice unfrozen?? - int temp 8C			CT-20	■	90				
31	839 62 30 48	same as above 1 piece of dark rock (mid run ~4 in long) no vis ice unfrozen?? - int temp 8C			CT-21	■	100				
32 33	838 10 32 00	dark grey sandy SILT/silty SAND less large rocks than above (0 25 0 5 in long) increasing sand with depth transition zone btw above and silty sand below			CT-22	■	100			PS (38 5% < 0 08mm) w = 16 8%	
34	836 57 33 53	dark grey/black silty SAND progressing to SAND with depth pieces of granitic rock (avg 1 in long 1 piece at end 3 5 in long) unfrozen int temp 8-12C			CT-23	■	82				
35 36	835 05 35 05	dark grey/black SAND with pieces of granitic rock - int temp 6C			CT-24	■	98				
37	833 52 36 58	interbeded SAND/SILT layers same as above (SAND) 1st foot of run is small rocks (sub ang to sub round) mid run 1 5 ft SILT layer (dark grey) unfrozen int temp 6-8C			CT 25	■	82				
38 39	832 00 38 10	dark grey interbedded SAND/SILT unfrozen, pieces of granitic rock (up to 2 in long) gravel in sand layer - int temp 11-13C			CT-26	■	75				
	830 48 39 62										

SRK Consulting
Engineers and Scientists

BORING LOG

PROJECT :	Minto Overburden Drilling Program 2008	BOREHOLE :	*08SWC278*
SITE :	Minto Mine, Yukon Canada	PAGE :	3 OF 3
FILE NO :	MINTO (2CM022 003)	DRILL :	Air Rotary
BORING DATE :	2008-03-26 TO 2008-03-29	CORE BARREL :	Triple tube (HQ)
DATUM :	NAD83 Zone 8V	COORDINATES :	6943900 00 N 383940 00 E

SAMPLE CONDITION		TYPE OF SAMPLER		LABORATORY AND IN SITU TEST	
▨	Remoulded	SS	Split spoon	PS	Particle size analysis
▨	Undisturbed	ST	Thin walled shelby tube	w	Water content
	Lost	PS	Piston sampler	D	Unit weight (kN/m³)
■	Soil core	CT	Core tube sample	k	Permeability (cm/s)

Torvane (Su) intact
(Sur) ◆ remoulded

Ground Temperature

DEPTH - m	ELEVATION - m DEPTH - m	STRATIGRAPHY DESCRIPTION	SYMBOL	WATER LEVEL - m	SAMPLES TYPE AND NUMBER	CONDITION	RECOVERY %	N or RQD	WATER CONTENT and LIMITS (%) W_P W W_L 20 40 60 80	LABORATORY and IN SITU TESTS	GROUND TEMPERATURE (°C) -5 0 5 UNDRAINED SHEAR STRENGTH (kPa) 25 50 75
		(same as above) - int temp 11C			CT-27	■	56		·	PS (17 8% < 0 08mm) w = 10 8%	
41	828 95 41 15	very weathered granitic rock broken down into SAND can break rock pieces with hand unfrozen									
42					CT-28	■	78				
43	827 43 42 67	same as above			CT-29	■	100				
44	825 90 44 20	same as above less sand more rock (still very incompetent)									
45					CT-30	■	97				
46	824 38 45 72	same as above - more competent rock little sand			CT-31	■	100				
47	822 86 47 24	END OF LOGGING at 47 24m (Borehole Depth = 246 80m)									
48											
49											
50											
51											
52											
53											
54											
55											
56											
57											
58											
59											

SRK Consulting
Engineers and Scientists

BORING LOG

PROJECT :	Minto Overburden Drilling Program 2008	BOREHOLE :	*08SWC280*
SITE :	Minto Mine Yukon Canada	PAGE :	1 OF 2
FILE NO :	MINTO (2CM022 003)	DRILL :	Air Rotary
BORING DATE :	2008-03-29 TO 2008-04-01	CORE BARREL :	Triple tube (HQ)
DATUM :	NAD83 Zone 8V	COORDINATES :	6943950.00 N 383671.00 E

SAMPLE CONDITION	TYPE OF SAMPLER	LABORATORY AND IN SITU TEST	
▨ Remoulded	SS Split spoon	PS Particle size analysis	Torvane (Su) ◇ intact
▨ Undisturbed	ST Thin walled shelby tube	w Water content	(Sur) ◆ remoulded
Lost	PS Piston sampler	D Unit weight (kN/m³)	Ground Temperature
■ Soil core	CT Core tube sample	k Permeability (cm/s)	

STRATIGRAPHY

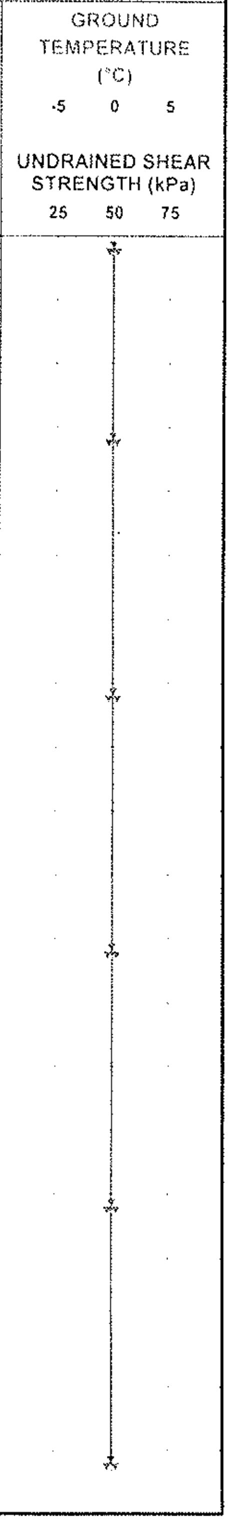
DEPTH - m	ELEVATION - m DEPTH - m	DESCRIPTION
	873.30 0.00	brown moist soft. SILT with traces of sand and gravel non-plastic, non-frozen
1	872.08 1.22	Not Recovered
	871.78 1.52	Not Recovered
2	871.01 2.29	Not Recovered
3	870.25 3.05	Not Recovered
4	869.34 3.96	brown. moist. soft. SILT with traces of sand and 15% subrounded to subangular gravel non-plastic non frozen
	868.73 4.57	same as above
5	868.12 5.18	Not Recovered
	867.81 5.49	dark grey. moist soft silty SAND with ocasional subrounded medium gravel non-plastic Nbn
6	867.20 6.10	
	866.59 6.71	dark grey. moist loose subrounded and rounded coarse SAND with 5 to 10% fines interbedded with dark grey moist soft SILT non-plastic. Nbn. traces of Vs
7	866.29 7.01	
8	865.68 7.62	dark grey moist soft SILT non-plastic traces of Vs Nbn
9	864.46 8.84	dark grey. moist soft sandy SILT non-plastic. Nbn
	864.16 9.14	same as above + ocasional angular small cobbles
10	862.63 10.67	Not Recovered
11		dark grey moist hard to stiff sandy SILT 20% sand with subangular gravel and occasional cobbles non-plastic Nbn
		same as above
12	861.11 12.19	same as above
	860.50 12.80	dark grey moist. hard to stiff silty SAND with subangular gravel and ocasional subangular cobbles. non-plastic
13	859.58 13.72	same as above
14		
15	858.06 15.24	dark grey moist. hard to stiff silty SAND with subangular cobbles and gravel (25% cobbles 10% gravel)
16	856.99 16.31	brownish grey wet loose SAND with subangular gravel. not frozen
17	856.54 16.76	alternate layers of grey wet. loose to medium dense coarse and fine SAND traces of gravel. Nbn
	855.62 17.68	Not Recovered
18	855.01 18.29	brownish grey. moist medium dense SAND with taces of lines and occas onal angular cobbles
19	853.79 19.51	weathered bedrock

WATER LEVEL - m: Frozen 0.3m above ground surface

SAMPLES

TYPE AND NUMBER	CONDITION	RECOVERY %	N or RQD	WATER CONTENT and LIMITS (%)	LABORATORY and IN SITU TESTS
CT-1	■	80			
CT-2	■	0			
CT-3	■	40			
CT-4	■	90			w = 10.3% PS (40.0% < 0.08mm)
CT-5	■	96			
CT-6	■	80			
CT-7	■	100			PS (33.0% < 0.08mm) w = 8.2%
CT-8	■	100			
CT-9	■	100			
CT-10	■	90			
CT-11	■	100			
CT-12	■	60			PS (56.5% < 0.08mm) w = 13.1%
CT-13	■	100			

WATER CONTENT and LIMITS (%): W_P W W_L — 20 40 60 80



F 106 REFERENCE MATERIAL [illegible] MINTO [illegible] PLOTTED 2008-05-22 11:05hrs

SRK Consulting
Engineers and Scientists

BORING LOG

PROJECT : Minto Overburden Drilling Program 2008
SITE : Minto Mine Yukon Canada
FILE NO : MINTO (2CM022 003)
BORING DATE : 2008-03-29 TO 2008-04-01
DATUM : NAD83 Zone 8V
BOREHOLE : 08SWC280
PAGE : 2 OF 2
DRILL : Air Rotary
CORE BARREL : Triple tube (HQ)
COORDINATES : 6943950 00 N 383671 00 E

SAMPLE CONDITION	TYPE OF SAMPLER	LABORATORY AND IN SITU TEST	
Remoulded	SS Split spoon	PS Particle size analysis	Torvane (Su) intact
Undisturbed	ST Thin walled shelby tube	w Water content	(Sur) ◆ remoulded
Lost	PS Piston sampler	D Unit weight (kN/m³)	Ground Temperature
▮ Soil core	CT Core tube sample	k Permeability (cm/s)	

DEPTH - m	ELEVATION - m DEPTH - m	STRATIGRAPHY: DESCRIPTION	SYMBOL	WATER LEVEL - m	SAMPLES: TYPE AND NUMBER	CONDITION	RECOVERY %	N or RQD	WATER CONTENT and LIMITS (%) Wp W WL 20 40 60 80	LABORATORY and IN SITU TESTS	GROUND TEMPERATURE (°C) -5 0 5 / UNDRAINED SHEAR STRENGTH (kPa) 25 50 75
	19 81	weathered bedrock			CT-14	▮	100				
21	851 96 21 34	weathered bedrock				▮					
22	851 35 21 95	competent bedrock			CT-15	▮	100				
23	850 44 22 86	END OF LOGGING at 22 86m (Borehole Depth = 265 18m)									
24											
25											
26											
27											
28											
29											
30											
31											
32											
33											
34											
35											
36											
37											
38											
39											

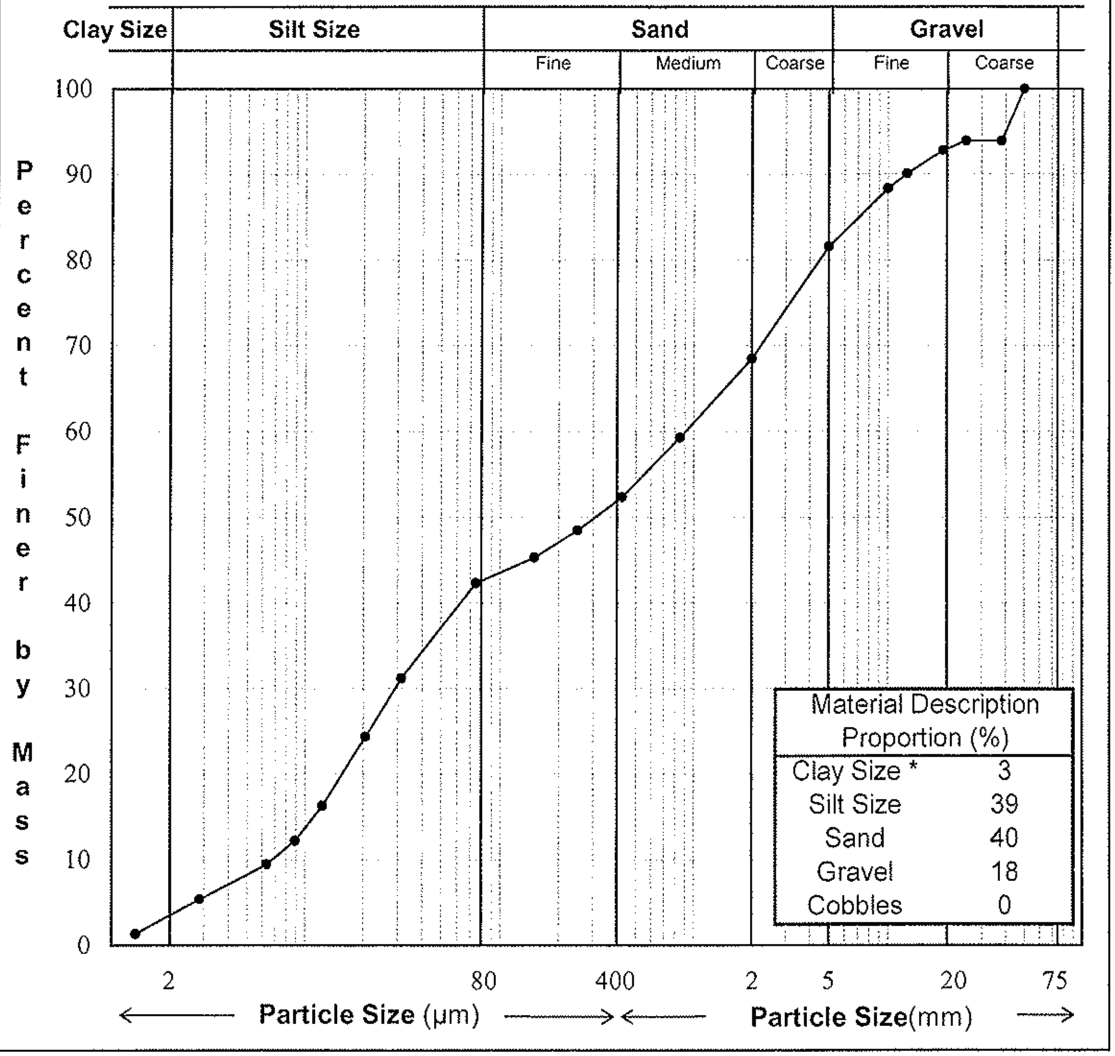
PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project: **Proposed Valley Dump**
Client: SRK Consulting Inc
Project No.: W14101068.006
Location: BH08-SWC270-S1
Sample No.: BH08-SWC270-S1
Depth: 10 - 11 ft
Description**: SAND AND SILT - some gravel, trace silt

Date Tested: 2008/04/23

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	100
38 mm	94
25 mm	94
19 mm	93
13 mm	90
10 mm	88
5 mm	82
2 mm	68
850 µm	59
425 µm	52
250 µm	48
150 µm	45
75 µm	42
31 µm	31
21 µm	24
12 µm	16
9 µm	12
6 µm	9
3 µm	5
1 µm	1



Material Description	Proportion (%)
Clay Size *	3
Silt Size	39
Sand	40
Gravel	18
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.
** The description is visually based & subject to EBA description protocols.

Reviewed By:

EBA Engineering
Consultants Ltd.

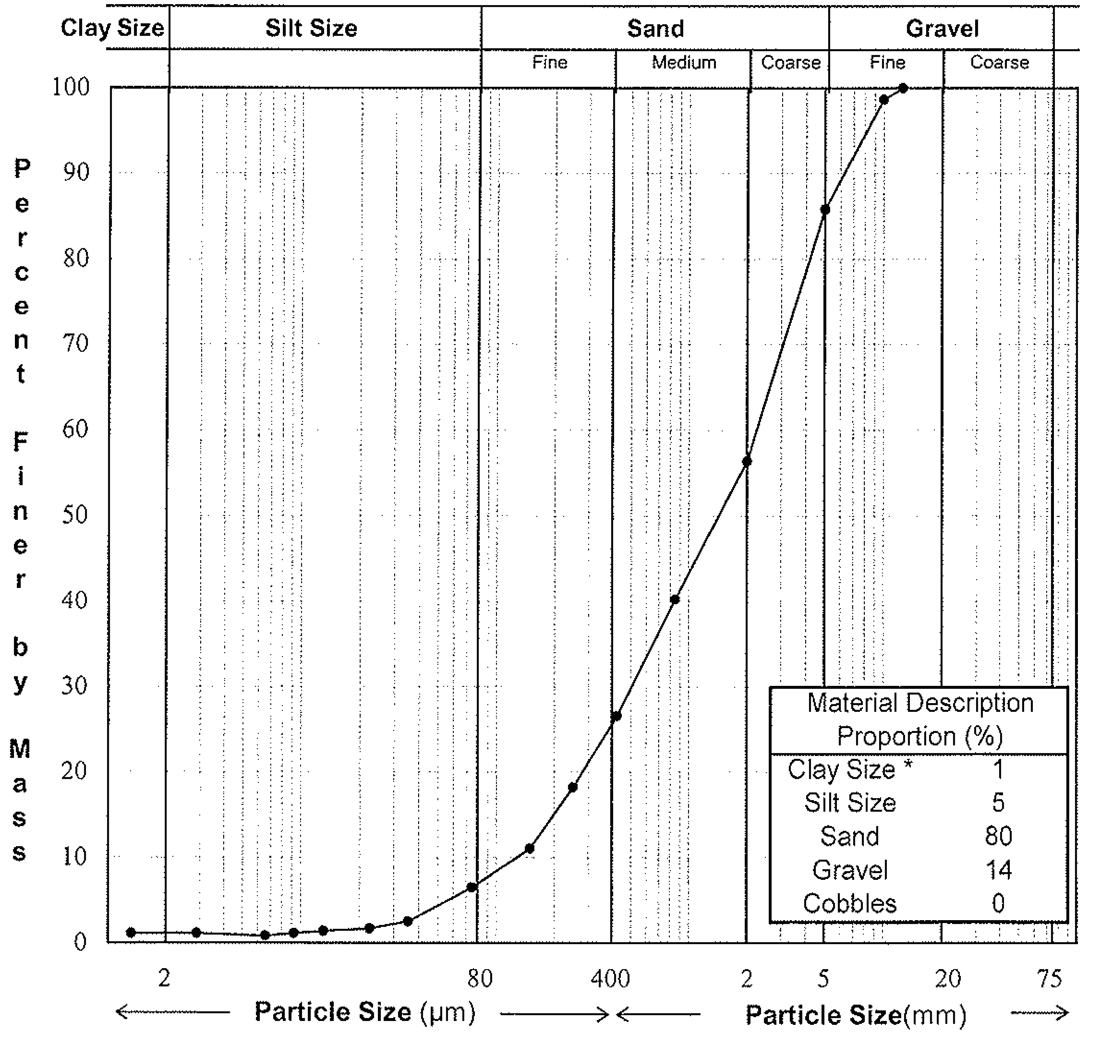
PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project: **Proposed Valley Dump**
Client: SRK Consulting Inc
Project No.: W14101068.006
Location: BH08-SWC270-S2
Sample No.: BH08-SWC270-S2
Depth: 31.2 - 32.2 ft
Description**: SAND - some gravel, trace silt, trace clay

Date Tested: 2008/04/23

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	100
10 mm	99
5 mm	86
2 mm	56
850 μm	40
425 μm	27
250 μm	18
150 μm	11
75 μm	7
36 μm	3
23 μm	2
13 μm	1
9 μm	1
7 μm	1
3 μm	1
1 μm	1



Material Description Proportion (%)	
Clay Size *	1
Silt Size	5
Sand	80
Gravel	14
Cobbles	0

Remarks: * The upper clay size of 2 μm, per the Canadian Foundation Engineering Manual.
** The description is visually based & subject to EBA description protocols.

Reviewed By:

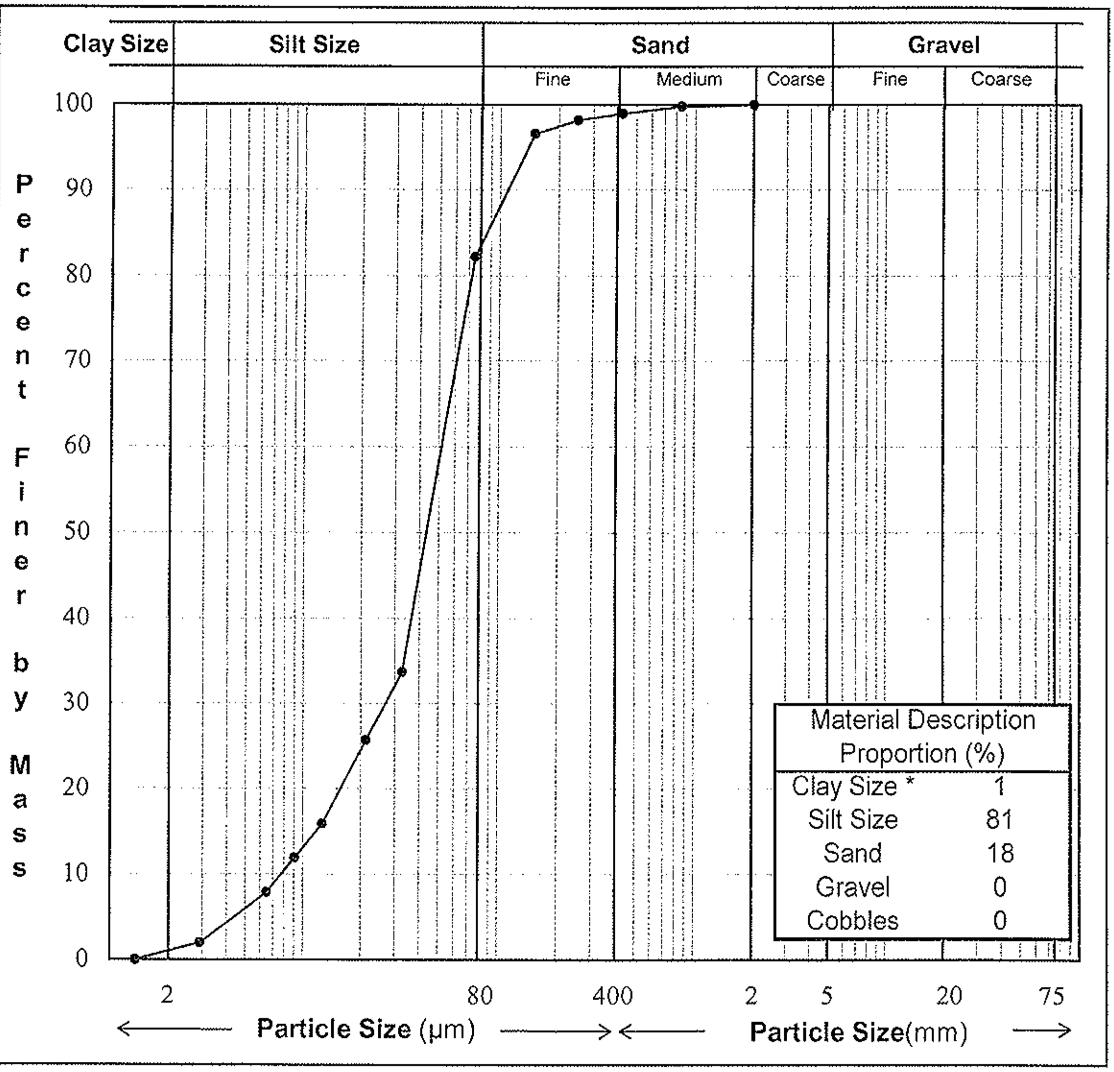
EBA Engineering Consultants Ltd.

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	**Proposed Valley Dump**	Date Tested:	2008/04/23
Client:	SRK Consulting Inc		
Project No.:	W14101068.006		
Location:	BH08-SWC271-S1		
Sample No.:	BH08-SWC271-S1		
Depth:	0.8 - 1.5 ft		
Description**:	SILT - some sand, trace clay		

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	
10 mm	
5 mm	
2 mm	100
850 µm	100
425 µm	99
250 µm	98
150 µm	97
75 µm	82
33 µm	34
21 µm	26
13 µm	16
9 µm	12
6 µm	8
3 µm	2
1 µm	0



Material Description	Proportion (%)
Clay Size *	1
Silt Size	81
Sand	18
Gravel	0
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.

** The description is visually based & subject to EBA description protocols.

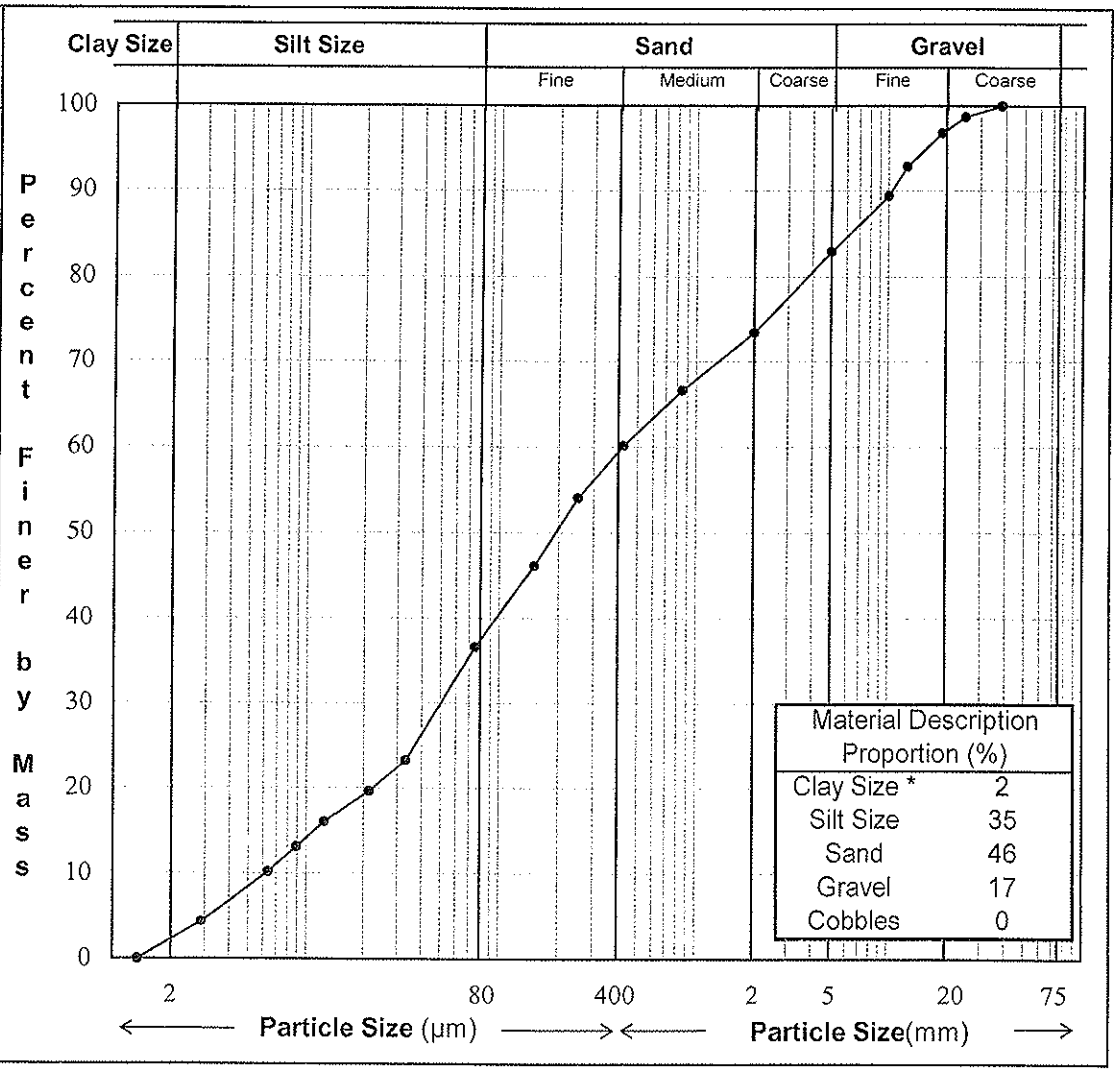
Reviewed By:

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project: **Proposed Valley Dump**
Date Tested: 2008/04/23
Client: SRK Consulting Inc
Project No.: W14101068.006
Location: BH08-SWC271-S4
Sample No.: BH08-SWC271-S4
Depth: 17.5 - 18.5 ft
Description**: SAND AND SILT - some gravel, trace clay

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	100
25 mm	99
19 mm	97
13 mm	93
10 mm	89
5 mm	83
2 mm	73
850 μm	67
425 μm	60
250 μm	54
150 μm	46
75 μm	37
33 μm	23
21 μm	20
12 μm	16
9 μm	13
6 μm	10
3 μm	4
1 μm	0



Material Description	Proportion (%)
Clay Size *	2
Silt Size	35
Sand	46
Gravel	17
Cobbles	0

Remarks: * The upper clay size of 2 μm, per the Canadian Foundation Engineering Manual.
** The description is visually based & subject to EBA description protocols.

Reviewed By:

EBA Engineering
Consultants Ltd.

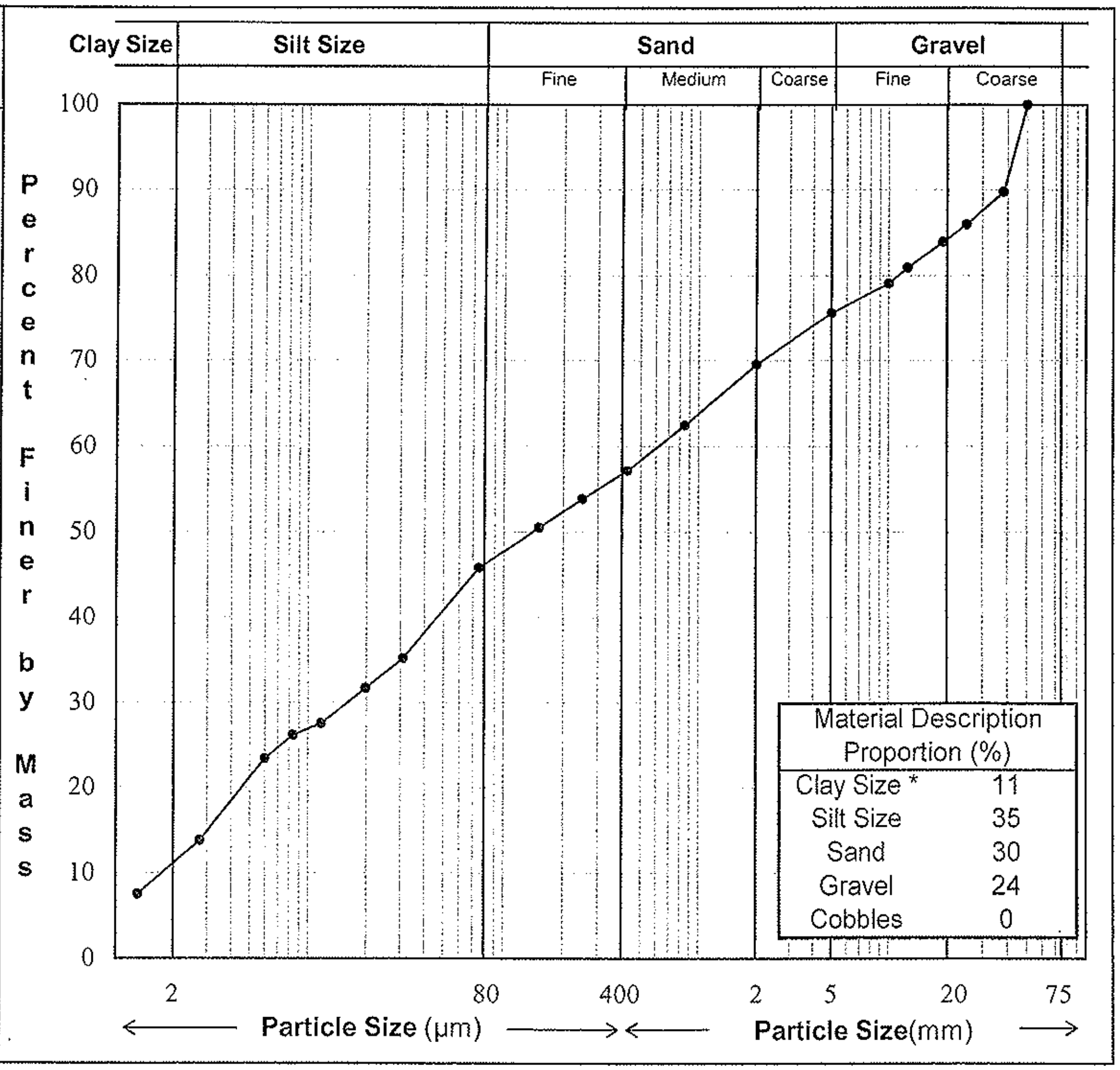
PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project: **Proposed Valley Dump**
Client: SRK Consulting Inc
Project No.: W14101068.006
Location: BH08-SWC271-S9
Sample No.: BH08-SWC271-S9
Depth: 82.5 - 83.5 ft
Description**: SILT - sandy, gravelly, some clay

Date Tested: 2008/04/23

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	100
38 mm	90
25 mm	86
19 mm	84
13 mm	81
10 mm	79
5 mm	76
2 mm	70
850 µm	62
425 µm	57
250 µm	54
150 µm	50
75 µm	46
31 µm	35
20 µm	32
12 µm	28
8 µm	26
6 µm	23
3 µm	14
1 µm	8



Material Description	Proportion (%)
Clay Size *	11
Silt Size	35
Sand	30
Gravel	24
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.
** The description is visually based & subject to EBA description protocols.

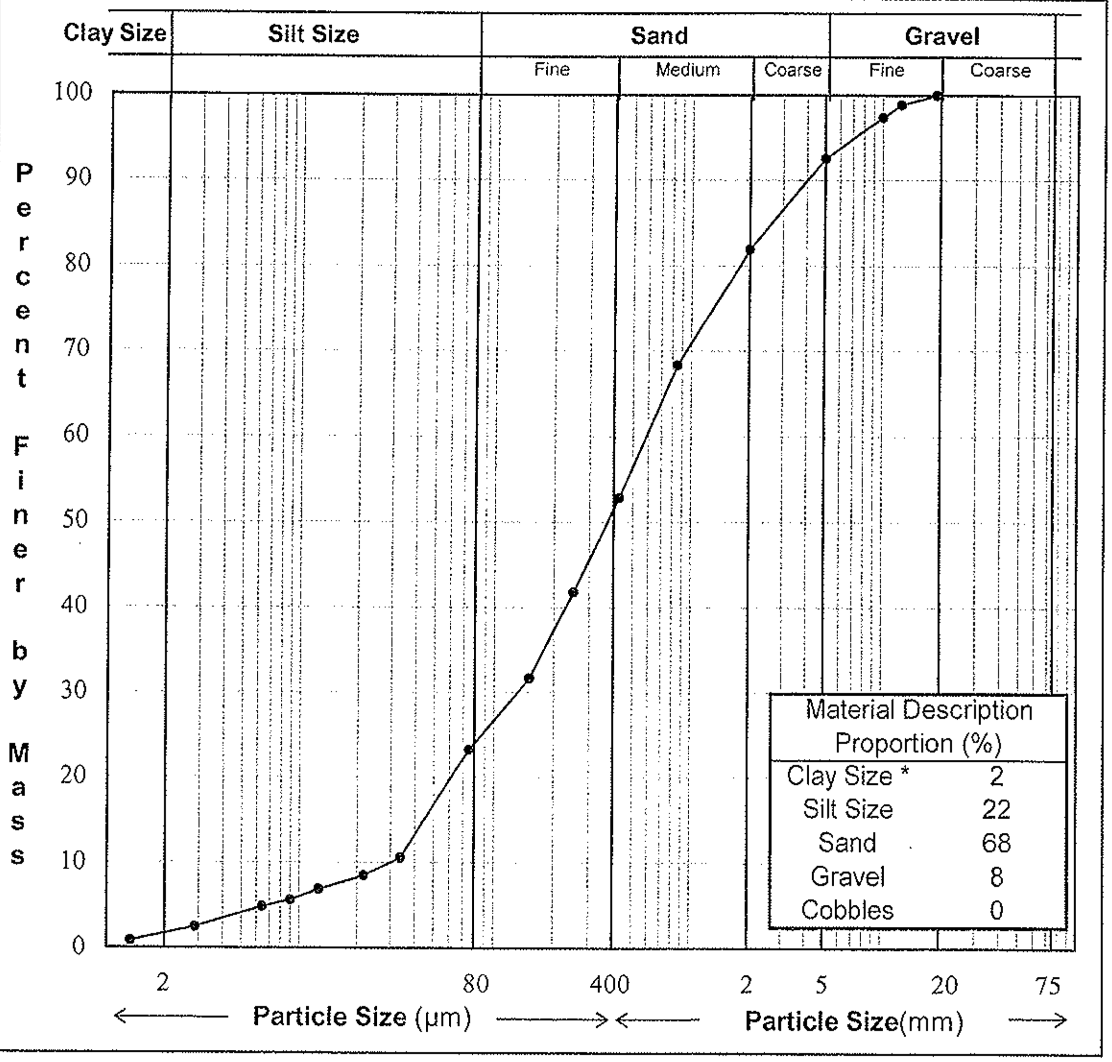
Reviewed By:

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	**Proposed Valley Dump**	Date Tested:	2008/04/23
Client:	SRK Consulting Inc		
Project No.:	W14101068.006		
Location:	BH08-SWC272-S1		
Sample No.:	BH08-SWC272-S1		
Depth:	4.0 - 5.0 ft		
Description**:	SAND - silty, trace gravel, trace clay		

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	100
13 mm	99
10 mm	97
5 mm	93
2 mm	82
850 µm	68
425 µm	53
250 µm	42
150 µm	32
75 µm	23
34 µm	11
22 µm	9
13 µm	7
9 µm	6
6 µm	5
3 µm	2
1 µm	1



Material Description	Proportion (%)
Clay Size *	2
Silt Size	22
Sand	68
Gravel	8
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.
** The description is visually based & subject to EBA description protocols.

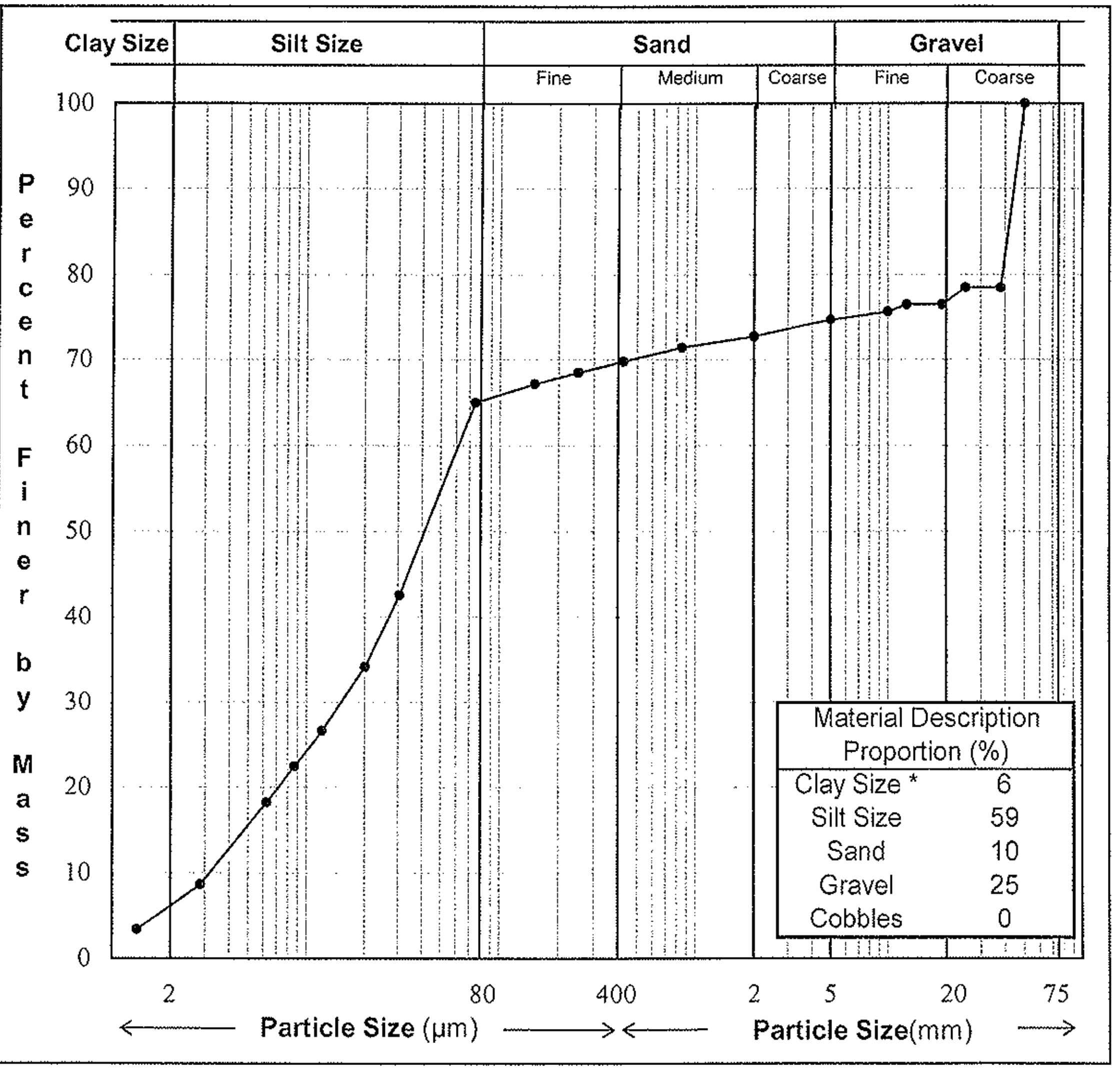
Reviewed By:

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	**Proposed Valley Dump**	Date Tested:	2008/04/23
Client:	SRK Consulting Inc		
Project No.:	W14101068.006		
Location:	BH08-SWC272-S4		
Sample No.:	BH08-SWC272-S4		
Depth:	37 - 38 ft		
Description**:	SILT - gravelly, trace sand, trace clay		

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	100
38 mm	78
25 mm	78
19 mm	77
13 mm	77
10 mm	76
5 mm	75
2 mm	73
850 μm	71
425 μm	70
250 μm	69
150 μm	67
75 μm	65
31 μm	43
20 μm	34
12 μm	27
9 μm	22
6 μm	18
3 μm	9
1 μm	3



Material Description Proportion (%)	
Clay Size *	6
Silt Size	59
Sand	10
Gravel	25
Cobbles	0

Remarks: * The upper clay size of 2 μm, per the Canadian Foundation Engineering Manual.
** The description is visually based & subject to EBA description protocols.

Reviewed By:

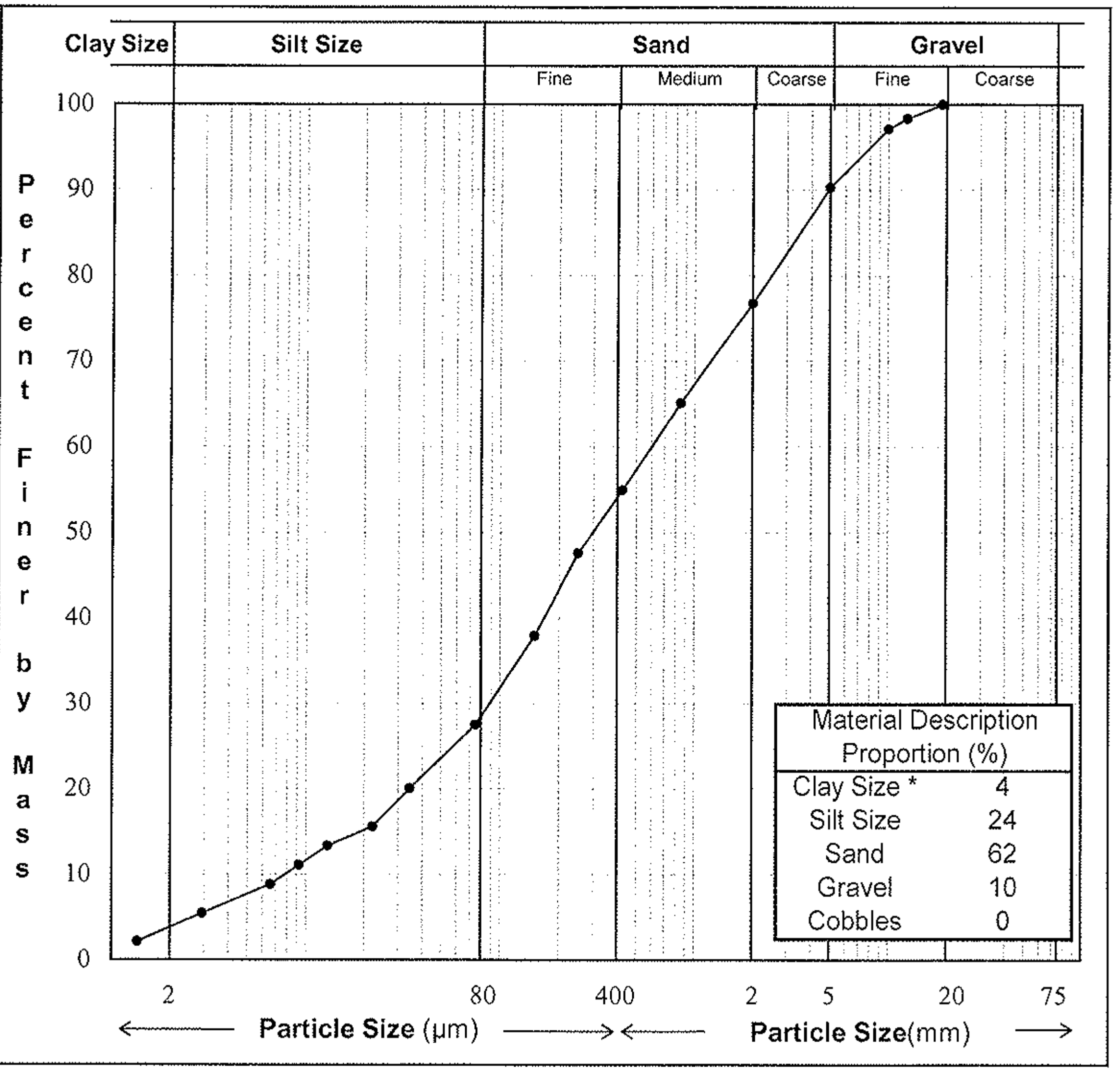
EBA Engineering
Consultants Ltd.

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	**Proposed Valley Dump**	Date Tested:	2008/04/23
Client:	SRK Consulting Inc		
Project No.:	W14101068.006		
Location:	BH08-SWC272-S5		
Sample No.:	BH08-SWC272-S5		
Depth:	40 - 41 ft		
Description**:	SAND - silty, some gravel, trace clay		

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	100
13 mm	98
10 mm	97
5 mm	90
2 mm	77
850 µm	65
425 µm	55
250 µm	48
150 µm	38
75 µm	27
35 µm	20
22 µm	16
13 µm	13
9 µm	11
7 µm	9
3 µm	5
1 µm	2



Material Description Proportion (%)	
Clay Size *	4
Silt Size	24
Sand	62
Gravel	10
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.

** The description is visually based & subject to EBA description protocols.

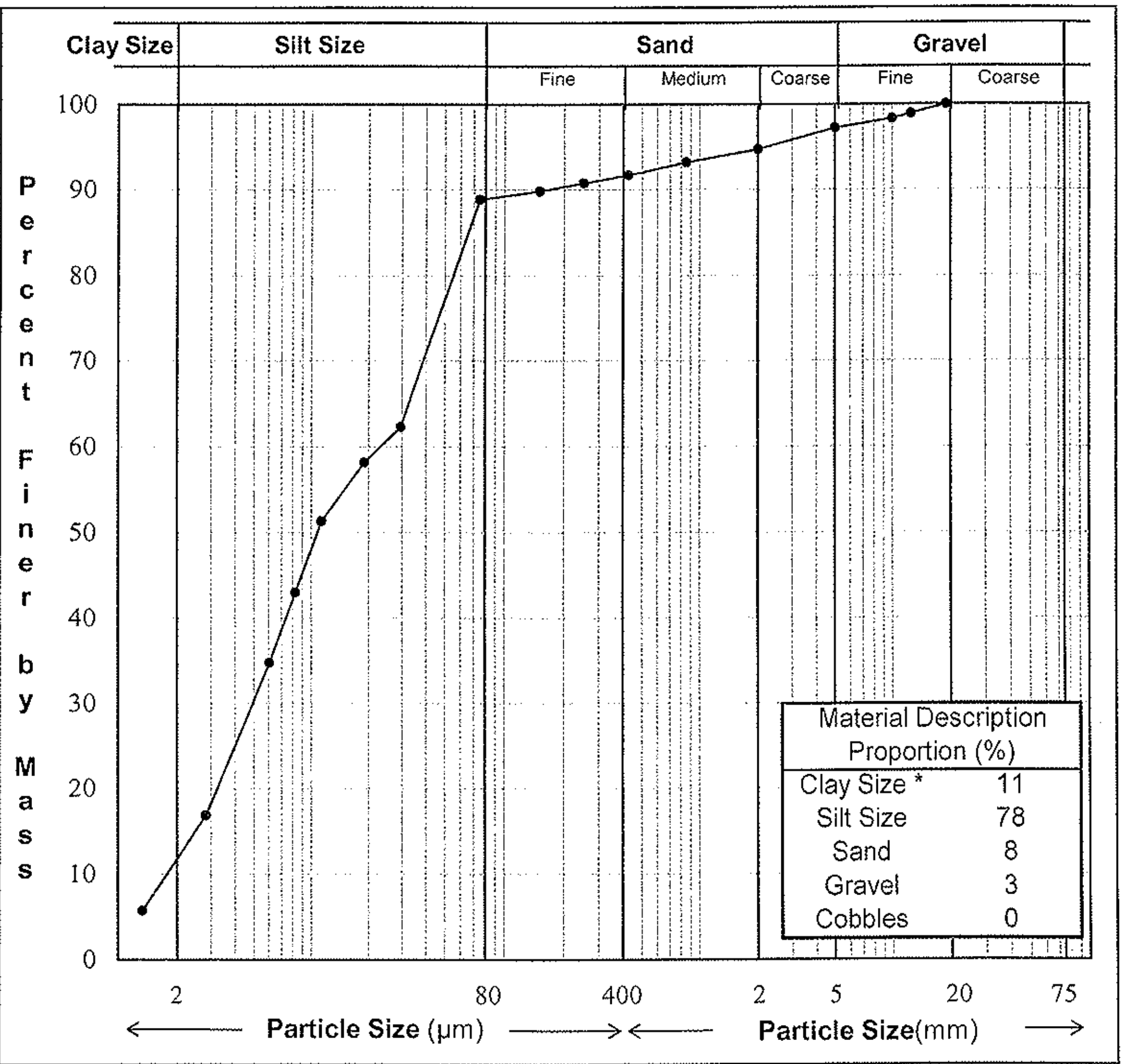
Reviewed By:

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project: **Proposed Valley Dump**
Date Tested: 2008/04/23
Client: SRK Consulting Inc
Project No.: W14101068.006
Location: BH08-SWC272-S9
Sample No.: BH08-SWC272-S9
Depth: 72 - 73 ft
Description**: SILT - trace sand, some clay, trace gravel

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	100
13 mm	99
10 mm	98
5 mm	97
2 mm	95
850 µm	93
425 µm	92
250 µm	91
150 µm	90
75 µm	89
30 µm	62
19 µm	58
11 µm	51
8 µm	43
6 µm	35
3 µm	17
1 µm	6



Material Description	Proportion (%)
Clay Size *	11
Silt Size	78
Sand	8
Gravel	3
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.
** The description is visually based & subject to EBA description protocols.

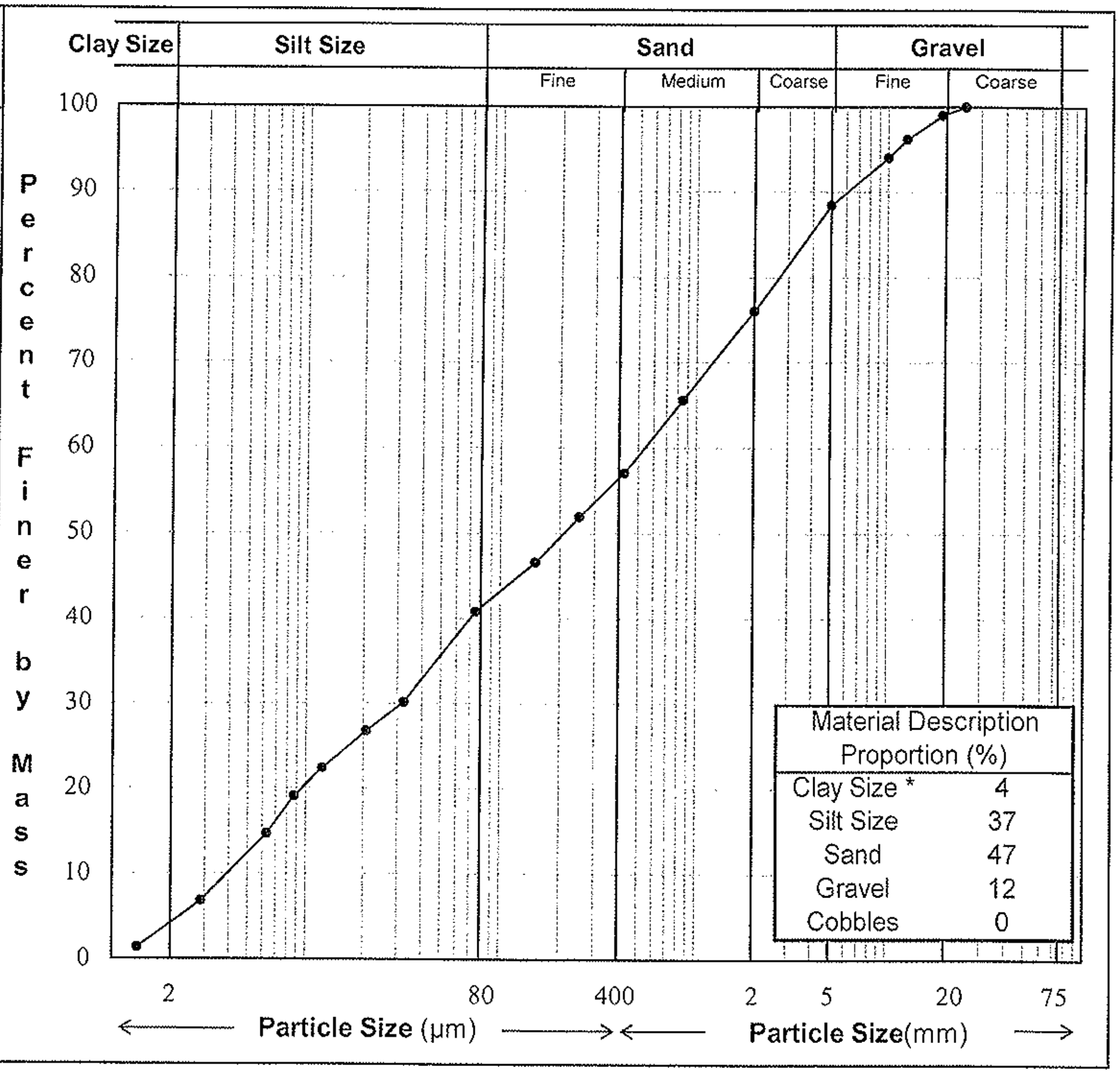
Reviewed By:

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project: **Proposed Valley Dump**
Date Tested: 2008/04/23
Client: SRK Consulting Inc
Project No.: W14101068.006
Location: BH08-SWC272-S11
Sample No.: BH08-SWC272-S11
Depth: 83 - 84 ft
Description**: SAND AND SILT - some gravel, trace clay

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	100
19 mm	99
13 mm	96
10 mm	94
5 mm	88
2 mm	76
850 µm	66
425 µm	57
250 µm	52
150 µm	47
75 µm	41
32 µm	30
21 µm	27
12 µm	22
9 µm	19
6 µm	15
3 µm	7
1 µm	1



Material Description	Proportion (%)
Clay Size *	4
Silt Size	37
Sand	47
Gravel	12
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.
** The description is visually based & subject to EBA description protocols.

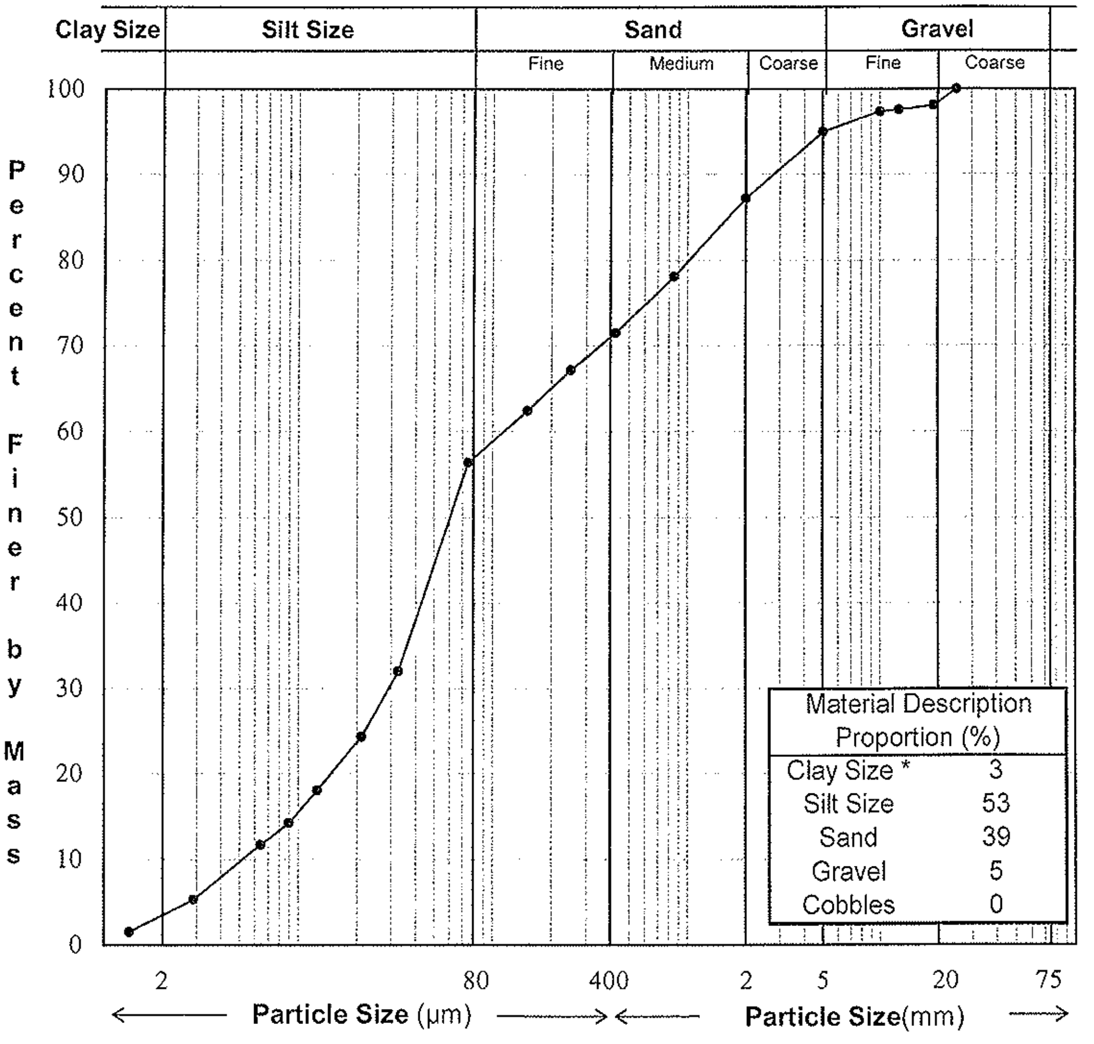
Reviewed By: ______________________

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project: **Proposed Valley Dump**
Date Tested: 2008/04/23
Client: SRK Consulting Inc
Project No.: W14101068.006
Location: BH08-SWC273-S1
Sample No.: BH08-SWC273-S1
Depth: 2.5 - 3.0 ft
Description**: SILT AND SAND - trace gravel, trace clay

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	100
19 mm	98
13 mm	98
10 mm	97
5 mm	95
2 mm	87
850 μm	78
425 μm	72
250 μm	67
150 μm	62
75 μm	56
33 μm	32
21 μm	24
13 μm	18
9 μm	14
6 μm	12
3 μm	5
1 μm	2



Material Description	Proportion (%)
Clay Size *	3
Silt Size	53
Sand	39
Gravel	5
Cobbles	0

Remarks: * The upper clay size of 2 μm, per the Canadian Foundation Engineering Manual.
** The description is visually based & subject to EBA description protocols.

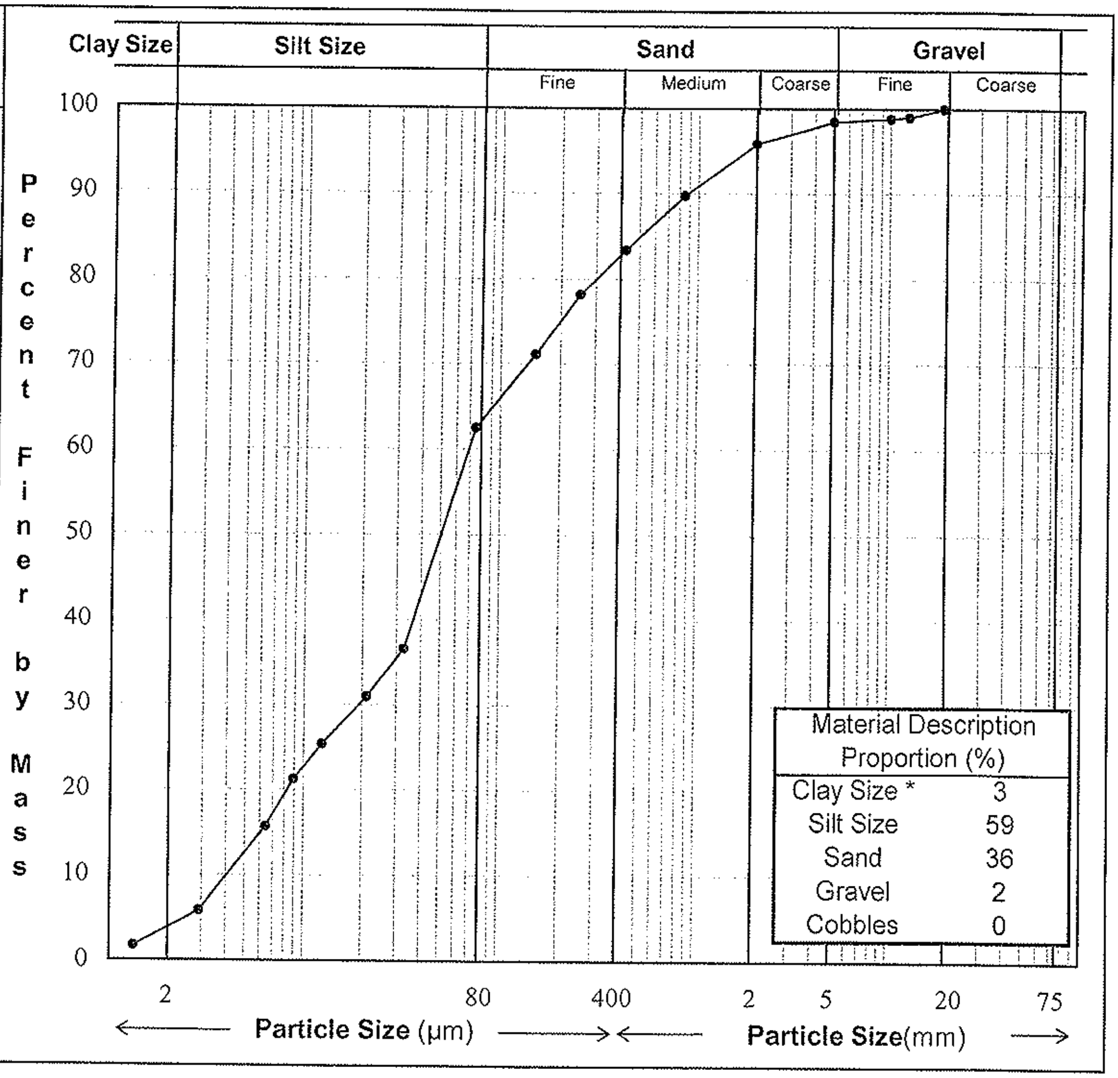
Reviewed By:

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	**Proposed Valley Dump**	Date Tested:	2008/04/23
Client:	SRK Consulting Inc		
Project No.:	W14101068.006		
Location:	BH08-SWC273-S5		
Sample No.:	BH08-SWC273-S5		
Depth:	48 - 48.5 ft		
Description**:	SILT AND SAND - trace clay, trace gravel		

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	100
13 mm	99
10 mm	99
5 mm	98
2 mm	96
850 µm	90
425 µm	83
250 µm	78
150 µm	71
75 µm	63
33 µm	37
21 µm	31
12 µm	25
9 µm	21
6 µm	16
3 µm	6
1 µm	2



Material Description	Proportion (%)
Clay Size *	3
Silt Size	59
Sand	36
Gravel	2
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.
** The description is visually based & subject to EBA description protocols.

Reviewed By:

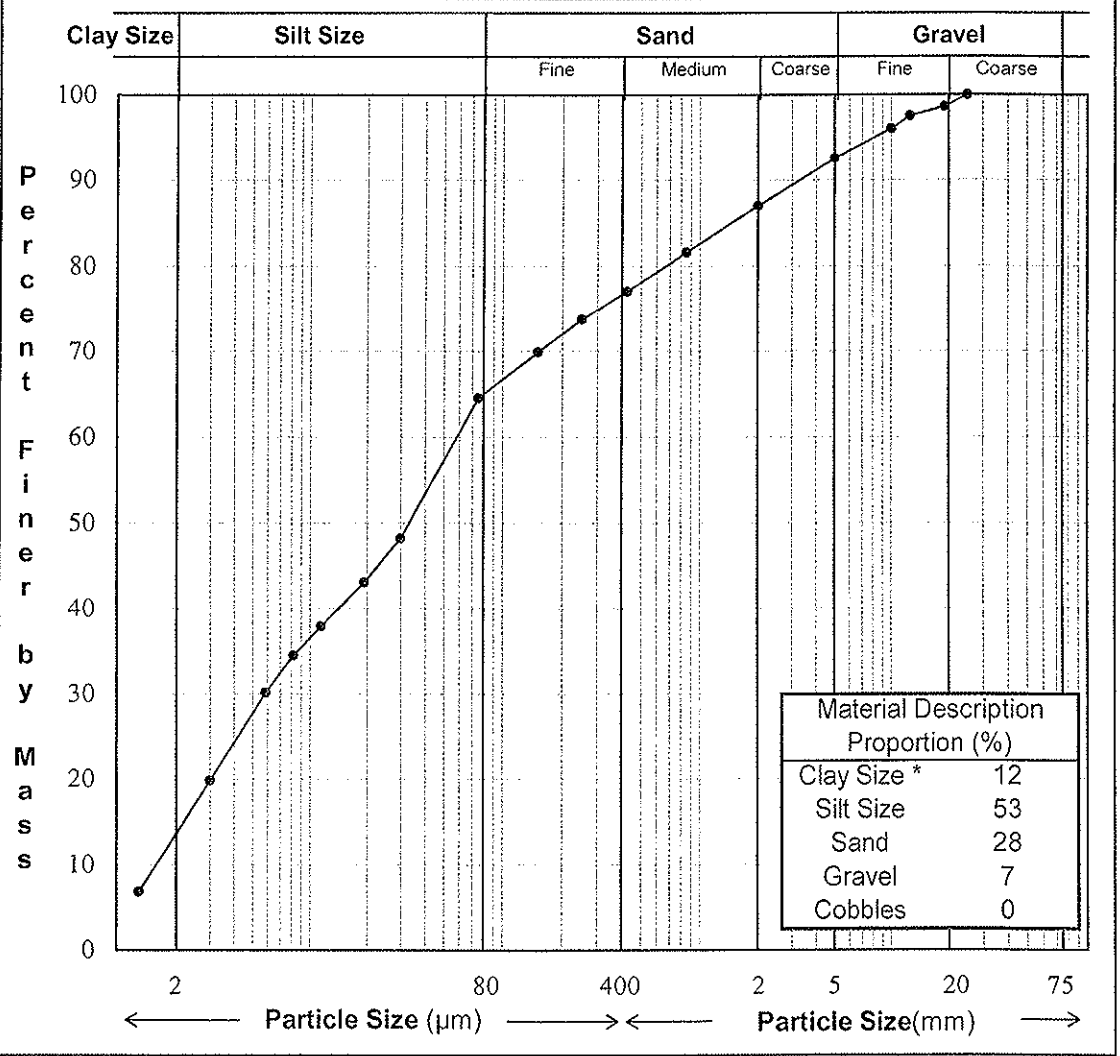
PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	**Proposed Valley Dump**
Client:	SRK Consulting Inc
Project No.:	W14101068.006
Location:	BH08-SWC273-S8
Sample No.:	BH08-SWC273-S8
Depth:	73 - 74 ft
Description**:	SILT - sandy, some clay, trace gravel

Date Tested: 2008/04/23

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	100
19 mm	99
13 mm	98
10 mm	96
5 mm	93
2 mm	87
850 μm	82
425 μm	77
250 μm	74
150 μm	70
75 μm	65
30 μm	48
19 μm	43
11 μm	38
8 μm	34
6 μm	30
3 μm	20
1 μm	7



Material Description	Proportion (%)
Clay Size *	12
Silt Size	53
Sand	28
Gravel	7
Cobbles	0

Remarks: * The upper clay size of 2 μm, per the Canadian Foundation Engineering Manual.

** The description is visually based & subject to EBA description protocols.

Reviewed By:

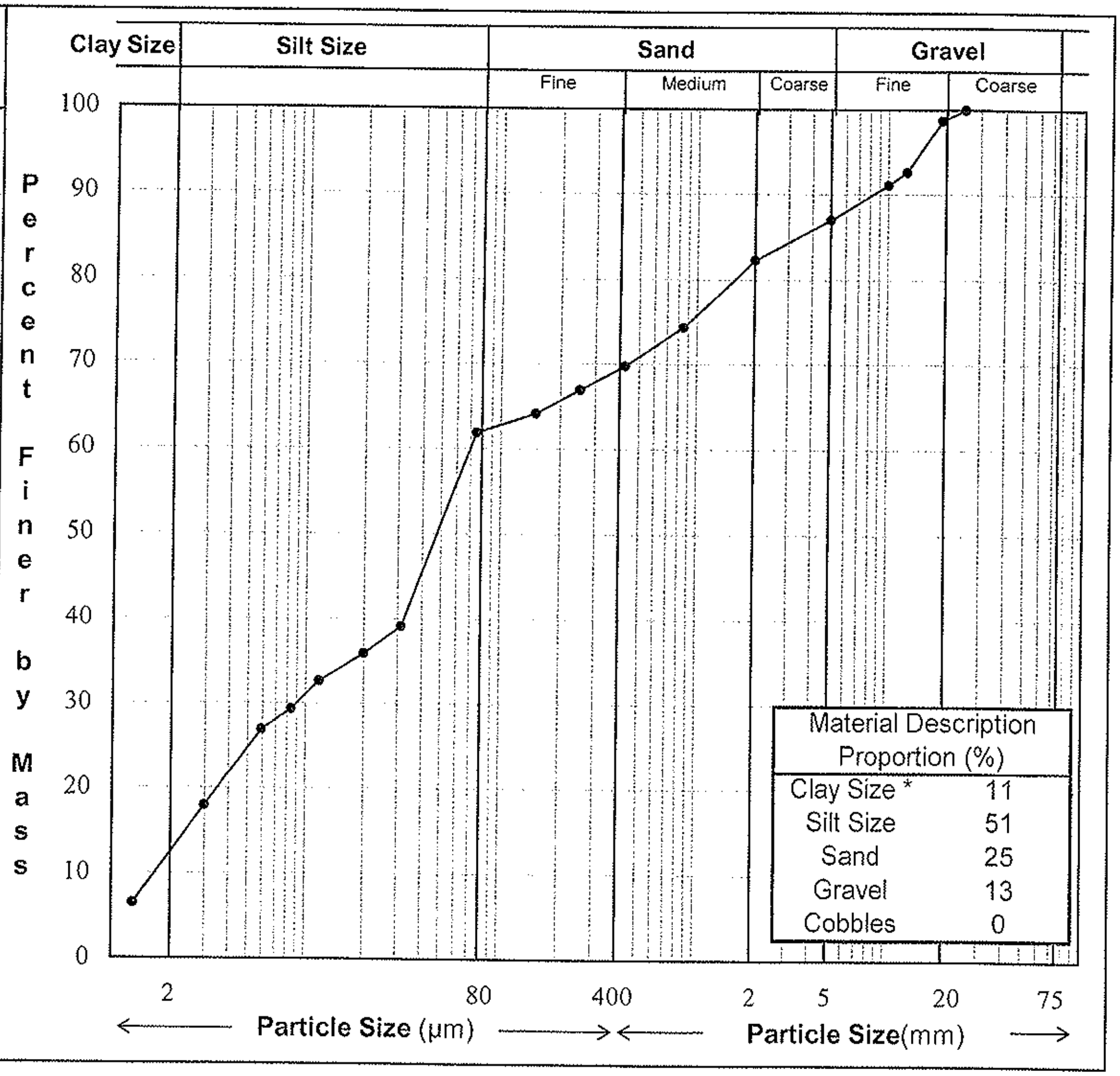
EBA Engineering
Consultants Ltd.

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	**Proposed Valley Dump**	Date Tested:	2008/04/23
Client:	SRK Consulting Inc		
Project No.:	W14101068.006		
Location:	BH08-SWC273-S14		
Sample No.:	BH08-SWC273-S14		
Depth:	126 - 127 ft		
Description**:	SILT - sandy, some gravel, some clay		

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	100
19 mm	99
13 mm	93
10 mm	91
5 mm	87
2 mm	82
850 µm	74
425 µm	70
250 µm	67
150 µm	64
75 µm	62
31 µm	39
20 µm	36
12 µm	33
8 µm	29
6 µm	27
3 µm	18
1 µm	7



Material Description	Proportion (%)
Clay Size *	11
Silt Size	51
Sand	25
Gravel	13
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.

** The description is visually based & subject to EBA description protocols.

Reviewed By:

EBA Engineering
Consultants Ltd.

PARTICLE SIZE DISTRIBUTION

ASTM C136 & D422

Project: **Proposed Valley Dump**

Project Number: W14101068.006

Date Tested: 4/23/2008

Borehole Number: 08-SWC273-S20

Depth: 169.5 - 170.1 ft

Soil Description: SAND - gravelly, trace silt

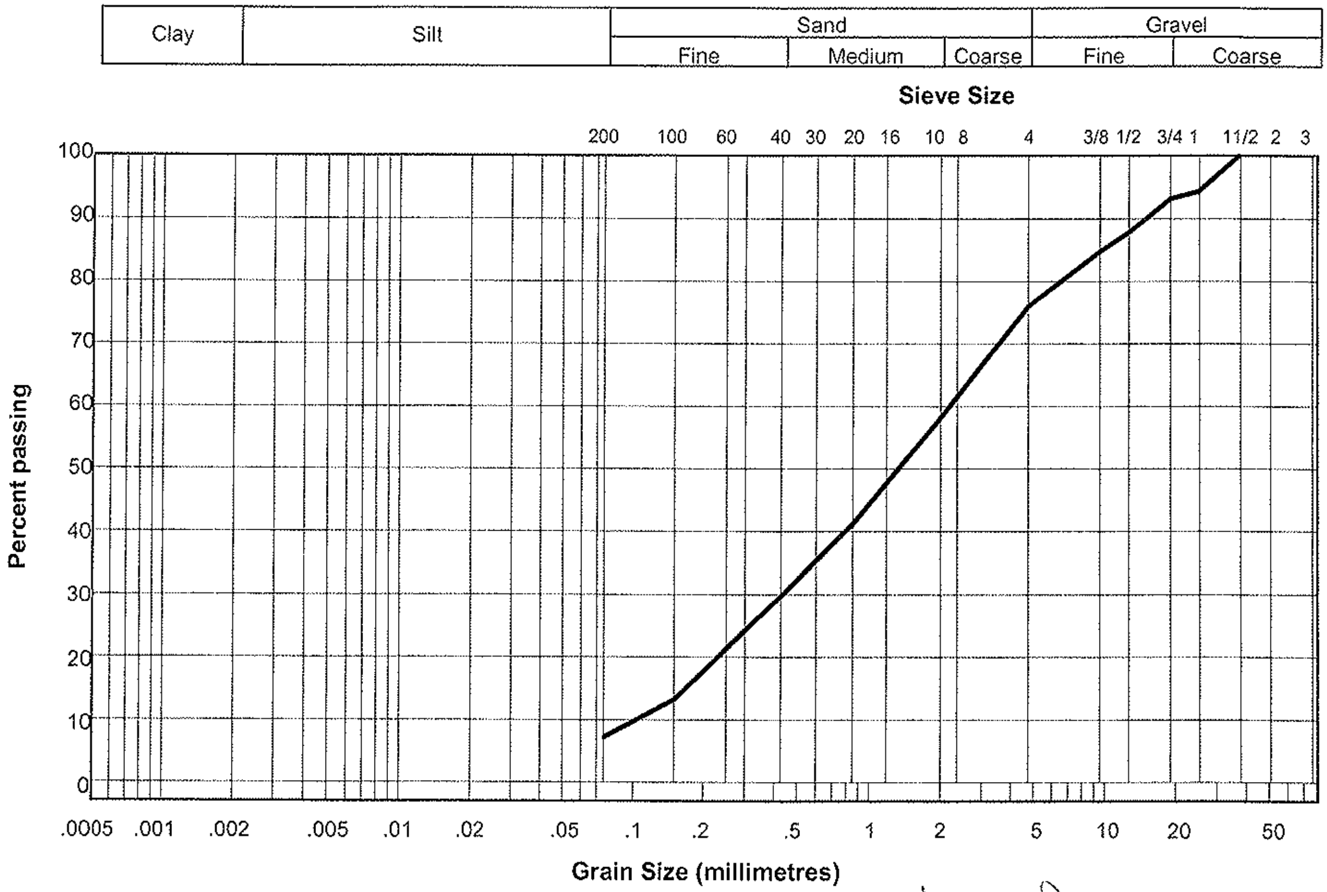
Cu: N/A

Cc: N/A

Natural Moisture Content: 17.8%

Remarks:

Sieve Size	Percent Passing
50.000	#N/A
37.500	100
25.000	94
19.000	93
12.500	88
9.500	85
4.750	76
2.000	58
0.850	41
0.425	30
0.250	21
0.150	13
0.075	7.3



Reviewed By:

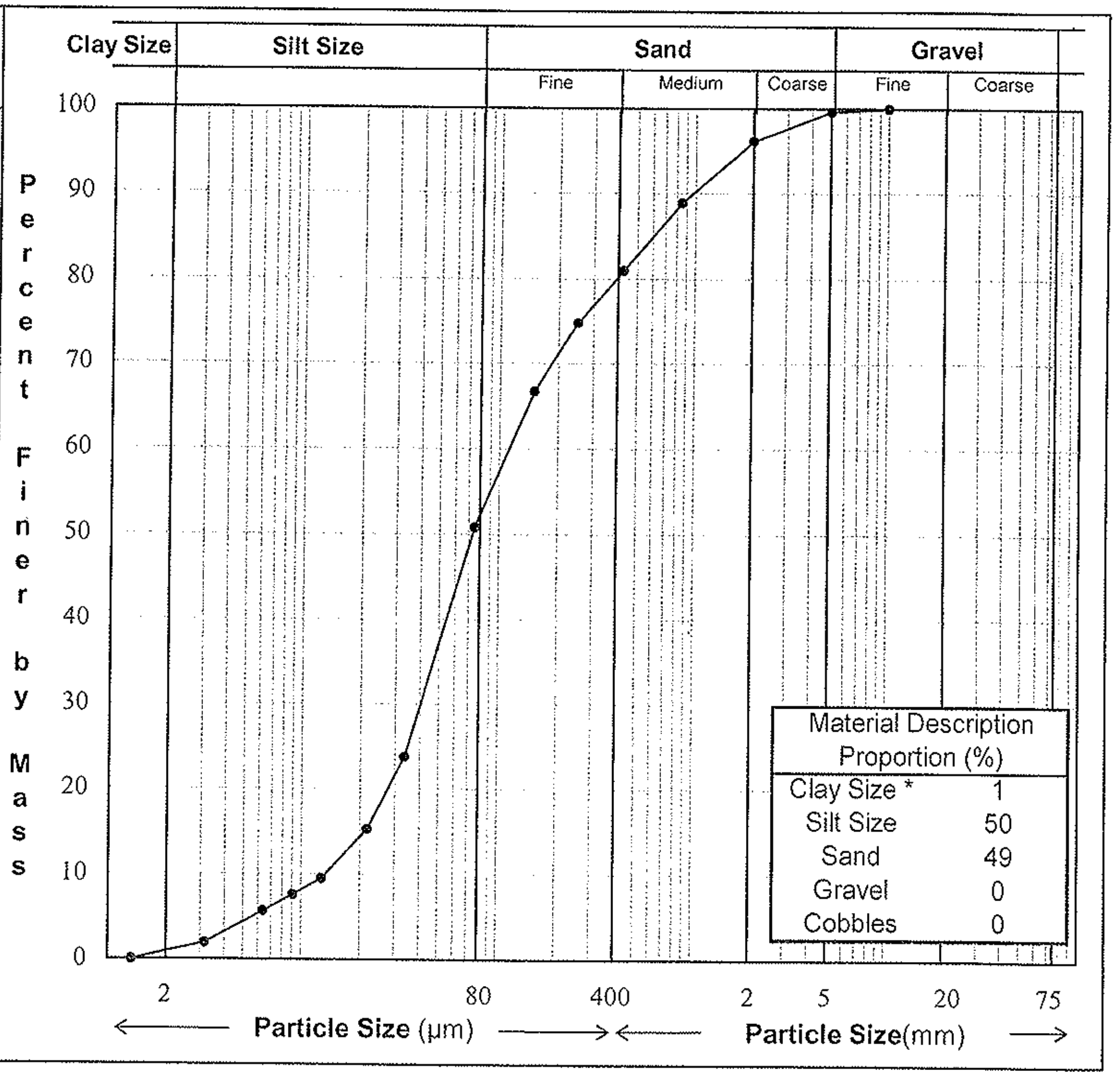
PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project: **Proposed Valley Dump**
Client: SRK Consulting Inc
Project No.: W14101068.006
Location: BH08-SWC274-S1
Sample No.: BH08-SWC274-S1
Depth: 10 - 11 ft
Description**: SAIL AND SAND - trace clay

Date Tested: 2008/04/23

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	
10 mm	100
5 mm	100
2 mm	96
850 µm	89
425 µm	81
250 µm	75
150 µm	67
75 µm	51
33 µm	24
22 µm	15
13 µm	10
9 µm	8
6 µm	6
3 µm	2
1 µm	0



Material Description	Proportion (%)
Clay Size *	1
Silt Size	50
Sand	49
Gravel	0
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.
** The description is visually based & subject to EBA description protocols.

Reviewed By:

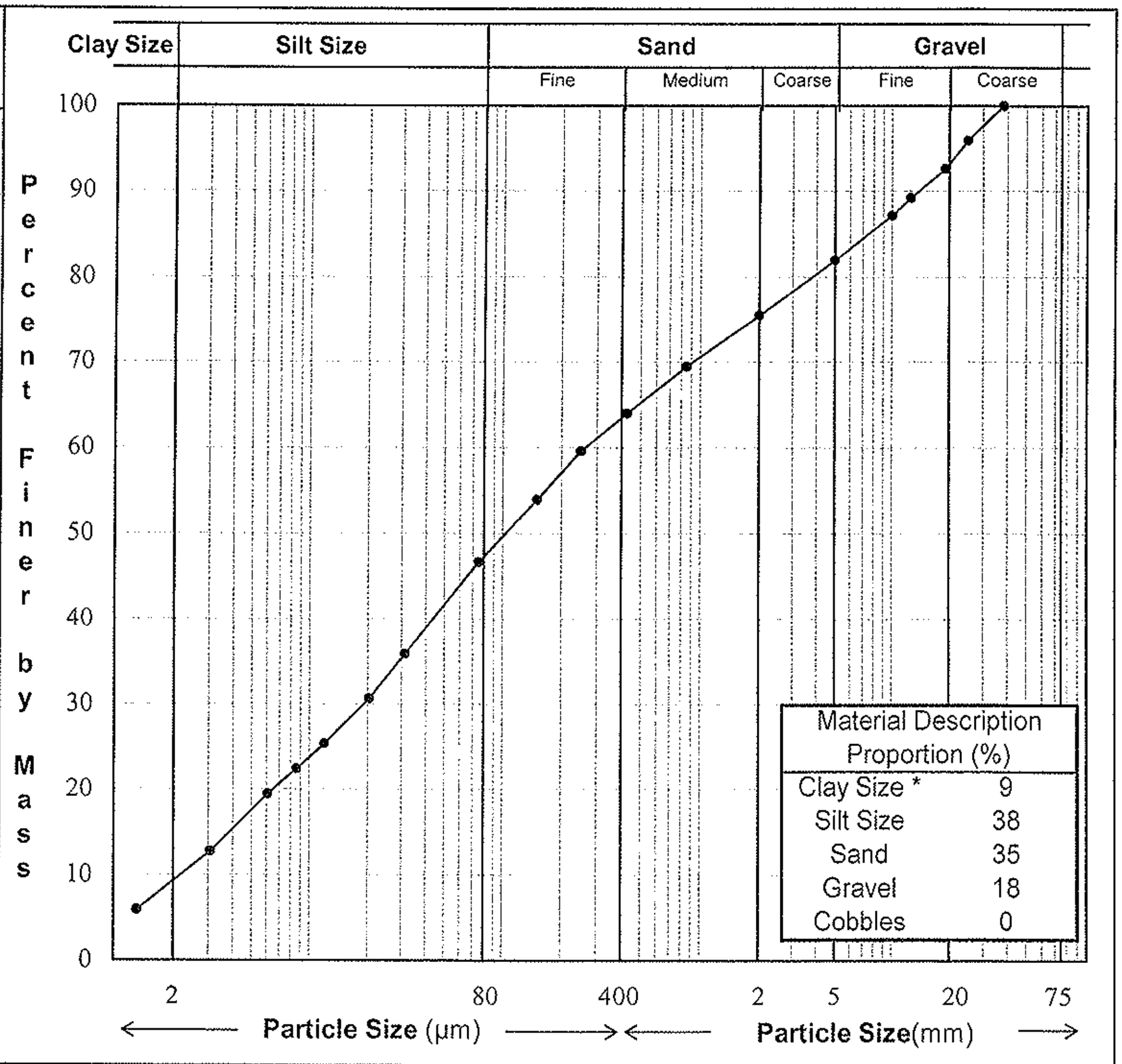
PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project: **Proposed Valley Dump**
Client: SRK Consulting Inc
Project No.: W14101068.006
Location: BH08-SWC274-S8
Sample No.: BH08-SWC274-S8
Depth: 71 - 72 ft
Description**: SILT AND SAND - some gravel, trace clay

Date Tested: 2008/04/23

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	100
25 mm	96
19 mm	93
13 mm	89
10 mm	87
5 mm	82
2 mm	75
850 µm	69
425 µm	64
250 µm	60
150 µm	54
75 µm	47
31 µm	36
20 µm	31
12 µm	25
9 µm	22
6 µm	19
3 µm	13
1 µm	6



Material Description	Proportion (%)
Clay Size *	9
Silt Size	38
Sand	35
Gravel	18
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.
** The description is visually based & subject to EBA description protocols.

Reviewed By:

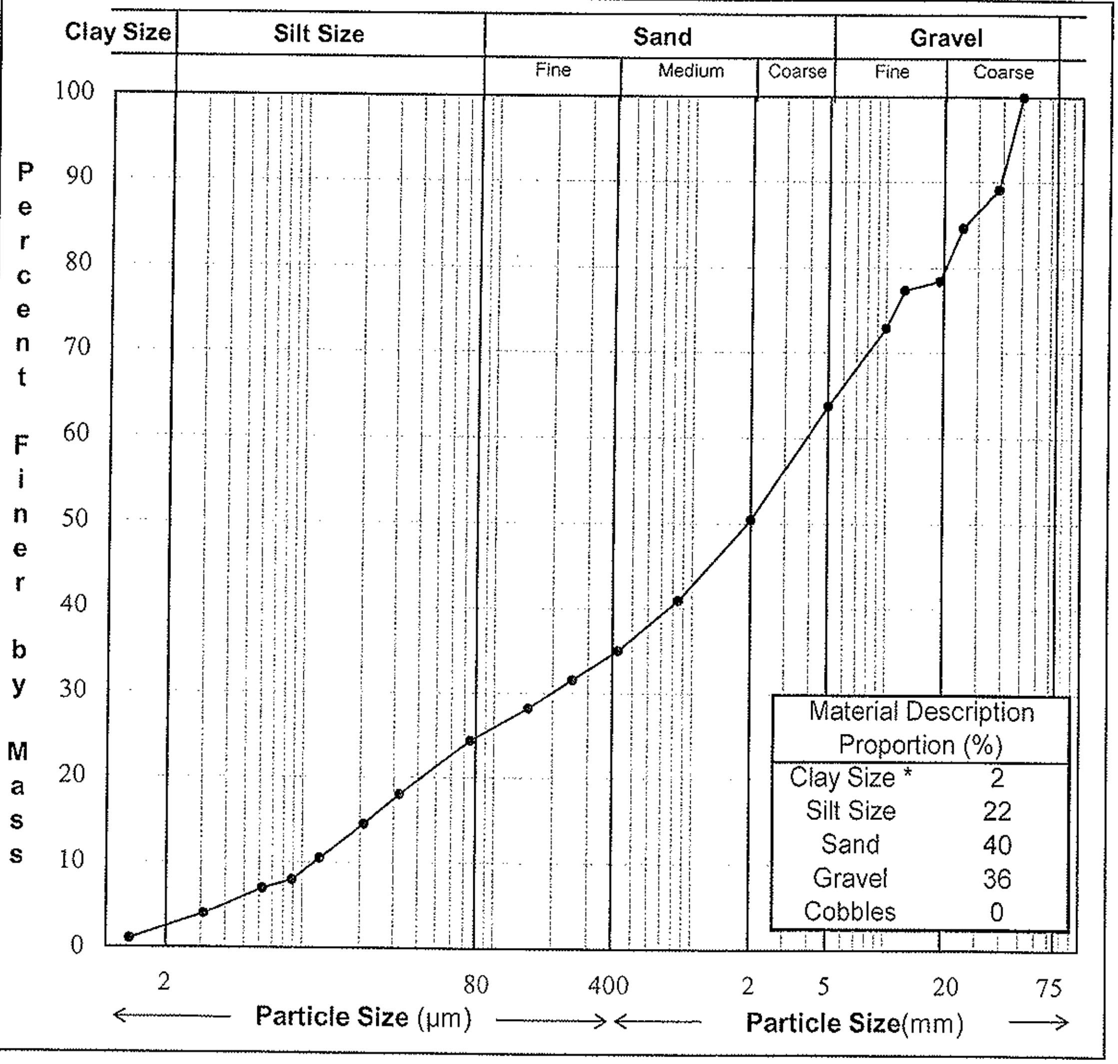
PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project: **Proposed Valley Dump**
Client: SRK Consulting Inc
Project No.: W14101068.006
Location: BH08-SWC274-S18
Sample No.: BH08-SWC274-S18
Depth: 115 - 116 ft
Description**: SAND AND GRAVEL - silty, trace clay

Date Tested: 2008/04/23

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	100
38 mm	89
25 mm	85
19 mm	78
13 mm	77
10 mm	73
5 mm	64
2 mm	50
850 µm	41
425 µm	35
250 µm	32
150 µm	28
75 µm	24
32 µm	18
21 µm	14
12 µm	10
9 µm	8
6 µm	7
3 µm	4
1 µm	1



Material Description	Proportion (%)
Clay Size *	2
Silt Size	22
Sand	40
Gravel	36
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.
** The description is visually based & subject to EBA description protocols.

Reviewed By:

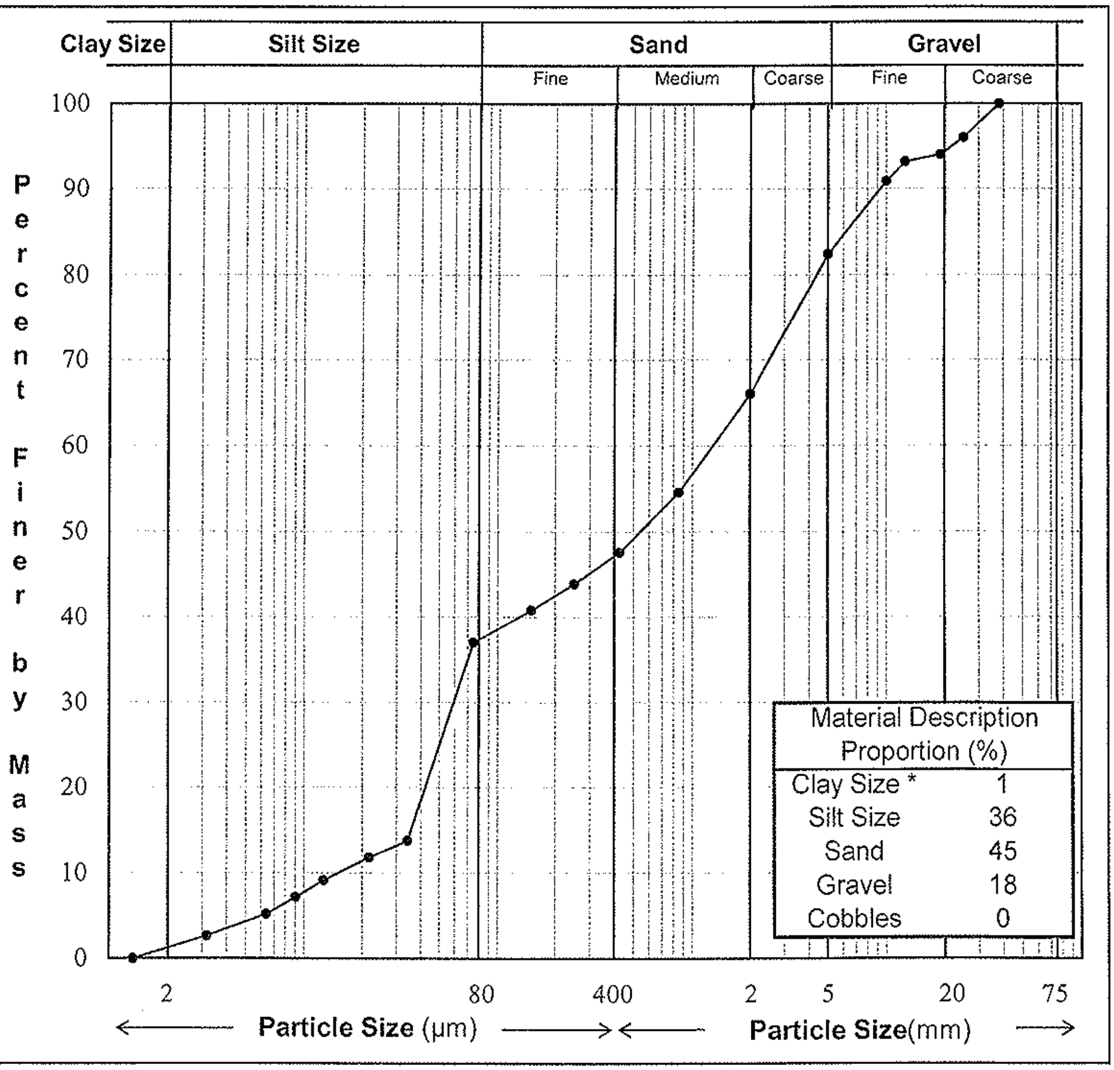
EBA Engineering
Consultants Ltd.

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	**Proposed Valley Dump**	Date Tested:	2008/04/23
Client:	SRK Consulting Inc		
Project No.:	W14101068.006		
Location:	BH08-SWC274-S20		
Sample No.:	BH08-SWC274-S20		
Depth:	126 - 124 ft		
Description**:	SAND AND SILT - some gravel, trace clay		

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	100
25 mm	96
19 mm	94
13 mm	93
10 mm	91
5 mm	82
2 mm	66
850 µm	55
425 µm	48
250 µm	44
150 µm	41
75 µm	37
34 µm	14
22 µm	12
13 µm	9
9 µm	7
6 µm	5
3 µm	3
1 µm	0



Material Description	Proportion (%)
Clay Size *	1
Silt Size	36
Sand	45
Gravel	18
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.

** The description is visually based & subject to EBA description protocols.

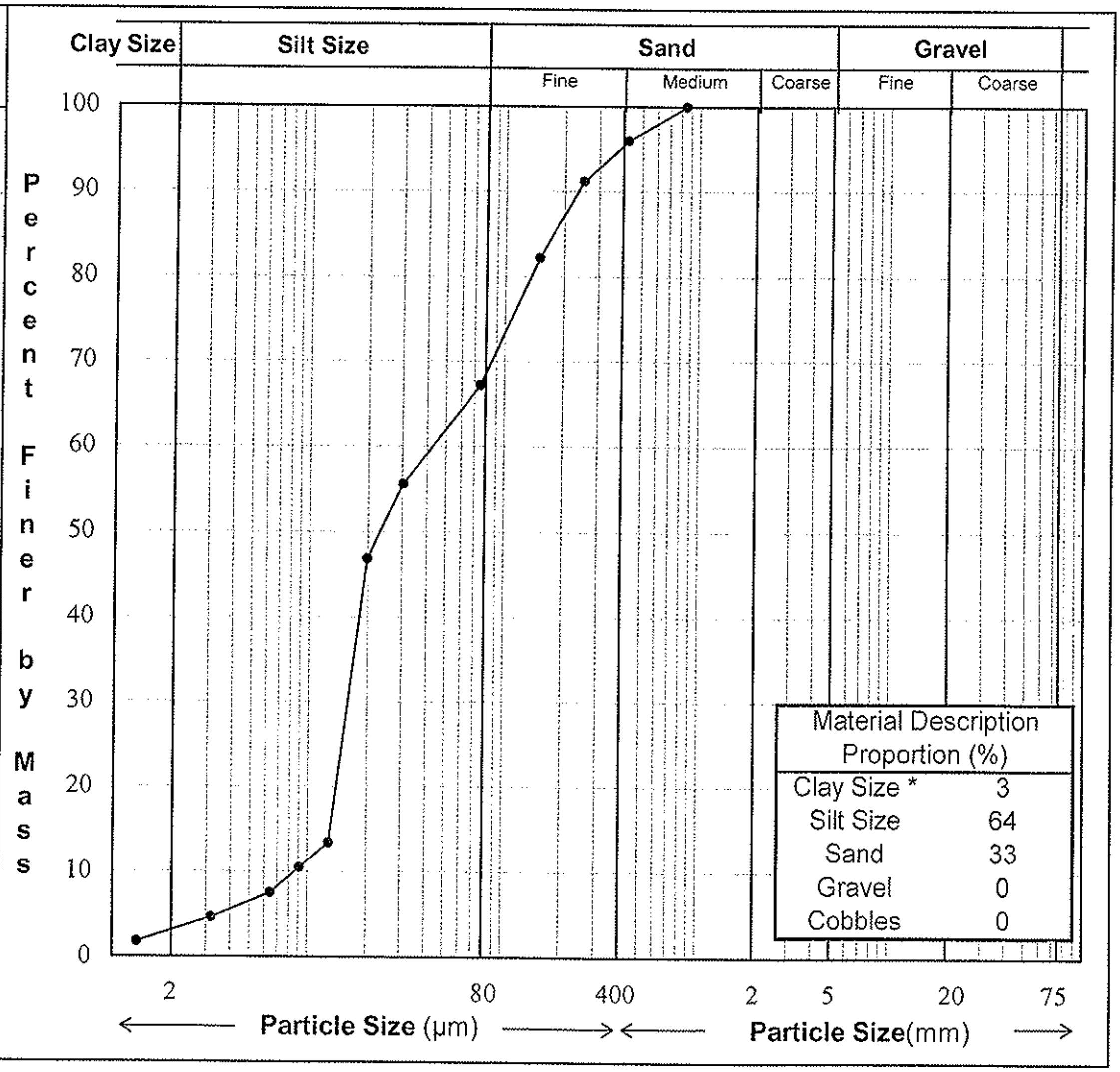
Reviewed By:

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	**Proposed Valley Dump**	Date Tested:	2008/04/23
Client:	SRK Consulting Inc		
Project No.:	W14101068.006		
Location:	BH08-SWC275-S2		
Sample No.:	BH08-SWC275-S2		
Depth:	5 - 6 ft		
Description**:	SILT - sandy, trace clay		

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	
10 mm	
5 mm	
2 mm	
850 μm	100
425 μm	96
250 μm	91
150 μm	82
75 μm	67
30 μm	56
20 μm	47
13 μm	13
9 μm	10
6 μm	8
3 μm	5
1 μm	2



Material Description	Proportion (%)
Clay Size *	3
Silt Size	64
Sand	33
Gravel	0
Cobbles	0

Remarks: * The upper clay size of 2 μm, per the Canadian Foundation Engineering Manual.

** The description is visually based & subject to EBA description protocols.

Reviewed By:

EBA Engineering
Consultants Ltd.

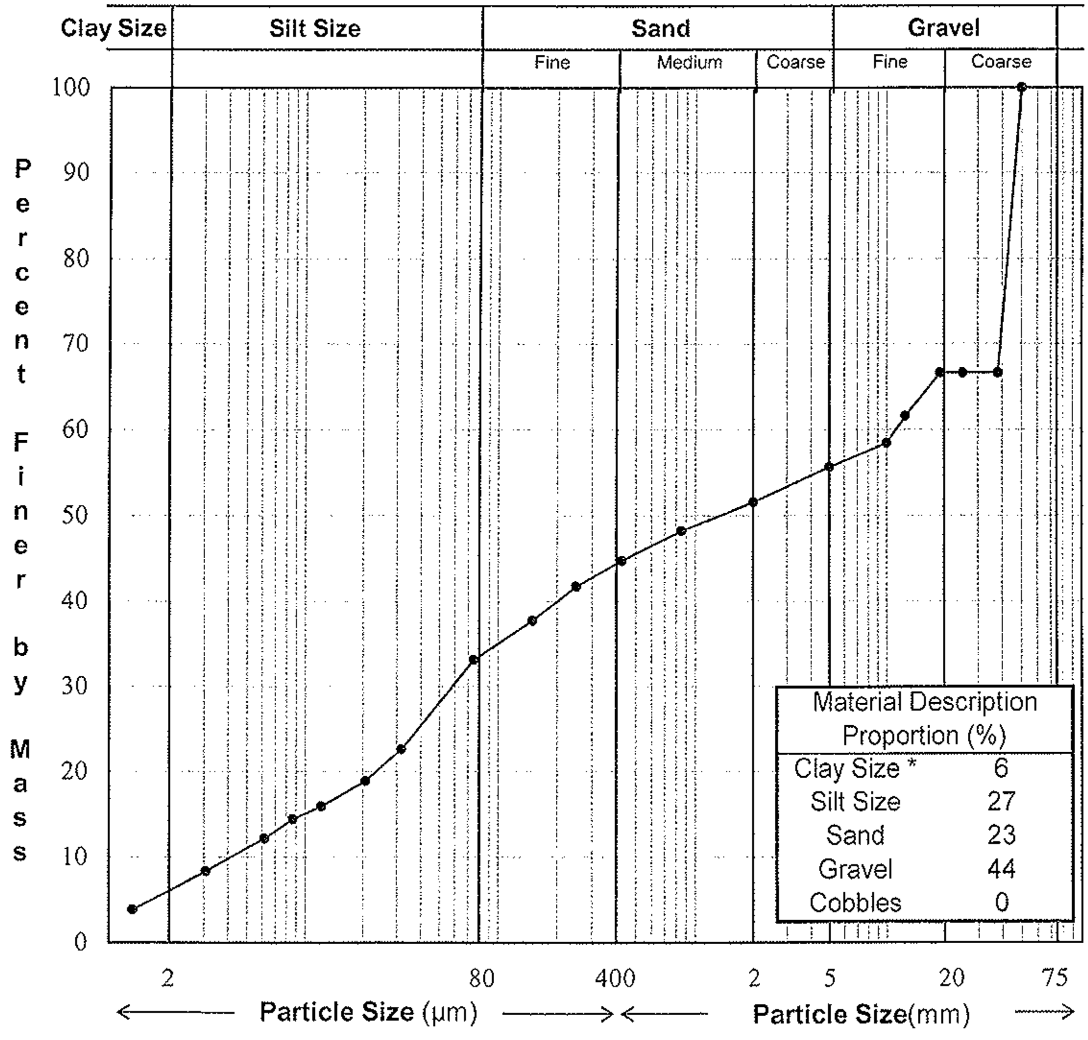
PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	**Proposed Valley Dump**
Client:	SRK Consulting Inc
Project No.:	W14101068.006
Location:	BH08-SWC275-S9
Sample No.:	BH08-SWC275-S9
Depth:	44 - 45 ft
Description**:	GRAVEL - silty, sandy, trace clay

Date Tested: 2008/04/23

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	100
38 mm	67
25 mm	67
19 mm	67
13 mm	62
10 mm	58
5 mm	56
2 mm	52
850 μm	48
425 μm	45
250 μm	42
150 μm	38
75 μm	33
32 μm	23
21 μm	19
12 μm	16
9 μm	14
6 μm	12
3 μm	8
1 μm	4



Material Description	Proportion (%)
Clay Size *	6
Silt Size	27
Sand	23
Gravel	44
Cobbles	0

Remarks: * The upper clay size of 2 μm, per the Canadian Foundation Engineering Manual.

** The description is visually based & subject to EBA description protocols.

Reviewed By:

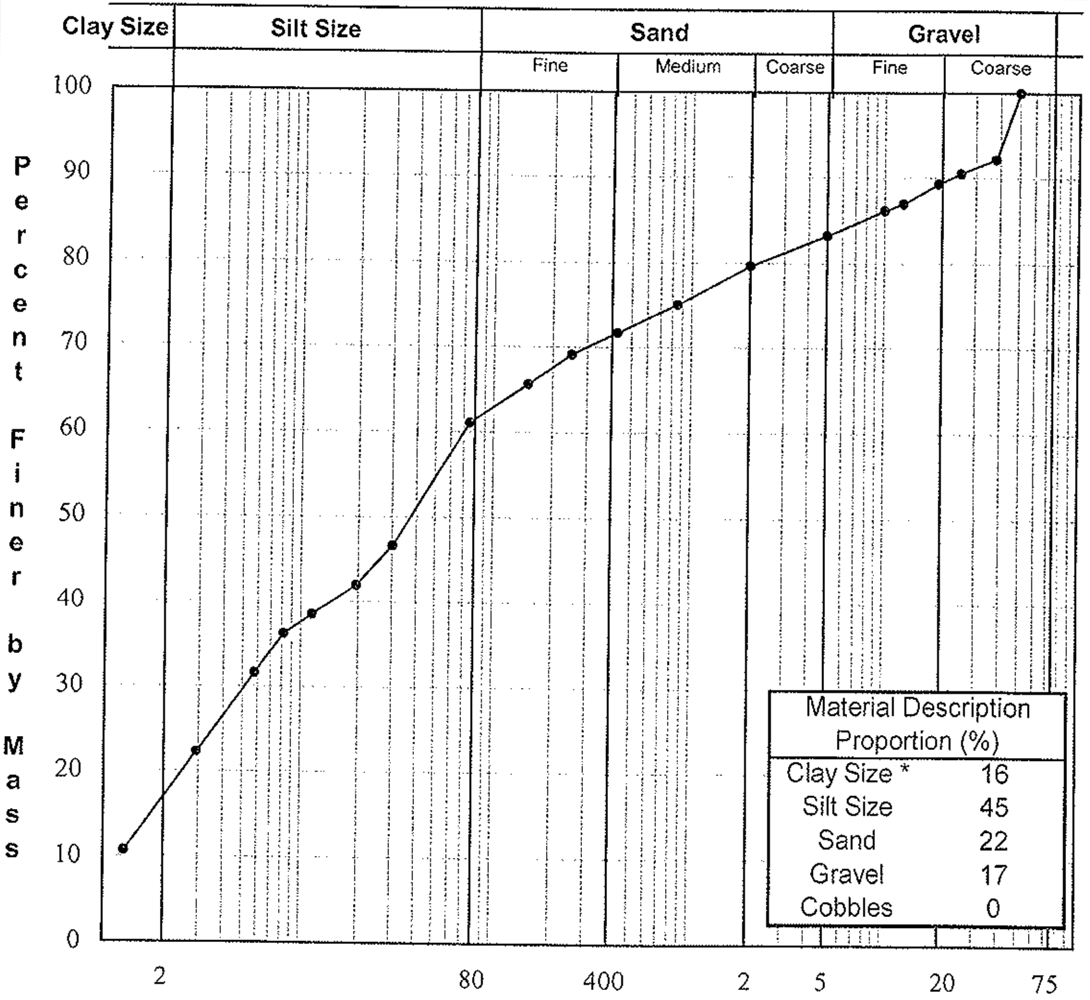
EBA Engineering
Consultants Ltd.

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	**Proposed Valley Dump**	Date Tested:	2008/04/23
Client:	SRK Consulting Inc		
Project No.:	W14101068.006		
Location:	BH08-SWC275-S14		
Sample No.:	BH08-SWC275-S14		
Depth:	64 - 65 ft		
Description**:	SILT - sandy, some gravel, some clay		

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	100
38 mm	92
25 mm	91
19 mm	89
13 mm	87
10 mm	86
5 mm	83
2 mm	80
850 µm	75
425 µm	72
250 µm	69
150 µm	66
75 µm	61
30 µm	47
20 µm	42
11 µm	38
8 µm	36
6 µm	32
3 µm	22
1 µm	11



Material Description Proportion (%)	
Clay Size *	16
Silt Size	45
Sand	22
Gravel	17
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.
** The description is visually based & subject to EBA description protocols.

Reviewed By:

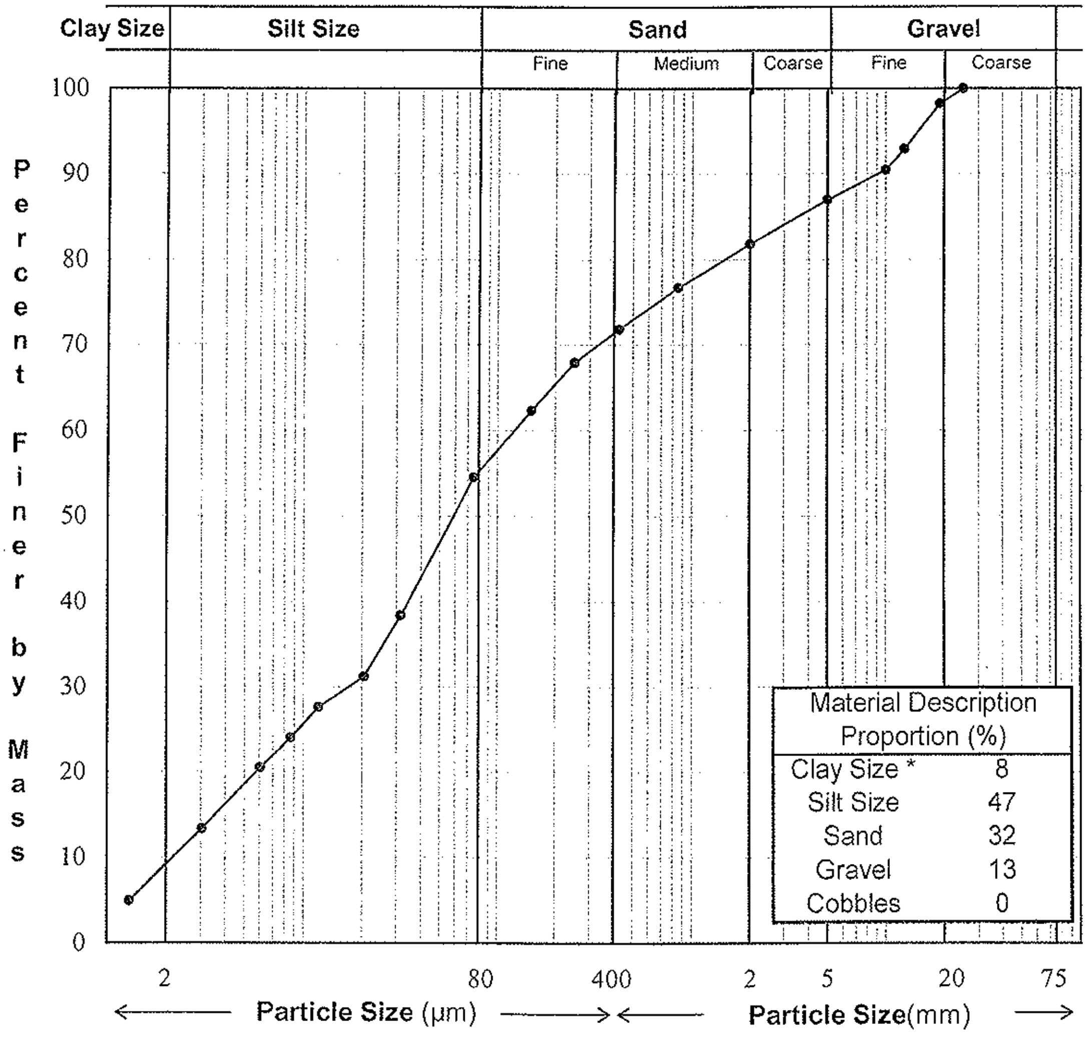
EBA Engineering Consultants Ltd.

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	**Proposed Valley Dump**	Date Tested:	2008/04/23
Client:	SRK Consulting Inc		
Project No.:	W14101068.006		
Location:	BH08-SWC275-S17		
Sample No.:	BH08-SWC275-S17		
Depth:	82 - 83 ft		
Description**:	SILT - sandy, some gravel, trace clay		

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	100
19 mm	98
13 mm	93
10 mm	90
5 mm	87
2 mm	82
850 µm	77
425 µm	72
250 µm	68
150 µm	62
75 µm	54
31 µm	38
20 µm	31
12 µm	28
9 µm	24
6 µm	20
3 µm	13
1 µm	5



Material Description	Proportion (%)
Clay Size *	8
Silt Size	47
Sand	32
Gravel	13
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.
** The description is visually based & subject to EBA description protocols.

Reviewed By:

PARTICLE SIZE DISTRIBUTION

ASTM C136 & D422

Project: **Proposed Valley Dump**

Project Number: W14101068.006

Date Tested: 4/23/2008

Borehole Number: 08-SWC277-S3

Depth: 36 - 36.5 ft

Soil Description: GRAVEL AND SAND - trace silt

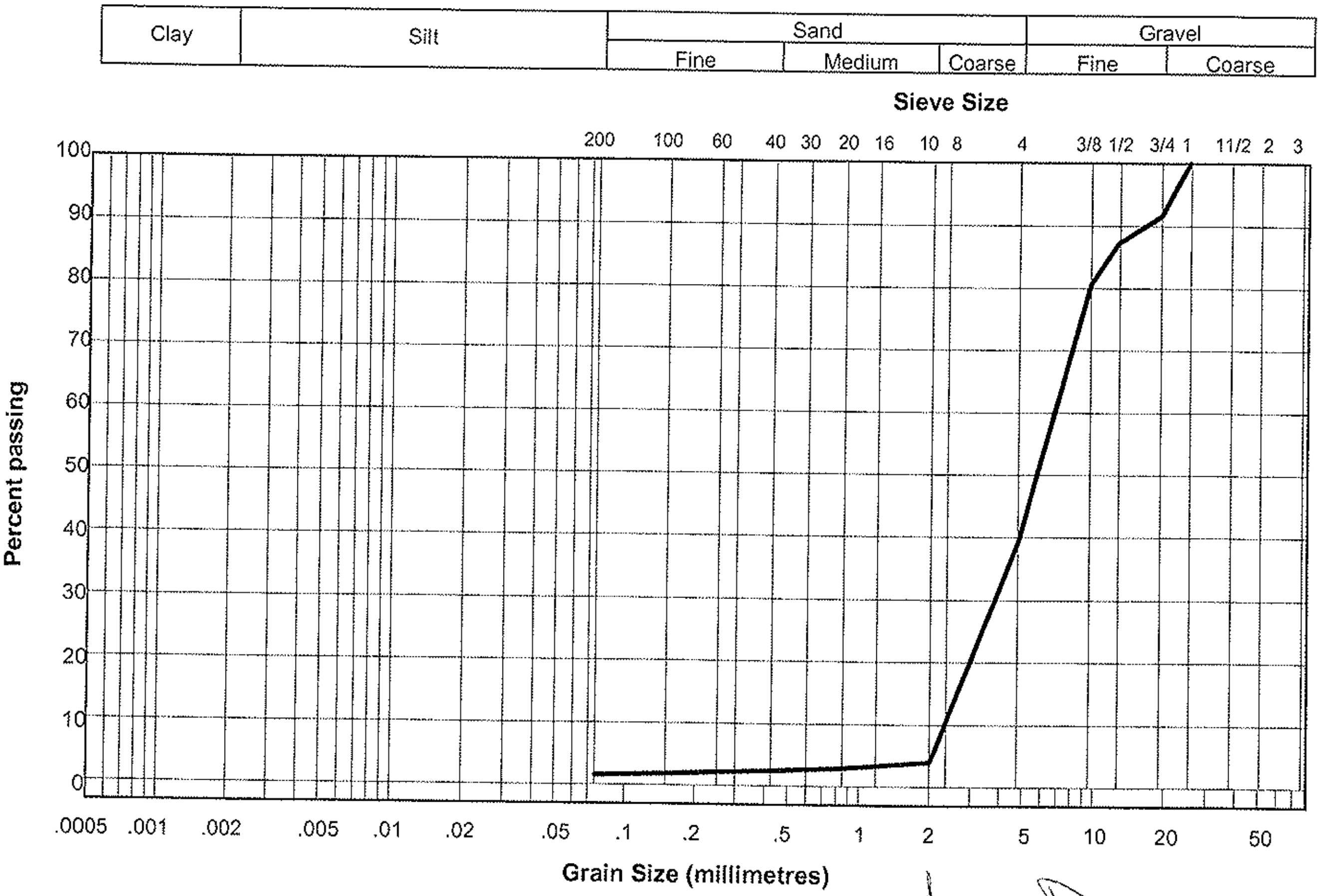
Cu: N/A

Cc: N/A

Natural Moisture Content: 21.2%

Remarks:

Sieve Size	Percent Passing
50.000	#N/A
37.500	#N/A
25.000	100
19.000	92
12.500	87
9.500	81
4.750	39
2.000	4
0.850	3
0.425	2
0.250	2
0.150	2
0.075	1.5



Reviewed By:

Data presented hereon is for the sole use of the stipulated client. EBA is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of EBA. The testing services reported herein have been performed by an EBA technician to recognized industry standards, unless otherwise noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, EBA will provide it upon written request.

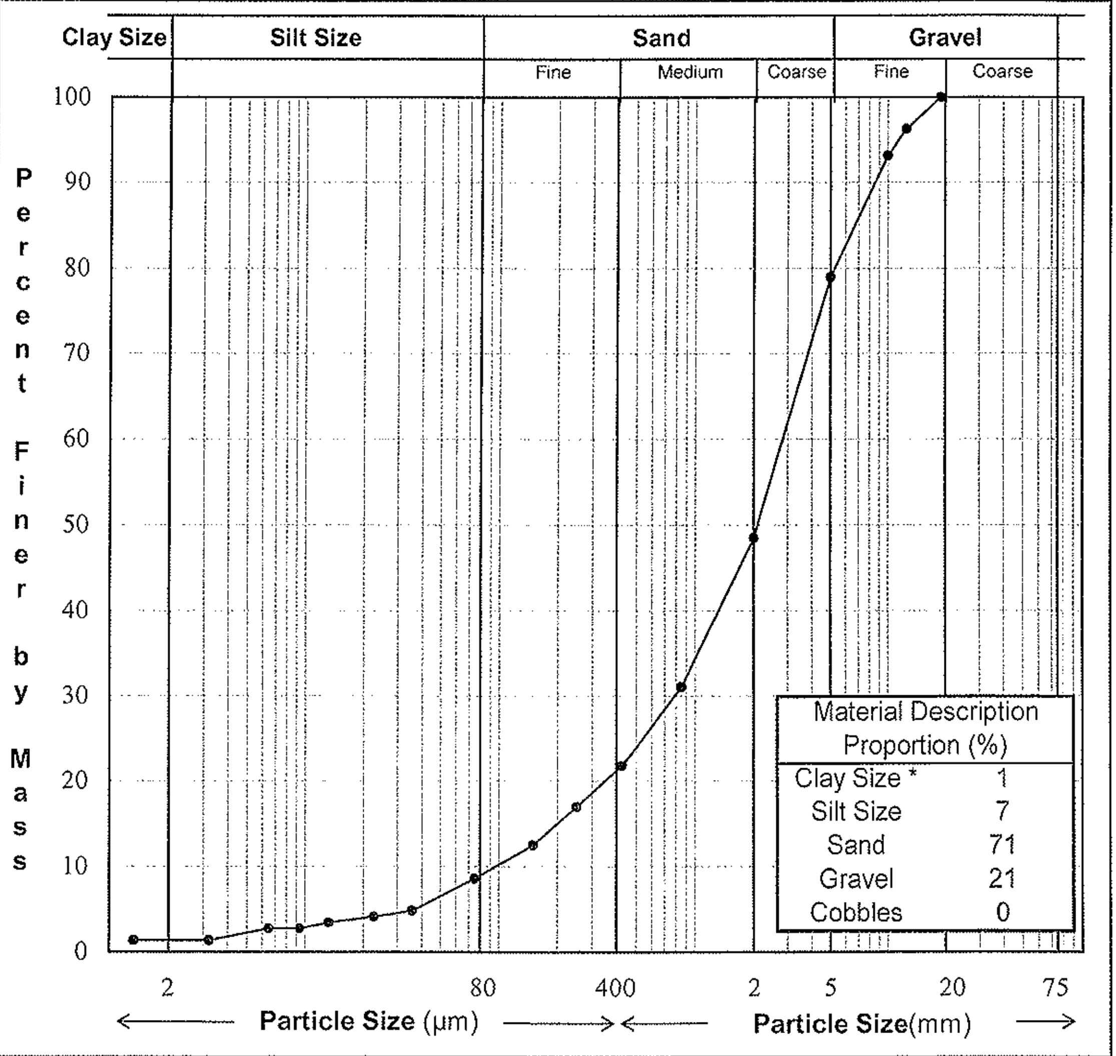
EBA Engineering Consultants Ltd.

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	**Proposed Valley Dump**	Date Tested:	2008/04/23
Client:	SRK Consulting Inc		
Project No.:	W14101068.006		
Location:	BH08-SWC277-S9		
Sample No.:	BH08-SWC277-S9		
Depth:	65 - 66 ft		
Description**:	SAND - gravelly, trace silt, trace clay		

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	100
13 mm	96
10 mm	93
5 mm	79
2 mm	48
850 µm	31
425 µm	22
250 µm	17
150 µm	13
75 µm	9
36 µm	5
23 µm	4
13 µm	3
9 µm	3
6 µm	3
3 µm	1
1 µm	1



Material Description	Proportion (%)
Clay Size *	1
Silt Size	7
Sand	71
Gravel	21
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.

** The description is visually based & subject to EBA description protocols.

Reviewed By: ____________

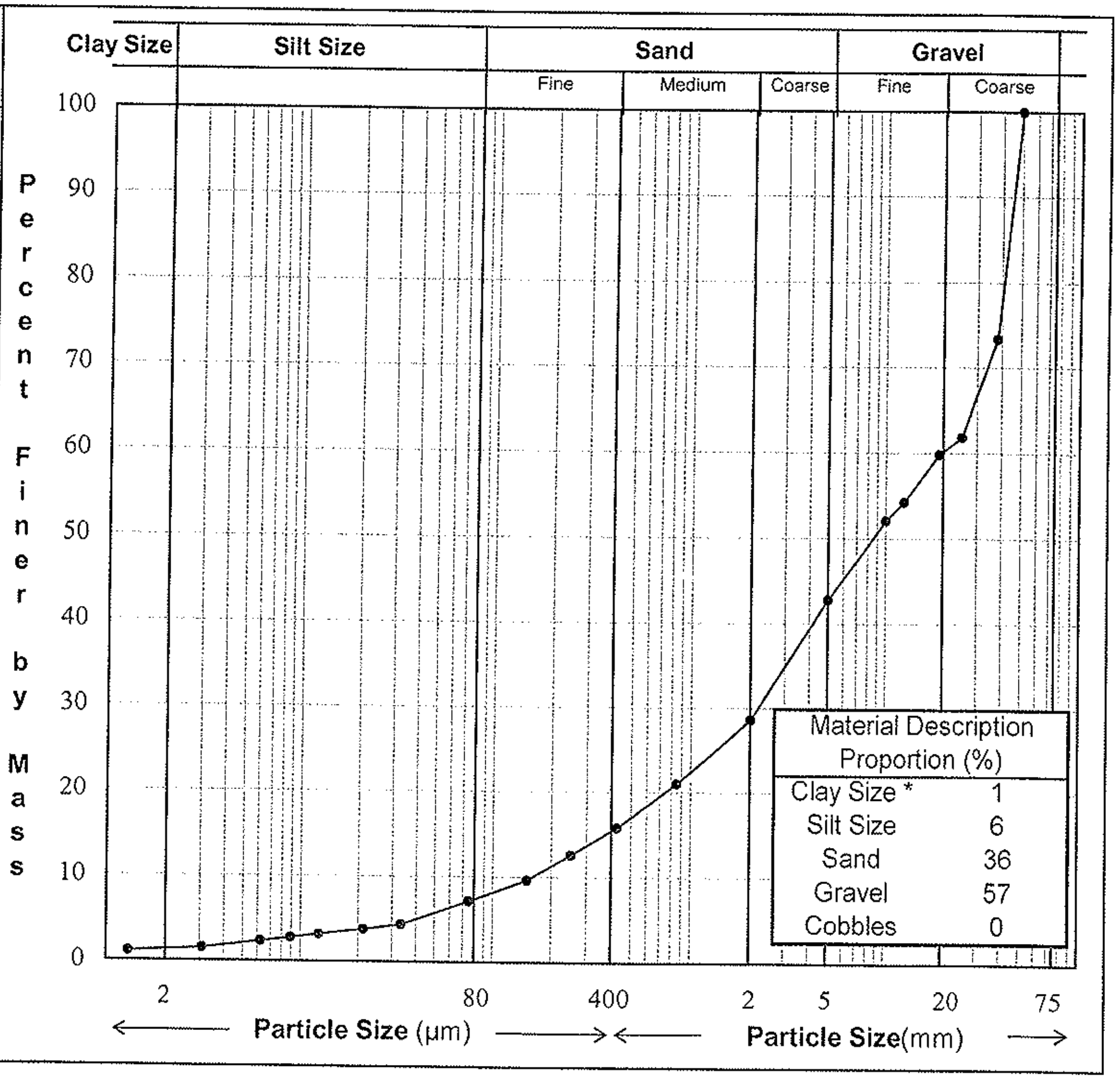
PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project: **Proposed Valley Dump**
Client: SRK Consulting Inc
Project No.: W14101068.006
Location: BH08-SWC277-S10
Sample No.: BH08-SWC277-S10
Depth: 71 - 72 ft
Description**: GRAVEL AND SAND - trace silt, trace clay

Date Tested: 2008/04/23

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	100
38 mm	73
25 mm	62
19 mm	60
13 mm	54
10 mm	52
5 mm	43
2 mm	29
850 µm	21
425 µm	16
250 µm	13
150 µm	10
75 µm	7
33 µm	4
21 µm	4
12 µm	3
9 µm	3
6 µm	2
3 µm	1
1 µm	1



Material Description	Proportion (%)
Clay Size *	1
Silt Size	6
Sand	36
Gravel	57
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.
** The description is visually based & subject to EBA description protocols.

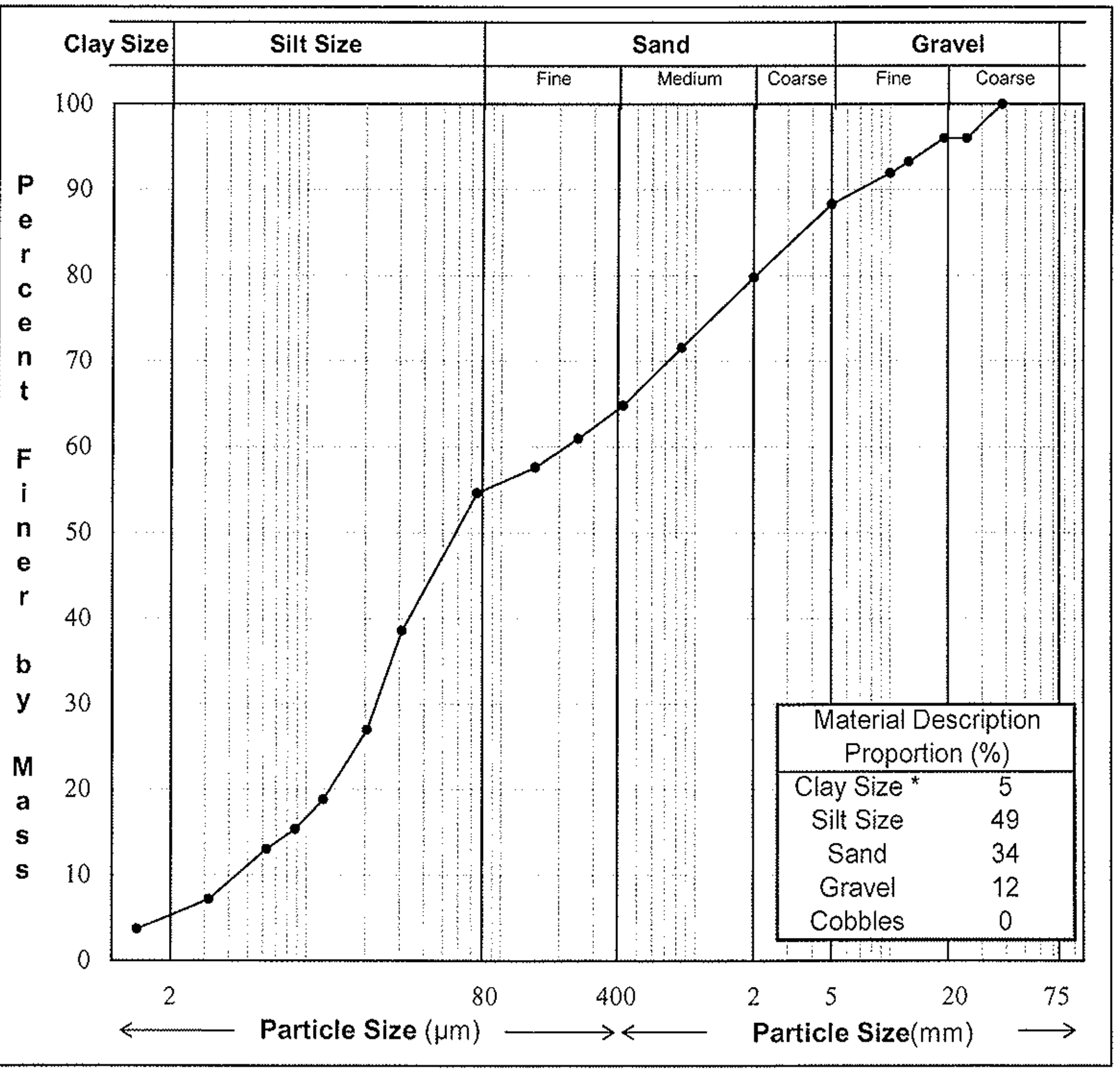
Reviewed By:

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	**Proposed Valley Dump**	Date Tested:	2008/04/23
Client:	SRK Consulting Inc		
Project No.:	W14101068.006		
Location:	BH08-SWC278-S2		
Sample No.:	BH08-SWC278-S2		
Depth:	0.0 - 1.0 ft		
Description**:	SILT - sandy, some gravel, trace clay		

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	100
25 mm	96
19 mm	96
13 mm	93
10 mm	92
5 mm	88
2 mm	80
850 µm	72
425 µm	65
250 µm	61
150 µm	58
75 µm	55
31 µm	39
21 µm	27
12 µm	19
9 µm	15
6 µm	13
3 µm	7
1 µm	4



Material Description	Proportion (%)
Clay Size *	5
Silt Size	49
Sand	34
Gravel	12
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.

** The description is visually based & subject to EBA description protocols.

Reviewed By:

PARTICLE SIZE DISTRIBUTION

ASTM C136 & D422

Project: **Proposed Valley Dump**

Project Number: W14101068.006

Date Tested: 4/23/2008

Borehole Number: 08-SWC278-S4

Depth: 26 - 26.5 ft

Soil Description: GRAVEL - trace sand

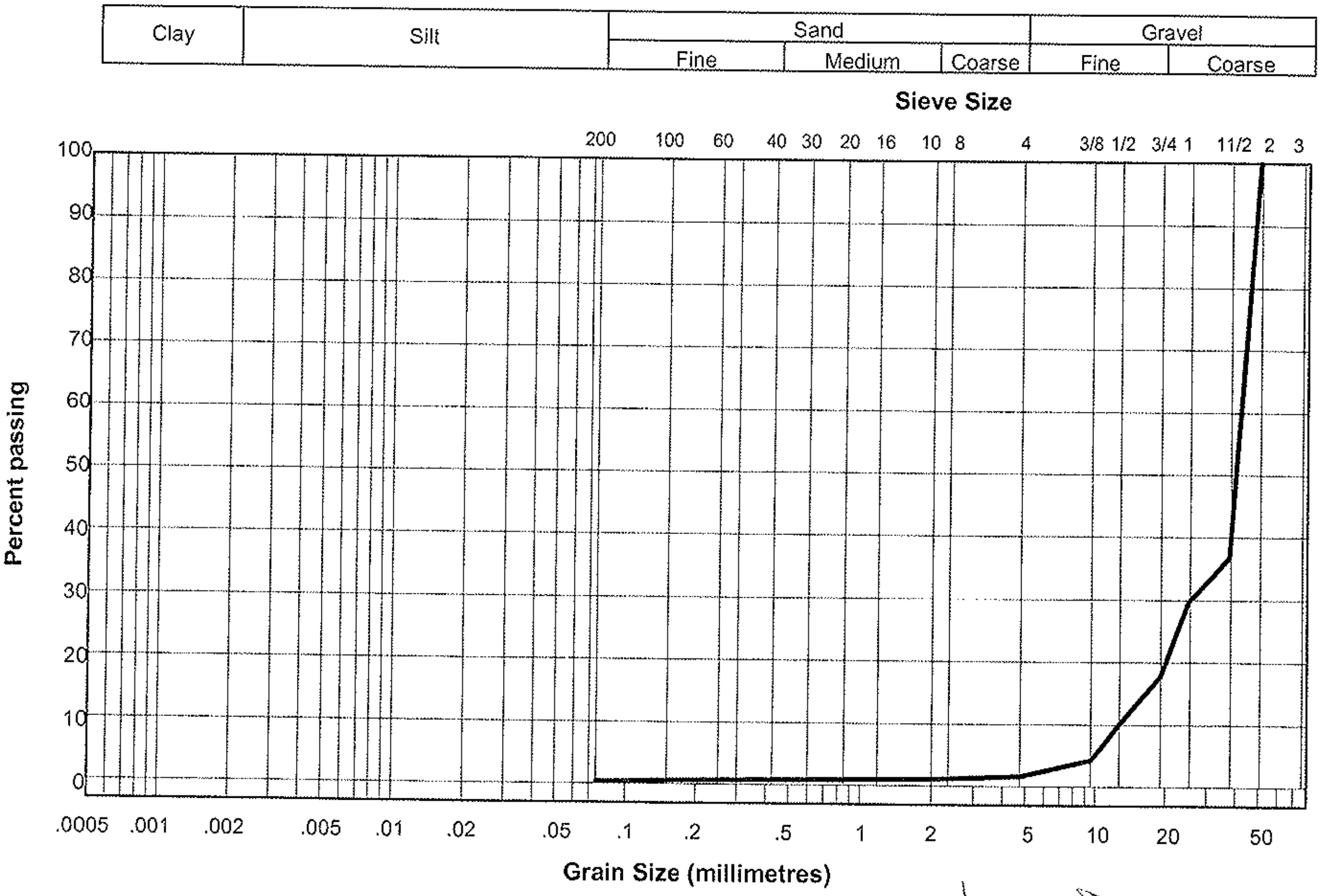
Cu: N/A

Cc: N/A

Natural Moisture Content: 1.3%

Remarks:

Sieve Size	Percent Passing
50.000	100
37.500	37
25.000	30
19.000	18
12.500	10
9.500	4
4.750	2
2.000	1
0.850	1
0.425	1
0.250	1
0.150	1
0.075	0.4



Reviewed By:

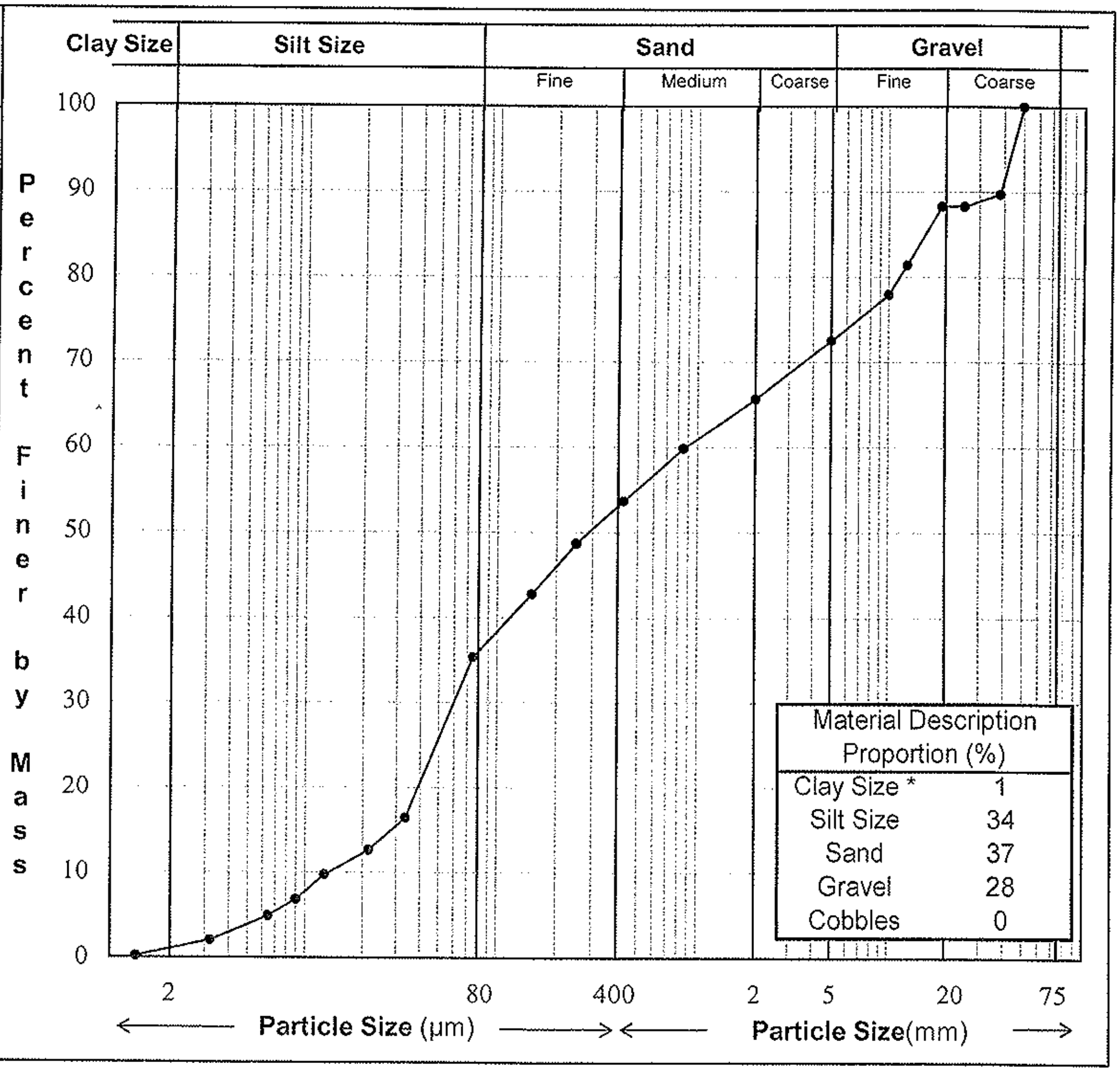
EBA Engineering Consultants Ltd.

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	**Proposed Valley Dump**	Date Tested:	2008/04/23
Client:	SRK Consulting Inc		
Project No.:	W14101068.006		
Location:	BH08-SWC278-S7		
Sample No.:	BH08-SWC278-S7		
Depth:	54 - 55 ft		
Description**:	SAND - silty, gravelly, trace clay		

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	100
38 mm	90
25 mm	88
19 mm	88
13 mm	81
10 mm	78
5 mm	73
2 mm	66
850 μm	60
425 μm	54
250 μm	49
150 μm	43
75 μm	35
33 μm	16
22 μm	13
13 μm	10
9 μm	7
6 μm	5
3 μm	2
1 μm	0



Material Description	Proportion (%)
Clay Size *	1
Silt Size	34
Sand	37
Gravel	28
Cobbles	0

Remarks: * The upper clay size of 2 μm, per the Canadian Foundation Engineering Manual.

** The description is visually based & subject to EBA description protocols.

Reviewed By:

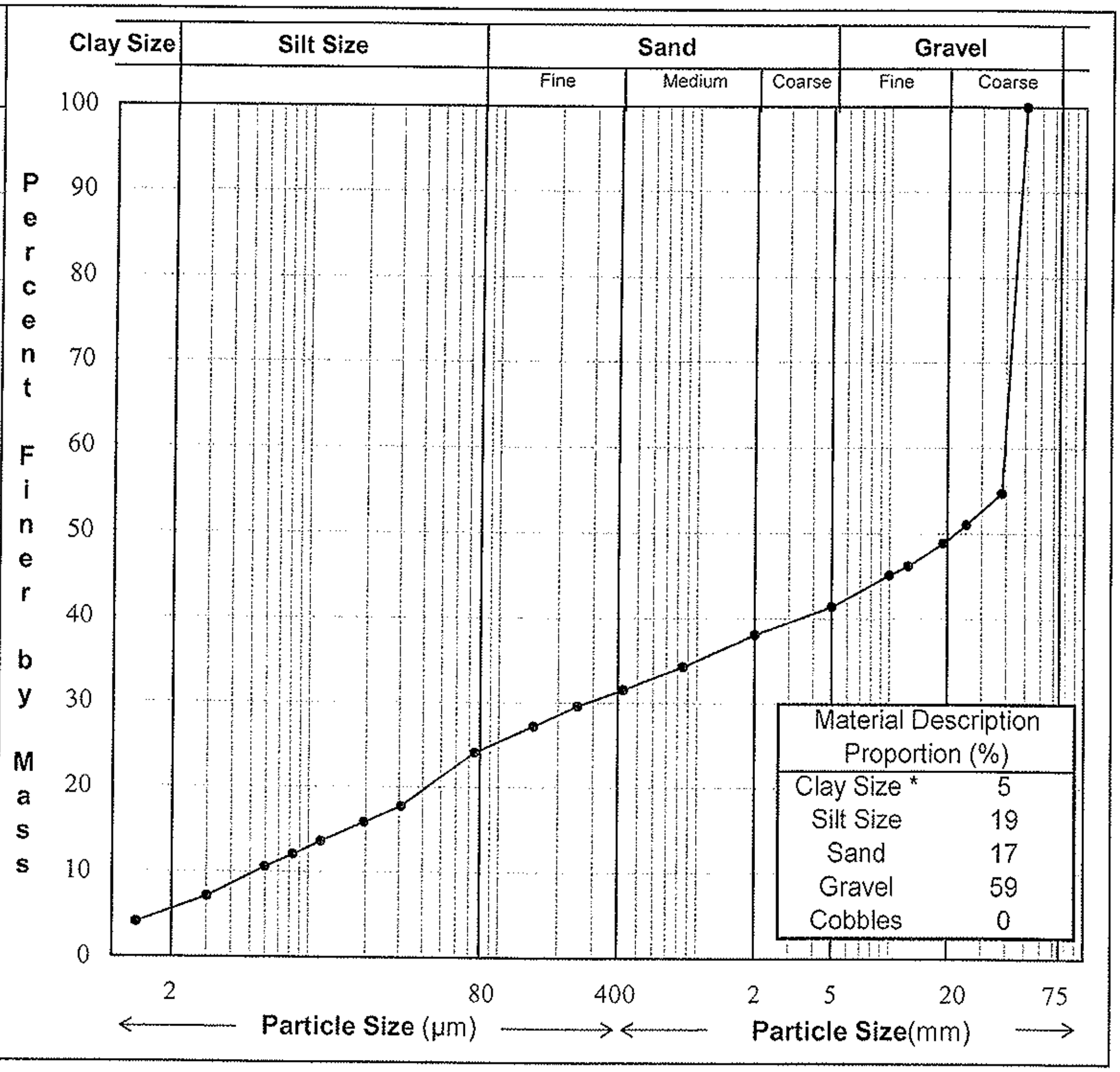
EBA Engineering Consultants Ltd.

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	**Proposed Valley Dump**	Date Tested:	2008/04/23
Client:	SRK Consulting Inc		
Project No.:	W14101068.006		
Location:	BH08-SWC278-S12		
Sample No.:	BH08-SWC278-S12		
Depth:	89 - 90 ft		
Description**:	GRAVEL - some silt, some sand, trace clay		

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	100
38 mm	55
25 mm	51
19 mm	49
13 mm	46
10 mm	45
5 mm	41
2 mm	38
850 µm	34
425 µm	32
250 µm	30
150 µm	27
75 µm	24
31 µm	18
20 µm	16
12 µm	14
8 µm	12
6 µm	11
3 µm	7
1 µm	4



Material Description Proportion (%)	
Clay Size *	5
Silt Size	19
Sand	17
Gravel	59
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.
** The description is visually based & subject to EBA description protocols.

Reviewed By:

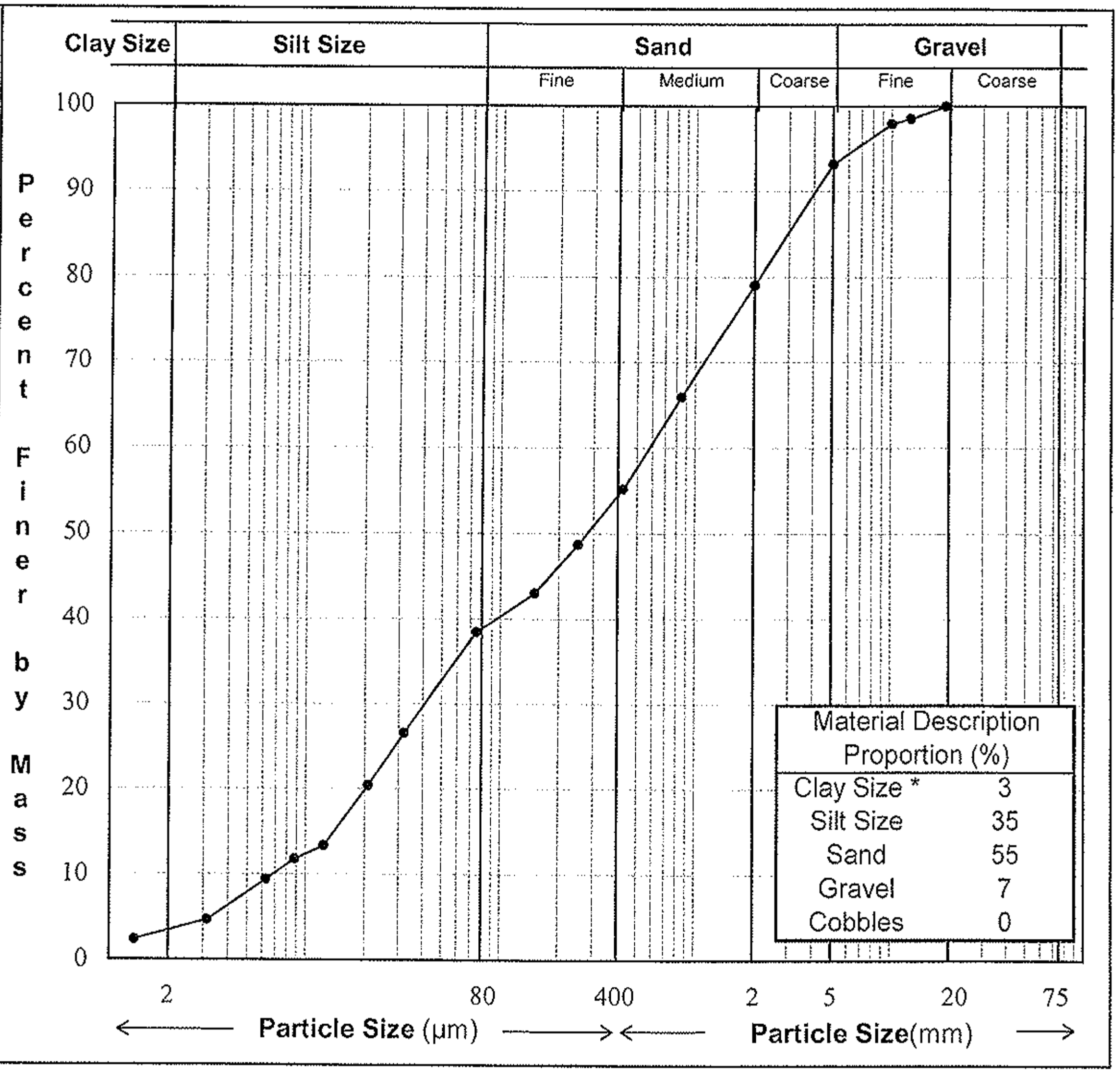
EBA Engineering Consultants Ltd.

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	**Proposed Valley Dump**	Date Tested:	2008/04/23
Client:	SRK Consulting Inc		
Project No.:	W14101068.006		
Location:	BH08-SWC278-S17		
Sample No.:	BH08-SWC278-S17		
Depth:	108 - 109 ft		
Description**:	SAND AND SILT - trace gravel, trace clay		

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	100
13 mm	99
10 mm	98
5 mm	93
2 mm	79
850 µm	66
425 µm	55
250 µm	49
150 µm	43
75 µm	38
32 µm	27
21 µm	20
12 µm	13
9 µm	12
6 µm	9
3 µm	5
1 µm	2



Material Description	Proportion (%)
Clay Size *	3
Silt Size	35
Sand	55
Gravel	7
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.
** The description is visually based & subject to EBA description protocols.

Reviewed By: ____________________

EBA Engineering
Consultants Ltd.

PARTICLE SIZE DISTRIBUTION

ASTM C136 & D422

Project: **Proposed Valley Dump**

Project Number: W14101068.006

Date Tested: 4/23/2008

Borehole Number: 08-SWC278-S23

Depth: 132 - 133 ft

Soil Description: GRAVEL AND SAND - some silt

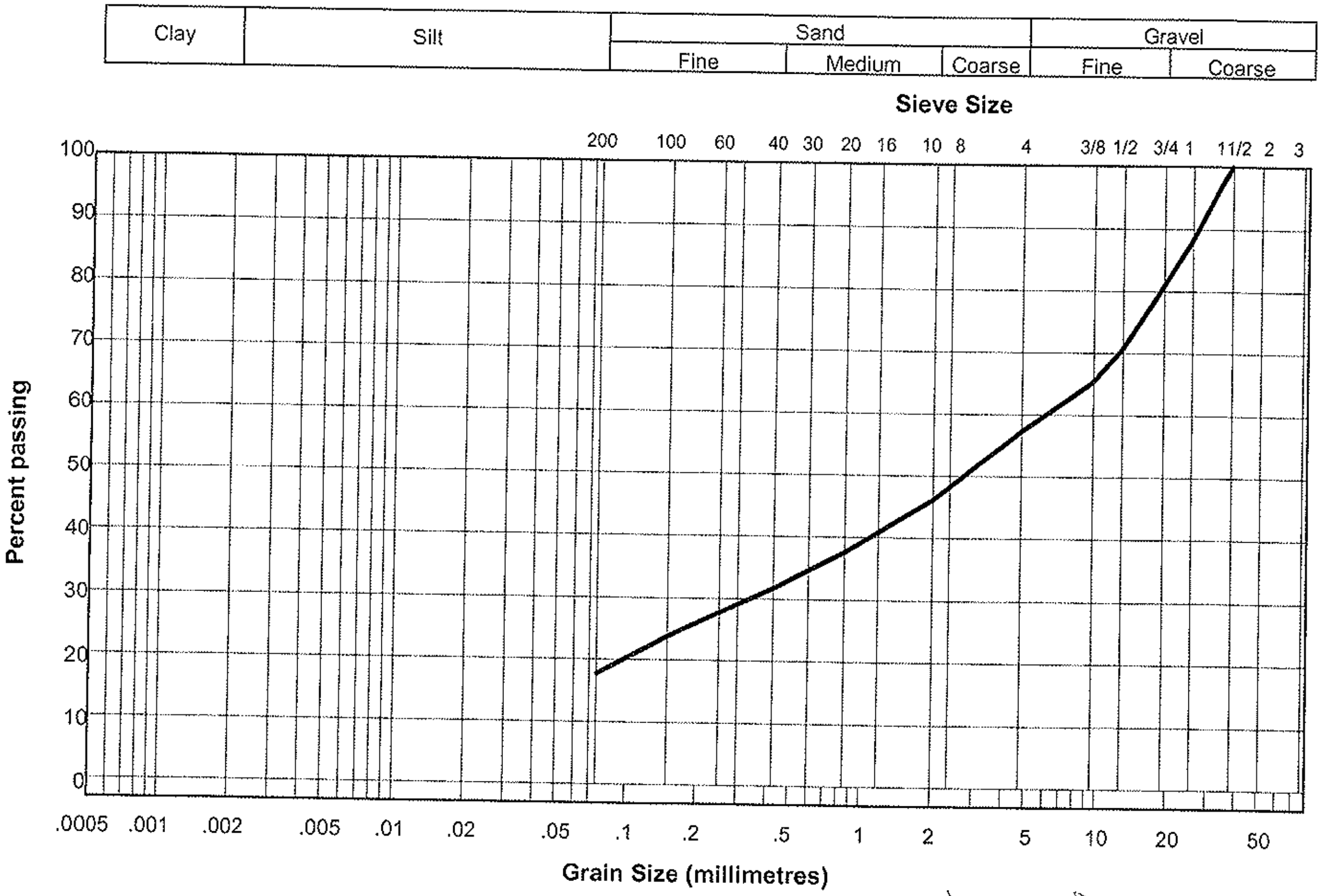
Cu: N/A

Cc: N/A

Natural Moisture Content: 10.8%

Remarks:

Sieve Size	Percent Passing
50.000	#N/A
37.500	100
25.000	88
19.000	81
12.500	70
9.500	65
4.750	57
2.000	46
0.850	38
0.425	32
0.250	28
0.150	24
0.075	17.8



Reviewed By:

EBA Engineering Consultants Ltd.

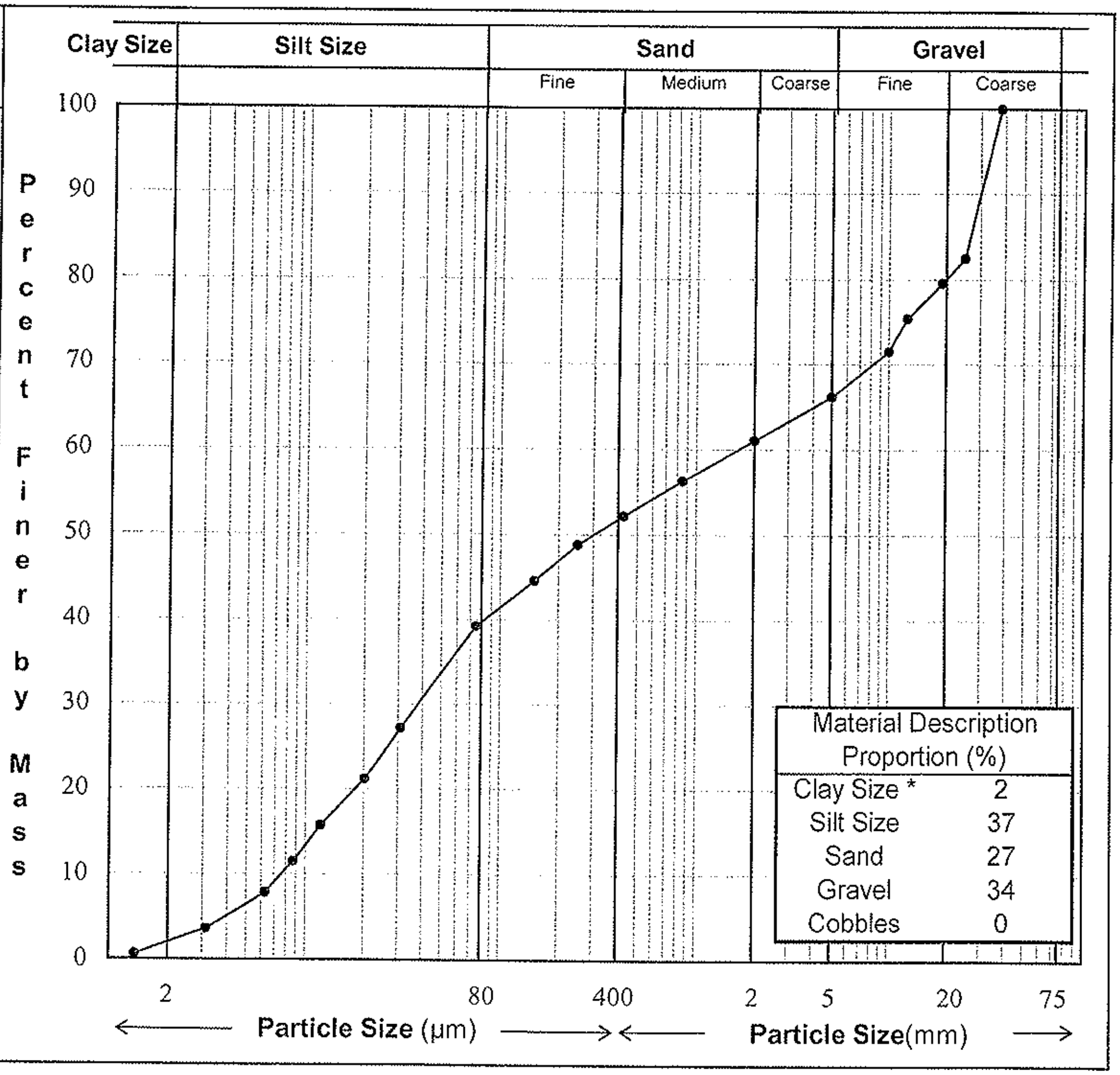
PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	**Proposed Valley Dump**
Client:	SRK Consulting Inc
Project No.:	W14101068.006
Location:	BH08-SWC280-S3
Sample No.:	BH08-SWC280-S3
Depth:	14 - 15 ft
Description**:	SILT - gravelly, sandy, trace clay

Date Tested: 2008/04/23

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	100
25 mm	82
19 mm	80
13 mm	75
10 mm	72
5 mm	66
2 mm	61
850 µm	56
425 µm	52
250 µm	49
150 µm	45
75 µm	39
31 µm	27
20 µm	21
12 µm	16
9 µm	11
6 µm	8
3 µm	4
1 µm	1



Material Description	Proportion (%)
Clay Size *	2
Silt Size	37
Sand	27
Gravel	34
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.

** The description is visually based & subject to EBA description protocols.

Reviewed By:

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project: **Proposed Valley Dump**

Client: SRK Consulting Inc

Project No.: W14101068.006

Location: BH08-SWC280-S5

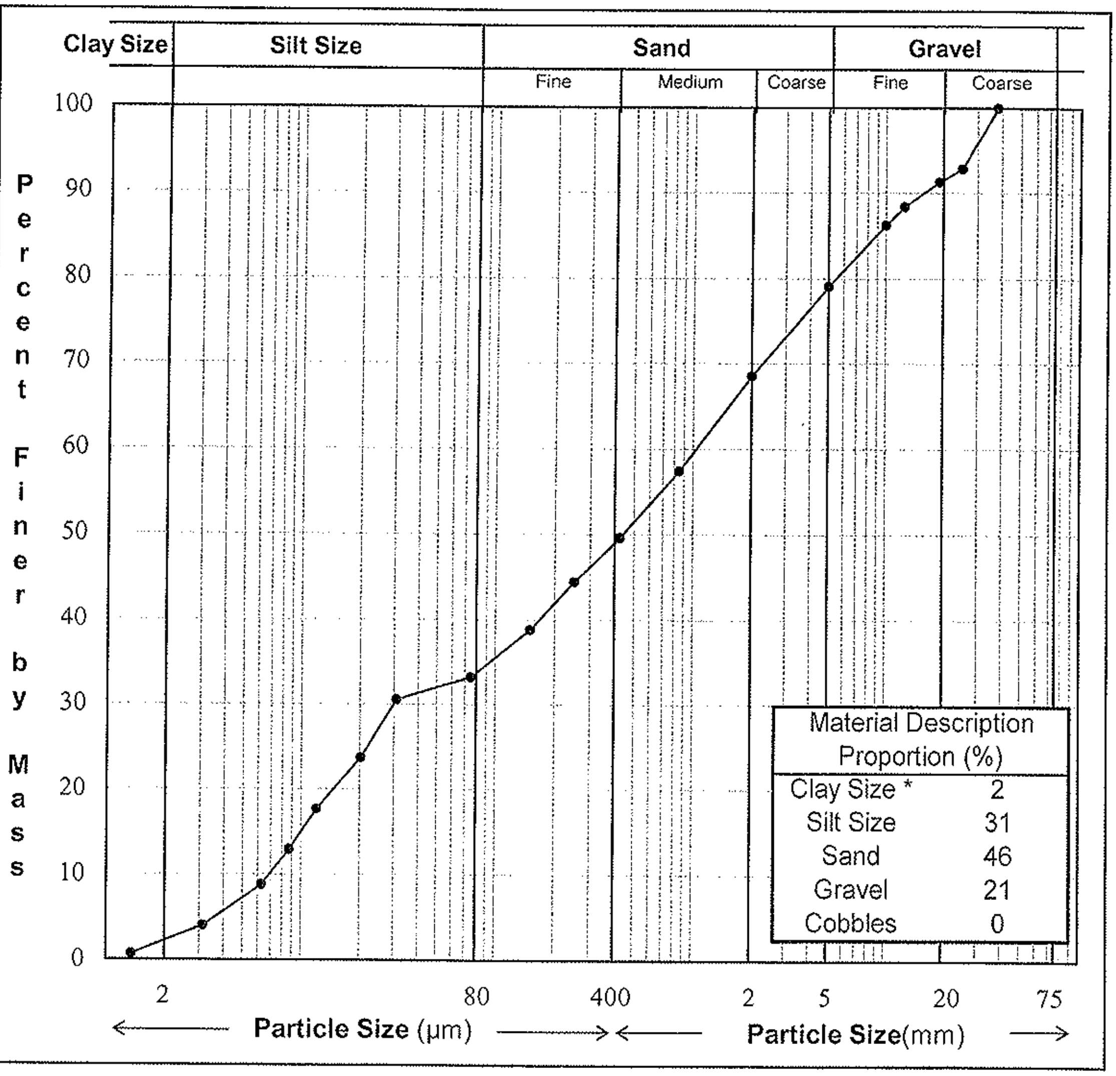
Sample No.: BH08-SWC280-S5

Depth: 31 - 32 ft

Description**: SAND - silty, gravelly, trace clay

Date Tested: 2008/04/23

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	100
25 mm	93
19 mm	91
13 mm	88
10 mm	86
5 mm	79
2 mm	69
850 µm	57
425 µm	50
250 µm	44
150 µm	39
75 µm	33
31 µm	31
20 µm	24
12 µm	18
9 µm	13
6 µm	9
3 µm	4
1 µm	1



Material Description	Proportion (%)
Clay Size *	2
Silt Size	31
Sand	46
Gravel	21
Cobbles	0

Remarks: * The upper clay size of 2 µm, per the Canadian Foundation Engineering Manual.

** The description is visually based & subject to EBA description protocols.

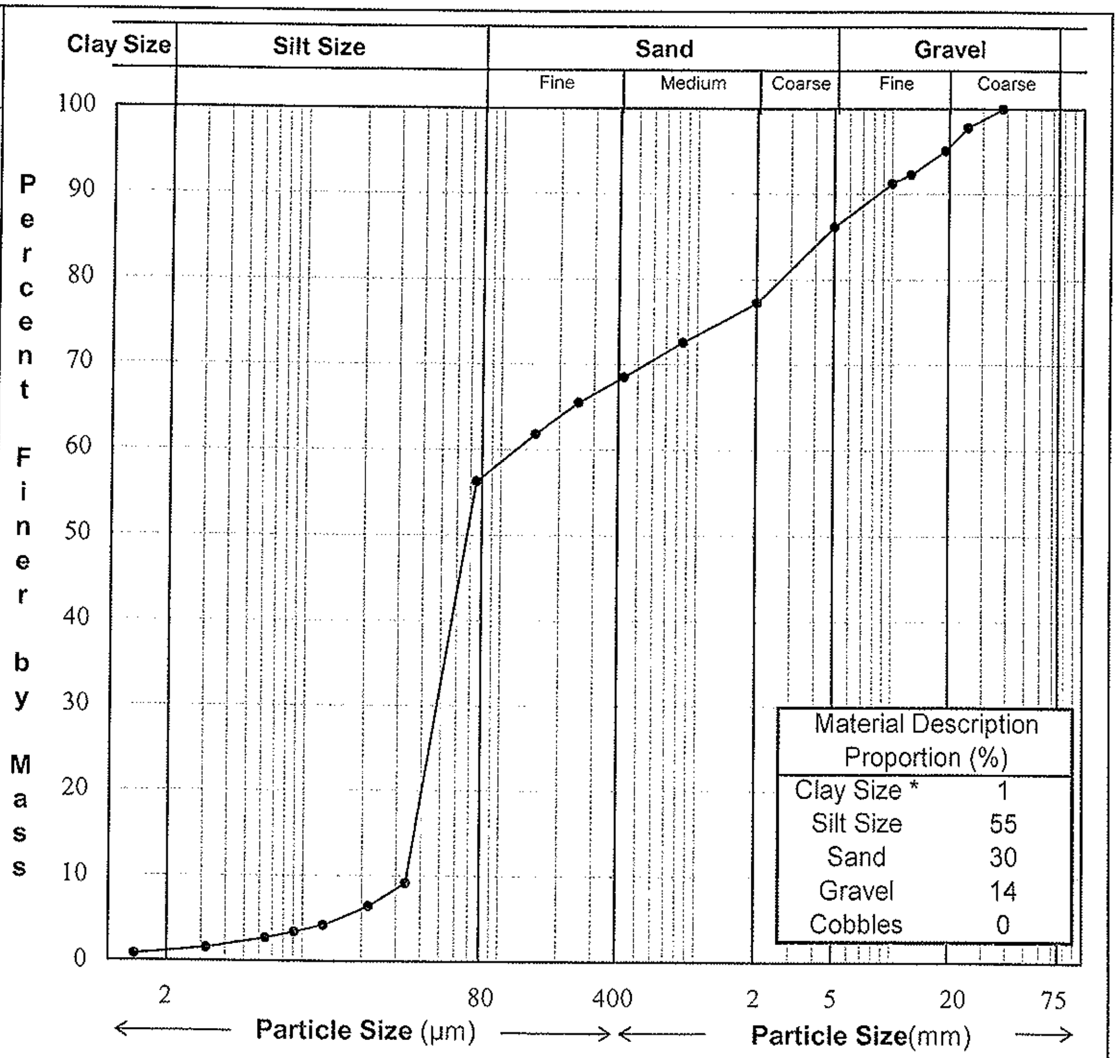
Reviewed By:

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	**Proposed Valley Dump**	Date Tested:	2008/04/23
Client:	SRK Consulting Inc		
Project No.:	W14101068.006		
Location:	BH08-SWC280-S8		
Sample No.:	BH08-SWC280-S8		
Depth:	59 - 60 ft		
Description**:	SILT - sandy, some gravel, trace clay		

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	100
25 mm	98
19 mm	95
13 mm	92
10 mm	91
5 mm	86
2 mm	77
850 μm	73
425 μm	68
250 μm	66
150 μm	62
75 μm	56
33 μm	9
22 μm	7
13 μm	4
9 μm	3
6 μm	3
3 μm	2
1 μm	1



Material Description	Proportion (%)
Clay Size *	1
Silt Size	55
Sand	30
Gravel	14
Cobbles	0

Remarks: * The upper clay size of 2 μm, per the Canadian Foundation Engineering Manual.

** The description is visually based & subject to EBA description protocols.

Reviewed By:

Atterberg Limits Test Form

ASTM D4318

Project: Proposed Valley Dump

Project Number: W14101068.006

Sample Description:

Sample Number: 08-SWC271-S4

Borehole Number: 08-SWC271-S4

Depth: 17.5 - 18.5 ft

Date Tested: 6/5/2008

Tested By: JP

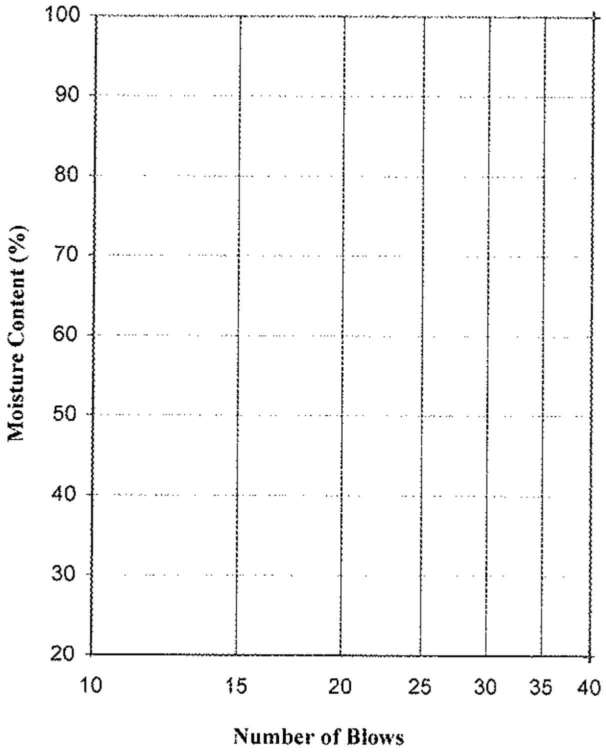
Plastic Limit Test

Trial Number	1	2	3
Tare Number			
Wt. Wet Soil + Tare			
Wt. Dry Soil + Tare			
Wt. of Tare			
Wt. of Water	0.00	0.00	
Wt. of Dry Soil	0.00	0.00	
Moisture Content (%)	#DIV/0!	#DIV/0!	

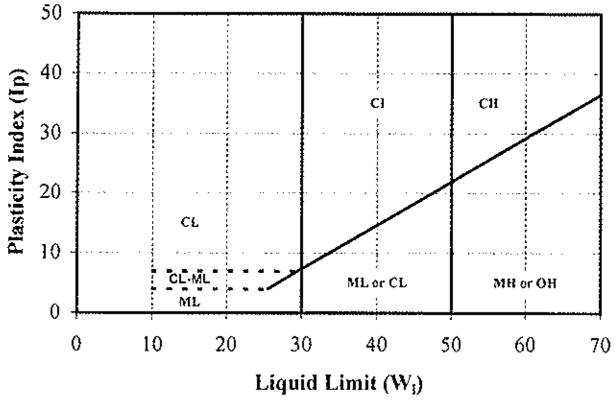
Liquid Limit Test

Trial Number	1	2	3
No. of Blows			
Tare Number			
Wt. Wet Soil + Tare			
Wt. Dry Soil + Tare			
Wt. of Tare			
Wt. of Water	0.00	0.00	0.00
Wt. of Dry Soil	0.00	0.00	0.00
Moisture Content (%)	#DIV/0!	#DIV/0!	#DIV/0!

Liquid Limit (W_l)



Plasticity Chart



LIQUID LIMIT (%)

PLASTIC LIMIT (%) #DIV/0!

PLASTICITY INDEX (%) #DIV/0!

Soil Description: Non-plastic

USCS Symbol:

Remarks: Non-plastic

EBA Engineering
Consultants Ltd.

Atterberg Limits Test Form

ASTM D4318

Project: Proposed Valley Dump

Sample Number: 08-SWC272-S4

Borehole Number: 08-SWC272-S4

Project Number: W14101068.006

Depth: 37 - 38 ft

Sample Description:

Date Tested: 6/5/2008

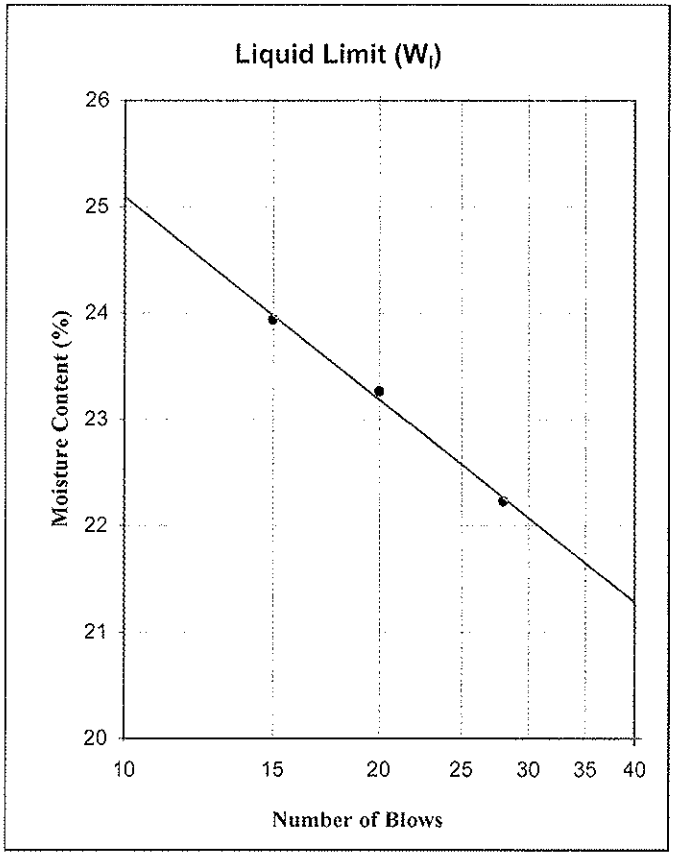
Tested By: JP

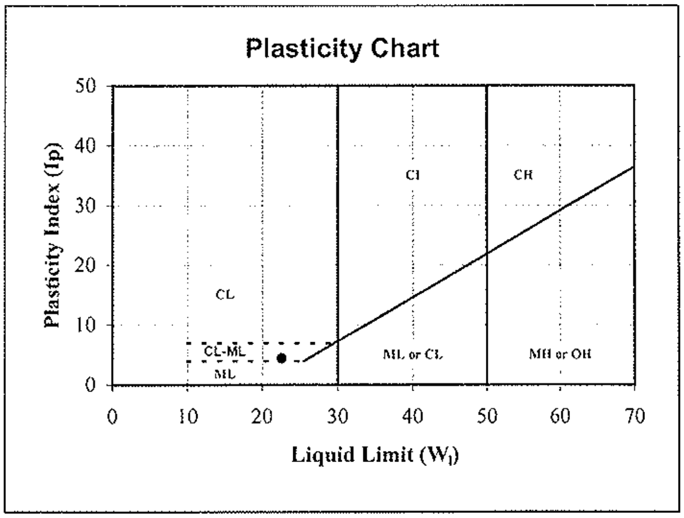
Plastic Limit Test

Trial Number	1	2	3
Tare Number			
Wt. Wet Soil + Tare	7.19	6.78	
Wt. Dry Soil + Tare	6.71	6.33	
Wt. of Tare	4.08	3.83	
Wt. of Water	0.48	0.45	
Wt. of Dry Soil	2.63	2.50	
Moisture Content (%)	18.3	18.0	

Liquid Limit Test

Trial Number	1	2	3
No. of Blows	15	20	28
Tare Number	A-1	A-2	A-3
Wt. Wet Soil + Tare	37.48	31.59	41.98
Wt. Dry Soil + Tare	31.00	26.36	35.10
Wt. of Tare	3.93	3.88	4.15
Wt. of Water	6.48	5.23	6.88
Wt. of Dry Soil	27.07	22.48	30.95
Moisture Content (%)	23.9	23.3	22.2





LIQUID LIMIT (%) 23

PLASTIC LIMIT (%) 18

PLASTICITY INDEX (%) 4

Soil Description: Low Plasticity

USCS Symbol: CL

Remarks:

EBA Engineering
Consultants Ltd.

Atterberg Limits Test Form

ASTM D4318

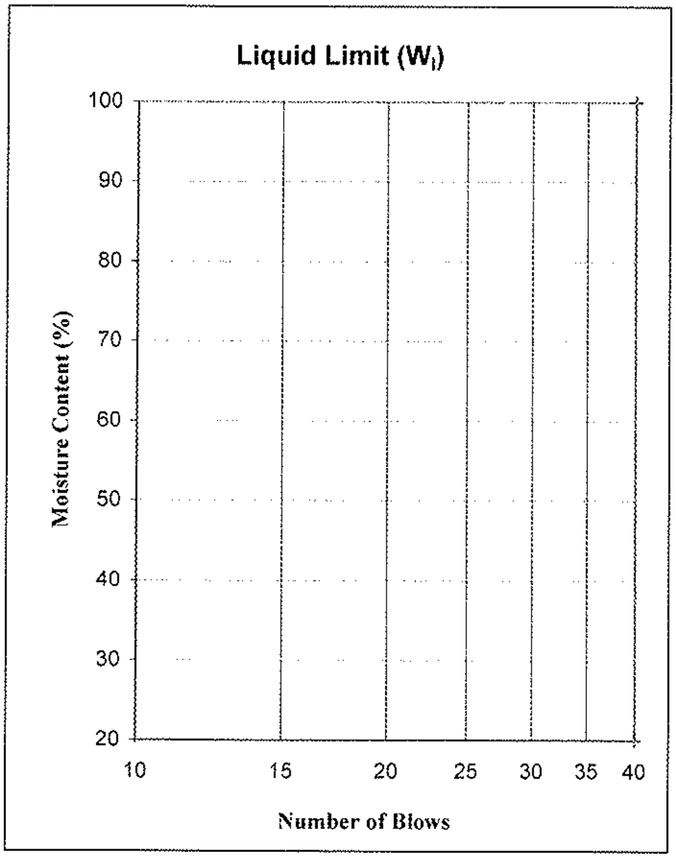
Project:	Proposed Valley Dump	Sample Number:	08-SWC272-S5
		Borehole Number:	08-SWC272-S5
Project Number:	W14101068.006	Depth:	40 - 41 ft
Sample Description:		Date Tested:	6/5/2008
		Tested By:	JP

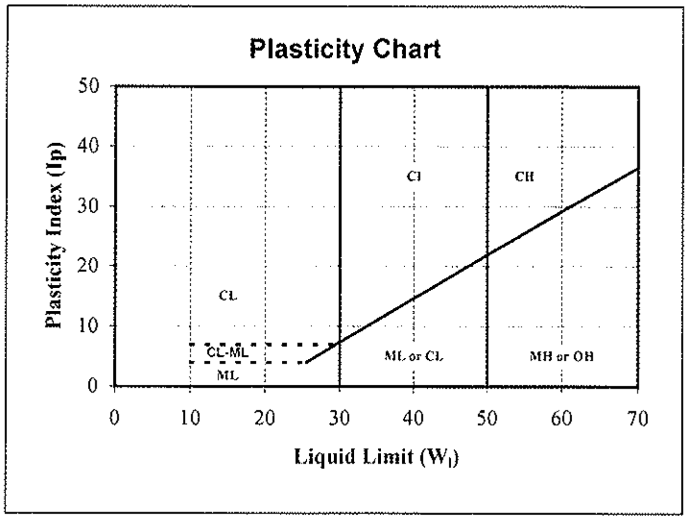
Plastic Limit Test

Trial Number	1	2	3
Tare Number			
Wt. Wet Soil + Tare			
Wt. Dry Soil + Tare			
Wt. of Tare			
Wt. of Water	0.00	0.00	
Wt. of Dry Soil	0.00	0.00	
Moisture Content (%)	#DIV/0!	#DIV/0!	

Liquid Limit Test

Trial Number	1	2	3
No. of Blows			
Tare Number			
Wt. Wet Soil + Tare			
Wt. Dry Soil + Tare			
Wt. of Tare			
Wt. of Water	0.00	0.00	0.00
Wt. of Dry Soil	0.00	0.00	0.00
Moisture Content (%)	#DIV/0!	#DIV/0!	#DIV/0!





LIQUID LIMIT (%)	
PLASTIC LIMIT (%)	#DIV/0!
PLASTICITY INDEX (%)	**#DIV/0!**

Soil Description: Non-plastic

USCS Symbol:

Remarks: Non-plastic

EBA Engineering
Consultants Ltd.

Atterberg Limits Test Form

ASTM D4318

Project: Proposed Valley Dump
Project Number: W14101068.006
Sample Description:

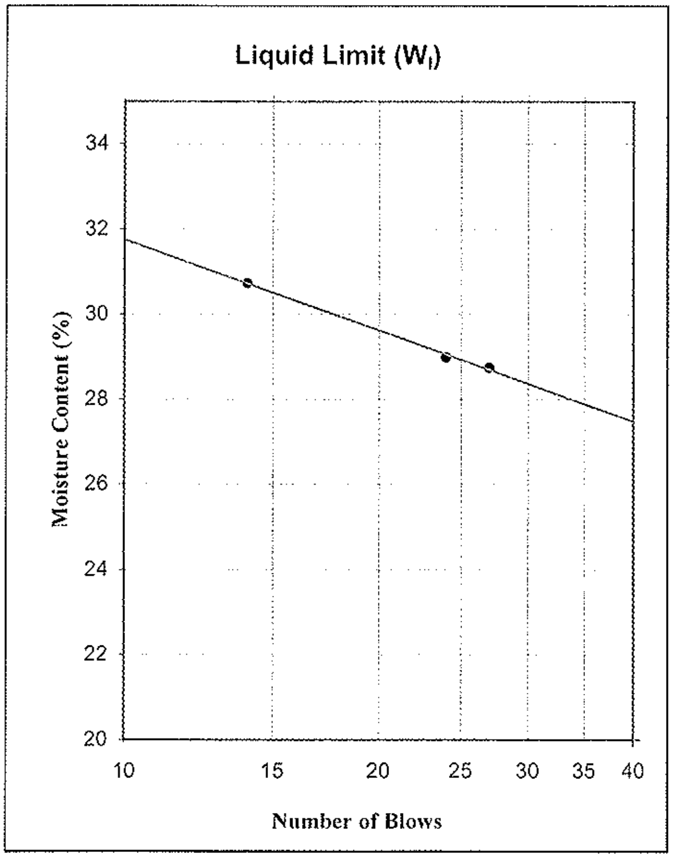
Sample Number: 08-SWC272-S9
Borehole Number: 08-SWC272-S9
Depth: 72 - 73 ft
Date Tested: 6/5/2008
Tested By: RC

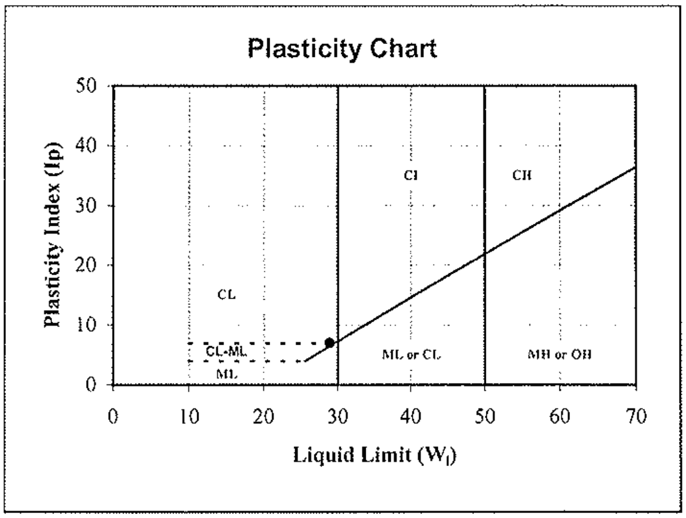
Plastic Limit Test

Trial Number	1	2	3
Tare Number	PL3	PL4	
Wt. Wet Soil + Tare	2.78	4.98	
Wt. Dry Soil + Tare	2.54	4.31	
Wt. of Tare	1.38	1.41	
Wt. of Water	0.24	0.67	
Wt. of Dry Soil	1.16	2.90	
Moisture Content (%)	20.7	23.1	

Liquid Limit Test

Trial Number	1	2	3
No. of Blows	14	24	27
Tare Number	U-1	U-2	U-3
Wt. Wet Soil + Tare	23.02	21.41	23.72
Wt. Dry Soil + Tare	18.53	17.49	19.29
Wt. of Tare	3.92	3.97	3.88
Wt. of Water	4.49	3.92	4.43
Wt. of Dry Soil	14.61	13.52	15.41
Moisture Content (%)	30.7	29.0	28.7





LIQUID LIMIT (%) 29
PLASTIC LIMIT (%) 22
PLASTICITY INDEX (%) 7

Soil Description: Low Plasticity

USCS Symbol: CL

Remarks:

EBA Engineering
Consultants Ltd.
eba

Atterberg Limits Test Form

ASTM D4318

Project:	Proposed Valley Dump	Sample Number:	08-SWC272-S11
		Borehole Number:	08-SWC272-S11
Project Number:	W14101068.006	Depth:	83 - 84 ft
Sample Description:		Date Tested:	7/5/2008
		Tested By:	RC

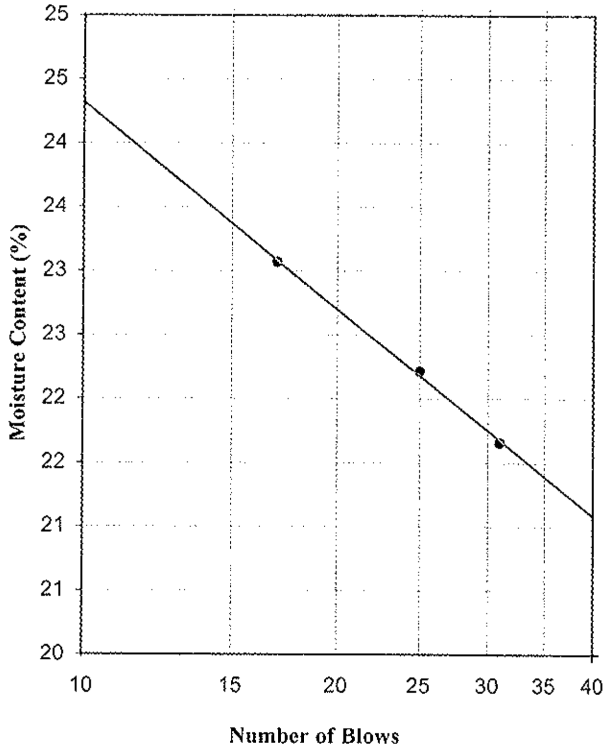
Plastic Limit Test

Trial Number	1	2	3
Tare Number	PL1	PL2	
Wt. Wet Soil + Tare	5.31	6.92	
Wt. Dry Soil + Tare	4.73	6.11	
Wt. of Tare	1.43	1.47	
Wt. of Water	0.58	0.81	
Wt. of Dry Soil	3.30	4.64	
Moisture Content (%)	17.6	17.5	

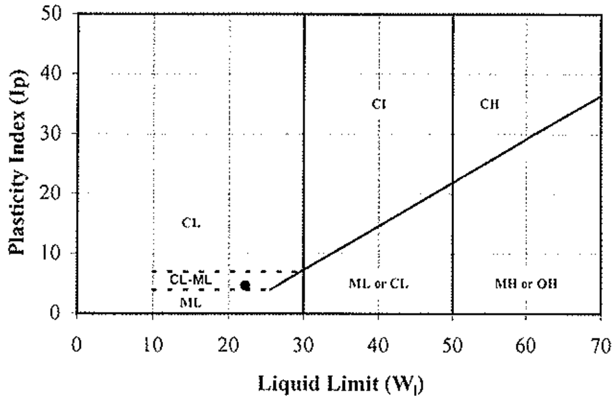
Liquid Limit Test

Trial Number	1	2	3
No. of Blows	17	25	31
Tare Number	U-1	U-2	U-3
Wt. Wet Soil + Tare	31.97	20.79	19.57
Wt. Dry Soil + Tare	26.71	17.70	16.80
Wt. of Tare	3.91	3.79	4.01
Wt. of Water	5.26	3.09	2.77
Wt. of Dry Soil	22.80	13.91	12.79
Moisture Content (%)	23.1	22.2	21.7

Liquid Limit (W_l)



Plasticity Chart



LIQUID LIMIT (%) 22

PLASTIC LIMIT (%) 18

PLASTICITY INDEX (%) 5

Soil Description: Low Plasticity

USCS Symbol: CL

Remarks:

EBA Engineering
Consultants Ltd.

Atterberg Limits Test Form

ASTM D4318

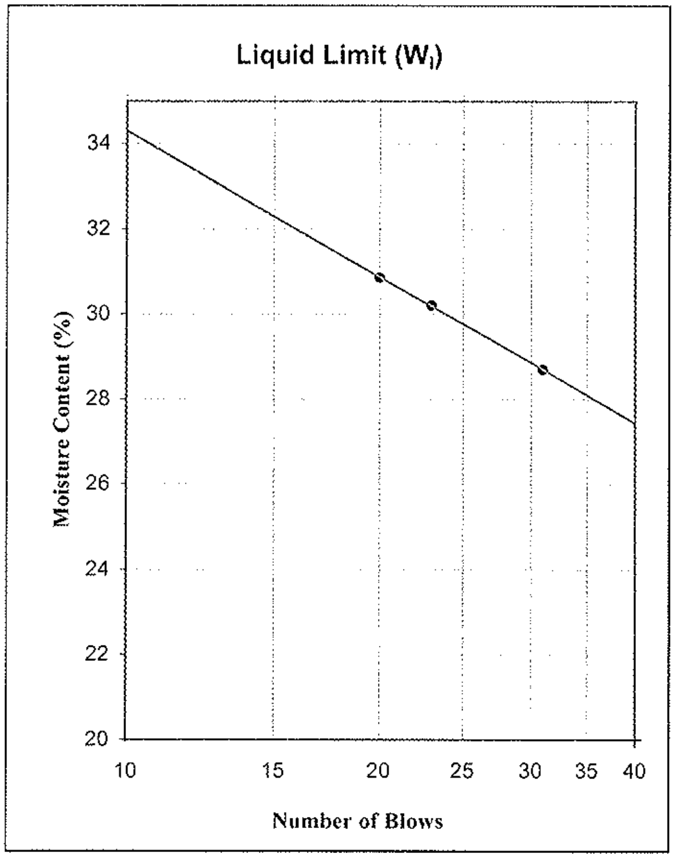
Project:	Proposed Valley Dump	Sample Number:	08-SWC273-S8
		Borehole Number:	08-SWC273-S8
Project Number:	W14101068.006	Depth:	73 - 74 ft
Sample Description:		Date Tested:	5/5/2008
		Tested By:	JP

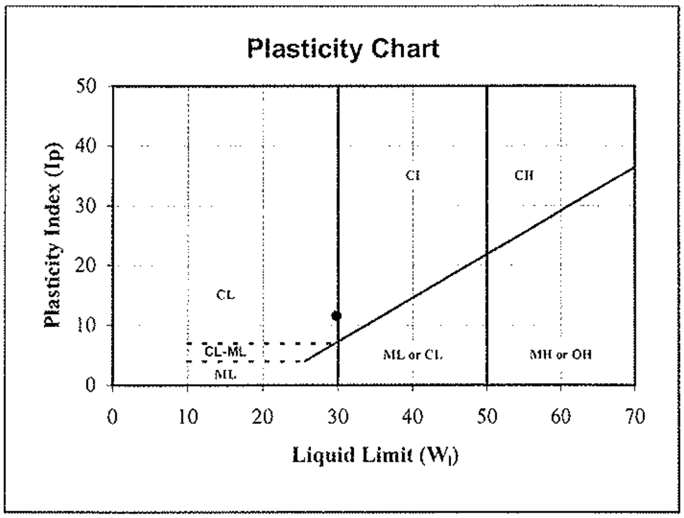
Plastic Limit Test

Trial Number	1	2	3
Tare Number			
Wt. Wet Soil + Tare	5.21	5.10	
Wt. Dry Soil + Tare	5.01	4.92	
Wt. of Tare	3.93	3.92	
Wt. of Water	0.20	0.18	
Wt. of Dry Soil	1.08	1.00	
Moisture Content (%)	18.5	18.0	

Liquid Limit Test

Trial Number	1	2	3
No. of Blows	20	23	31
Tare Number	c	d	e
Wt. Wet Soil + Tare	13.02	18.37	20.09
Wt. Dry Soil + Tare	10.86	15.05	16.50
Wt. of Tare	3.86	4.06	3.99
Wt. of Water	2.16	3.32	3.59
Wt. of Dry Soil	7.00	10.99	12.51
Moisture Content (%)	30.9	30.2	28.7





LIQUID LIMIT (%) 30
PLASTIC LIMIT (%) 18
PLASTICITY INDEX (%) 12

Soil Description: Medium Plasticity

USCS Symbol: CI

Remarks:

EBA Engineering
Consultants Ltd.

Atterberg Limits Test Form

ASTM D4318

Project: Proposed Valley Dump

Project Number: W14101068.006

Sample Description:

Sample Number: 08-SWC273-S14

Borehole Number: 08-SWC273-S14

Depth: 126 - 127 ft

Date Tested: 6/5/2008

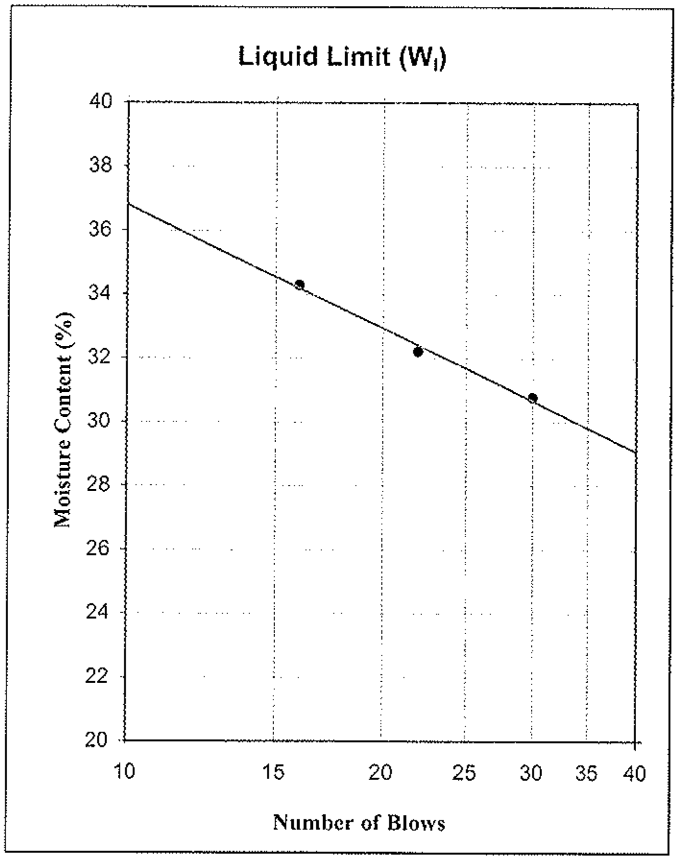
Tested By: RC

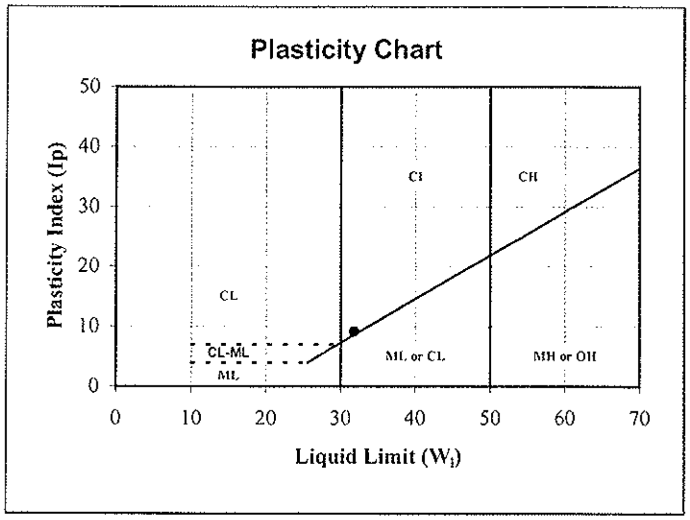
Plastic Limit Test

Trial Number	1	2	3
Tare Number	PL1	PL2	
Wt. Wet Soil + Tare	3.68	6.02	
Wt. Dry Soil + Tare	3.25	5.16	
Wt. of Tare	1.34	1.39	
Wt. of Water	0.43	0.86	
Wt. of Dry Soil	1.91	3.77	
Moisture Content (%)	22.5	22.8	

Liquid Limit Test

Trial Number	1	2	3
No. of Blows	22	30	16
Tare Number	A-1	A-2	A-3
Wt. Wet Soil + Tare	28.33	34.48	29.52
Wt. Dry Soil + Tare	22.42	27.32	22.98
Wt. of Tare	4.07	4.06	3.91
Wt. of Water	5.91	7.16	6.54
Wt. of Dry Soil	18.35	23.26	19.07
Moisture Content (%)	32.2	30.8	34.3





LIQUID LIMIT (%) 32

PLASTIC LIMIT (%) 23

PLASTICITY INDEX (%) 9

Soil Description: Medium Plasticity

USCS Symbol: CI

Remarks:

EBA Engineering
Consultants Ltd.

Atterberg Limits Test Form

ASTM D4318

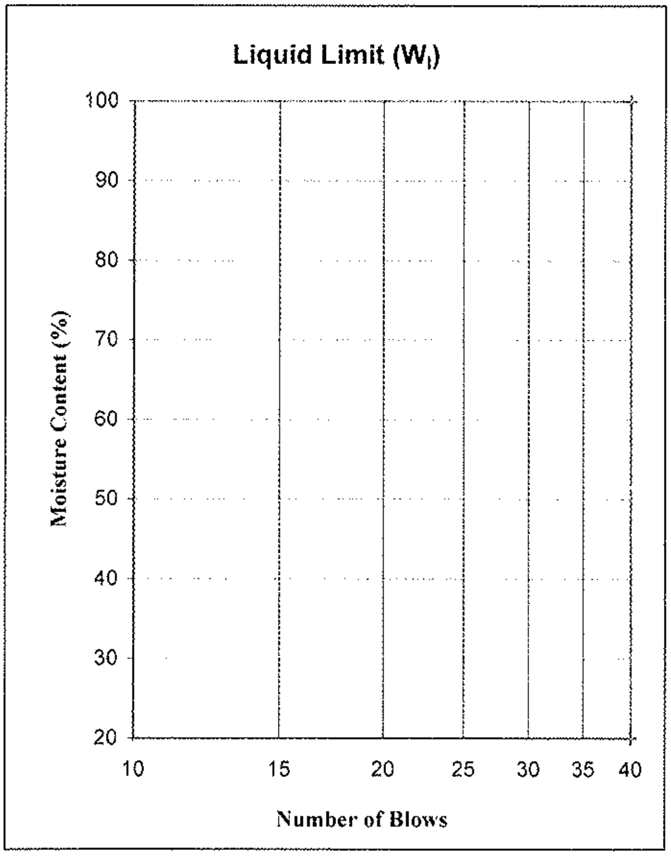
Project:	Proposed Valley Dump	Sample Number:	08-SWC274-S1
		Borehole Number:	08-SWC274-S1
Project Number:	W14101068.006	Depth:	10 - 11 ft
Sample Description:		Date Tested:	6/5/2008
		Tested By:	JP

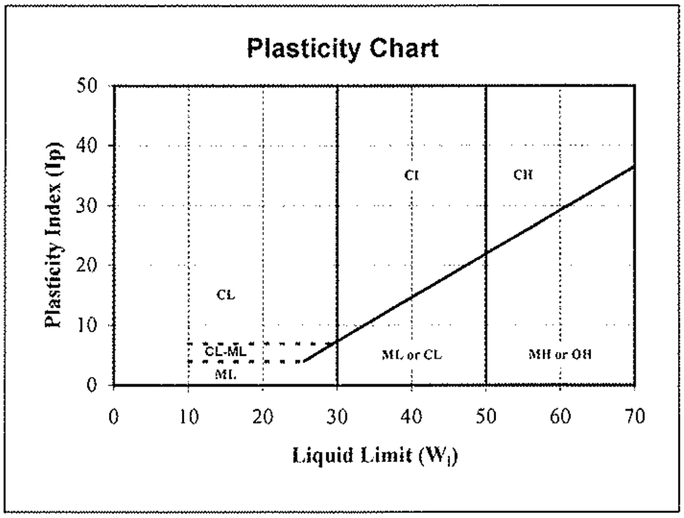
Plastic Limit Test

Trial Number	1	2	3
Tare Number			
Wt. Wet Soil + Tare			
Wt. Dry Soil + Tare			
Wt. of Tare			
Wt. of Water	0.00	0.00	
Wt. of Dry Soil	0.00	0.00	
Moisture Content (%)	#DIV/0!	#DIV/0!	

Liquid Limit Test

Trial Number	1	2	3
No. of Blows			
Tare Number			
Wt. Wet Soil + Tare			
Wt. Dry Soil + Tare			
Wt. of Tare			
Wt. of Water	0.00	0.00	0.00
Wt. of Dry Soil	0.00	0.00	0.00
Moisture Content (%)	#DIV/0!	#DIV/0!	#DIV/0!





LIQUID LIMIT (%)

PLASTIC LIMIT (%) #DIV/0!

PLASTICITY INDEX (%) #DIV/0!

Soil Description: Non-plastic

USCS Symbol:

Remarks: Non-plastic

EBA Engineering Consultants Ltd.

Atterberg Limits Test Form

ASTM D4318

Project: Proposed Valley Dump

Project Number: W14101068.006

Sample Description:

Sample Number: 08-SWC274-S8

Borehole Number: 08-SWC274-S8

Depth: 71 - 72 ft

Date Tested: 6/5/2008

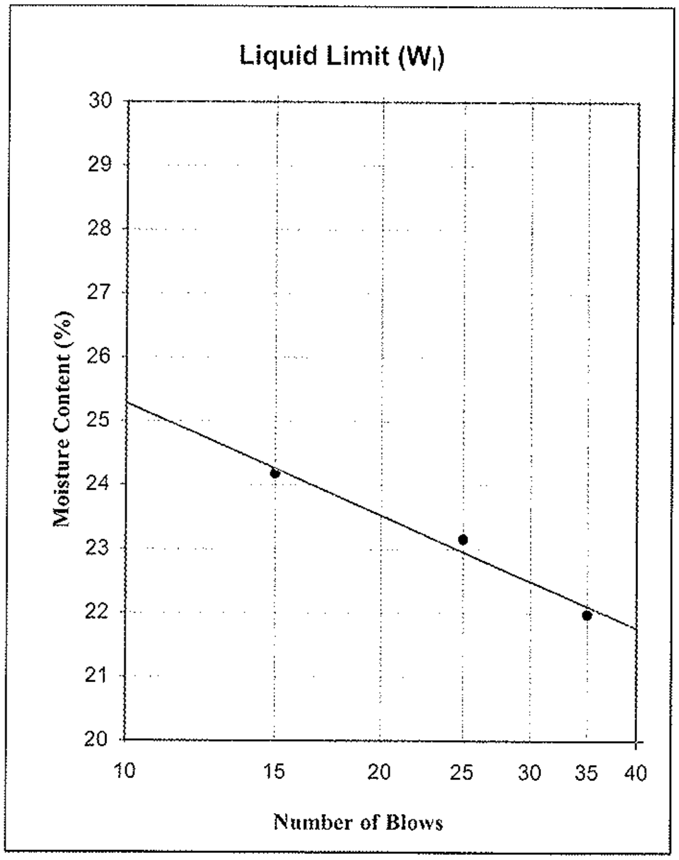
Tested By: JP

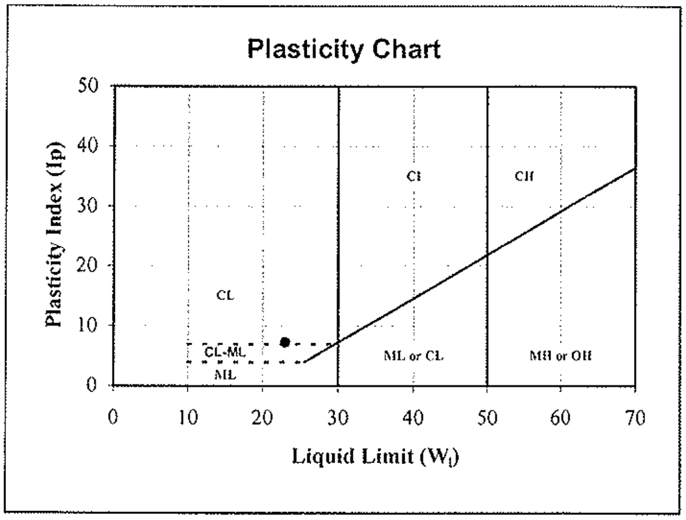
Plastic Limit Test

Trial Number	1	2	3
Tare Number	A-4	A-5	
Wt. Wet Soil + Tare	5.25	6.06	
Wt. Dry Soil + Tare	5.07	5.79	
Wt. of Tare	3.97	4.00	
Wt. of Water	0.18	0.27	
Wt. of Dry Soil	1.10	1.79	
Moisture Content (%)	16.4	15.1	

Liquid Limit Test

Trial Number	1	2	3
No. of Blows	15	25	35
Tare Number	A-1	A-2	A-3
Wt. Wet Soil + Tare	27.73	28.53	29.23
Wt. Dry Soil + Tare	23.10	23.91	24.67
Wt. of Tare	3.95	3.96	3.93
Wt. of Water	4.63	4.62	4.56
Wt. of Dry Soil	19.15	19.95	20.74
Moisture Content (%)	24.2	23.2	22.0





LIQUID LIMIT (%)	23
PLASTIC LIMIT (%)	16
PLASTICITY INDEX (%)	7

Soil Description: Low Plasticity

USCS Symbol: CL

Remarks:

EBA Engineering
Consultants Ltd.

Atterberg Limits Test Form

ASTM D4318

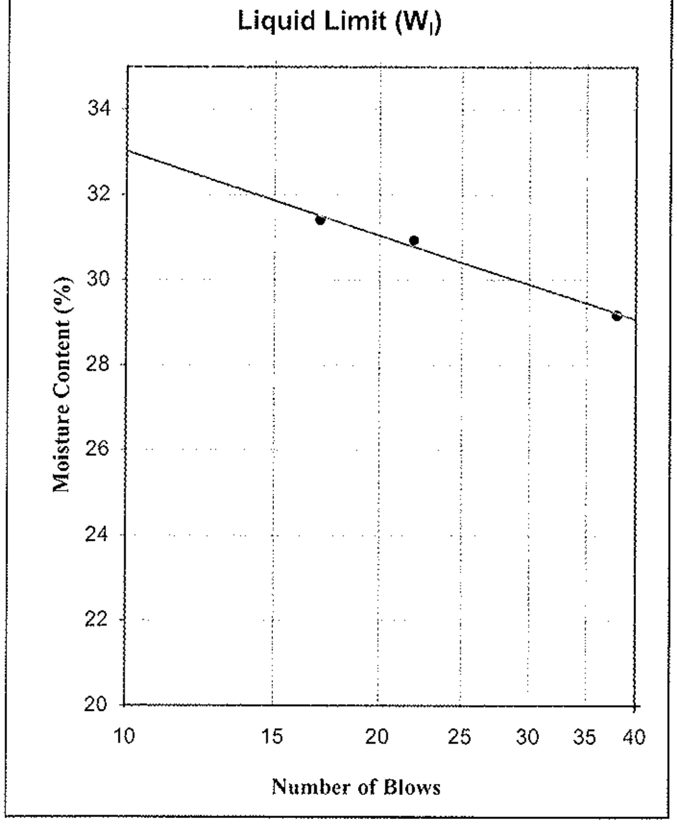
Project:	Proposed Valley Dump	Sample Number:	08-SWC275-S14
		Borehole Number:	08-SWC275-S14
Project Number:	W14101068.006	Depth:	64 - 65 ft
Sample Description:		Date Tested:	5/5/2008
		Tested By:	JP

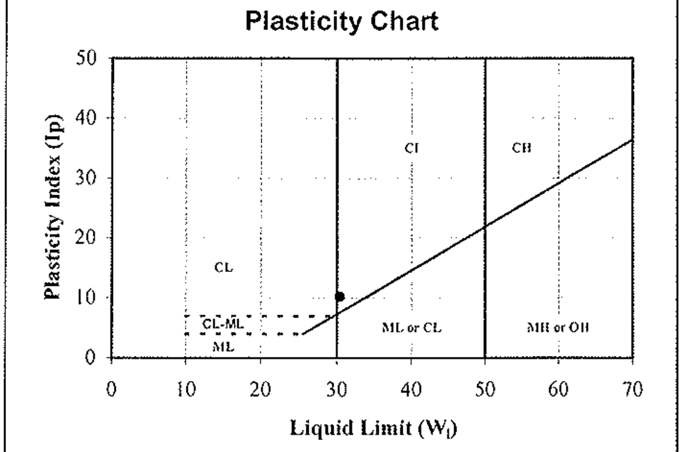
Plastic Limit Test

Trial Number	1	2	3
Tare Number	A-4	A-5	
Wt. Wet Soil + Tare	5.69	5.62	
Wt. Dry Soil + Tare	5.38	5.34	
Wt. of Tare	3.89	3.91	
Wt. of Water	0.31	0.28	
Wt. of Dry Soil	1.49	1.43	
Moisture Content (%)	20.8	19.6	

Liquid Limit Test

Trial Number	1	2	3
No. of Blows	17	22	38
Tare Number	A-1	A-2	A-3
Wt. Wet Soil + Tare	24.59	25.69	27.79
Wt. Dry Soil + Tare	19.68	20.57	22.41
Wt. of Tare	4.05	4.02	3.97
Wt. of Water	4.91	5.12	5.38
Wt. of Dry Soil	15.63	16.55	18.44
Moisture Content (%)	31.4	30.9	29.2





LIQUID LIMIT (%) 30

PLASTIC LIMIT (%) 20

PLASTICITY INDEX (%) 10

Soil Description: Medium Plasticity

USCS Symbol: CI

Remarks:

EBA Engineering
Consultants Ltd.

Atterberg Limits Test Form

ASTM D4318

Project: Proposed Valley Dump

Project Number: W14101068.006

Sample Description:

Sample Number: 08-SWC278-S2

Borehole Number: 08-SWC278-S2

Depth: 0.0 - 0.1 ft

Date Tested: 5/5/2008

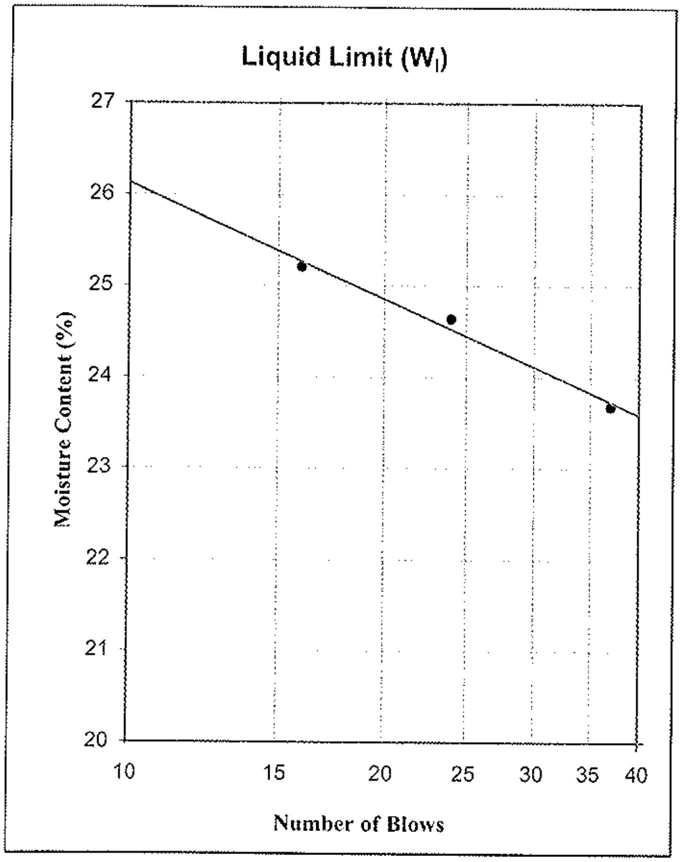
Tested By: JP

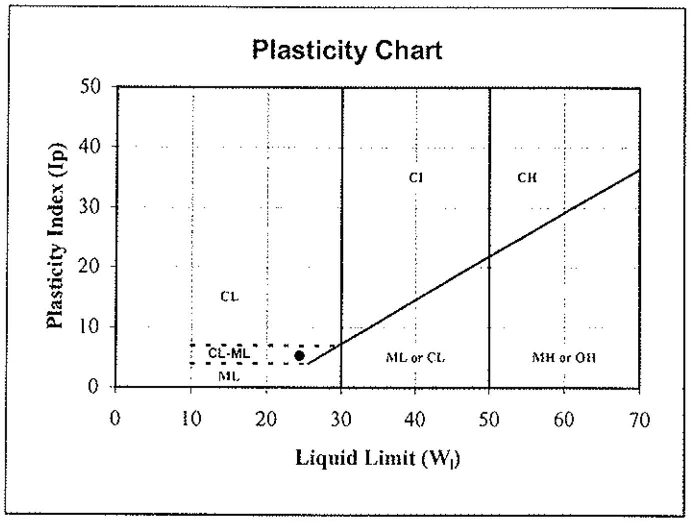
Plastic Limit Test

Trial Number	1	2	3
Tare Number	A-4	A-5	
Wt. Wet Soil + Tare	6.22	5.89	
Wt. Dry Soil + Tare	5.83	5.59	
Wt. of Tare	3.86	3.96	
Wt. of Water	0.39	0.30	
Wt. of Dry Soil	1.97	1.63	
Moisture Content (%)	19.8	18.4	

Liquid Limit Test

Trial Number	1	2	3
No. of Blows	16	24	37
Tare Number	A-1	A-2	A-3
Wt. Wet Soil + Tare	14.40	26.46	25.15
Wt. Dry Soil + Tare	12.31	22.02	21.11
Wt. of Tare	4.02	4.00	4.05
Wt. of Water	2.09	4.44	4.04
Wt. of Dry Soil	8.29	18.02	17.06
Moisture Content (%)	25.2	24.6	23.7





LIQUID LIMIT (%) 24

PLASTIC LIMIT (%) 19

PLASTICITY INDEX (%) 5

Soil Description: Low Plasticity

USCS Symbol: CL

Remarks:

EBA Engineering
Consultants Ltd.

MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

APPENDIX D

Geotechnical Design – Proposed Reclamation Overburden Dump

Minto Explorations Ltd.
Whitehorse, Yukon

ISSUED FOR USE

GEOTECHNICAL DESIGN PROPOSED RECLAMATION OVERBURDEN DUMP MINTO MINE, YUKON

W14101068.004

February 2008

EBA Engineering Consultants Ltd.
p. 867.668.3068 • f. 867.668.4349
Calcite Business Centre • Unit 6, 151 Industrial Road • Whitehorse, Yukon Y1A 2V3 • CANADA

TABLE OF CONTENTS

PAGE

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 GENERAL

The Minto Mine is a copper-gold mine located about 240 km north of Whitehorse, Yukon and is owned and operated by Minto Explorations Ltd. (Minto). The general location of the Minto Mine, along with its specific structures, is shown in Figure 1. The mine is being developed as an open pit mining operation and has been in production since June 2007. Development of the Area 1 Open Pit commenced with stripping in April 2006, and currently operates on an ongoing basis with either ore being stockpiled for processing and/or waste materials being disposed of at one of the waste dumps. There are currently two waste dumps permitted at the Minto Mine - the Main Waste Dump (MWD), and the Ice-Rich Overburden Dump (IROD). The MWD is used to store both non ice-rich overburden and waste rock materials. The IROD is to be used for storing ice-rich overburden. To date, Minto has only used the MWD for waste from the open pit.

Minto has proposed the design and construction of a third waste dump, immediately west of the MWD, for the storage of non ice-rich overburden for possible use in future reclamation. Consequently, EBA Engineering Consultants Ltd. (EBA) was retained by Minto to undertake the geotechnical design of this third waste dump, the Reclamation Overburden Dump (ROD).

This design report presents the geotechnical design of the proposed ROD. Background information involving the proposed ROD, findings of several geotechnical characterization programs, which EBA conducted in 1997, 2005 and most recently January 2008, and analytical work associated with the geotechnical design of the ROD are summarized within this report. Furthermore, construction and monitoring recommendations for the ROD are also included.

EBA received approval from Minto to proceed with the geotechnical design of the ROD in December 2007.

This report is subject to the General Conditions provided in Appendix A.

1.2 SCOPE OF WORK

EBA's scope of work was specifically the geotechnical design of the proposed ROD, and did not include detailed waste deposition planning.

1.3 REPORT FORMAT

This geotechnical design report is contained in one volume and presents the main text together with the figures and appendices.

2.0 BACKGROUND INFORMATION

2.1 REQUIREMENT FOR A RECLAMATION OVERBURDEN DUMP

As recommended in EBA's design report (EBA, 1998a), "Geotechnical Evaluation, Proposed Main Waste Dump" dated April 1998, current mining operations for the MWD construction have been completed with the finer grained non ice-rich overburden material being placed within the interior of the MWD and only coarser free draining waste rock placed around the perimeter. This practice was recommended and is being used to ensure the long term stability of the structure; it did not account for the potential reuse of the finer grained overburden material for reclamation purpose.

The construction of the proposed ROD will allow reuse of this overburden material for mine reclamation purposes.

2.2 SCHEDULE OF ACTIVITIES TO DATE

The following information summarizes the main activities involving the proposed ROD that occurred prior to the completion of this design report.

- Minto provided EBA with the layout, geometry and associated volume of the proposed ROD, as shown in Figure 2 (labelled "original Reclamation Overburden Dump layout provided by Minto"). Minto's assumptions for this layout and geometry included the placement of approximately 10 m lifts with a 30 m berm setback to yield an overall slope of 2.5H:1V. The structure was reported to contain approximately 550,000 m^3 of material.
- EBA reviewed the existing geotechnical information for the proposed ROD site and the overburden material to be stockpiled within the dump and issued the letter report (EBA, 2007), "Proposed Reclamation Overburden Dump, Minto Mine, YT" dated December 13, 2007. This letter report summarized the available geotechnical information and indicated that based on this information, the proposed ROD could be designed as an engineered structure at this location.
- Minto provided EBA with two samples of the typical overburden material to be stored within the proposed ROD. These samples were collected by Minto from the Area 1 Open Pit on December 10, 2007. These samples were sent to EBA's Edmonton laboratory for strength determination testing. Results from the testing would not be available until mid to end January 2008.
- Minto submitted a letter to Yukon Government – Energy, Mines and Resources (EMR) entitled "Re: QML-0001 Notification of need to start a Reclamation Material Stockpile (RMS)" dated December 12, 2007 and a copy of EBA, 2007. Minto's letter discussed the immediate use of the proposed ROD as current open pit development planning required the removal of the overburden material from the south portion of the pit. With Minto's current waste dump permitting, this overburden material would be placed within the MWD and encapsulated with waste rock and lost to future reuse.

- On December 14, 2007, a meeting was held between EMR, Minto, and EBA to discuss the use and design of the proposed ROD.
- EMR issued the letter, "Temporary Approval for Reclamation Overburden Dump, Minto Mine", dated December 20, 2007. This letter stipulated conditions for the temporary approval of the proposed ROD layout provided by Minto.
- At the time of this report, no overburden material has been placed within the proposed ROD.

2.3 DESIGN INFORMATION

EBA developed the geotechnical design for the proposed ROD from the following background information:

- A drawing supplied by Minto on December 6, 2007 that detailed the proposed layout, geometry, and associated volume, and
- Several conversations and meetings with Minto involving the ROD's construction and intended use.

In addition, EBA also used the following information from EBA's files:

- A 1998 report (EBA, 1998a) entitled "Geotechnical Evaluation, Proposed Main Waste Dump" summarizing the geotechnical design of the MWD;
- A 1998 report (EBA, 1998b) entitled "1997 Geotechnical Program and Construction Inspection Reports" detailing the 1997 geotechnical investigations ;
- A 2006 report (EBA, 2006a) entitled "Geotechnical Design, Ice-Rich Overburden Dump" summarizing the geotechnical design of the IROD; and
- A 2006 letter report (EBA, 2006b) entitled "Addendum to Geotechnical (Open Pit) Feasibility Study" detailing a geotechnical investigation of the overburden material in the south portion of the open pit in the fall 2005.

3.0 RECLAMATION OVERBURDEN SOURCING AND CHARACTERIZATION

3.1 OVERBURDEN SOURCING

The current open pit development plan indicates that approximately 370,000 m^3 (insitu) of overburden will be excavated from the south portion of the Area 1 Open Pit and placed within a current waste dump. This south portion of the Area 1 Open Pit is referred to as Phase 2 of the Area 1 Open Pit.

This overburden could be stored in the proposed ROD and used for reclamation purposes, as required. It is understood that the overburden material would be excavated the pit between January 2008 and April 2008.

Figure 2 identifies the location of the Phase 2, Area 1 Open Pit which is the source of the overburden.

3.2 OVERBURDEN CHARACTERIZATION

EBA has undertaken two separate characterization programs to evaluate the geotechnical properties of overburden located in the south portion of the Area 1 Open Pit. The first program was completed in November 2005 and formed part of EBA, 2006b. The second program was completed in January 2008 to supplement the data required for the ROD design.

3.2.1 2005 Overburden Characterization Program

The 2005 overburden characterization program included five boreholes drilled in the south portion of the Area 1 Open Pit. Figure 2 shows the location of these boreholes, 1200173-042 through -045B. Borehole logs summarizing the soil and ground ice descriptions, as well as the laboratory index testing (moisture content, particle size distribution, and Atterberg limit determinations) are presented in Appendix B. Individual particle size distribution results are also presented in Appendix B with the associated borehole log. Frozen bulk densities were also recorded for select permafrost samples.

A 25 mm PVC pipe was installed in Borehole 1200173-042 to enable the installation of a ground temperature cable at a later date. This cable would be used to determine the ground temperature profile within the south portion of the Area 1 Open Pit. The cable was installed on March 8, 2006.

3.2.1.1 Moisture Content Determination

A total of 114 moisture content determinations were undertaken. Figure C.1, in Appendix C, graphically summarizes the moisture content versus elevation for each borehole and provides the overall combined maximum, minimum, average and standard deviation values. The overall combined average moisture content along with the upper and lower standard deviation values are also presented in Figure C.1.

The moisture content results varied throughout the depth of each borehole and corresponding elevations. No correlation between the moisture content and elevation can be derived from this data.

3.2.1.2 Particle Size Distribution

A total of 24 particle size distribution determinations were completed. Table C.1, in Appendix C, summarizes the particle size distribution versus elevation for each borehole in tabular form and provides the overall combined maximum, minimum, average and standard deviation values for each particle size classification (Clay, Silt, Sand, and Gravel).

The particle size distribution results varied throughout the depth of each borehole and corresponding elevations. No correlation between the particle size distribution and elevation can be derived from this data.

3.2.1.3 Atterberg Limit Determination

A total of eight Atterberg limit determinations were completed. Table C.1, in Appendix C, summarizes the Atterberg limit versus elevation for each borehole in tabular form and provides the overall combined maximum, minimum, average and standard deviation values for the liquid limit, plastic limit, and plasticity index.

The Atterberg limit results indicate a fairly consistent plasticity index from the ground surface to elevation 795 m. Results from elevation 772 m to 774 m are also consistent but elevated from those above.

3.2.1.4 Measured Frozen Bulk Density

A total of 14 frozen bulk density determinations were completed. Figure C.2 graphically summarizes the 85% of measured bulk density versus elevation for each borehole and provides the overall combined maximum, minimum, average and standard deviation values for the 85 % of measured bulk density results. Figure C.3 graphically summarizes moisture content versus 85 % of measured bulk density for each sample. The 85 % of measured bulk density is being used to evaluate the measured bulk densities to account for field measurement corrections. Figure C.2 and C.3 are presented in Appendix C.

The bulk density results varied throughout the depth of each borehole and corresponding elevations. No correlation between the frozen bulk density and elevation can be derived from this data.

Figure C.3 shows the expected inverse relationship between moisture content and frozen bulk density.

3.2.1.5 Ground Temperature Profile

Readings from the ground temperature cable installed in Borehole 1200173-042 were obtained on five occasions between March 24 and October 29, 2006. The ground temperature profiles from these readings are presented graphically in Figure C.4, Appendix C.

The readings indicate a relatively uniform ground temperature of close to -0.6°C at depth and seasonal warming over the top 10 m. The active layer depth was up to 2 m.

3.2.2 2008 Overburden Characterization Program

Minto provided two overburden samples, 08-ROD-OB01 and –OB02, in December 2007 for laboratory strength parameter testing for the proposed ROD design. Both samples were from the south portion of the Area 1 Open Pit as shown in Figure 2. The first sample was from the eastern section of the 796 m bench while the other sample came from the west end of the 808 m bench.

The following tests were undertaken at EBA's Edmonton laboratory:

- Particle size distributions (sieve and hydrometer analyses),
- Moisture density relationship (proctor at standard effort), and
- Direct shear tests.

3.2.2.1 Laboratory Test Results

A summary of the laboratory test results is presented in Table 1. The individual laboratory test results are attached in Appendix D.

TABLE 1: LABORATORY TEST RESULTS – 2008 OVERBURDEN SAMPLES

Sample	Type of Test	Results
08-ROD-OB01	Particle Size Distribution	Clay: 18 %, Silt: 30 %, Sand: 14 %, Gravel: 38 %
	Moisture Density Relationship	Maximum Dry Density (standard effort): 1780 kg/m^3 Optimum Moisture Content: 15.5 %
	Direct Shear Tests	Tested at 85 % MDD - Peak Strength: θ´ = 26.7°, c´ = 13.5 kPa Tested at 90 % MDD - Peak Strength: θ´ = 27.7°, c´ = 8.3 kPa
08-ROD-OB02	Particle Size Distribution	Clay: 8 %, Silt: 18 %, Sand: 15 %, Gravel: 59 %(1)

Note: (1) Laboratory result affected by the presence of one large gravel particle.

3.2.3 Summary of Overburden Geotechnical Characteristics

The above testing programs have found the overburden material typically comprises non-plastic silty sand or sandy silt to low plastic silty clay. These soils are typical of the colluvium that blankets the hillsides in the area.. Particle size distribution results are highly variable but average to a material comprised of approximately 13 % clay, 38 % silt, 33 % sand and 16 % gravel sized particles. The moisture content results ranged from 5.6 % to 57.9 % with an average of 20.4 % and standard deviation of 9.4 %.

The Atterberg limit results give an indication of the mechanical sensitivity of the overburden material at different moisture contents. The plastic limit (PL) defines the moisture content at which the material changes from being a semisolid to a plastic state and the liquid limit (LL) defines the moisture content at which the material changes from a plastic state to a liquid state. The Atterberg limit results indicated that for the material between the ground surface and elevation 795 m the plastic limit, liquid limit and plasticity index averaged 15, 21 and 6, respectively. Materials with these characteristic parameters are expected to behave as granular, non cohesive soils. The results from elevation 772 m to 775 m indicated elevated values of 24, 42, and 18, respectively. With an average moisture content of 20 %, roughly half of the overburden material excavated from above elevation 795 m will be around its liquid limit when it thaws within the dump. Consequently, trafficability in summer conditions could be impaired.

The moisture density relationship determined an optimum moisture content of 15.5% at a maximum dry density (MDD) (standard effort) of 1780 kg/m^3. With an average moisture content of 20%, the overburden material will typically be above its optimum moisture content.

Direct shear tests undertaken at 85 % and 90 % of MDD determined an internal angle of friction of 26.7° and 27.7° and a cohesion intercept of 13.5 kPa and 8.3 kPa at peak shear strength, respectively. Testing was completed at 85 % and 90 % of MDD to represent the loose state of the dumped frozen overburden material during construction of the dump.

None of the 14 bulk density results were below the 1.7 Mg/m^3 threshold set as the "non ice-rich/ice-rich classification". Therefore, all of these samples are considered non ice-rich. Interpolating the results presented in Figure C.3, a moisture content greater than 36 % would indicate the presence of ice-rich overburden (bulk density less than 1.7 Mg/m^3).

Of the 114 moisture content results, only six were in excess of the interpolated intersection of the 1.7 Mg/m^3 limit, which would indicate ice-rich material. Therefore, in general terms, the majority of overburden sampled would be considered non ice-rich.

4.0 RECLAMATION OVERBURDEN DUMP SITE CHARACTERIZATION

4.1 SITE CHARACTERIZATION PROGRAMS

EBA has undertaken two separate site characterization programs to evaluate the geotechnical properties of the proposed ROD foundation located adjacent to the MWD. The first program was completed in September and October 1997 (EBA, 1998b) and formed part of the geotechnical evaluation of the MWD (EBA, 1998a). The second program was completed in January 2008 to supplement the data required for the ROD design.

4.1.1 1997 Site Characterization Program

The 1997 site characterization program included seven boreholes drilled within the vicinity of the proposed ROD location and two testpits excavated within colluvium material at the MWD. Four of the seven boreholes are located within the proposed ROD footprint while the remaining three are located east of the footprint. Figure 2 shows the location of these seven boreholes, 97-G17 through –G23, and two testpits, 97-TP01 and –TP02. Borehole logs summarizing the soil and ground ice descriptions, as well as the laboratory index testing (moisture content, particle size distribution, and Atterberg limit determinations) are presented in Appendix E. Individual particle size distribution results are also presented in Appendix E with the associated borehole log.

Relatively undisturbed Shelby tube samples were obtained from Testpit 97-TP01 and –TP02. Two Shelby tubes were recovered from a depth of 0.3 m to 0.6 m (1 to 2 feet) from Testpit 97-TP01 and two Shelby tubes were taken from Testpit 97-TP02 between 1.0 m to 1.2 m (3 and 4 feet). Laboratory tests conducted on these samples include:

- Particle size distributions (sieve and hydrometer analyses),
- Atterberg limit determination, and
- Direct shear tests.

4.1.1.1 Laboratory Test Results – Shelby Tube Samples

A summary of the laboratory test results for the Shelby tube samples from Testpit 97-TP01 and –TP02 is presented in Table 2. The individual laboratory test results are attached in Appendix F.

TABLE 2: LABORATORY TEST RESULTS – 1997 SHELBY TUBE SAMPLES

Sample	Type of Test	Results
97-TP01	Particle Size Distribution	(1A) Clay: 8.9 %, Silt: 41.4 %, Sand: 43.0 %, Gravel: 6.7 % (1B) Clay: 7.2 %, Silt: 31.7 %, Sand: 40.4 %, Gravel: 20.7 %
	Atterberg Limits	Plastic Limit: 12, Liquid Limit: 17, Plasticity Index: 5
	Direct Shear Tests	Peak Strength: θ´ = 35º Residual Strength: θ´ = 28º
97-TP02	Particle Size Distribution	(2A) Clay: 18.6 %, Silt: 28.0 %, Sand: 25.5 %, Gravel: 27.9 % (2B) Clay: 21.7 %, Silt: 32.9 %, Sand: 27.7 %, Gravel: 17.7 %
	Atterberg Limits	Plastic Limit: 15, Liquid Limit: 28, Plasticity Index: 13
	Direct Shear Tests	Peak Strength: θ´ = 30º Residual Strength: θ´ = 25º

4.1.2 2008 Site Characterization Program

The 2008 site characterization program was completed to provide additional subsurface information within the vicinity of the proposed ROD. The program consisted of a testpitting program in which three testpits were excavated up to a depth of 4.5 m. Figure 2 shows the location of these testpits, 08-ROD-TP01 through –TP03. Testpit logs summarizing the soil and ground ice descriptions, as well as the laboratory index testing (moisture content) are presented in Appendix G. Individual particle size distribution results are also presented in Appendix G with the associated testpit log.

5.0 SITE CONDITIONS

5.1 SURFACE FEATURES

The proposed ROD site is located over gently sloping (about 3º to 4º, or 17H:1V) terrain in the upper portion of a valley, and is directly west of the MWD and 60 m upslope of the IROD access road. The Pelly laydown site is located approximately 240 m downslope in the southeast direction. The IROD is located 320 m south.

The proposed ROD footprint is located on a northwest facing slope on the east side of the upper valley. The terrain steepens to the north and west of the proposed ROD site. Topographic information presented in Figure 2 indicates the presence of several small ephemeral creeks that converge to the middle of this upper valley roughly 30 m to the southwest of the proposed ROD footprint. These creeks collect the surface runoff water and route it down the mountain side. Three ephemeral creeks are shown within the proposed ROD footprint; one originates roughly 150 m northwest of the dump and runs through the upper portion of the dump while the other two originate within the MWD and run through the bottom portion. One of the creeks (farthest east) that originate within the MWD has been disrupted by overburden fill placement within that dump.

The site and adjacent area has sparse to locally dense tree cover. The area was subject to a forest fire in 1995 that has resulted in areas of fallen trees with deciduous species regrowth.

5.2 SUBSURFACE CONDITIONS

The geotechnical site characterizations indicate that the subsurface conditions within the proposed ROD footprint generally comprise a thin veneer of peat and vegetation overlying a silty sand colluvium overlying residual soil (residuum).

The area to the south, towards the middle of this upper valley, generally comprise of a thin veneer of peat and vegetation overlying fine-grained sand and silt overlying coarser-grained sand with some silt and gravel. These soils are believed to be of colluvial origin and underlain by residual soil.

Throughout the mine site these residual soils grade into weathered bedrock (granodiorite).

5.2.1 Groundwater

Groundwater was noted between 1.2 m and 2.1 m at 97-G19 and at 1.5 m at 97-G22 during the site characterizations. No other borehole or testpit completed within the vicinity of the proposed ROD site identified groundwater.

5.2.2 Permafrost

Permafrost was encountered in one of the four boreholes, 97-G23, located within the proposed ROD footprint. The observed ice contents in this borehole were logged as Nf (Ice not visible – poorly bonded or friable) with moisture content results less than 15%. These moisture results are consistent with the overlying unfrozen soils at that location and indicate a non ice-rich material. The active layer at the time of drilling, September 14, 1997, was 5.1 m.

Permafrost was also encountered in Testpit 08-ROD-TP01 through –TP03, at varying depths. The observed ice contents in the three testpits typically ranged from Nbn (Ice not visible – well bonded) to visible ice at 5% to 15% of the total volume. The moisture contents ranged between 11.6 % and 31.0 %. These moisture results are consistent with the overlying unfrozen soils at that location and indicate a non ice-rich material. The maximum recorded active layer thickness was about 1.8 m on January 10, 2008.

5.2.3 Bedrock

Depths to competent bedrock (granodiorite) are unknown as all of the boreholes and testpits within the vicinity of the proposed ROD terminated in the colluvial soils. Weathered bedrock outcrops are present within the vicinity of the IROD and MWD.

6.0 RECLAMATION OVERBURDEN DUMP DESIGN

6.1 DESIGN CONSIDERATIONS

The primary considerations for the geotechnical design of the proposed Reclamation Overburden Dump are summarized below.

- The proposed ROD geometry could be maintained over a relatively short period of time as the overburden material will likely be reused for reclamation purposes. Consequently, the design life of the structure will be re-evaluated within five years.
- The volume of unused overburden to be permanently stored within the ROD is unknown.
- Minto's construction plan to utilize two benches to place the overburden material at an angle of repose (when frozen) will minimize time and effort flattening the slope angle of the dump sideslope, while providing a shallower overall slope angle.
- Localized shallow slip surface failures and sloughing of the 1.5H:1V sideslopes as the overburden thaws are expected and acceptable as long as the overall dump stability is maintained.
- Based on the occurrence of these shallow slip surface failures and sloughing, the proposed ROD footprint has been offset 60 m from the IROD access road and 30 m from the main ephemeral creek southwest of the dump. Furthermore, the construction of the 30 m wide 890 m bench will act as a catchment area in the event of sloughing of the 900 m bench.
- If required, slope remediation of the sloughed material can be completed during the design life of the structure. This adaptive management approach could entail flattening the sideslopes or constructing a waste rock shell in any problematic areas.
- Dependant on the volume of the unused material and final closure planning, the overburden should be recontoured with flatter sideslopes or an external toe berm or shell comprised of waste rock material could be incorporated into the closure design.

6.2 LAYOUT AND GEOMETRY

The original proposed ROD layout provided by Minto in December 2007 has been modified to alleviate several construction issues that would have arisen if the ROD was constructed at that specific location – specifically, permafrost and the main ephemeral stream located down the middle of the valley. The new layout of the proposed ROD is shown in Figure 2.

The geometry of the dump will be a crescent shaped structure with two main benches, one at elevation 890 m and the other at elevation 900 m, as shown in Figure 2 and 3. The 890 m bench will have a 30 m crest width. The 900 m bench is the ultimate elevation of the dump. Each bench will have a 1.5H:1V sideslope. The overall sideslope of the proposed

ROD will be 2.75H:1V. The maximum thickness of the overburden will be in the order of 20 m.

The proposed ROD will be able to contain approximately 479,000 m^3 of material. Based on the 370,000 m^3 (insitu) of overburden to be excavated from the Phase 2 Area 1 Open Pit, there will be adequate storage volume with normal bulking factors.

6.3 STABILITY EVALUATION

6.3.1 Analysis Methodology

Limit equilibrium analyses were conducted to determine the factor of safety against slope failure during construction and maintenance of the dump. All analyses were conducted using the commercially available two-dimensional, limit equilibrium software, SLOPE/W (Geo-Slope International Ltd., GeoStudio 2007 (Version 7.03)). The principles underlying the method of limit equilibrium analyses of slope stability are as follows:

- A slip mechanism is postulated;
- The shear resistance required to equilibrate the assumed slip mechanism is calculated by means of statics;
- The calculated shear resistance required for equilibrium is compared with the available shear strength in terms of factor of safety; and
- The slip surface with the lowest factor of safety is determined through iteration.

A factor of safety is used to account for the uncertainty and variability in the strength and porewater pressure parameters, and to limit deformations.

Earthquake loading has been modeled using pseudostatic peak horizontal ground acceleration.

6.3.1.1 Analyzed Profile

Stability analyses were carried out for a typical profile of the proposed ROD. The foundation at this location was inferred to be silt and sand with varying percentages of gravel, grading into coarser material. Although permafrost was only encountered within the south corner of the 890 m bench (97-G23 and 08-ROD-TP01), its presence was incorporated into the stability evaluation. The depth to permafrost was assumed to range from 2 m to 5 m beneath the overall sideslope. The alignment 2 profile presented in Figure 4 summarizes the typical profile used in the analyses.

6.3.1.2 Failure Scenarios

Two scenarios were evaluated for assessing the dump stability. Scenario 1 assessed the overall dump stability based on a deeper failure plane cutting through the dump to the permafrost interface in the foundation soil. The failure would then follow the permafrost interface and exit below the toe of the slope. The presence of the permafrost in the foundation soils will not greatly affect the overall dump stability as it is considered non ice-rich and thaw stable. It has been postulated, based on previous EBA experience, that some thaw at the base of the active layer will occur and that the shear strength acting along the thawed frozen interface will be a controlling factor in the overall dump design. For purposes of the limit equilibrium analyses, the underlying permafrost is considered much stronger than the unfrozen soil; therefore, the risk of shear failure through the frozen ground was not analysed.

Scenario 2 assessed the stability of the overburden material itself. The proposed ROD construction plan involves 1.5H:1V sideslopes for the 890 m and 900 m bench with an overall 2.75H:1V slope for the structure. It is anticipated that these 1.5H:1V sideslopes will exhibit localized shallow slip surface failures and sloughing once the material thaws in the summer resulting in flatter slopes. The extent of sloughing will be dependent on the moisture content and strength characteristics of the overburden material placed within the dump in the vicinity of the sideslope. Stability analyses were completed based on relatively shallow failures through the 890 m bench and a deep seated failure through the 900 m bench. All failures were forced to exit through the toe of the slope.

6.3.2 Design Criteria

The guidelines for minimum design factor of safety have been adopted from the British Columbia Interim Guidelines for Investigation and Design of Mine Dumps (Waste Rock Design Manual).

The design criteria adopted from the guidelines are included in Table 3.

TABLE 3: DESIGN FACTORS OF SAFETY

Stability Condition	Minimum Design Factor of Safety
Long Term Stability	1.3
Seismic (Pseudostatic) Stability	1.1

The Waste Rock Design Manual recommends that seismic stability should be evaluated using pseudostatic horizontal accelerations that correspond to a 10% probability of exceedance in 50 years. When work was originally undertaken on the MWD in the mid 1990's, the Canadian Geological Survey Pacific Geosciences Centre provided a value for the peak horizontal acceleration for the project site of 0.15 g. An updated value for the site has been provided by the Pacific Geosciences Centre and the current peak horizontal acceleration that corresponds to a 10% probability of exceedance in 50 years is 0.055 g. The reasoning for the decrease in the peak ground acceleration provided by the Pacific Geosciences Centre is that seismic data collection has increased substantially in the Yukon in recent years. A better understanding of ground motion and improved modelling has resulted in revised predictions, which are considered to be more accurate and representative for the project area.

6.3.3 Material Properties

The material properties chosen for the overburden and foundation materials in the stability analyses are presented in Table 4. The properties for the materials were selected based on the completed laboratory testing, and properties used in the design of the existing facilities on the site.

TABLE 4: MATERIAL PROPERTIES USED IN STABILITY ANALYSES

Material	Angle of Internal Friction (º)	Cohesion (kPa)	Unit Weight (kN/m³)
Overburden	25	--	18
Active Layer	28	--	18
Permafrost	--	--	--

6.3.3.1 Overburden

The shear strength parameters, internal friction angle and cohesion, were determined by evaluating the results of direct shear tests on samples of overburden material. Sample 08-ROD-OB01 was sampled from the actual overburden to be placed within the dump. Direct shear testing of this sample was undertaken at 85 % and 90 % of MDD to represent the loose state of the dumped frozen overburden material during construction of the dump. Results indicated an internal angle of shearing resistance of approximately 27º and a cohesion intercept between 8.3 kPa and 13.5 kPa at peak shear strength. These test results were evaluated with the direct shear tests from samples from 97-TP01 and –TP02. These testpits were not located within the Area 1 Open Pit; however, the material is of similar nature to the overburden. The results from samples from 97-TP01 and –TP02 are presented in Table 2.

Based on these results and evaluation, strength parameters of θ´ = 25º and c´ = 0 kPa were used for the stability analyses.

6.3.3.2 Active Layer

The active layer soils are typically a silty sand or silt and sand with trace to some gravel. This material is believed to be representative of the colluvium found at Testpit 97-TP01. Direct shear testing of a silty sand colluvium sample from Testpit 97-TP01 indicates this material could exhibit strain-softening behaviour with a peak friction angle of 35° and a residual friction angle of 28°.

Based on these results, strength parameters of θ´ = 28° and c´ = 0 kPa were used for the stability analyses.

6.3.3.3 Permafrost

The permafrost soil found beneath the south corner of the proposed ROD is typically a silty sand with some gravel. For the purpose of these analyses, this material has been modelled to act as bedrock to force the critical failure surface to the contact of the thawed and frozen material.

6.3.4 Porewater Pressure Conditions

6.3.4.1 Natural Stratigraphy

The geotechnical drilling and testpitting at this site suggests that the existing active layer was relatively dry; however, free flowing water was noted at two locations. Therefore, it is possible that a shallow perched groundwater table may exist for short periods of the year.

A groundwater table at the original ground surface was used for the stability analyses.

6.3.4.2 Overburden

The potential for a phreatic surface developing within the dump was not considered due to the following:

- The overburden will be placed in a loose state which will allow for any free water within the dump to drain with the slow rate of thaw of the overburden; and
- If required, a diversion berm will be constructed upstream of the dump to control surface run-on water.

6.3.5 Stability Analyses

6.3.5.1 Scenario 1 – Static and Pseudostatic (Earthquake) Cases for Foundation Soils

The results of the minimum factors of safety calculated during the static and pseudostatic stability analyses for Scenario 1 are summarized in Table 5. Figure 4 presents the typical profile used for the analyses and the resulting critical slip surfaces.

TABLE 5: SUMMARY OF STABILITY ANALYSES RESULTS – SCENARIO 1

Case		Minimum Factor of Safety of the ROD
1	Static, deep seated failure from the 900 m bench toe to the permafrost contact, failure of the 890 m bench	1.9
2	Static, relatively shallow failure through the 890 m bench to the permafrost contact, failure commences approx. 10 m offset from 890 m bench crest	1.3
3	Pseudostatic, deep seated failure from the 900 m bench toe to the permafrost contact, failure of the 890 m bench	1.6
4	Pseudostatic, relatively shallow failure through the 890 m bench to the permafrost contact, failure commences approx. 10 m offset from 890 m bench crest	1.1

6.3.5.2 Scenario 2 – Static and Pseudostatic (Earthquake) Cases for Overburden Only

The results of the minimum factors of safety calculated during the static and pseudostatic stability analyses for Scenario 2 are summarized in Table 6. Figure 5 presents the typical profile used for the analyses and the resulting critical slip surfaces.

TABLE 6: SUMMARY OF STABILITY ANALYSES RESULTS – SCENARIO 2

Case		Minimum Factor of Safety of the ROD
5	Static, deep seated failure from the 900 m bench toe to the permafrost contact, failure of the 890 m bench	1.7
6	Static, relatively shallow seated failure through the 890 m bench to the slope toe, failure of approximately half of 890 m bench	1.3
7	Static, relatively shallow failure through the 890 m bench to the slope toe, failure commences approx. 6 m offset from 890 m bench crest	1.0
8	Pseudostatic, deep seated failure from the 900 m bench toe to the permafrost contact, failure of the 890 m bench	1.4
9	Pseudostatic, relatively shallow seated failure through the 890 m bench to the slope toe, failure of approximately half of 890 m bench	1.1

6.3.5.3 Scenario 1 and 2 – Discussion

With the exception of Case 7, these results indicate that the factor of safety for the overall dump stability based on the failure planes through the foundation soils and the overburden material itself (Scenario 1 and 2, respectively) exceed the design criteria in both the static and pseudostatic condition.

For failure planes through the foundation soils (Scenario 1), Case 1 and 3 determined the factor of safety against a deep seated failure that would mobilize the entire 890 m bench material to be 1.9 for the static analyses and 1.6 for the pseudostatic analyses. Case 2 and 4 determined that the minimum 1.3 (static) and 1.1 (pseudostatic) factor of safety is achieved approximately 10 m upslope of the 890 m bench crest. These results indicate that slip surface failures with factors of safety less than 1.3 are present between the 890 m crest and this 10 m offset. The mobilization of this material will not affect the overall dump stability.

For failure planes through the overburden (Scenario 2), Case 5 and 8 determined the factor of safety against a deep seated failure that would mobilize the entire 890 m bench material to be 1.7 for static analyses and 1.4 for pseudostatic analyses. Case 6 and 9 determined that the minimum 1.3 (static) and 1.1 (pseudostatic) factor of safety is achieved approximately 15 m upslope of the 890 m bench crest.

Case 7 indicates that the overburden material approaches unity (static) at approximately 6 m upslope of the 890 m bench crest. This indicates that based on the soil parameters used in the analyses, as the overburden material thaws it will have shallow slip failures and sloughing over time until the crest of the slope reaches this offset. Should this be the case, a resulting sideslope of 1.9H:1V would be created from the original 1.5H:1V slope. These shallow slip failures and sloughing will occur with the 900 m bench sideslope as well. If both the 890 m and 900 m 1.5H:1V sideslope naturally flattens to approximately 1.9H:1V, the 890 m bench crest width will be reduced to roughly 10 m.

To achieve the design criteria factors of safety, 1.3 (static) and 1.1 (pseudostatic), for the 890 m and 900 m overburden sideslopes and limit the potential of shallow slip failures and sloughing, the sideslopes would require flattening from 1.5H:1V to 2.75H:1V. Given the design life of this dump and its intended use, the construction of 2.75H:1V sideslopes are not likely warranted. This is also based on the fact that the overall dump stability meets the design criteria and that buffer zones have been incorporated into its design to contain shallow surface failures.

EBA recommends an adaptive management approach of visually monitoring the dump's crests and toes as the overburden thaws and regularly after that could provide an effective means of noting potential areas of instability that could be remediated before failure.

Slope remediation of the sloughed material areas can be completed during the design life of the structure. This could entail flattening the sideslopes or constructing a waste rock shell in the area of instability, if necessary.

To initiate remediation of areas of instability that exceed the expected distance of slope movement, the intermediate buffer limit, as presented in Figure 5, has been incorporated into the design. Should any overburden material encroach on the intermediate buffer limit the affected sideslope and bench must be repaired to the satisfaction of the Geotechnical Engineer.

6.3.5.4 Liquefaction Potential

Liquefaction potential of the overburden was assessed by comparing the Atterberg limit results to empirical relationships developed for assessment of liquefiable soil types as presented in Seed et al., 2003. Based on the limited available data, the unfrozen overburden material is considered potentially susceptible to cyclically induced liquefaction. This is a result of the fact that the water content on the unfrozen overburden is expected to be greater than 85 % of the material's liquid limit.

Additional information of the characteristics of the unfrozen overburden material placed within the dump is required to further assess potential for liquefaction. This information involves measuring the density of the inplace material (currently expected to be loose), determining its moisture content (whether the material drains once thawed), and completing index testing of the overburden (particle size distribution and Atterberg limits). This information would need to be collected in the summer of 2008 once the overburden material thaws.

Another approach to this potential issue is to assume that the overburden material will liquefy and design the dump accordingly. One option could involve constructing a waste rock shell or toe berm on the exterior slope of the dump to provide some additional lateral constraint against any instability within the overburden slope. This approach would result in the construction of a dump similar to the MWD. This construction method does not allow for easy reuse of the material; and this reuse is the main reason for the proposed ROD.

As indicated, the potential susceptibility of the overburden to liquefaction commences once the material thaws within the dump; therefore, placement of frozen overburden in the winter/spring of 2008 is not a concern. A summer 2008 characterization program is recommended to further assess whether or not the overburden material is liquefiable under the design earthquake. If this program is not completed, a waste rock shell or toe berm on the exterior slope of the dump must be constructed prior to May 2009.

7.0 SURFACE WATER MANAGEMENT

As previously indicated, the topographic information presented in Figure 2 indicates the presence of several small ephemeral creeks that converge to the middle of the upper valley roughly 30 m to the southwest of the proposed ROD footprint. These creeks collect the surface runoff water and route it down the mountain side. Three ephemeral creeks are shown within the proposed ROD footprint; one originates roughly 150 m northwest of the dump and runs through the upper portion of the dump while the other two originate within the MWD and run through the bottom portion. One of the creeks (farthest east) that originate within the MWD has been disrupted by overburden fill placement within that dump.

Neither these creeks nor any other natural drainage courses were able to be seen during the 2008 site characterization due to the presence of snow cover.

Three site reconnaissance visits, one prior to spring freshet, one at spring freshet and other in the summer 2008, are required to evaluate whether an upstream diversion berm to limit the volume of run-on water through the dump is required. This berm would divert run-on water from the catchment area above the dump to the main ephemeral creek.

It is understood that surface water ponds along the IROD access road downstream of the proposed ROD site during the summer months. The ponded water should be monitored and removed should it encroach within 40 m of the design toe.

Localized erosion of the dump slope is expected and not a concern for the overall stability of the dump. Any areas of consistent localized erosion that causes significant material transport should be remediated.

8.0 CONSTRUCTION RECOMMENDATIONS

General construction recommendations for the ROD are summarized below.

- Subgrade preparation for the proposed ROD is not required. The organic mat should remain undisturbed.
- The particle size distribution and moisture content of the overburden to be stored within the ROD is highly variable; however, if overburden material of low moisture content and/or coarser grained is sourced during pit development it should be used within the exterior slope on the dump.
- Minto must monitor the overburden material to determine whether it should be stored within the ROD (non ice-rich) or IROD (ice-rich).
- A monitoring program must be incorporated to provide photographs and record (as built) information of the construction progress.
- Regular visual inspections by Minto should be completed to note potential areas of instability.
- The intermediate buffer limit, presented in Figure 5, must be monitored. Should sloughed material encroach upon this limit, slope remediation must be completed by either flattening the sideslopes or constructing a waste rock shell in the area of instability.
- Construction should be completed in freezing conditions to aid with trafficability. As indicated in Section 3.2.3, trafficability of the overburden material will be hampered as the soil thaws.

- Removal of the overburden material must be completed in a manor that provides safe working conditions.

9.0 PERFORMANCE MONITORING

Performance monitoring is an integral part of the design, construction, and operation of the ROD. This section describes a recommended minimum monitoring program for the construction and operation phases of the dump.

The results of the monitoring program can be the basis of an adaptive management process that continually reviews the operation of the dump.

A monitoring program must be incorporated to provide photographs and record (as built) information of the construction progress.

9.1 VISUAL MONITORING

It is understood that the proposed dump will be constructed in the winter of 2008 when the overburden waste soils are frozen. Field observations and performance monitoring should be completed in the spring/summer of 2008 to evaluate the dump performance once the materials thaw. This monitoring should continue on a monthly basis and include the following:

- Inspection of the external slopes for any signs of distress;
- Inspection of the crest of the dump for any signs of transverse cracking; and
- Inspection of the dump toe for any signs of seepage from the base.

EBA recommends visual monitoring of the dump's crests and toes as the overburden thaws and regularly after that could provide an effective means of noting potential areas of instability that could be remediated before failure.

The intermediate buffer limit, as presented in Figure 5, must be monitored on a regular basis. Should any overburden material encroach on the intermediate buffer limit the effected sideslope and bench must be repaired to the satisfaction of the Geotechnical Engineer.

Any ponded water along the IROD access road should be monitored and removed if it comes within 40 m of the ROD design toe.

9.2 OVERBURDEN MATERIAL MONITORING

Monitoring of the overburden waste soils should be completed during open pit development to ensure only non ice-rich overburden waste is placed in the proposed Reclamation Overburden Dump. Ice-rich waste should be placed in the Ice-Rich Overburden Dump.

9.3 DEFORMATION SURVEYS

The breaklines (crest and toes) of the ROD should be surveyed at the completion of each main construction phase to determine the record (as built) geometry and to establish a basis for determining future deformations. These same breaklines should be resurveyed and reviewed in June and September of each year, or periodically at the discretion of the Geotechnical Engineer, to monitor deformation movements.

10.0 ANNUAL INSPECTION

It is recommended that an annual site inspection be conducted by the Geotechnical Engineer during the operational period to document the performance of the ROD. The specific tasks of these visits include:

- Inspection of the external slopes for any signs of distress;
- Inspection of the crest of the dump for any signs of transverse cracking;
- Inspection of the dump for any signs of seepage from the base;
- Review of survey data to confirm conformance with design assumptions; and
- Preparation of an annual report that summarizes the data and provides recommendations for maintenance or modification to the dump.

11.0 LIMITATIONS

Geological conditions are innately variable and are seldom spatially uniform. At the time of this report, information on stratigraphy at the project was at identified borehole locations from past studies. In order to develop recommendations from this information, it is necessary to make some assumptions concerning conditions other than at the specifically tested locations. Adequate monitoring should be provided during construction to check that these assumptions are reasonable.

The recommendations prepared and presented in this report are based on the geotechnical data gathered by EBA from previous reports and the current laboratory testing and site characterization program The provided data, in the form of geotechnical boreholes and associated laboratory index property test results, has been supplemented by EBA's direct observations of the site.

This report and the recommendations contained in it are intended for the sole use of Minto Explorations Ltd. EBA does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report if the information presented in this report is used or relied upon by any party other than that specified above for the proposed ROD. Any such unauthorized use of this report is at the sole risk of the user. Additional information regarding the use of this report is presented in the attached General Conditions, which form a part of this report.

12.0 CLOSURE

EBA trusts that this report satisfies your requirements. Please do not hesitate to contact the undersigned should you have any questions or comments.

Respectfully Submitted,
EBA Engineering Consultants Ltd.

J.P.W. BERKERS
Feb 07/08

J. RICHARD TRIMBLE
Feb 7/08

prepared by:
Jason P.W. Berkers, P.Eng.
Project Engineer
Direct Line: 867.668.2071 x233
jberkers@eba.ca

reviewed by:
J. Richard Trimble, M.Sc. (Eng.), P.Eng.
Project Director, Yukon Region
Direct Line: 867.668.2071 x222
rtrimble@eba.ca

PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
SIGNATURE
Date Feb 7/08
PERMIT NUMBER PP003
Association of Professional
Engineers of Yukon

REFERENCES

EBA, 1998a. “Geotechnical Evaluation, Proposed Main Waste Dump”. Minto Explorations Ltd. Minto Mine, Yukon. (EBA Project No. 0201-11509, dated April 1998).

EBA, 1998b. “1997 Geotechnical Program and Construction Inspection Reports”. Minto Explorations Ltd. Minto Mine, Yukon. (EBA Project No. 0201-11509, dated February 1998).

Seed et al., 2003. “Recent Advances in Soil Liquefaction Engineering: A Unified and Consistent Framework”. College of Engineering. University of California. Berkeley. Report No. EERC 2003-06.

EBA, 2006a. “Geotechnical Design, Ice-Rich Overburden Dump”. Minto Explorations Ltd. Minto Mine, Yukon. (EBA Project No. 1200173, dated January 2006).

EBA, 2006b. “Addendum to Geotechnical (Open Pit) Feasibility Study”. Minto Explorations Ltd. Minto Mine, Yukon. (EBA Project No. 1200173, dated May 25, 2006).

EMR, 2007. “Temporary Approval for Reclamation Overburden Dump, Minto Mine”. Minto Explorations Ltd. Minto Mine, Yukon. (QML-0001, dated December 20, 2007).

Minto, 2007. “Re: QML-0001, Notification of need to start Reclamation Material Stockpile (RMS)”. Government Yukon – Energy, Mines and Resources. Minto Mine, Yukon. (QML-0001, dated December 12, 2007).

EBA, 2007. “Proposed Reclamation Overburden Dump, Minto Mine, YT”. Minto Explorations Ltd. Minto Mine, Yukon. (EBA Project No. W14101068.004, dated December 13, 2007).

MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

APPENDIX E

Phase IV ML/ARD Assessment and Post-Closure Water Quality Prediction

MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

Minto Mine Expansion- Phase IV
ML/ARD Assessment and Post-closure Water Quality Prediction

Prepared for:

Minto Explorations Ltd.
Suite 900, 999 West Hastings Street
Vancouver BC, V6C 2W2

Prepared by:

SRK Consulting
Engineers and Scientists

Project No. 1CM002.001

August 2010

Minto Mine Expansion- Phase IV ML/ARD Assessment and Post-closure Water Quality Prediction

Minto Explorations Ltd.

Suite 900-999 West Hastings Street
Vancouver, B.C. V6C 2W2

SRK Consulting (Canada) Inc.
Suite 2200, 1066 West Hastings Street
Vancouver, B.C. V6E 3X2

Tel: 604.681.4196 Fax: 604.687.5532
E-mail: vancouver@srk.com Web site: www.srk.com

SRK Project Number 1CM002.001

August 2010

Table of Contents

List of Tables

List of Figures

List of Appendices

1 Introduction

As part of plans to expand the Minto Mine, Minto Explorations Ltd. (MintoEx) asked SRK to carry out an assessment of the metal leaching and acid rock drainage (ML/ARD) potential of the waste rock and tailings that will be produced during mining of new deposits. This report covers ML/ARD assessment of the Minto Mine Expansion- Phase IV, which consists of open pit mining of the near-surface portions of the Area 2 and Area 118 deposits, and underground exploration and mining of related mineralization at greater depths. Finally, this report also includes a post-closure water quality prediction for lower Minto Creek for the period following completion of Phase IV mining, processing, and site reclamation activities.

2 Background

2.1 Geological Setting

Section 2.1 is adapted from Section 6 of SRK (2009).

2.1.1 Regional Geology

The Minto Project is found in the north-northwest trending Carmacks Copper Belt along the eastern margin of the Yukon-Tanana Composite Terrain, which is comprised of several metamorphic assemblages and batholiths (Figure 2.1). The Belt is host to several intrusion-related Cu-Au mineralized hydrothermal systems. The Yukon-Tanana Composite Terrain is the easternmost and largest of the pericratonic terranes accreted to the Paleozoic northwestern margin of North America (e.g., Colpron *et al.*, 2005). It is interpreted to be the product of a continental arc and back-arc system, preserving meta-igneous and metasedimentary rocks of Permian age on top of a pre-Late Devonian metasedimentary basement (e.g., Piercey *et al*. 2002).

The Minto Property and surrounding area are underlain by plutonic rocks of the Granite Mountain Batholith (Early Mesozoic Age) (Figure 2.2) that have intruded into the Yukon-Tanana Composite Terrain. They vary in composition from quartz diorite and granodiorite to quartz monzonite. The batholith is unconformably overlain by clastic sedimentary rocks thought to be the Tantalus Formation and andesitic to basaltic volcanic rocks of the Carmacks Group. Both are assigned a Late Cretaceous age. Immediately flanking the Granite Mountain Batholith, to the east, is a package of undated mafic volcanic rocks, outcropping on the shores of the Yukon River. The structural relationship between the batholith and the undated mafic volcanics is poorly understood because the contact zone is not exposed.

2.1.2 Property Geology and Lithological Description

Much of the geological understanding of the rock around the Minto deposits is based on observations from diamond drill core and extrapolation from regional observations. The reason for this is poor outcrop exposure, due to deep weathering and oxidation of the exposed outcrop. The terrain was not glaciated during the last ice age event.

The hypogene copper sulphide mineralization at Minto is hosted wholly within the Minto pluton, which intrudes near the boundary between the Stikinia and Yukon-Tanana terrains, however since the contact is not exposed it is unclear if the pluton stitches the two terrains. The Minto pluton is predominantly of granodiorite composition. Hood et al. (2008) distinguish three varieties of the intrusive rocks in the pluton. The first variety is a megacrystic K-feldspar granodiorite. It gradually ranges in mineralogy to quartz diorite and rarely to quartz monzonite or granite, typically maintaining a massive igneous texture. An exception occurs locally where weakly to strongly foliated granodiorite is seen in distinct sub-parallel zones several metres to tens of metres thick. A second variety of igneous rock is a folded quartzofeldspathic gneiss with centimeter-thick compositional layering and folded by centimetre to decimetre-scale disharmonic, gentle to isoclinal folds (Hood et al., 2008). The third variety of intrusive is a biotite-rich gneiss. MintoEx geologists consider all units to be similar in origin and are variously deformed equivalents of the same intrusion.

Copper sulphide mineralization is found in the rocks that have a structurally imposed fabric, ranging from a weak foliation to strongly developed gneissic banding. For this reason all core logging by the past and present operators separates the foliated to gnessic textured granodiorite as a distinctly discernable unit. It is generally believed by MintoEx geologists that this foliated granodiorite is just variably strained equivalents of the two primary granodiorite textures and not a separate lithology.

The contact relationship between the foliated deformation zones and the massive phases of granodiorite is generally very sharp. These contacts do not exhibit chilled margins and are considered by MintoEx geologists to be structural in nature, separating the variably strained equivalents of the same rock type. Tafti and Mortensen (2004) had interpreted the sharp contacts to be zones of deformed rock within the unfoliated rock i.e rafts or roof pendants. Supergene mineralization occurs proximal to near-surface extension of the primary mineralization and beneath the Cretaceous conglomerate.

2.1.3 Veining

Veins in the Minto Deposit appear to have been emplaced after the copper sulphide mineralization and are therefore not economically significant. The most common veins are very narrow (less than 30 cm) steeply dipping, simple quartz-feldspar pegmatite veins that often contain cavities that are indicative of shallow emplacement. The veins crosscut foliation in the deformation zones and the sulphide mineralization, and this cross-cutting is taken as evidence of their post sulphide mineral emplacement. Other types of late veins found in the deposit include thin (less than 2 mm) calcite, epidote, hematite and gypsum stringers, and fracture coatings. Quartz veining is extremely rare and economically insignificant.

2.2 Deposit Types

Section 2.2 is adapted from Section 7 of SRK (2009).

The abundance of the high Cu/S mineral bornite in a moderately oxidized magmatic system along with the obvious magnetite association suggests that Minto belongs to one of two recognized deposit types: Magnetite Skarn or Iron Oxide Copper Gold ("IOGC"). The lack of a typical calc-silicate skarn mineral assemblage seems to preclude the skarn deposit type, this appears to leave the IOCG model or alternatively it belongs to a previously unrecognized deposit type.

The host rocks to the Minto deposit were emplaced in a deep batholitic setting (exceeding 9 km deep to perhaps as much as 18-20 km deep), which is not considered to be the typical porphyry environment. The host is a moderately oxidized magma (Tafti and Mortensen, 2004) with widespread iron oxide (magnetite and hematite) mineralization. At least some of the hematite is supergene in origin but it is unclear if some hematite is also primary. There are very strong structural controls on ore mineral emplacement and there is no apparent genetic link to a specific phase of intrusion. Typical porphyry-type alteration zoning such as widespread propylitization, argillization, barren silicic core, or large barren pyritic halo is not recognized. Stockwork style, fracture or vein mineralization is also not present.

2.3 Mineralization

Section 2.3 is adapated from Section 8 of SRK (2009).

2.3.1 Mineralization

The primary hypogene sulphide mineralization consists of chalcopyrite, bornite, euhedral chalcocite and minor pyrite. Metallurgical testing also indicates the presence of covellite. Texturally, sulphide minerals predominantly occur as disseminations and foliaform stringers along foliation planes in the deformed granodiorite (i.e. sulphide stringers tend to follow the foliation planes). Sulphide mineral content, however, tends to increase where this foliation is disrupted by intense folding. In addition, semi-massive to massive mineralization is also observed; this style of mineralization tends to obliterate the foliation altogether. Silver telluride (hessite) is observed in polished samples but has not been logged macroscopically. Native gold and electrum have both been reported as inclusions within bornite and accounts for the high gold recoveries in test copper concentrates. Occasionally, coarse free gold is observed associated with chloritic or epidote lined fractures that cross-cut the sulphide mineralization. The free gold may be due to secondary enrichment during a later hydrothermal process overprinting the main copper sulphide-gold event. Sulphide mineralization is almost always accompanied by variable amounts of magnetite and biotite mineralization. While these minerals occur in the non-deformed rocks they are present in the mineralized horizons in a much greater abundance in the range of an order of magnitude greater than background.

Mineralization at Area 2 / 118 is distinct from the other Minto deposits in that mineralization is predominantly disseminated (+ occasional foliaform stringers) and that semi-massive to massive sulphide mineralization is absent; as a whole, the mineralization is more homogenous and consistent as compared to Minto Main and Minto North. The primary mineral assemblage at Area 2 / 118 includes chalcopyrite-bornite-magnetite with minor amounts of pyrite; and a crude zoning is present in that the higher grade northern half of the deposit shows increased bornite concentrations up to 8% locally.

2.3.2 Alteration, Weathering and Oxidation

Pervasive, strong potassic alteration occurs within the flat lying zones of mineralization, and is the predominant alteration assemblage observed in all of the Minto deposits. The potassic alteration assemblage is characterized by elevated biotite contents and minor secondary k-feldspar overgrowth on plagioclase relative to the more massive textured country rock. Biotite concentrations range up to 30 to 70% by volume locally, compared to about 5% in waste rock. Additional alteration includes the replacement of mafic minerals by secondary chlorite, epidote, or sericite observed both in mineralized and waste rock interstitially or fracture/vein proximal, as well as variable degrees of hematization of feldspars. Uncommon but locally pervasive sericite-muscovite alteration is observed associated with post-mineral brittle faults; this type of alteration is most common in the Area 2 / 118 Deposit.

The contacts between the altered and unaltered rocks are sharp, as are the contacts between mineralized rocks and waste rocks.

Copper oxide mineralization, like the hematitization seen at surface in float, trenches, and in the upper mineralized zones at Ridgetop is the result of supergene oxidation processes. This surface mineralization at Minto Main and Area 2 / 118 represents either the erosion remnants of foliated horizons that are located above the deposits or is vertical remobilization of copper up late brittle faults and fracture zones that intersect primary sulphide mineralization at depth. Chalcocite is the prime mineral in these horizons along with secondary malachite, minor azurite and rare native copper. The mineralization is found as fracture fill and joint coatings and more rarely interstitial to rock forming silicate minerals.

In addition to the obvious copper oxide minerals, oxidation is also evident by pervasive iron staining (limonite), earthy hematite, clay alteration of feldspars, and a significant loss in bulk density. The degree and distribution of copper oxide minerals appears to be directly related to the depth of the water table. For the most part this is confined to about -30 m but up to -60 m beneath the surface and is generally sub parallel with the present topographic surface.

2.4 Physical Setting

Sections 2.4.1 and 2.4.2 are reproduced from Section 4 of SRK (2009).

2.4.1 Climate

The climate in the Minto area of the Yukon is considered sub-arctic with short cool summers and long cold winters. The average temperature in the summer is 10°C and the average temperature in the winter is –20°C. Average precipitation is approximately about 25 cm of rain equivalent per annum in the form of rain and snow.

Like most northern Canadian mines the weather does not impede year round operation of the mine and processing plant except in short periods of harsh cold temperatures which may drop to –50°C, which can cause open pit mining operations to be temporarily suspended.

2.4.2 Physiography

The property lies in the Dawson Range, part of the Klondike Plateau, an uplifted surface that has been dissected by erosion. Local topography consists of rounded rolling hills and ridges and broad valleys (Figure 2.3). The highest elevation on the property is approximately 1,000 m above sea level, compared to elevations of 460 m along the Yukon River. Slopes on the property are relatively gentle and do not present accessibility problems. Bedrock outcrops can often be found at the tops of hills and ridges. There are no risks of avalanche on the property.

Overburden is colluvium primarily comprised of granite-based sand from weathering of the granitic bedrock in the area and is generally thin but pervasive but can reach +50 m in depth. Seams of clay and ice lenses are also present sporadically. South-facing slopes generally provide well-drained, sound foundation for buildings and roads. North-facing slopes in the area typically contain permafrost.

Vegetation in the area is sub-Arctic boreal forest made up of largely spruce and poplar trees. The area has experienced several wildfires over the years, and has no old-growth trees remaining.

2.4.3 Drainage Patterns

Minto Creek follows a moderately steep-sided ENE-trending V-shaped valley before reporting to the Yukon River. The profile of the creek contains a steep section where the channel is incised into exposed bedrock (commonly referred to as ‘Minto Canyon’), and it is useful to consider the upper and lower portions of the catchment independently.

The existing mine facilities and all proposed Phase IV facilities are located within the upper Minto Creek watershed, upgradient of the Water Retention Dam and monitoring station W3 (Figure 2.4). The Water Retention Dam was constructed at a point where the Minto Creek valley narrows, naturally directing surface and any groundwater flow through a narrow cross-section. Along the profile of Minto Creek between the Water Retention Dam and the top of Minto Canyon, overburden tapers out and effectively eliminates significant groundwater flow between the upper and lower portions of Minto Creek. Minto Canyon forms a barrier to fish passage, and the canyon and upper Minto Creek are not considered to be fish habitat.

Lower Minto Creek extends from the base of Minto Canyon to the confluence of Minto Creek with the Yukon River, and is monitored at monitoring station W1. The catchment area reporting to station W1 is roughly five times that reporting to station W3, and there are a number of undisturbed catchments that contribute flow and background chemical loadings to Minto Creek above W1. Lower Minto Creek is considered to be fish habitat due to seasonal use by fish migrating in from the Yukon River when flow conditions permit.

2.5 Exploration and Mining History

The Minto deposit was first identified during the 1970s through exploration that followed up on a stream sediment anomaly in Minto Creek. Drilling by several operators was carried out during the 1970s, ‘80s, and ‘90s, and resulted in the definition of the Minto deposit as a mineable resource. The permit to mine the deposit was granted in 1995, and construction began in 1997 only to be halted by an extended period of low copper prices.

MintoEx re-started mine construction in 2005 and commenced production in 2007. Mining in the Main Pit was carried out by conventional truck and shovel methods, with processing consisting of crushing, grinding and froth flotation. Tailings were dewatered through filtration, hauled, placed and roller-compacted in the Dry Stack Tailings Facility (DSTF) located southeast of the Main Pit.

Waste rock was placed initially in the Main Waste Dump (MWD), and later in the Southwest Waste Dump (SWD). Overburden was placed in the Overburden Stockpile. Stockpiles of low grade ore and mixed oxide/sulphide ore were stored in the Blue Stockpile and the Oxide Stockpile, respectively, adjacent to and east of the MWD. All of the stockpiles and dumps noted above are located upgradient of the Main Pit.

Exploration by MintoEx in the time since construction recommenced in 2005 has identified a number of mineable deposits within the Minto claim block, as well as several prospects that remain the subject of further evaluation. Deposits that have been demonstrated to contain economic reserves to date include Area 2, Area 118, Ridgetop North, Ridgetop South, and Minto North. Planning has proceeded to the point that expansion to extract the Area 2 and Area 118 deposits is proposed as the Phase IV Expansion.

2.6 Phase IV Expansion Plan

Details of the Phase IV expansion plan are provided in the Project Description (SRK 2010). A summary of details that are relevant to the Phase IV ML/ARD assessment and water quality prediction are included here.

2.6.1 Phase IV Mining Areas

Phase IV mining will include an open pit component and an underground mining component.

Open pit mining will consist of completion of mining in the Main Pit, mining of the Area 2 Pit in two stages (Stage 1 and Stage 2), and mining of the Area 118 pit.

Underground mining will extract deeper portions of the Area 2 and Area 118 resources, and will also include advancement of underground infrastructure to exploration targets at Minto East and Copper Keel. The underground workings will be accessed through a portal collared south of the Area 2 Pit, with a decline ramp being excavated from the portal to the mineral reserves and exploration targets. The portal will be at the highest elevation of the underground workings.

A detailed schedule of Phase IV mining and processing activities is included in the Phase IV Project Description (SRK 2010).

2.6.2 Phase IV Waste Management

Management of Phase IV overburden and waste rock is detailed in the Waste Management Plan (EBA 2010A) and management of Phase IV tailings is detailed in the Tailings Management Plan (EBA 2010B). Information from these two plans that is relevant to Phase IV ML/ARD assessment and water quality prediction is summarized below.

Waste rock and overburden

Overburden from the Area 2 and Area 118 pits will be in the placed in the Southwest Waste Dump Expansion Overburden Area (SWDE OVB) or used directly in progressive reclamation activities.

Waste rock from the Area 2 and Area 118 pits will be managed on the basis of copper content. Table 2-1 summarizes quantity of waste rock in each of five ranges of copper content (Grade Bins).

The Mill Valley Fill Expansion will be constructed exclusively of Grade Bin 0.0 material, and Grade Bin 0.0 material will also be placed in the SWD and the Area 1 Open Pit Buttress[1] (EBA 2010A). Grade Bin 0.0-0.05 and Grade Bin 0.05-0.10 waste rock will also be placed in the SWD and the Area 1 Open Pit Buttress. Waste rock with higher copper content (Grade Bin 0.10-0.20 and Grade Bin 0.20-0.64, collectively Grade Bin 0.1-0.64) will be used in the Area 1 Open Pit Buttress to the extent that scheduling permits, and excess Grade Bin 0.1-0.64 waste rock will be either be placed directly into the Main Pit below the final tailings surface elevation or stored temporarily in the Grade

---

[1] The Area 1 Open Pit Buttress is a rock fill shell that will be placed against the overburden materials exposed in the south wall of the Area 1 Open Pit (also known as the Main Pit). To prevent loss of storage volume that could arise from movement of the overburden wall during pit filling, the buttress will be constructed early in the Phase IV schedule.

Bin Disposal Area (GBDA) within the Main Pit footprint. Any material placed in the GBDA will be relocated into the Main Pit below the final water elevation during closure works.

The Area 118 pit will be backfilled with either overburden or waste rock from the Area 2 pit prior to the completion of mining. If waste rock is used for backfill, it will consist of the same Grade Bin waste rock that is scheduled to be placed in the SWD.

Underground mining will produce a relatively small volume of waste rock that will be disposed on surface, mostly from initial decline development prior to opening up areas where underground waste can be used as backfill. The underground rock slated for surface disposal will be either disposed according to copper content (as per Grade Bins listed in Table 2-1:) or simply managed as described above for Grade Bin 0.1-0.64 open pit waste.

Table 2-1: Phase IV Waste Rock Quantity and Copper Content

Grade Bin [(1)]	Volume [(2)] (million m^3)	Tonnes [(3)] (T)	Contained Copper [(3)] (T)
0.0	8.77	17,197,898	0
0.00-0.05	0.18	346,904	102
0.05-0.10	0.18	362,042	270
0.10-0.20	0.44	863,532	1,302
0.20-0.64	1.79	3,511,013	13,497

Notes:

1. 'Grade Bin' indicates a copper grade category used in block modeling. It should be noted that 'Grade Bin 0.0' is an operational term- the waste in this category has copper content <50 mg/kg, and therefore while copper content of this material will be low, it will be somewhat greater than indicated
2. From Table 1 in Waste Management Plan (EBA 2010A)
3. From block model

Source:T:\1CM002.001_PhaseIV_WaterQualityPrediction\Report_MLARDcharacterization+WQP\Tables\[Table2-x_GradeBin_Volume+CopperContent.xlsx]

Tailings

Tailings management will transition from placement of filtered tails in the DSTF to placement of thickened tails in the Main Pit, and possibly in the Area 2 pit after mining is complete (EBA 2010B). As described above, a waste rock buttress will be required to stabilize overburden in the south wall, and direct placement of GBDA 0.1-0.64 waste rock below the final tailings elevation may also be carried out depending on operational factors. The final tailings elevation will remain below the elevation of the low point in the rim of the Main Pit.

2.6.3 Phase IV Closure Plan

No reductions in loadings from the site due to reclamation measures have been incorporated into the site water quality prediction. The exception is the permanent subaqueous disposal of Grade Bin 0.1 to 0.64 waste rock, which will either be carried out during operations or relocated as part of closure activities.

A comprehensive description of planned reclamation measures is covered in a separate Phase IV closure plan document (EBA 2010C); the following is a summary of the operational and closure activities that are relevant to the post-closure water quality prediction:

- Reclamation of DSTF during Phase IV operations;
- Routing of diverted runoff from the catchment upstream of the DSTF through the Area 2 pit;
- Routing of runoff from the catchment upstream of the Main Pit (including runoff from the SWD and MWD) into the Main Pit lake;
- Removal of the Blue Stockpile and the Oxide stockpile, and reclamation of the underlying footprint to a standard that results in runoff having background water quality;
- Construction of sediment control facilities that limit sediment release to lower Minto Creek to less than 30 mg/L;
- Placement of all Grade Bin 0.1-0.64 waste rock below the water level in the Main Pit; and
- Placement of all Phase IV tailings below the water level in the Main Pit.

2.7 Pre-production Testing and Operational Monitoring

2.7.1 Mine Rock

Pre-production Testing

During initial review of the Minto Mine project proposal, eight drill core samples were retrieved and subjected to ABA testing, whole rock analysis and petrographic examination (Mills 1997).

- ABA testing was carried out at BC Research of Vancouver BC by the BC Research Standard Method, and included determination of total sulphur (S(T)), sulphate sulphur ($S(SO_4)$), neutralization potential (NP) by sulphuric acid titration to an end point of pH 3.5, and inorganic carbon content. Liquor from the NP determination was subjected to a 30-element ICP scan.
- Whole rock analysis was carried out to determine trace element content and major element content as oxide equivalents. The method of whole rock analysis was not specified.
- Petrographic examination and determination of modal mineralogy were carried out at Vancouver Petrographics of Fort Langley, BC.

The primary conclusions of the pre-production test were that waste rock was expected to be net acid neutralizing, and that the main acid neutralizing mineral was calcite (calcium carbonate, $CaCO_3$).

Operational Testing of Waste Rock

ABA testing of Main Pit overburden and waste rock has been carried out on composite samples of blast hole cuttings from each waste blast since mining commenced according to the BC Research Standard Method, as specified by Water Use Licence QZ96-006. Samples have been collected by mine geologists and delivered to SGS CEMI of Burnaby BC for ABA testing by the BC Research method. Semi-annual reports have been prepared for the six month period ending in April and June of each year, and these reports are submitted to regulators for review (e.g. Minto Explorations Ltd. (2010)).

Results of operational ABA monitoring of waste rock are shown graphically in Figure 2.5. The excess of neutralization potential (NP) over acid potential (AP) appears to confirm the conclusion from pre-production testing that the Main Pit waste rock is not likely to be net acid generating.

2.7.2 Tailings

Operational Testing

Operational monitoring of Main Pit tailings has been carried out to track the ABA characteristics of the tailings produced over the operating period to date, and to verify that the as-produced tailings remain appropriate for dry-stack disposal of tailings from Main Pit ore.

ABA testing of tailings has been carried out according to the BC Research Standard Method, as specified by Water Use Licence QZ96-006. Samples for testing have consisted of 1 to 2 kg monthly composite samples, prepared from 200 to 500 gram tailings samples which were collected daily and stored in sealed plastic bags prior to preparation of the monthly composite sample.

The monthly composite was sent to Minto’s accredited laboratory (SGS CEMI) where ABA analysis was conducted. The Acid Potential (AP) is determined from percent sulphide sulphur (obtained by subtracting percent sulphate sulphur from percent total sulphur). Additionally, paste pH and total inorganic carbon (TIC) were determined. Results have been reported to regulators, together with waste rock ABA results, in a semi-annual monitoring report (e.g. Minto Explorations Ltd. (2010)).

Results of operational ABA monitoring of Main Pit tailings are shown graphically in Figure 2.6. The excess of neutralization potential (NP) over acid potential (AP) appears to confirm the conclusion from pre-production testing that the Main Pit tailings are not likely to be net acid generating.

3 Methods

3.1 Phase IV Mine Rock

3.1.1 Static Tests

Exploration Assays

During recent exploration (2005 – 2008) all drill core from the Minto property was sawn and half core was sent for multi-element determination by aqua regia digestion followed by ICP-MS finish. Analyses were typically carried out at ALS Chemex (North Vancouver BC) and its predecessors.

ABA Testing- Area 2

Two rounds of ABA testing were carried out on samples from exploration drilling of the Area 2 deposit.

In 2007, testing of 36 samples was carried out at ALS Chemex according to an in-house method analogous to the Sobek method (Sobek et al., 1978). The BC Research method was not used because it is an uncommon method that has been largely avoided by industry in recent years, and because senior staff at SGS CEMI (the only laboratory in western Canada that provides the ABA testing services using the BC Research method) recommended that alternate methods be employed.

The following excerpt from the Area 2 prefeasibility study (SRK, 2007) describes the process that was followed to select samples for testing.

Italics below reproduced from SRK (2007).

> *To select samples for Acid-Base Accounting ("ABA") testing, the Area 2 model described in Section 9 was reviewed using GEMS and FracSIS. The following objectives were used as guides for sample selection:*
>
> - *Areal coverage of waste within the ultimate (Phase 3) Area 2 pit shell, but external to the ore zones, based on core drilled through the end of 2006;*
> - *Areal coverage of waste situated between the sub-parallel lenses of ore;*
> - *Targeted coverage of ore and mineralized waste lying immediately adjacent to the ore horizons.*
>
> *Where further refinement was required for sample selection, trace element content of the available core was assessed. Analytical records were compiled from the exploration assay records and summary statistics were calculated (minimum value, 10th, 50th, and 90th percentile values, and maximum value). Based on a review of the summary statistics for assayed elements, copper, iron, and sulphur were chosen as parameters to be used in defining the final selection of samples to be tested, with the median (50th percentile) and 90th percentile values for copper being the primary selection criteria.*
>
> *Core intervals from fourteen 2006 drillholes were identified by MintoEx for ABA testing. The core intervals selected by MintoEx were reviewed by SRK and found to satisfy the sampling objectives and criteria listed above. At the time of sample selection, no exploration drilling had been done in the south-western region of the ultimate pit as it was outside the mineralized zones. As a result, waste characterization for this region of the pit has not yet been carried out. Figure 19-21* (in SRK 2007) *shows the collar locations of the 2006 drillholes that were sampled for ML/ARD testing. Figure 19-22* (in SRK 2007) *through 19-29* (in SRK 2007) *show cross sections with the selected sample intervals plotted with the ultimate pit outline, borehole traces, and outlines of ore horizons.*

> *Twenty-three samples of bulk granodiorite waste were selected for laboratory testing, with areal coverage of internal waste and of peripheral waste being the main criteria for selection samples.*
>
> *Core logs from exploration drilling indicated sharp contacts between ore horizons and internal waste. A review of the exploration assay database showed that the transition from high grade zones to barren waste intervals was sharp, with copper concentrations in Area 2 declining from ore grade to background levels over a single assay interval (typically 1.5 m). This sharp transition from ore to waste is similar to the waste/ore transition encountered during mining of the Main Zone. To assess the ML/ARD characteristics of the mineralized waste rock in the transition zone, ten samples were selected for laboratory testing.*
>
> *Three ore samples were selected for laboratory testing from the available core intervals to allow an assessment of whether inclusion of a small portion or ore within the waste rock (due to operational mis-classification) would have the potential to change the overall interpretation of the geochemical performance of the waste dumps. The selected ore samples were from the 240A, 270, and 280 horizons, and had total copper contents ranging from 0.45 to 1.29%, and total sulphur contents of 0.005 to 4.5%.*

In 2008, an additional 20 samples were tested at ALS Chemex by the same methods as were used in 2007. These samples expanded ABA coverage to include the southwest portion of the pit for which no samples were available in the previous round of testing, and selections were made based on similar criteria to those described above for the 2007 testing. The 2008 samples were selected from core intervals drilled in 2007, and consisted of eleven samples of bulk granodiorite waste, seven samples of mineralized waste, and two samples of ore.

ABA Testing- Underground

An additional round of ABA testing was carried out in 2010 on drill core samples from rock along or adjacent to the alignment of the proposed decline. Using the exploration drillhole database provided by MintoEx and the preliminary decline alignment, SRK selected appropriate diamond drillhole intervals for testing. Intervals were selected from 2008 and 2009 drillholes, where the interval was within 20 m lateral distance of the decline centreline and within 10m elevation of the decline floor. Sample frequency was based on an approximate target of one sample for each 100 m length of decline. Testing was carried out at SGS CEMI by the Sobek acid-base accounting method (Sobek et al., 1978), along with inorganic carbon determination by Leco furnace and sulphate sulphur determination by hydrochloric acid leach. Twenty-seven samples were tested.

Sequential MWMP

The Meteoric Water Mobility Procedure (MWMP) is a procedure used to evaluate the potential for dissolution and leaching of weathering products from weathered mine rock (NDEP, 1990). It involves a single pass column leach over a period of 24 hours, using a 1:1 ratio of rock to extracting fluid, and is sometimes considered to chemically represent waste rock porewater.

A sequential MWMP (SMWMP) method has been devised to evaluate the accumulation of soluble weathering products in a leachate that passes through multiple aliquots of unleached weathered rock. This procedure is analogous to extending the flowpath which is encountered by a pore volume of water- leachate from the first cycle is recycled through an unleached aliquot of weathered rock in the second cycle, and subsequent cycles follow the same procedure. Care is taken to maintain a 1:1 water to rock ratio, and since water is both lost for analyses and is locked up in the spent charge, the mass leached in each stage is reduced. The initial mass of weathered rock ultimately determines the number of cycles that can be run, although all possible cycles need not be run if results warrant terminating the test.

Four SMWMP tests were carried out on Minto samples at SGS CEMI in 2009 with the goal of gaining insight into porewater chemistry of the existing waste dumps. Four 40 L grab samples were collected by SRK in 2009 and shipped to SGS CEMI for testing. Each test consisted of seven cycles of recycling leachate through unleached weathered rock, with analysis of pH, sulphate, other anions, and dissolved elements carried out in each cycle. Modified ABA testing and elemental determinations were carried out to provide sample characteristics.

Grab samples were collected under late February conditions using a bar to loosen frozen rock. Samples were collected from the Blue Ore Stockpile (two samples), the Main Waste Dump, and the Southwest Waste Dump, and are assumed to be typical material.

The mineralogical composition of the four SMWMP samples was determined by X-ray diffraction with Rietveld refinement at the Department of Earth and Ocean Sciences at the University of British Columbia.

3.1.2 Kinetic Testing: Humidity Cell Tests

Description- Humidity Cell Tests

Four humidity cell tests were started in July 2009 at SGS CEMI and these tests were ongoing at the time of preparation of this report. The objective of these tests was to evaluate the release rates of weathering products, including major and trace elements, under laboratory weathering conditions. A range of copper and sulphur content was targeted for the four tests during sample selection to provide a broad indication of variation of release rates with degree of mineralization.

Sample Selection- Humidity Cell Tests

At the time of sample selection, the mine plan envisioned accessing Phase 3 of the Area 2 deposit via open pit. The exploration ICP database (2005 - 2008) was queried to yield a list of core intervals that were both within the Phase 3 pit shell and contained less than 0.5% copper. The resulting list of 363 core intervals was taken to represent the Area 2 waste rock.

Summary statistics were calculated for the 363 Area 2 waste rock core intervals, including 50th, 75th, and 95th percentile concentrations of copper and sulphur. It was decided to target four separate populations for humidity cell testing:

1. 50th percentile concentrations of both copper and sulphur;
2. 50th percentile copper, 75th percentile sulphur;
3. 75th percentile copper, 50th percentile sulphur; and
4. 95th percentile copper and 95th percentile sulphur.

A shortlist of drill core intervals that approximately met each of the above criteria was forwarded to site staff for retrieval from archived diamond drill core from exploration drilling. Site staff were given latitude to select any interval from within each category shortlist for collection and forwarding to SGS CEMI for characterization and testing, due to the known challenges with locating specific intervals in a timely fashion. Table 3-1 summarizes the core intervals retrieved and the corresponding relative copper and sulphur contents- three were sourced from within the Area 2 Phase 2 pit, and one (HC1) was sourced from within three metres of the Phase 2 pit shell. Note that the HC1 sample was targeted to include rock with 95th percentile copper and sulphur content, but that the actual sample retrieved contained copper and sulphur at roughly 90th percentile concentrations.

Table 3-1: Phase IV Humidity Cell Samples

HCT ID	Hole ID	From	To	Copper	Sulphur	Selection Characteristics
		(m)	(m)	(%)	(%)	
HC 1	211	83.08	86.08	0.21	0.51	~90th percentile copper, ~90th percentile sulphur
HC 2	196	53.94	55.44	0.01	0.01	50th percentile copper, 50th percentile sulphur
HC 3	196	45.64	47.14	0.1	0.02	~75th percentile percentile copper, ~50th percentile
HC 4	211	70.79	73.79	0.01	0.08	~50th percentile copper, ~75th percentile sulphur

Source: X:\01_SITES\Minto\1CM002.001_PhaseIV_WaterQualityPrediction\Report_MLARDcharacterization+WQP\Tables\[Table3-1_HCT_SampleSources.xlsx]

Test Method- Humidity Cell Tests

Humidity cell tests (HCTs) were carried out at SGS CEMI according ASTM D5744 (ASTM, 2007). For each test, a one kilogram charge of material (crushed to pass a 6.3 mm (¼”) sieve) was placed in a Plexiglas column (25.5 cm long, with an inner diameter of 10.2 cm). Each sample was subjected to consecutive 3 day cycles of moist and dry air, and the final day of the weekly cycle consisted of leaching of the sample by flooding with 500 mL (first flush 750 mL) of water and allowing the flood leach to drain into a collection container through a perforated acrylic disk topped with nylon mesh. Laboratory temperatures were maintained between 20 and 22° C.

Monitoring was carried out weekly to determine pH, conductivity, oxidation reduction potential (ORP) and dissolved oxygen (DO). Additional biweekly sampling was carried out to monitor sulphate, chloride, fluoride, acidity, alkalinity, and a suite of elements by ICP-MS.

3.1.3 Kinetic Testing: Barrel Tests

Description- Barrel Tests

Barrel tests are intended to provide a site-based weathering test that permits evaluation of rates of release of weathering products under site temperature and precipitation conditions. These tests also provide a larger scale of testing than is typically carried out in a laboratory setting.

Sample Selection- Barrel Tests

Initial efforts to understand the ML/ARD potential of Area 2 waste rock noted that there were two broad categories of Area 2 waste rock. The first category, containing by far the largest tonnage, was referred to as ‘Bulk Waste’ and was defined as all rock with less than 0.1% sulphur content (as determined by ICP). The second, and much smaller, category, was referred to as ‘Mineralized Waste’ and consisted of all rock with sulphur greater than 0.1% and copper less than 0.5% (as an approximation of mine cut-off grade). The Mineralized Waste material was identified as having a higher risk for ML/ARD, and barrel tests were proposed to evaluate samples of Mineralized Waste.

Exploration diamond drill core intervals within the Area 2 Phase 3 pit shell were identified which had sulphur content corresponding to four statistical categories. Table 3-2 lists these categories, the target sulphur content, and the number of drill core intervals that met the criteria for selection.

Table 3-2: Barrel Test Sample Selection Characteristics

Target Sulphur	Selection Characteristics	Copper range	Sulphur Range	No. of Intervals in Sulphur Range
(%)		(%)	(%)	
0.15	10th percentile sulphur amongst Mineralized Waste population with sulphur >0.1%	0.005 - 0.45	0.14 - 0.16	292
0.37	50th percentile sulphur amongst Mineralized Waste population with sulphur >0.1%	0.005 - 0.49	0.36 - 0.40	170
0.79	75th percentile sulphur amongst Mineralized Waste population with sulphur >0.1%	0.005 - 0.49	0.74 - 0.84	167
1.41	90th percentile sulphur amongst Mineralized Waste population with sulphur >0.1%	0.05 - 0.49	1.28 - 1.54	159
Source:	X:\01_SITES\Minto\1CM002.001_PhaseIV_WaterQualityPrediction\Report_MLARDcharacterization+WQP\Tables\[Table3-x_Barrel_SampleSources.xlsx]			

Test Method- Barrel Tests

In Fall of 2009, five 200 L plastic barrels were set up at site in purpose-built stands to raise the barrels off the ground and allow monitoring of barrel drainage. Four barrels are filled with pieces of drill core broken to < 5 cm (2”) size, and one barrel is empty and serves as a blank. Each barrel has several vent holes which are fitted with angled PVC fittings to ensure that fully oxygenated conditions are maintained within the barrel.

The barrels are open to the atmosphere and incident precipitation falls on the barrels. Rainfall and snowmelt percolate through the rock in the barrel, and barrel leachate is collected in a 20 L pail located beneath the barrel. Barrel leachate reports to the 20L pail via plastic tubing that is connected to the barrel through a bulkhead located in the lowest point of the base of the barrel.

Monthly monitoring is planned during non-freezing part of the year. Inspections will be carried out following substantial rain events at site, and samples will be collected on the first opportunity of each month when not frozen. Samples will be collected directly from the tubing where possible, and from the 20L pail when necessary. Field measurements will include pH, conductivity, and temperature, and samples will be collected for determination of laboratory pH and conductivity, acidity, alkalinity, anions (chloride, fluoride and sulphate) and trace-level dissolved metals by ICP-MS/OES.

3.2 Phase IV Tailings

3.2.1 Static Tests

Sample Source

Residues from metallurgical testing carried out on Area 2 and Area 118 ore samples were subjected to additional testing for purposes of ML/ARD characterization. For both deposits, locked cycle testing was carried out by G&T Metallurgical Services (G&T) of Kamloops, BC.

Area 2 ore samples consisted of drill core from each of the ore horizons that make up the Area 2 deposit (G&T, 2007). The core samples used to prepare the ore composites were selected by MintoEx personnel. Each of the seven ore horizons that make up the Area 2 deposit were tested separately, and the cleaner and rougher tails from each were reserved as separate products. To evaluate the acid-generating potential and trace metal content of the tailings, aliquots of rougher and cleaner tails from each ore horizon were combined, according to the ‘as-produced’ mass ratio. A combined sample (37% L Zone tails, 63% M Zone tails) was also tested to evaluate the ML/ARD characteristics of a mixed tailings product that would result from mixing of the tailings from the two main ore horizons (representing approximately 90% of the Area 2 ore) at the expected proportions in the final tailings mass (SRK, 2007).

Two Area 118 ore samples were subject to metallurgical testing. Ore samples consisted of drill core from the upper and lower portions of the Area 118 deposit (G&T (2009) and SRK (2009)). As for Area 2 samples, aliquots of rougher and cleaner tails from each ore sample were combined, according to the ‘as-produced’ mass ratio.

Test Methods

Tailings residues from metallurgical testing were submitted to ALS Chemex (Area 2 samples) and SGS CEMI (Area 118 samples) for further analysis. ABA testing was carried out on all samples, consisting of determination of total sulphur by induction furnace, sulphate- sulphur by hydrochloric acid leach, total inorganic carbon (TIC) by evolved gas analysis, and neutralization potential (NP) by the Sobek method (Sobek et al., 1978). Acid potential (AP) was calculated by multiplying total sulphur less sulphate sulphur by the conventional factor of 31.25.

Elemental analysis of tailings products was by aqua regia digestion followed by determination of major and trace element content by a combination of ICP-MS and ICP-AES.

3.2.2 Kinetic Tests- Subaqueous Column Tests

Description

Two subaqueous tailings columns were started in September 2009 at SGS CEMI and these tests were ongoing at the time of preparation of this report. The objective of these tests was to evaluate the porewater chemistry that would develop over a long period of contact with Phase IV tailings solids under a water cover.

Sample Source

The tailings being tested in these subaqueous columns were produced during metallurgical testing of Area 118 and Ridgetop ore samples. Details are as follows:

- Column 1: Area 118 subaqueous tailings column sample was a composite of upper and lower Area 118 ore tails produced in G&T tests 2351-33 and 2351-34 (G&T, 2009).
- Column 2: Ridgetop subaqueous tailings column sample was a composite of upper and lower Ridgetop ore tails produced in G&T tests 2351-35 and 2351-35 (G&T, 2009).

The Ridgetop subaqueous tailings column is included in this discussion for purposes of assessing the influence of different ore sources on tailings porewater chemistry.

Test Methods

The subaqueous tailings columns were constructed of 5.08 cm (2”) internal diameter Plexiglas columns with an acrylic perforated disk topped with nylon mesh at the base of the column to retain the tailings solids, yet allow drainage for sampling. Approximately 2.5 kg of tailings solids were placed in each column, yielding a height of tailings of roughly 1 m in each column. Sampling ports were installed in the base of the column and in the side of the column above the tailings/ water interface.

Columns were initially saturated by slowly adding deionized water through the bottom sampling port. Once the tailings column was saturated, an additional volume of water was gently added from the top of the column to establish a 30cm column of water above the tailings/ water interface.

Operation of the subaqueous column tests consisted of circulation of water in the water cover using a peristaltic pump to ensure fully oxygenated conditions were maintained at the tailings interface. Sampling was carried out weekly from both bottom and side ports to determine pH, conductivity, oxidation reduction potential (ORP) and dissolved oxygen (DO). Additional biweekly sampling was carried out from both ports to monitor sulphate, chloride, fluoride, acidity, alkalinity, and a suite of elements by ICP-MS. For each sampling round, the minimum amount of water required for analysis was removed. Deionized water was added to the water cover each week to maintain 30 cm of water above the tailings interface.

4 Results and Discussion

4.1 Phase IV Mine Rock

4.1.1 Mineralogy

Samples for sequential MWMP tests were also subject to mineralogical determinations by quantitative x-ray diffraction (XRD). These samples were sourced from existing Main Pit dumps and stockpiles- given the similarity between the host rocks between the Main Pit and the Phase IV pits, the mineralogy is expected to be indicative. Results of XRD are reported in Appendix D.4 and are summarized in Table 2-1; the lower limit of quantitation for this technique is in the sub-percent range, and reported values less than 1% should be treated as approximate. Results from SMWMP testing are discussed in Section 4.1.2, however the mineralogical results are discussed here because they are useful for subsequent discussion.

All four samples were dominated by plagioclase, quartz, and potassium feldspar; chalcopyrite was detected in both Blue WD samples (at concentrations of 1.5 and 2.0 wt. %), and no other sulphide minerals were detected. All samples contained detectable calcite (wt.% values ranged from 0.3% for the Main Waste Dump sample up to 2.9% for Blue WD Sample 2), and two samples contained detectable siderite (0.3 wt % for the SW Dump Waste Rock sample; 0.8 wt % for Blue WD Sample 2). A mixed calcium/ magnesium carbonate (provisionally classified as dolomite) was identified in Blue WD Sample 2. All samples contained silicate minerals that may contribute to NP measurements determined by titration; the mineral clinochlore was present in all samples, and the clay minerals kaolinite and smectite (montmorillonite) were identified in select samples.

These results indicate that a portion of the inorganic carbon in Minto waste rock is present in a mineral form (siderite ($FeCO_3$)) that does not provided net acid neutralization, due to oxidation of the ferrous iron released when siderite is dissolved. The resulting ferric iron hydrolyzes and precipitates as iron oxyhydroxide minerals, releasing protons (H^+) and consuming available alkalinity in the same amount as released in the original dissolution of siderite.

4.1.2 Static Tests

Elemental Determinations

Exploration assay result for core intervals within the Phase IV final pit shells (Area 2 Phase 2, Area 118) were separated into ore and waste intervals, based on intersections with the modelled ore horizons used for mine planning purposes. Statistical summaries that describe the assay results are provided in Appendix A. Summary statistics for selected elements of interest (copper, cadmium, chromium, and manganese, based on operational water quality monitoring results) are shown in Table 4-2.

Table 4-1: Results of quantitative phase analysis (wt.%)

Mineral	Ideal Formula	Blue WD Sample 1 N. Side	Blue WD Sample 2 S. Side	Main Waste Dump	SW Dump Waste Rock
Quartz	SiO_2	26.8	28.9	26.3	26.4
Clinochlore	$(Mg,Fe^{2+})_5Al(Si_3Al)O_{10}(OH)_8$	3.0	1.8	5.8	3.8
Kaolinite	$Al_2Si_2O_5(OH)_4$	1.9	3.2	1.8	
Muscovite	$KAl_2AlSi_3O_{10}(OH)_2$	3.6	3.6	3.6	
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$	6.0	5.2	5.1	6.0
Plagioclase	$NaAlSi_3O_8$ – $CaAl_2Si_2O_8$	40.1	34.5	42.5	52.2
K-feldspar	$KAlSi_3O_8$	15.6	16.7	12.9	10.8
Dolomite	$CaMg(CO_3)_2$		0.4		
Calcite	$CaCO_3$	1.5	2.9	0.3	0.4
Siderite	$Fe^{2+}CO_3$		0.8		0.3
Chalcopyrite	$CuFeS_2$	1.5	2.0		
Montmorillonite	$(Na,Ca)_{0.3}(Al,Mg)_2Si_4O_{10}(OH)_2 \cdot nH_2O$			1.8	
Total		100.0	100.0	100.0	100.0

Area 2 waste core intervals had a median copper content equal to the detection limit of 0.005% copper, which is reflective of the unmineralized nature of the bulk granodiorite waste rock. The maximum copper content (3.5%) of the Area 2 waste core intervals reflects the inclusion of ore-grade mineralized zones within the waste rock that are too small or too narrow to separate from the bulk waste. The large decrease in copper content between the maximum and 95th percentile values indicates that degree to which the maximum values are anomalous. The cadmium content of the Area 2 waste core intervals showed a similar skewed distribution, with the 95th percentile value of 0.25 ppm being equal to the detection limit. Other trace element concentrations in Area 2 waste core intervals were somewhat less skewed to high values.

Area 118 waste core intervals had higher median (0.03%) and maximum (3.9%) copper contents than Area 2. However, exploration assays were only carried out on waste core intervals drilled through 2008, and were available only for 6 waste core intervals. As Area 118 waste will be a small component of the overall waste tonnage produced in Phase IV, further discussion of the limited available data is not warranted.

Selenium determinations were not included in the reported exploration assay results. When queried, ALS Chemex was able to retrieve selenium results for some of the exploration core intervals from the raw ICP scans. However, the lower detection limit for the exploration assay method was 5 ppm, and over 85% of the results provided indicated a selenium concentration of 5 ppm. Elemental analysis of SMWMP samples (discussed below) returned selenium concentrations of 0.7 and 2.5 ppm for the Main Waste Dump and Southwest Waste Dump samples, respectively.

Table 4-2: Phase IV Waste Rock: Summary of Selected Elemental Content from Exploration Assays

Pit	Summary Statistic	Total Cu %	Cd_ppm	Cr_ppm	Mn_ppm
Area 2	Max	3.5	4.6	119	1430
Area 2	95th Percentile	0.17	0.25	38	738
Area 2	75th Percentile	0.01	0.25	8	612
Area 2	50th Percentile	0.005	0.25	7	543
Area 2	25th Percentile	0.005	0.25	5	447
Area 2	5th Percentile	0.005	0.25	4	280
Area 2	Min	0.005	0.25	0.5	40
Area 2	Average	0.04	0.26	11	528
Area 2	Count	2037	2037	2037	2037
Area 118	Max	0.0	0.25	8	554
Area 118	95th Percentile	0.0	0.25	7.8	551
Area 118	75th Percentile	0.0	0.25	7	524
Area 118	50th Percentile	0.01	0.25	7	464
Area 118	25th Percentile	0.00625	0.25	7	427
Area 118	5th Percentile	0.005	0.25	6.3	412
Area 118	Min	0.005	0.25	6	411
Area 118	Average	0.02	0.25	7.0	475
Area 118	Count	6	6	6	6
Source:	X:\01_SITES\Minto\1CM002.001_PhaseIV_WaterQualityPrediction\Report_MLARDcharacterization+WQP\Tables\[Table4-1_WR_Element_SummaryStats.xls				

Acid Base Accounting- Area 2

Results of 2007 and 2008 ABA testing are provided in tabular form in Appendix B.

Results show that sulphur in Area 2 mine rock is dominantly in the sulphide form. Figure 4.1 contains a plot of sulphide sulphur and total sulphur that shows the excellent 1:1 correlation between sulphide and total sulphur for most samples. One sample of mineralized waste had total sulphur concentration 64% higher than the corresponding sulphide sulphur concentration, likely due to sulphate sulphur hosted in gypsum veins ($CaSO_4 \cdot 2H_2O$). Samples categorized as bulk waste had total sulphur contents up to 0.11%, and samples categorized as mineralized waste had total sulphur contents up to 0.75%. A comparison of sulphide sulphur and copper content showed that the copper mineral chalcopyrite ($CuFeS_2$) could account for most of the sulphide sulphur in the samples tested (Figure 4.2); as chalcopyrite is widely observed in Minto rocks, it is likely an important sulphur host.

To evaluate the degree to which NP measured by titration is likely to be derived from carbonate minerals, the NP values were compared with inorganic carbon content (converted to common units of kg $CaCO_3$/tonne). Figure 4.3 shows the results of this comparison and illustrates two main points: that NP and inorganic carbon content (denoted as NP_{TIC}) are generally well correlated, particularly for bulk waste, and that NP values systematically exceed NP_{TIC} values by an amount of around 10 kg $CaCO_3$/tonne. Both the $NP > NP_{TIC}$ phenomenon and the magnitude of roughly 10 kg $CaCO_3$/ tonne have been observed on other projects, and the typical conclusion is that silicate minerals (such as clays) are contributing a component of the neutralization that is measured in the NP titration.

Results of NP and AP determinations are shown in Figure 4.4. The current permit for the Minto Mine classifies rock with NP:AP ratio (NPR) greater than 3 as non-potentially acid generating (Non-PAG). It is common practice to categorize rock with a NPR between 1 and 3 as having uncertain potential for acid generation (Uncertain), and to categorize rock with a NPR ratio of less than 1as potentially acid generating (PAG). These three categories (Non-PAG, Uncertain, and PAG) are adopted here for purposes of discussion.

It should be noted that specifying a NPR of 3 as the lower limit of the Non-PAG category is conservative. Theoretically, if grain-scale weathering is occurring at neutral pH, and if all NP is in the form of calcium and magnesium carbonates that are available to react, a NPR of 2 is the upper limit of this ratio that is required to ensure that neutral weathering conditions will persist indefinitely. This upper limit is sometimes referred to as a ‘critical NPR’, as it defines the transition from theoretically PAG to Non-PAG material. If grain-scale weathering occurs under acid pH conditions, the ‘critical NPR’ is less than 2, and can be as low as 1. The rationale for adopting a NPR of 3 as the lower limit of the Non-PAG category is to account for uncertainty related to interpreting ABA results. For example, uncertainty can arise from not knowing the mineral form of NP at the screening stage, or from scale effects such as concentration of sulphide grains in the blast fines (which has occurred at some mines, thereby causing the NPR of the blast fines to be lower than the bulk rock NPR). Defining Non-PAG as NPR>3 provides some insurance, in light of the uncertainty, that Non-PAG rock will not develop dump-scale acidic weathering conditions.

Bulk waste samples had NPRs in excess of seven and were categorized as Non-PAG. Mineralized waste samples had NPRs ranging from 0.6 to 61: one sample had NPR< 1 (PAG); six samples had NPR values between 1 and 3 (Uncertain); and ten samples had NPR>3 (Non-PAG). Ore samples had NPR values ranging from 1.5 to 42, with three samples having NPR values between 1 and 3 (Uncertain) and 2 samples having NPR>3 (Non-PAG).

For purposes of comparing method performance, operational monitoring results were charted in a similar fashion, with neutralization potential determined by the BC Research method (BCR_NP) plotted against NP_{TIC} (Figure 4.5). Similar to the Sobek NP method, the BC Research method commonly indicated a higher value for neutralization potential than was indicated by inorganic carbon content; however, the correlation between the two test methods was much lower, with BCR_NP exceeding NP_{TIC} more than five-fold in some cases. On the basis of these observations, it is recommended that operational monitoring in Phase IV adopt the Sobek method of NP determination and maintain the measurement of inorganic carbon content.

A conservative assumption that is often adopted is that neutralization by silicate minerals is insufficiently reactive to maintain neutral pH weathering conditions, and that only calcium and magnesium carbonate minerals can reactive quickly enough to maintain the circum-neutral pH weathering conditions that are important for limiting leaching of trace elements like copper.

Figure 4.6 plots NP_{TIC} and AP for Phase IV samples, along with operational monitoring results[2] from the Main Pit for comparison. This figure shows that, while NP_{TIC} values are lower than NP values, using NP_{TIC} values for characterization of ARD potential would result in no substantial change in categorization of ARD potential: bulk waste NPRs (based on NP_{TIC}) remain greater than 3, and mineralized waste and ore NPRs (based on NP_{TIC}) remain distributed between Non-PAG, Uncertain and PAG categories. It should be noted that the results from operational monitoring show a similar distribution of material characteristics from Main Pit wastes (based on NP_{TIC}:AP), with the great majority of samples being classified as Non-PAG, a minority of samples classified as Uncertain, and two samples classified as PAG. Further, for materials with low total sulphur concentrations like those measured in most Phase IV rock, silicate weathering can generate alkalinity at rates that are significant in neutralizing acidity arising from sulphide oxidation.

Acid Base Accounting- Underground

A plan view of the preliminary decline alignment and the locations of decline samples tested is shown in Figure 4.7. Sample origins, copper content, and results of ABA testing of samples from the preliminary decline alignment are provided in Appendix C and are summarized in Figures 4.8, 4.9 and 4.10.

Figures 4.8 and 4.9 show plots of NP vs. AP and NP_{TIC} vs. AP, respectively. Sulphide sulphur content of most of the samples is low, with corresponding AP values less than 5 kg $CaCO_3$ equiv./ tonne for 23 of 27 samples tested. Using the ARD classification described above for Area 2 rock, all samples with AP<5 kg $CaCO_3$ equiv./ tonne would be classified as Non-PAG using either NP or NP_{TIC} values. Four of 27 samples tested would be classified as either Uncertain or PAG- three of these four are some of the deepest samples tested (from drillholes 07SWC211, 06SWC080, and 06SWC116 in Figure 4.7), and represent a location where the decline passes through mineralization. All PAG and Uncertain samples have copper content near 1% (see Appendix C)- this rock would either be sent directly to the mill or stockpiled for later processing. Overall, these results are similar to those from Area 2 rock, which show that bulk rock will not generate ARD and that mineralized rock has some potential to generate ARD.

A plot of NP_{TIC} vs. NP for decline samples is shown in Figure 4.10. As for Area 2 and Main Pit rock, NP_{TIC} was typically less than NP, which suggests that a portion of the NP measured by titration was derived from non-carbonate sources (likely silicate minerals such as clays).

---

[2] The NP titration used for operational monitoring is carried out according to the BC Research method, as specified by the mine's water use license, despite the method being no longer commonly used in the field of ARD assessment. Results are not directly comparable to those NP values determined by the Sobek method (a standard method in widespread use); as a result, inorganic carbon content provides the only consistent measure of NP between operational monitoring and Phase IV characterization.

Sequential MWMP

Results of Sequential MWMP testing are provided in tabular form in Appendix D1 through D3, including ABA tests and elemental determinations for MWMP samples.

Selected results are plotted in Figure 4.11. Inspection of the charts for sulphate, copper and manganese reveals that concentrations of these three important elements had not stabilized after 7 cycles and that additional mass was dissolved in each cycle. Follow-up equilibrium modelling (not provided) on the SMWMP results using PHREEQC showed that gypsum (calcium sulphate) and malachite (basic copper carbonate) were all approaching saturation, but remained undersaturated in Cycle 7 leachate (Table 4-3).

It should be noted that the Blue WD samples were tested to aid development of source terms for the Blue Ore Stockpile area for purposes of water quality prediction. MintoEx has committed to milling the ore stockpiles in the Blue Ore Stockpile area, and therefore no source term for that facility has been derived.

Results for mineralogical characterization by XRD were discussed previously in Section 4.1.1.

Table 4-3: Saturation Indices for SMWMP Test Cycle 7 leachates

			Saturation Indices				
Sample		Sequence #	gypsum	tenorite	malachite	calcite	dolomite
Blue WD Sample 1	North Side	Sequence 7	-0.05	0.49	-0.23	0.26	1.11
Blue WD Sample 2	South Side	Sequence 7	-0.09	0.54	-0.24	0.41	1.60
Main	Waste Dump	Sequence 7	-1.06	0.17	-0.98	0.49	1.66
SW Dump	Waste Rock	Sequence 7	-0.55	0.25	-0.81	0.42	1.60

Source: U:\1CM002.001_PhaseIV_WaterQualityPrediction\Report_MLARDcharacterization+WQP\Tables\[Table4-3_SMWMP_PHQoutput.xlsx]

4.1.3 Kinetic Tests

Humidity Cell Tests

Results to date for the four Phase IV humidity cell tests (HCTs) are provided in Appendix E.

Over 51 weeks of testing, leachate pH for all four HCTs has drifted lower from typical initial values between pH 7.5 and 8 to values typically between 7.3 and 7.7. The greatest degree of variability in leachate pH was observed in HC1, which had the highest copper and sulphur concentrations of the four samples being tested. Leachate pHs for all four tests appear to have been within a stable range since around Week 30 of testing.

Sulphate release rates were initially elevated (around 30 mg/kg/week) for HC1, and declined over the duration of testing to levels similar to HC2, -3 and -4 (<5 mg/kg/week) by Week 50. Sulphate release from HC2, -3, and -4 was relatively stable over the duration of testing to date.

Copper release rates from all four HCTs declined over the duration over testing and appear to be crudely related to the copper content of the sample. HC1 had order-of-magnitude higher release rates than the other samples, with typical release rates around 0.01 mg/kg/week. HC2, -3, and -4 had typical copper release rates within an apparently stable range of around 0.0002 to 0.001 mg/kg/week.

Cadmium release rates from HC1 were initially elevated over later rates and declined over the duration of testing. Calculated rates of release of cadmium from HC2, -3, and -4 were influenced by detection level cadmium concentrations in HCT leachate and appear to have been stable at or near the detection level-indicated rate of around 0.000002 mg/kg/week.

Release rates for other elements were either stable or declining over the duration of testing.

Barrel Tests

Results from initial monitoring of barrel tests were incomplete at the time of report preparation. Monitoring of barrel test leachate is planned going forward to inform future site water quality assessments.

4.1.4 Implications for Waste Rock Management

The ABA characterization of Phase IV waste rock has shown that it will have similar characteristics to waste rock that has been produced from the Main Pit. The majority of the waste rock will consist of unmineralized granodiorite that has low sulphur content and modest carbonate mineral content; this bulk waste material is uniformly classified as Non-PAG and does not present a risk for generation of ARD. The bulk waste is appropriate for disposal in upland waste dumps.

A minor component of the waste rock will consist of mineralized rock that contains sub-economic copper grades and ranges in ARD classification from Non-PAG to PAG. This material will also contain a larger inventory of copper and other trace elements (e.g. arsenic, cadmium, chromium, manganese, molybdenum, nickel, zinc) that could impair downstream water quality if leaching occurs at unacceptable levels. If mixed with bulk waste, the mineralized waste rock would represent a minor risk for development of ARD and a more substantial risk for release of elevated concentrations of trace elements over the long term.

Due to the risk of long term trace element release from the mineralized waste, MintoEx has developed a mine plan that entails selective handling of most of the mineralized waste stream. Segregation of mineralized waste on the basis of copper content is proposed, with both the risk of ARD and trace element leaching being minimized by storage of mineralized waste under saturated conditions following the completion of closure activities. During operations, mineralized waste will either be co-disposed with thickened tailings in the Main Pit or stockpiled within the Main Pit footprint for later relocation below the ultimate water level in the Main Pit lake.

4.2 Phase IV Tailings

4.2.1 Static Test Results

Complete results of Phase IV tailings static testing are included in Appendix F, and results of operational monitoring of tailings generated from Main Pit ore are included in Appendix G for comparative purposes.

Total sulphur (S(T)) and sulphide sulphur (S(Sx)) content (calculated as the difference between S(T) and sulphate sulphur ($S(SO_4)$)) for the Phase IV tailings are shown in Figure 4.12. Operational results from Main Zone tails are shown for comparative purposes. For Area 2 and Area 118 samples with S(T)<0.2%, most of the sulphur is in the sulphide form. For the two Area 2 samples with S(T)>0.2%, S(T) was measurably greater than S(Sx) due to the measurable $S(SO_4)$ content which suggests the test samples may have contained gypsum (these samples represent the deepest Area 2 ore horizons (P Zone and Q Zone)). By comparison, the operational Main Zone tails have consistently returned near-equal S(Sx) and S(T) content.

Figure 4.13 shows a plot of neutralization potential calculated from inorganic carbon content (NP_{TIC}) vs. NP for Phase IV tailings samples; results from operational monitoring of Main Zone tailings are shown for comparison. All Area 2 samples have NP_{TIC} < NP, with NP_{TIC} values being 10 to 20 kg $CaCO_3$/ tonne less than corresponding NP values. In contrast, both Area 118 samples have NP_{TIC} > NP. These results suggest that both silicate minerals and iron or manganese carbonates contribute to the various NP measurements for the Phase IV tailings. NP determinations for Main Zone samples have been carried out according to the BC Research method as specified by the site's water use license QZ96-006; the wide range of NP values and the narrower range of NP_{TIC} values suggest that the BC Research method (BC Research, 1995) may not be reflecting the carbonate mineral content of the samples appropriately (this was the stated intention of specifying the BC Research method in QZ96-006).

Plots of NP vs. AP and NP_{TIC} vs. AP are shown in Figure 4.14 and Figure 4.15. All Phase IV samples had NP:AP ratios greater than 2, and all but one sample had NP_{TIC}:AP ratios greater than 2. The operational monitoring results from the Main Zone tailings are shown for comparison in Figure 4.15; the Main Zone tails display a similar range of NP_{TIC}:AP ratios as observed in the Phase IV testing.

The elemental content of the Phase IV tailings test samples are provided in Appendix F, and the elemental content of from nine monthly composites from 2009 are provided for comparison (these nine sets of results are the complete set of available operational data at the time of report preparation). While trace element content of the monthly composite samples is often below the metallurgical detection limits provided, the following comparisons can be made:

- Copper and chromium content in the Phase IV samples was somewhat lower than in the available Main Zone monthly composites; and

- Iron, manganese, and zinc contents of Phase IV samples were similar to or slightly higher than the same elements in the available Main Zone monthly composite results.

Other trace element concentrations (including arsenic, cadmium and selenium) in Phase IV tailings samples were similar to typical crustal average concentrations for granitic rocks (Price 1997).

4.2.2 Kinetic Tests

Column Test Results

At the time of report preparation, 46 weeks of subaqueous tailings column testing had been received; results are provided in both tabular and chart form in Appendix H.

Monitoring of water cover pH from both Column 1 (Area 118 tails) and Column 2 (Ridgetop tails) has shown a decline from initial circum-neutral pH levels to slightly acidic values (between pH 5.5 and 6.5) in the latter weeks of testing to date. This decline in pH coincides with stable and low sulphate concentrations, and a decline in conductivity and major cation concentrations. These observations are consistent with the addition of deionized water (pH 5.5) to the water cover through the course of testing, coupled with depletion of readily available NP at the tailings surface. Trace element concentrations are uniformly low over time in the water cover in both columns. Of note, the manganese concentrations in the surface water in both columns over time suggest that there is a flux of manganese from the tails into the overlying water (although concentrations remain low at <0.03 mg/L).

Monitoring of bottom port leachate showed a consistent range of pH, typically ranging from pH 7 to pH 8 for both columns over the course of testing to date. Sulphate concentrations peaked in Week 6 of testing for both columns (Column 1 peak value of 67 mg/L; Column 2 peak value of 101 mg/L), before rapidly declining to < 20 mg/L by Week 15 and continuing to decline for the duration of the test. Similarly, alkalinity concentrations for both columns peaked in Week 8, then declined to long term stable values, with Column 2 (Ridgetop tails) having two-fold higher alkalinity concentrations in the most recent results. Major cations showed a similar pattern, with early peaks and lower stable concentrations in latter weeks of testing.

The following trace elements had similar concentrations in both surface water and bottom port leachate: arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc. The following points discuss notably elevated concentrations of trace elements in bottom port water (compared to surface water) from t he subaqueous tailings columns:

- Barium increased dramatically in Column 1 leachate beginning in Week 14, and appeared to stabilize at concentrations around 2.3 mg/L over the latest 10 weeks of testing for which results were available (Weeks 36 to 45). Inspection of sulphate concentrations shows a corresponding dramatic decline, and the increase in barium concentrations is thought to result from equilibrium dissolution of the sparingly-soluble mineral barite (barium sulphate) when sulphate concentrations became favourable.

- Manganese concentrations for both bottom ports peaked in Week 6, with a maximum concentration of 0.085 mg/L. In latter weeks, manganese concentrations declined more than 50%, with concentrations from Column 1 bottom port of less than half the concentrations in both water covers and Column 2 manganese concentrations approaching those of the water covers.
- Molybdenum concentrations in bottom port leachate from both columns appeared to be increasing in latter weeks. Concentrations remained below maxima (near 0.03 mg/L) reached in Week 6 of testing.

Overall, the differences in porewater geochemistry from the two tailings samples, as represented by column bottom port leachate, are minor.

4.2.3 Implications for Tailings Management

Phase IV tailings are expected to be similar to tailings produced from the Main Zone ore bodies. Test results indicate that there is minimal risk of widespread acid weathering conditions developing within the Phase IV tailings. Operational monitoring of the DSTF has shown that there is a potential for neutral pH leaching of manganese from the Main Zone tails, and it is expected that the Phase IV tails would behave in a geochemically-similar fashion.

Disposal of Phase IV tailings as a thickened tails product below the final spill elevation in the mined-out Main Pit will serve to minimize neutral pH metal leaching. Two factors will be most significant in this regard:

- disposal of the bulk of the tailings in a permanently-saturated state will minimize oxidation of contained metal-bearing sulphide minerals, and subsequent leaching of soluble oxidation products; and
- in-pit placement of a thickened tailings product will result in low volumes of pore fluid expelled from the tailings to the overlying water via consolidation over time.

5 Post-closure Water Quality Prediction

5.1 Approach

The Minto Phase IV post-closure water quality prediction has been developed using the GoldSim software package (GoldSim, 2010). MintoEx specified that predictions were required for Minto Creek monitoring stations W3 and W1, and for the parameters aluminum, ammonia, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, nitrate, nitrite, selenium, silver, thallium and zinc.

Monthly estimates of post-closure water chemistry at stations W1 and W3 were made using a water and load balance approach. Inputs to the water and load balance (WLB) consisted of the post-closure water balance prepared by Clearwater Consultants Limited (Clearwater) as well as estimates of source water chemistry from the various mine components. The prediction was carried out on the basis of dissolved loads, and then equivalent total loads were estimated.

For the purposes of the water quality prediction, the post-closure period is assumed to be the period following reclamation and decommissioning of the mine site when steady state conditions have been established. In the context of the Phase IV mine plan, a key aspect of these steady state conditions will be the filling of the Main Pit and the Area 2 Pit to the respective spill points, and the development of stable chemical loadings to these water bodies.

The philosophy in developing the WLB was to arrive at a conservative, but reasonable, estimate of post-closure water chemistry in Minto Creek. In practical terms, this philosophy was manifested in the selection of appropriate chemical source terms for the various mine components; where some uncertainty existed about the appropriate source terms, conservative (typically higher) values were selected for use as model inputs.

5.2 Inputs to Water Quality Prediction

5.2.1 Water balance

A post-closure water balance was prepared by Clearwater that estimated monthly runoff from various subcatchments of Minto Creek for a range of return periods (CCL 2010). The catchment flows for the average return period were adopted as the basis for the GoldSim water and load balance. The subcatchments of Minto Creek were defined to allow loads to be assigned to various discrete sources of load (e.g. waste dumps, pit walls, and dry stack tails). The water balance and a map showing the discrete catchments is included as Appendix I.

5.2.2 Source Terms

Undisturbed Catchment Areas

Minnow Environmental Inc. (Minnow) has reviewed monitoring records from reference streams within the Minto Creek catchment, and from the main stem of Minto Creek (Appendix J). The reviewed records span the pre-operational and operational periods through the end of 2009.

Minnow evaluated three approaches to characterizing water quality from undisturbed catchment areas:

- Option 1- water quality in undisturbed tributary catchments reporting to routine monitoring stations W6 and W7 through 2008, and the broader Minto Creek data set for 2005 (prior to significant site disturbance- stations W1, W2, W3, W8, W9, W10);
- Option 2- water quality in undisturbed tributary catchments reporting to routine monitoring stations W6 and W7 for the entire period of record; and
- Option 3- water quality in undisturbed tributary catchments reporting to routine monitoring stations W6 and W7 for the entire period of record (through 2009), and the broader Minto Creek data set for 2005 (prior to significant site disturbance- stations W1, W2, W3, W8, W9, W10).

Option 3 represented an update of Option 1 to include 2009 monitoring results. The annual and monthly mean concentrations for the Option 2 and Option 3 data sets were compared. Both approaches were found to yield similar mean concentrations, and Minnow recommended adopting Option 3 as the source term water chemistry for runoff from undisturbed catchment areas.

Dry Stack Tailings Facility

To appropriately estimate long-term chemical loadings from the DSTF, an estimate of tailings pore water chemistry was required. No samples of tailings porewater have been collected to date. Operational monitoring of water quality immediately below the DSTF has occurred at stations W8 and W8A. Both stations monitor discharge from finger drains constructed in the foundation of the DSTF. Monitoring results from W8 and W8A show considerable variation in concentrations over time, as typified by the plots of copper and sulphate concentrations shown in Figure 5.1.

Dissolved copper concentrations observed in DSTF seepage are typical of sources where secondary copper minerals provide a control on the upper limit of dissolved copper concentrations. Water chemistry for individual sampling dates where dissolved copper measured greater than 0.1 mg/L were evaluated using the geochemical equilibrium model PHREEQC, and results indicated that seepage waters were at or near equilibrium with respect to the common secondary copper minerals tenorite (CuO) and/or malachite ($Cu_2CO_3(OH)_2$.

The highest sulphate and dissolved copper concentrations in DSTF seepage were measured in the sample collected at station W8 on August 19, 2009. The water chemistry from this sample was adopted as a preliminary source term for DSTF seepage; a review of trace element concentrations in all W8 and W8A results from 2008 to present was carried out, and where warranted higher trace element concentrations were substituted into the preliminary source term to arrive at a final source term water chemistry that was incorporated into the water and load balance.

There are a number of elements that are expected to cause the adopted source term to result in a conservative estimate of DSTF loadings, including:

- The model assumes all tailings are unfrozen and contributing load, while monitoring shows that a portion of the DSTF tailings are frozen; and
- High (typically the highest) values from operational seepage monitoring were selected for use as source terms; for concentrations of trace elements not controlled by mineral equilibria, this may overestimate annual loading by applying uniformly high concentrations throughout the year. Monitoring results show differing degrees of seasonal variability for different trace elements.

Other assumptions made in defining the DSTF source term include:

- In the post-closure period tailings seepage will contain minimal suspended solids, and dissolved concentrations will be equal to total concentrations;
- Tailings seepage and runoff flows will be a function of precipitation directly onto the footprint of the DSTF, and that there will be insignificant volumes of upgradient water contacting DSTF tailings;
- Tailings seepage will have circum-neutral pH;
- Water chemistry at site water quality monitoring stations is reflective of tailings porewater chemistry; and
- No reduction in loading rates from the DSTF will occur as a result of reclamation of the DSTF.

In-Pit Tailings Facility

A conservative estimate of loadings to the pit lake due to post-closure consolidation of Main Pit thickened tails was developed to evaluate whether the in-pit tails are likely to be a significant source of load. The scoping estimate was developed as follows:

1. The in-pit tailings deposit was approximated as having a surface area of 18.5 ha and an average thickness of 60 m (actual projected maximum thickness will be roughly 60 m). These dimensions slightly exceed the expected actual dimensions indicated by subsequent mine planning.

2. For scoping purposes, a rate of porewater release (0.17 m^3 porewater/ m^2 tailings surface area) was adopted from results of consolidation analysis of slurry tails carried out for another copper mine project. The reference slurry tailings were modelled as a 90 m thick deposit having a finer grind than the Minto Phase IV tails (tails with a finer grind take longer to consolidate, so relatively more consolidation happens post-deposition). The initial consolidation rate for the third year after cessation of deposition was adopted, to correspond

to the planned 2 years between the end of tailings deposition and the completion of closure works. This adopted porewater release rate is an overestimation of the consolidation rate due to the following factors:

a. The adopted reference rate is based on slurry tails rather than thickened tails;

b. The adopted reference rate is based on a 90m thick deposit rather than a 60m thick deposit;

c. The adopted reference rate was derived for tails that had a finer particle size distribution than is planned for Minto Phase IV tails; and

d. The scoping assessment assumes consolidation of the Minto Phase IV tails will continue at this rate indefinitely, whereas in actuality consolidation rates will decrease with time.

To estimate loading to the pit lake, the maximum concentrations observed in Column 2 leachate (Section 4.2.2) were adopted to represent porewater chemistry. Selection of Column 2 was based on the generally higher leachate concentrations than measured from Column 1.

Main Dump and Southwest Dump

Waste rock from the Main Pit was initially placed in the Main Dump. Construction of the Main Dump is complete and construction of the Southwest Dump has been started using Main Pit waste rock. Water chemistry of drainage from these facilities has been recently monitored at several stations (including W15, W30, W31, W32, W38, W39, and W40).

Maximum dissolved copper concentration was observed in the sample collected at W15 on April 27, 2010. The water chemistry from W15 on April 27, 2010 was evaluated using PHREEQC, and it was found that the water was slightly oversaturated with respect to the copper minerals tenorite and malachite. As noted previously in the DSTF discussion, formation of these copper minerals commonly limits aqueous copper concentrations under neutral leaching conditions, and the characteristic green staining indicative of malachite is observed on pit walls and on waste rock particles at Minto. The results of seepage equilibrium modelling were in good agreement with the results of modelling the leachate from the sequential MWMP testing discussed in Section 4.1.2.

The complete water chemistry from W15 for April 27, 2010 has been adopted as the preliminary model source term for release of copper and other parameters from all waste rock produced through the end of Phase IV. Maximum dissolved trace element concentrations in other samples draining waste rock were inspected to ensure that the W15 water chemistry was an appropriate source term, and the maximum observed trace element concentrations (for most elements) were substituted into the source term where these exceeded the April 27, 2010 concentrations at W15. The exceptions were:

- Cadmium: a comparison between maximum cadmium concentrations in waste dump seepage and average annual loadings indicated by scale-up[3] of humidity cell release rates[4] showed that using maximum seepage cadmium concentrations as a source concentration was overly conservative. As a result, the average annual field-scale cadmium concentration indicated by humidity cell release rates (0.000544 mg/L) was adopted as the source concentration used in the water quality prediction.
- Iron and manganese: as for cadmium, maximum iron and manganese concentrations in waste dump seepage (Fe-D 22.8 mg/L; Mn- D 17.8 mg/L) were found to much higher than those indicated by HCT results for long term mean concentrations. Appropriate scale up of HCT results suggested concentrations similar to those observed in the April 27, 2010 results, and those concentrations (Fe-D 2.91 mg/L; Mn- D 0.569 mg/L) were used in the source term. Use of average concentrations is not likely to cause seasonal effects in lower Minto Creek to be overlooked, as most waste rock drainage will report to the fully-mixed Main Pit lake (which is expected to have a residence time on the order of a few years).

Table 5-1 contains the concentrations that were adopted for the MWD and SWD source term.

---

[3] Laboratory release rates were multiplied by three scaling factors to estimate equivalent field release rates. These factors were:

- A temperature factor of 0.2, to account for lower rates of chemical reactions under field conditions. Typical lab operating temperatures were 20°C and average site ground temperatures were assumed to be 0°C; application of the Arrhenius equation (assuming an activation energy of 60 kJ/mol) suggests a factor of 0.17 would be justified.
- A particle size factor of 0.2, to account for the difference in reactive surface area between the crushed HCT sample and the blasted rock that will be present at full scale.
- A contact or flushing factor of 0.5, to account incomplete flushing of weathering products from the full scale waste dumps (HCT operating procedure ensure complete flushing of weathering products).

The complete scale-up calculation followed the model below:

- Laboratory release rate (mg/kg/wk) x 52 wk/yr x scaling factors (temperature factor of 0.2, particle size factor of 0.2, contact (flushing) factor of 0.5).

[4] Cadmium release from HC 2, HC 3, and HC4 was nearly identical- these cells contained rock that was selected to have copper and sulphur concentrations ranging from the 50th to the 75th percentile for Area 2 waste. Cadmium concentrations in HC2, HC3, and HC4 leachate for nearly all cycles were below the detection limit of 0.000005 mg/L; field-scale release rates were estimated from lab release rates (determined from leachate concentrations assuming detection level concentration where actual concentrations were below decection) by applying scaling factors as discussed in for the pit wall source term.

Other assumptions made in defining the MWD and SWD source term include:

- In the post-closure period waste rock seepage will contain minimal suspended solids, and dissolved concentrations will be equal to total concentrations;
- Waste rock seepage and runoff flows will be a function of precipitation directly onto the footprint of the dumps, and that there will be insignificant volumes of upgradient water contacting the majority of the waste rock;
- Waste rock seepage and runoff will have circum-neutral pH (as indicated by acid base accounting);
- Water chemistry at site water quality monitoring stations is reflective of waste rock porewater chemistry; and
- No reduction in loading rates from the MWD and SWD will occur as a result of reclamation of the waste dumps.

Table 5-1: Concentrations Adopted as MWD and SWD Source Term

Parameter	Concentration mg/L
Ag-D	0.00
Al-D	2.65
As-D	0.0034
Cd-D	0.00054
Cr-D	0.003
Cu-D	0.42
Fe-D	2.91
Hg-D	0.00
Mn-D	0.569
Mo-D	0.0139
Ni-D	0.008
Pb-D	0.0027
Se-D	0.0044
Tl-D	0.00
Zn-D	0.062

Source: U:\1CM002.001_PhaseIV_WaterQualityPrediction\Report_MLARDcharacterization+WQP\Tables\[Table5-1_MWDSourceTerm.xlsx]

Mill Valley Extension Dump

The Mill Valley Fill Dump (MVF) will be constructed of waste rock with lower copper content, defined as Grade Bin 0.0 material; this will be waste that is designated as having the lowest copper content within the block model that is used for mine planning purposes. While there will be a much lower copper inventory within this dump than in the Main Dump and the Southwest Dump, the MVF will nevertheless generate a load of copper and other soluble weathering products that needs to be accounted for in the estimation of post-closure water quality.

One approach to estimating MVF loads would be to simply apply the same source term as was adopted for the Main and Southwest dumps. However, given the lower degree of mineralisation that will be contained in the MVF, a check calculation was carried out using the results from humidity cell testing to assess whether copper concentrations would likely be sufficiently elevated to cause formation of secondary copper minerals (as seems to be the case in the existing dumps).

Humidity cell HC2 (Section 4.2.2) tested a sample having approximately 50th percentile concentrations of both copper (0.01%) and sulphur (0.01%), and this was considered a reasonable representation of MVF waste rock. Scale-up calculations[3] of annual loads were carried out on stable HC2 results (e.g. laboratory copper release rate of 0.00033 mg/kg/wk; equivalent field scale copper release rate of 0.00035 mg/kg/yr), and the results were applied to flow volumes to arrive at estimates of aqueous concentrations. Results of this exercise indicated that initial runoff from the MVF would likely be at or near geochemical equilibrium with secondary copper minerals, and that trace element concentrations would be similar to those concentrations in the Main/ Southwest Dump source term. As a result, the source term adopted for the Main and Southwest dumps was also adopted for the MVF. This is expected to be a conservative approach, as over time leaching of copper and other weathering products will be lower for the MVF than for the other waste rock.

Assumptions inherent to adopting the waste rock source term for the MVF include those noted previously for the MWD and the SWD.

Main Pit and Area 2 Pit Walls

Loadings from the pit walls exposed above the final lake elevations were estimated using results of humidity cell testing along with estimates of reactive rock mass. As shown in Figure 5.2 and Figure 5.3, nearly all the mineralized material exposed in pit walls will be well below the final lake elevations. Humidity cells HC2 and HC3 contained rock with copper ranging from 0.01 to 0.1% (50th to 75th percentile) and sulphur ranging from 0.01 to 0.02% (roughly 50th percentile), and an average of release rates from these two tests was adopted as an appropriate input to estimating loads from pit walls.

Reactive rock mass was estimated for each pit wall by multiplying the approximate wall rock surface area by a thickness of 2 m. Loadings from the resulting reactive rock mass were then estimated by multiplying rock mass by estimates of field release rates as described previously[3].

Assumptions inherent to the estimates of loadings from Main Pit and Area 2 pit walls include:

- Loading rates remain constant over time, as fresh weathering surfaces are exposed by ravelling of walls; and
- Pit lakes reach final elevation quickly and long-term loadings from pit walls below the final lake elevation are minimal.

Area 118 Pit Backfill

Annual loadings from Area 118 Pit backfill were estimated based on scale up of humidity cell release rates in a manner similar to that described above for the Main Pit and Area 2 Pit walls. Area 2 Pit backfill mass was estimated by reducing the mined tonnage of ore and waste from the Area 118 pit by a by bulking factor (1.3) to account for the reduction in bulk density that occurs during blasting and excavation.

Assumptions inherent to the estimates of loadings from Area 118 backfill include:

- All backfill consists of bulk waste rock (not overburden) from the Area 2 pit;
- Disposal within the pit does not reduce weathering rates;
- Loadings are not limited by mineral equilibria (e.g. removal of dissolved copper through formation of secondary copper minerals); and
- Closure measures do not reduce loadings.

Main Pit and Area 2 Pit Lakes

The pit lakes were treated as fully-mixed reservoirs that received mass and load from sources and released a fully-mixed flow at the outlet at flow rates specified by the water balance. No source term was developed for the pit lakes, as all loads are accounted for through discrete sources.

Assumptions inherent to this approach include that the pits are full to the respective spill points, that pit lake stratification does not occur and that the pits do not act as a geochemical sink.

Ore Stockpile and Mill Laydown Areas

Annual loadings from the Ore Stockpile and Mill Laydown pads were estimated based on scale up of humidity cell release rates in a manner similar to that described above for the Main Pit and Area 2 Pit walls. A mine rock thickness of 2 m was assumed to exist over the footprint of both areas, and laboratory release rates from humidity cells HC2 and HC3 were converted to field release rates as described for pit walls.

Nitrogen Loadings

Nitrogen loadings (mostly in the form of ammonia and nitrate) due to leaching of blasting residues can be important during active mining. Loadings typically decrease dramatically after blasting ceases in conjunction with final ore extraction, however loadings can continue at environmentally-significant levels for some number of years as blast residues are flushed.

A common approach to evaluating nitrogen release is described by Ferguson and Leask (1988).

That method was developed based on observations of nutrient export from coal mines in the Elk Valley of SE BC compared to actual explosives use. This resulted in estimated proportion of explosives not consumed during detonation. Inputs to the method are: the total annual use of explosives the year before a prediction is required and the type of explosives employed (with slurry explosives substantially increasing leaching rates). The latter was found to be a significant factor in the study and resulted in good predictions of actual N export.

While the method is based on explosives use the year before the prediction is required, the loading used to calibrate to explosives residue leaching reflects the cumulative effect of leaching of explosives residues in all previous years. The authors recognized this.

During mining of Phase IV at Minto, the primary explosive in use is expected to be ANFO, with emulsion used when wet conditions are encountered during non-freezing times of the year. The consumption rate is expected to be 0.8 to 0.9 kg explosive/ tonne of waste and ore. Because ANFO has the highest nitrogen content and the highest susceptibility to generating blasting residues, all explosives were assumed to be ANFO for the purposes of this evaluation, and consumption was assumed to be 0.9 kg ANFO (0.315 kg N) per tonne. The maximum annual mining rate (12.97 million tonnes (planned for 2014)) was adopted for evaluation purposes.

The approach recommended by Ferguson and Leask suggests a loss of 0.2% of nitrogen contained in explosives used in the preceding year of mining is appropriate for mines that do not use slurry explosives. Using this approach the total blast residue nitrogen mass was estimated as follows:

- 12.98 million tonnes x 0.315 kg explosive (as N)/ tonne x 0.2% = 8 176 kg leachable N.
- Considering flow volumes at station W3, this works out to be about 9 mg/L as nitrate.

In the study by Ferguson and Leask, all explosive residue was assumed to be leached in the year following generation. However, the study was carried out where continuous mining was occurring year over year, and where leached residues were being replaced year over year through consumption of additional explosives. Where mining has halted and no new nitrogen is being stored, it seems unrealistic to assume that explosives leaching will be complete in a single year with no further release in subsequent years. However, no case studies of nitrogen export on cessation of mining were identified. For that reason, a decay approach to nitrogen release was considered, whereby half the remaining N load would leach in a given year. Using this approach, nitrogen release in the fifth year post-mining would have declined to 6% of the stored residues, down from 50% in the first year.

Given the lack of standard rigorous approaches available to estimate long term rates of nitrogen export, it was felt that the existing site monitoring results likely provide the best insight into the upper limits of what might reasonably be expected immediately post-closure. For that reason, the maximum or near-maximum concentrations of nitrogen species that have been observed at station W3 (see Figure 5.4) were adopted as source term concentrations for the water and load balance. The maximum concentrations were 8.8 mg/L nitrate-N, and 0.62 mg/L ammonia-N, respectively, and these were adopted as source terms. Maximum nitrite-N values (4.04 to 4.13 mg/L) were observed in three samples collected on Oct 30, 2007; these values were considered to be outliers and were not considered realistic for use as a source term. The next highest nitrite-N concentration at W3 (0.35 mg/L) was adopted as the value to be used as a source term. Over time, experience from other closed mines has shown that nitrogen-species loading declines substantially after the use of blasting agents is halted, and the same qualitative pattern is expected at Minto in the post-closure period.

Underground Workings

No source term or load has been attributed to the underground workings. The underground workings are expected to be at least partially flooded following the cessation of mining, although there may not be discharge from the portal given the relatively high elevation of the portal and the proximity of some of higher elevation workings to the Area 2 pit. The workings themselves are not expected to be a significant source of load, given the small exposed surface area, the low expected rates of water flux, and the geochemical similarity of the underground rocks to the surface-disposed waste rock and tailings.

Particulate Loadings from Suspended Solids

To estimate total concentrations of the parameters of interest, operational monitoring records from W3 from 2008 onwards were evaluated to determine the composition of suspended sediment. Median elemental concentrations of suspended sediment were calculated from total suspended solids (TSS) results and from the associated elemental load (based on the difference between total (unfiltered) and dissolved (filtered) water chemistry). It was assumed that site discharge (at W3) would contain 30 mg/L TSS (the upper limit allowed under the current water licence), and incremental loadings due to suspended solids were calculated for each month.

In the GoldSim model, the incremental loadings from suspended solids were added as a discrete source to the dissolved load reporting to W3. For runoff entering Minto Creek between W3 and W1, the source term was calculated from actual site monitoring data; since the total concentrations from undisturbed ground runoff were used, no allowance for additional loading due to suspended solids was necessary.

5.3 Structure of the Water and Load Balance

The GoldSim model used to develop the post closure water quality estimate consists of a water balance component that mirrors the post-closure water balance developed by CCL, and a load balance component that combines the source terms described in the previous section to appropriate flows. Figure 5.5 and Figure 5.6 show the schematic layout of the water balance and the load balance, respectively, within the model.

5.4 Water and Load Balance Results and Discussion

Post-closure monthly water chemistry estimates for stations W3 and W1 are presented in Table 5-2 and Table 5-3, respectively.

Figure 5.7 contains pie charts that represent the relative annual load contribution from each of the sources in water and load balance to the total annual load that would report to W1. For copper, waste rock will be the dominant load source, with over 70% of the total annual load estimated to be derived from the Southwest Dump, the Main Dump, and the Mill Valley Fill. For manganese, the DSTF is shown to be the largest contributor (at 42%), with other mine sources contributing an additional 25% of the total. For all other parameters shown in Figure 5.7, runoff from undisturbed portions of the catchment (both above W3 and between W3 and W1) represents the dominant source of annual loading. It should be noted that the relative contributions shown in Figure 5.7 are based on the 'reasonable worst case' source terms used in the prediction, and that the magnitude of the relative contributions from mine sources should also be considered as 'reasonable worst case' estimates.

The predictions for nitrogen species (nitrate, nitrite and ammonia) are based on the upper limit of observed concentrations to date at station W3. Standard calculations to quantify leaching of blast residues from Phase IV mining have shown that the maximum concentrations observed to date at W3 are reasonable upper limits for concentrations that can be expected in the post-closure period, and these were adopted in the water and load balance. Leaching of nitrogen species will decline with time, and for this reason the predicted concentrations should not be used as inputs to any assessments of post-closure stream productivity.

The predicted manganese loads reporting to W3 are strongly influenced by the manganese concentration adopted for the DSTF source term (5.04 mg/L in dissolved form). As discussed in Section 5.2.2, the maximum observed manganese concentrations in waste rock seepage exceed concentrations suggested by long term manganese release from waste rock HCTs; no parallel kinetic tests are available for tailings, and therefore the maximum observed manganese concentration in tailings seepage was adopted. It is likely that the maximum observed concentrations exceed long term average concentrations, however at this time the conservative approach is to adopt the maximum observed manganese concentration for the DSTF source term.

June concentrations at W1 are based on average background runoff concentrations- there is not the same degree of conservatism in the prediction for June at W1 as for other months. For periods when there is no flow from the upper Minto Creek catchment, concentrations at W1 will vary with background runoff concentrations and may well exceed the average concentrations adopted as the background source term. This condition is expected to be identical to conditions that would have occurred under similar flow regimes in the pre-mining period.

The following points highlight some aspects of the prediction approach which contribute a measure of conservatism to the predictions of post-closure water quality:

- Where uncertainty was encountered, or when required model inputs were poorly defined, choices were made that lead to higher estimates of loading.
- Waste dump loads will report to Main Pit lake, where settling of solids and some degree of removal of dissolved load is expected to occur. No attempt was made to account for mass removal due to these processes.

- Example: some dissolved iron and manganese will be removed as oxide or oxyhydroxide precipitates; these minerals are known to scavenge trace elements from the water column, and can be expected to be responsible for some reduction in loadings to lower Minto Creek.
- Example: depending on pH conditions, some dissolved aluminum will also be removed as aluminum hydroxide precipitates. Source terms for both waste rock and tailings allow for slightly alkaline pH values (in the pH 8 range) - under these conditions, aluminum is considerably more soluble than at neutral pH and predicted aluminum loadings are higher.

Table 5-2: Minto Phase IV Post-closure Water Quality Prediction: Station W3- Total Concentrations

	Ag mg/L	Al mg/L	As mg/L	Cd mg/L	Cr mg/L	Cu mg/L	Fe mg/L	Hg mg/L	Mn mg/L	Mo mg/L	Ni mg/L	Pb mg/L	Se mg/L	Tl mg/L	Zn mg/L	Ammonia-N mg/L	Nitrate-N mg/L	Nitrite-N mg/L
January	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
February	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
March	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
April	0.00018	1.5	0.0017	0.00023	0.0023	0.097	1.9	3.7E-05	0.37	0.0048	0.0042	0.0011	0.0013	2.0E-05	0.027	0.62	8.8	0.35
May	0.00017	1.7	0.0019	0.00020	0.0026	0.091	2.3	3.7E-05	0.37	0.0047	0.0056	0.0011	0.0014	8.7E-05	0.025	0.62	8.8	0.35
June	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
July	0.00018	2.3	0.0032	0.00031	0.0037	0.19	3.0	2.5E-04	0.91	0.0077	0.0076	0.0017	0.0027	5.9E-05	0.037	0.62	8.8	0.35
August	0.00019	2.3	0.0032	0.00034	0.0035	0.22	3.0	1.5E-04	0.83	0.0090	0.0075	0.0018	0.0029	4.8E-05	0.042	0.62	8.8	0.35
September	0.00020	1.8	0.0021	0.00023	0.0028	0.12	2.4	6.5E-05	0.45	0.0057	0.0057	0.0013	0.0016	4.6E-05	0.031	0.62	8.8	0.35
October	0.00019	1.6	0.0017	0.00026	0.0024	0.094	2.1	4.5E-05	0.38	0.0049	0.0050	0.0013	0.0014	3.7E-05	0.027	0.62	8.8	0.35
November	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: U:\1CM002.001_PhaseIV_WaterQualityPrediction\Report_MLARDcharacterization+WQP\Tables\[Table5-1_and_Table5-2_W3+W1_Prediction.xlsx]

Note: Zero (‘0’) values indicate periods of no flow, as indicated by the post-closure water balance.

Table 5-3 Minto Phase IV Post-closure Water Quality Prediction: Station W1- Total Concentrations

	Ag mg/L	Al mg/L	As mg/L	Cd mg/L	Cr mg/L	Cu mg/L	Fe mg/L	Hg mg/L	Mn mg/L	Mo mg/L	Ni mg/L	Pb mg/L	Se mg/L	Tl mg/L	Zn mg/L	Ammonia-N mg/L	Nitrate-N mg/L	Nitrite-N mg/L
January	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
February	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
March	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
April	0.000052	0.30	0.0005	0.000086	0.0009	0.023	0.4	1.4E-05	0.08	0.0015	0.0011	0.00029	0.00046	7.4E-06	0.009	0.10	1.4	0.056
May	0.000068	0.83	0.0010	0.000091	0.0016	0.035	1.2	2.0E-05	0.16	0.0022	0.0036	0.00056	0.00082	9.3E-05	0.011	0.22	3.2	0.125
June	0.000050	1.68	0.0011	0.000044	0.0036	0.006	2.5	1.4E-03	0.11	0.0010	0.0049	0.00077	0.00041	3.0E-05	0.009	0.01	0.1	0.004
July	0.000055	0.47	0.0008	0.000046	0.0010	0.025	0.7	7.4E-05	0.13	0.0018	0.0020	0.00036	0.00057	3.5E-05	0.008	0.07	1.0	0.038
August	0.000073	0.30	0.0008	0.000044	0.0009	0.024	0.4	3.4E-05	0.12	0.0025	0.0018	0.00037	0.00057	4.1E-05	0.008	0.06	0.9	0.036
September	0.000106	0.81	0.0010	0.000089	0.0016	0.043	1.2	3.6E-05	0.20	0.0025	0.0032	0.00061	0.00084	4.1E-05	0.014	0.23	3.2	0.128
October	0.000050	0.30	0.0005	0.000156	0.0009	0.014	0.5	2.3E-05	0.08	0.0015	0.0020	0.00076	0.00069	3.1E-05	0.008	0.07	1.0	0.040
November	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: U:\1CM002.001_PhaseIV_WaterQualityPrediction\Report_MLARDcharacterization+WQP\Tables\[Table5-1_and_Table5-2_W3+W1_Prediction.xlsx]

Note: Zero (‘0’) values indicate periods of no flow, as indicated by the post-closure water balance.

- Phase IV bulk waste rock was assumed to generate long-term loadings similar to the combined bulk and mineralized waste from Main Pit. No attempt was made to reduce modelled loadings to account for the lower long-term loading rates that will result from selective management of mineralized waste in Phase IV.
- The adopted tailings and waste rock source terms typically assume maximum trace element concentrations in dump seepage over the long term. While decline in weathering rates over time is challenging to quantify, experience elsewhere has shown that, under neutral pH weathering conditions, weathering rates are fastest for freshly-broken rock and tend to decline over time as sulphide minerals oxidize and surfaces of other mineral grains weather. No attempt was made to reduce modelled loadings to account for declining weathering rates as mine wastes age.
- Reclamation of the DSTF is a component of the Phase IV mine plan, and will in all likelihood result in some reduction in loadings from the DSTF. No attempt was made to reduce modelled loadings to account for the reduction in long-term loading rates that result from DSTF reclamation.

This report, **"1CM002.001 Minto Mine Expansion- Phase IV ML/ARD Assessment and Post-closure Water Quality Prediction"**, has been prepared by SRK Consulting (Canada) Inc.

Prepared by

ORIGINAL SIGNED
AND STAMPED

Dylan MacGregor. GIT (B.C.)
Senior Geochemist

Reviewed by

ORIGINAL SIGNED
AND STAMPED

Stephen Day, P.Geo. (B.C.)
Principal Geochemist

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

6 References

ASTM, 2007. Standard Test Method for Laboratory Weathering of Solid Materials Using a Humidity Cell. Publication date Oct. 1, 2007.

BC Research Incorporated. 1995. Test Procedures to Evaluate The Acid Production Potential Of Ore and Waste Rock (BC Research Method). Project No. 0-05-644, August 1995.

Colpron, M., Gladwin, K., Johnston, S.T., Mortensen, J.K. and Gehrels, G.E., 2005. Geology and juxtaposition history of the Yukon-Tanana, Slide Mountain, and Cassiar terranes in the Glenlyon area of central Yukon. Canadian Journal of Earth Sciences, 42, 1431-1448.

Clearwater Consultants Limited (2010). Memorandum CCL-MC7: Minto Mine – Phase IV Closure Water Balance. Prepared for Access Consulting Group, August 2010.

EBA Engineering Consultants, 2008. Geotechnical Design, Proposed Southwest Waste Dump, Minto Mine, Yukon. Prepared for Minto Explorations Ltd., September 2008.

EBA Engineering Consultants, 2010A. Phase IV Development Preliminary Waste Management Plan, Minto Mine, YT. Prepared for Minto Explorations Ltd., August 2010.

EBA Engineering Consultants, 2010B. Preliminary Phase IV Tailings Management Plan, Minto Mine, YT. Prepared for Minto Explorations Ltd., August 2010.

EBA Engineering Consultants, 2010C. Phase IV Closure Plan. Prepared for Minto Explorations Ltd., August 2010.

GoldSim Technology Group, 2010. User’s Guide, GoldSim, Probabilistic Simulation Environment (Version 10.1). Issaquah, WA.

G&T Metallurgical Services Ltd. 2007. Metallurgical Performance Of Area 2 Ore Zones, Minto Explorations Ltd. Yukon, Canada. Report KM1966, prepared for Minto Explorations Ltd., June 2007.

G&T Metallurgical Services Ltd. 2009. Pre-Feasibility Metallurgical Testing On Samples From The Area 118 And Ridgetop East Zones At The Minto Mine, Yukon, Canada. Report KM2351, prepared for SRK Consulting, May 2009.

Hood, S., Hickey, K., Colpron, M. and Mercer, B., 2008. High-grade hydrothermal copper-gold mineralization in foliated granitoids at the Minto mine, central Yukon. Yukon Exploration and Geology.

Mills,C. (1997). An Assessment of the Results of Acid base Accounting (ABA) and Mineralogical Testwork on Eight Samples form the Proposed Minto, Yukon Territory, Mine Site. Prepared February 1997 for the Selkirk First Nation.

Minto Explorations Ltd. 2010. Report on ABA Testing for Minto Mine Projecct, QZ96-006, Period Ending October 31, 2009. Prepared April 2010.

Nevada Department of Environmental Protection, 1990. Meteoric Water Mobility Procedure. Prepared September 1990.

Pearson, W.N. and Clark, A.H., 1979. The Minto Copper Deposit, Yukon Territory, A Metamorphosed Orebody in the Yukon Crystalline Terrane. Economic Geology, Vol. 74, p. 1577-1599.

Piercey, S.J., Mortensen, J.K., Murphy, D.C., Paradis, S. and Creaser, R.A., 2002. Geochemisty and tectonic significance of alkali mafic magmatism in the Yukon-Tanana terrane, Finlayson Lake region, Yukon. Canadian Journal of Earth Sciences, 39(12), 1729-1744.

Price, W.A. (1997), DRAFT Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia, British Columbia Ministry of Employment and Investment, Energy and Minerals Division, Smithers, BC, (April), 143p.

Sobek A A, Schuller W A, Freeman J R, and Smith R M., 1978. Field and laboratory methods applicable to overburden and minesoils. USEPA Report No. 600/2-78-054, 203 pp.

SRK Consulting (2007). Area 2 Pre-feasibility Study Minto Mine, Yukon. Prepared for Minto Explorations Ltd. November 2007.

SRK Consulting (2009). Minto Phase IV Pre-Feasibility Technical Report. Prepared for Minto Explorations Ltd., December 2009.

SRK Consulting (2010). Minto Mine Expansion - Phase IV Project Description. Prepared for Minto Explorations Ltd., July 2010.

Tempelman-Kluit, D.J., 1984. Maps of Laberge (105 E) and Carmacks (115 I) map sheets; with legends. Geological Survey of Canada Open File 1101.

Williams, P.J., Barton, M.D., Johnson, D.A., Fontboté, L., De Haller, A., Mark, G., Oliver, N.H.S., and Marschik, R., 2005. Iron Oxide Copper-Gold Deposits: Geology, Space-Time Distribution and Possible Modes of Origin. In Economic Geology, 100th Anniversary Volume, J.W. Hedenquist, J.F.H. Thompson, R.J. Goldfarb, and J.P. Richards (eds.), p.371-405.

MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

APPENDIX F

Minto Mine Seepage Monitoring Plan

MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

MINTO MINE
Seepage Monitoring PLAN
VERSION 2011-01

Prepared by:
Minto Explorations Ltd.

Vancouver, British Columbia
June 22, 2011

Table of Contents

List of Figures

1. Introduction

Minto Explorations Ltd. (MintoEx) was issued Water Use Licence QZ96-006, Amendment 7 on March 31, 2011. Amendment 7 included a number of conditions including Condition 61, which required MintoEx to file a Seepage Monitoring Plan within 90 days of the effective date of the licence.

For reference, the text of Condition 61 is as follows:

> *Condition 61.* *Within 90 days of the effective date of this licence, the Licensee shall submit to the Board a seepage monitoring plan for the site to assess acid rock drainage/ metal leaching conditions at the site including sampling during spring runoff and early fall. At a minimum the seepage monitoring plan shall include the ore stockpile areas, overburden dumps, waste rock dumps, DSTSF, the mill area, as well as known seepage locations.*

The deadline for filing a Seepage Monitoring Plan (90 days after the issuance of Amendment 7) is June 29, 2011.

This document constitutes the required Seepage Monitoring Plan.

2. Seepage Monitoring Approach

Seepage surveys will be conducted by walking the toe of each waste dump, stockpile or other area of interest. For each seepage monitoring event, survey routes will be recorded using the tracking function of a GPS.

Where actively flowing seepage is encountered, a sample will be collected according to the following protocols. The sample location will be recorded using GPS. Three photographs will be taken at each station: one close-up photograph, showing the substrate the seepage is interacting with; one upgradient photograph, showing the area from which the seepage is flowing; and one downgradient photograph, showing the seepage flowpath and area that seepage water reports to.

Where pooled water is identified at a toe along the survey route, the pool will be examined for evidence that is actively being fed by seepage. Examples of evidence that indicate active seepage inflows include surface outflow from the pool, surface inflow to the pool, or in certain cases fully saturated ground downgradient of a pool which demonstrates active flow out of the pool via a shallow subsurface pathway. Where no evidence of active inflow to a pool is observed, a sample from a pool will not be collected.

3. Seepage Monitoring Locations

Seepage surveys will be carried out along the downgradient (lowest elevation) toe of each waste dump, stockpile or other area of interest. The survey routes that will be inspected during each seepage monitoring event are shown in Figure 1. Samples will be collected where actively flowing seepage is observed along these routes.

Monitoring of seepage has been occurring at several routine monitoring stations as part of the Water Quality Surveillance Program. These stations include W-8, W-8A, W-17, W-32, W-37, W-38, W-39 and W-40. Monitoring frequency at these routine monitoring stations is either weekly or monthly, and redundant monitoring of these stations is not included in this plan. Locations of these routine monitoring stations are shown for reference in Figure 1. Routine monitoring results for stations that monitor seepage will be compiled with results from seepage surveys for annual reporting.

Where the location of the downgradient toe of the waste dump, stockpile or other area of interest changes over time, the route surveyed will change such that, for any given monitoring event, monitoring will be carried out along the downgradient toe.

4. Seepage Monitoring Frequency

Seepage monitoring, as described in this Seepage Monitoring Plan, will be carried out two times per year.

The first round will be scheduled to occur during spring runoff conditions, and will typically take place early to mid May.

The second round of seepage monitoring will be scheduled to occur during early fall conditions, and will typically take place in mid to late September or early October.

5. Field Records

For each sample, field data and observations will be recorded on a purpose-designed form. This form would include fields for the following information:

- Date and time of sample collection;
- Coordinates of station location;
- Weather at time of sample collection;
- Field measurements of pH, conductivity, temperature;
- Sketch of the sampling location, showing any relevant features (e.g. location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps);
- Water colour, turbidity, and presence of any precipitates or mineral staining;
- Colour of sediment on filter and number of filters used.

6. Seepage Analytical Suite

Seepage samples will be collected and analyzed for the parameters identified as suites B, N, and FP in Appendix 3 of Water Use Licence QZ96-006, Amendment 7.

These analytical suites are defined as follows:

- Suite B: Physical parameters, Conductivity, Total Dissolved Solids, Alkalinity, sulphate, ICP Scan- Dissolved Metals.
- Suite N: Nutrients: Ammonia-N, Nitrate-N, Nitrite-N and Phosphorous.
- Suite FP: Field Parameter: In-situ parameters- pH, Conductivity and Temperature.

7. Analysis of Seepage Monitoring Samples

Analysis will be carried out a certified external laboratory. Generally, the same laboratory will be used that performs the analysis of samples collected under the water quality surveillance program.

8. Quality Assurance

Field duplicate samples will be collected at a frequency of one field duplicate sample per ten seepage monitoring samples.

One field blank sample will be collected during each seepage monitoring event. Field blank samples will be collected from deionized water supplied by the analytical laboratory, using the exact methods employed to collect seepage monitoring samples (including field filtration and preservation of the dissolved metals field blank).

9. Reporting

Results of the seepage monitoring program will be included as part of the annual report for Water Use Licence QZ96-006.

The seepage monitoring program summary will include results from routine monitoring stations that monitor seepage. Reporting will include a figure showing the seepage survey routes, seepage sample locations, and relevant routine monitoring stations that monitor seepage flows.

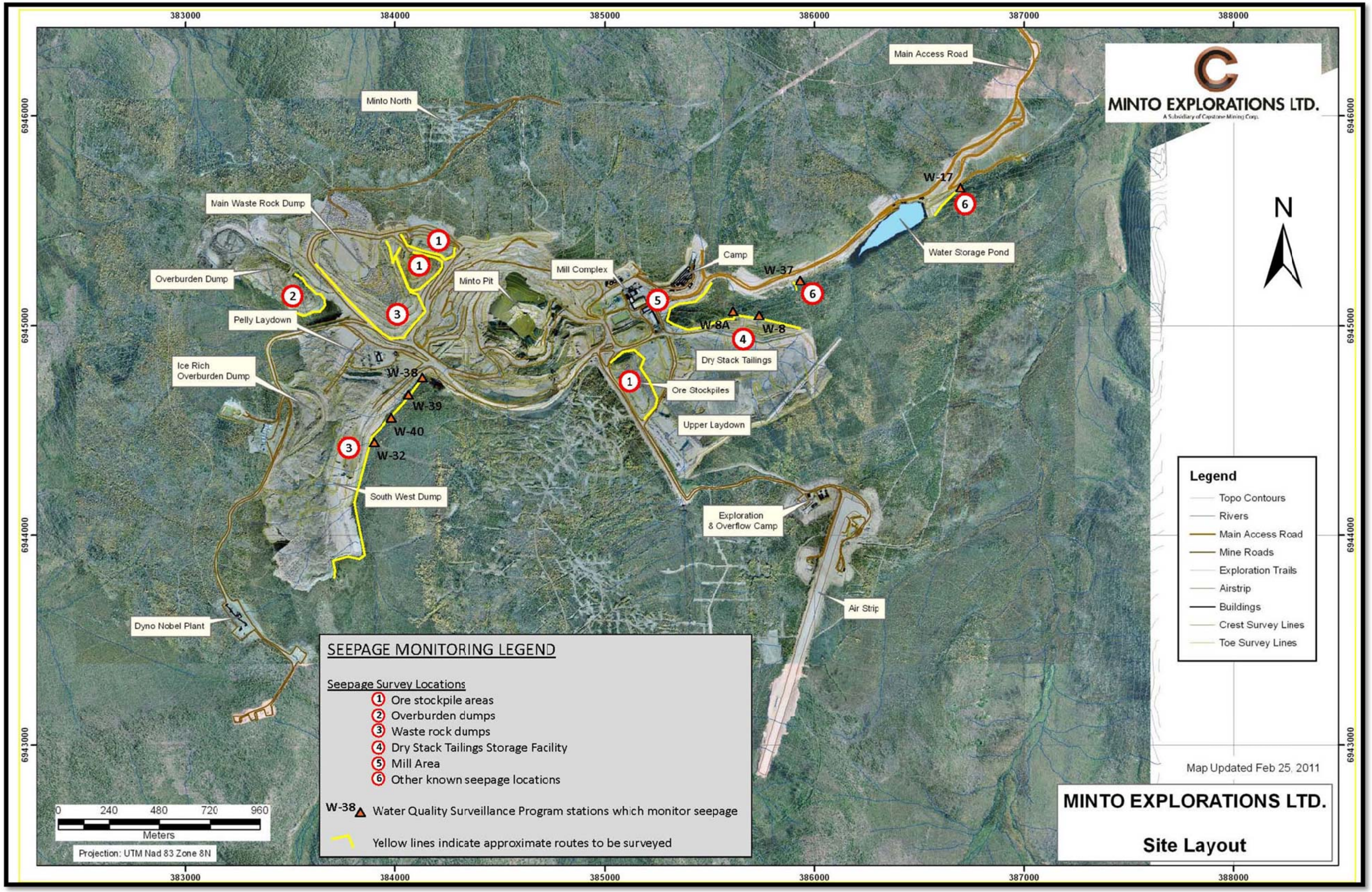


Figure 1 Minto Mine Site Layout Showing Seepage Monitoring Survey Routes and Existing Water Quality Surveillance Program Stations

MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

APPENDIX G

Adaptive Management and Monitoring Plan

Minto Explorations Ltd.

A SUBSIDIARY OF CAPSTONE MINING LTD.

WATER USE LICENCE QZ96-006

ADAPTIVE MONITORING AND MANAGEMENT PLAN

MINTO MINE, YUKON TERRITORY

MAY 2011

MINTO EXPLORATIONS LTD.

ADAPTIVE MONITORING AND MANAGEMENT PLAN

MINTO MINE, YUKON TERRITORY

MAY 2011

DISTRIBUTION LIST

1 Copy + 5 PDF*	Yukon Water Board
1 Copy + 3 PDF	Yukon Government, Energy Mines and Resources, Mineral Resources Division
1 Copies + 3 PDF	Selkirk First Nation
1 Copies + 3 PDF	Minto Explorations Ltd.
1 Copies + 1 PDF	Access Consulting Group

*PDF = digital version of report

PROJECT CONTACT LIST

MINTO EXPLORATIONS LTD. Subsidiary of Capstone Mining Corp. Suite 900 - 999 West Hastings Street Vancouver BC V6C 2W2 Telephone: (604) 684-8894 Fax: (604) 688-2180 http://www.capstonemining.com	**John Knapp** General Manager, Minto Mine Minto Explorations Ltd. Email: john.knapp@mintomine.com **Colleen Roche** Manager, Sustainability & Environmental Affairs Minto Explorations Ltd. Email: colleenr@capstonemining.com **Rob Wilson** Environment Manager Minto Explorations Ltd. Email: robw@mintomine.com
ACCESS CONSULTING GROUP #3 Calcite Business Centre 151 Industrial Road Whitehorse, Yukon Y1A 2V3 Telephone: (867) 668-6463 Fax: (867) 667-6680 http://www.accessconsulting.ca	**Scott Keesey** Environmental Manager Email: scott@accessconsulting.ca

Table of Contents

List of Figures

List of Tables

1.0 INTRODUCTION AND BACKGROUND

Minto Explorations Ltd. (“MintoEx”), a wholly owned subsidiary of Capstone Mining Corp. (“Capstone”), owns and operates a high-grade copper mine (the “Minto Mine”), located within Selkirk First Nation (“Selkirk”) Category A Settlement Land Parcel R-6A, approximately 240 km northwest of Whitehorse, Yukon Territory. The Minto Mine commenced commercial operations in October 2007. MintoEx conducts operations pursuant to various authorizations, including a Quartz Mining Licence and Type A Water Use Licence.

On November 19, 2009, MintoEx submitted a project proposal to the Designated Office of the Yukon Environmental and Socio-economic Assessment Board (“YESAB”) in accordance with the Yukon Environmental and Socio-economic Assessment Act (“YESAA”). This proposal detailed a revised Water Management Plan for Minto Mine including revised effluent standards. YESAB subsequently issued its Evaluation Report on March 3, 2010 recommending that the project proceed subject to certain conditions. Selkirk First Nation and Yukon Government issued a joint Decision Document on March 26, 2010 accepting all of YESAB’s recommendations. Licensing followed, as described below. As per clause 76 of Water Use Licence QZ96-006 Amendment #7 issued on March 31, 2011 MintoEx has revised the Adaptive Management and Monitoring Plan (AMMP). The AMMP revisions are intended to better reflect the terms and conditions of the licence. MintoEx submits the AMMP to the Yukon Water Board for review and approval.

1.1 LOCATION

The Minto Mine is located on the west side of the Yukon River within Selkirk Category A Settlement Land Parcel R-6A (Figure 1-2), approximately 240 km northwest of Whitehorse, Yukon Territory and is centered at 62°37'N latitude and 137°15'W longitude (NAD 83, UTM Zone 8 coordinates 6945000N, 384000E). Highway 2 is located on the east side of the Yukon River and the mine can be accessed by summer barge crossing or winter ice bridge crossing at Minto Landing. MintoEx is the 100% registered owner of the 164 claims which comprise the Minto Mine.

The Minto Mine site is accessible from Whitehorse, Yukon Territory, by the Klondike Highway (YG Highway No. 2) to Minto Landing. Passage across the Yukon River can be made by barge in the summer or by ice-bridge in the winter. A gravel road provides access from the west side of the Yukon River to the Minto Mine site. The highway, river crossing and gravel access road are suitable for heavy transport traffic. Storage capacity for consumables at the Minto Mine site is sufficient for 10 weeks which, historically, is sufficient for the impassable freeze-up period and thaw period of the Yukon River. When possible, operations personnel are transported to the Minto Mine by bus or light vehicle from Whitehorse and Pelly Crossing and by air when ground transport is not feasible due to river conditions.

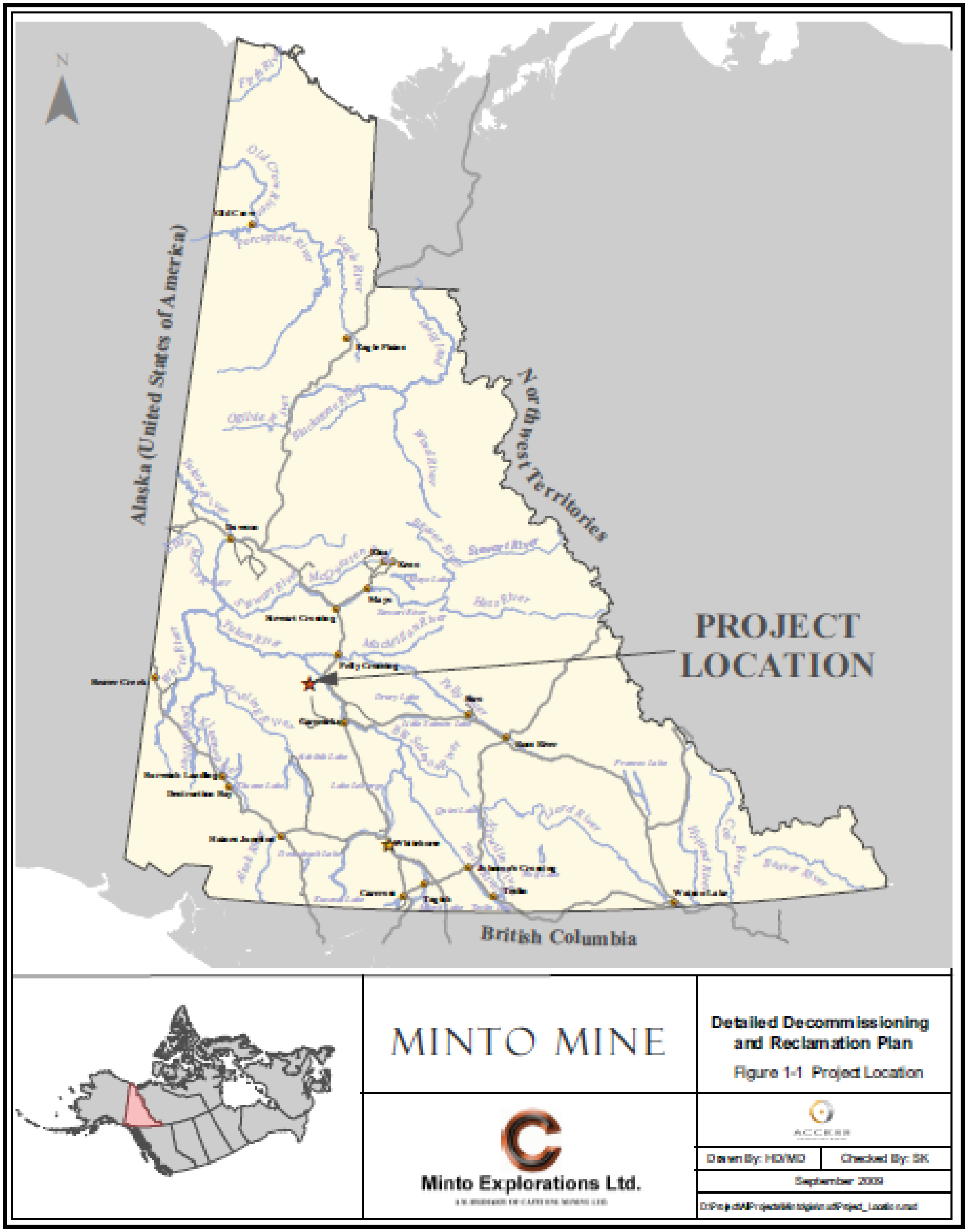


Figure 1-1 Minto Mine – General Location in Yukon

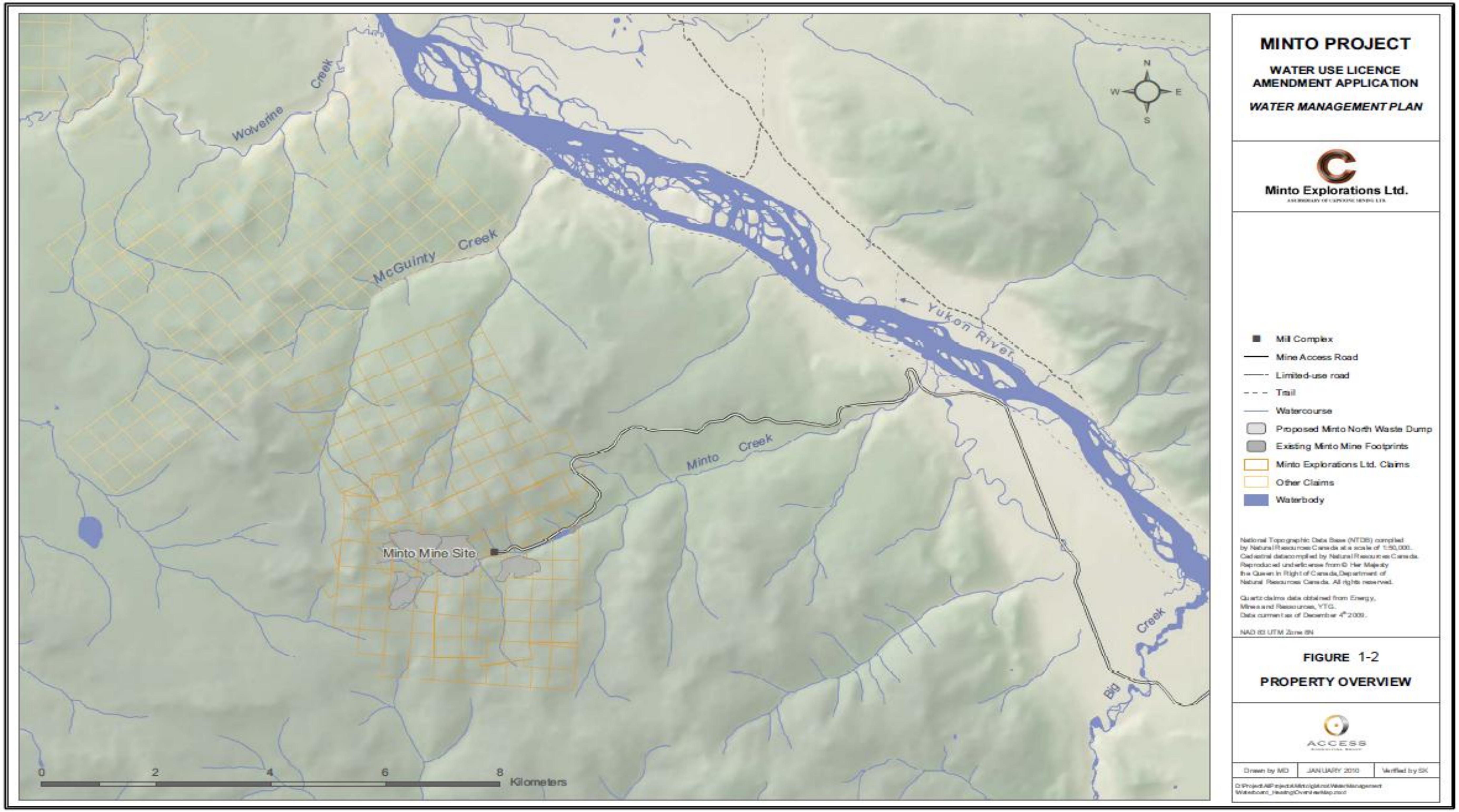


Figure 1-2 Minto Mine Area Overview

1.2 LICENSING

1.2.1 Type A Water Use Licence QZ96-006

MintoEx holds Type A Water Use Licence QZ96-006 ("WUL QZ96-006") originally issued in April 1998 and valid until its expiry date of June 30, 2016.

MintoEx submitted a Type A Water Use Licence application (QZ96-006), following which the Yukon Water Board (the "Board") convened a public hearing into the application in May 1997. After deliberations by the Board, the Type A Water Use Licence was subsequently issued in April 1998 pursuant to the Yukon Waters Act and Regulations for the mine and milling operations. The Type A Licence was supported by the Selkirk First Nation (SFN) and contained typical licence terms and conditions to ensure that mitigation measures identified during the environmental assessment were implemented. The original expiry date for the Water Use Licence QZ96-006 was June 30, 2006 (since amended to June 30, 2016).

Water Use Licence QZ96-006 was amended (Amendment #1) to revise the decommissioning requirements for the project, and to request the submission of an interim plan as the project was not yet constructed. The project is still subject to Water Use Licence QZ96-006.

Generally, the Type A Water Use Licence is considered more restrictive that the Federal Metal Mining Effluent Regulations (MMER) under the Fisheries Act, which apply to the Minto Mine, however, separate reporting for effluent discharge and receiving water monitoring is required by the Federal Department of Environment Canada.

As the Type A Water Use Licence (QZ96-006), Type B Water Use Licence (MS95-013), and Yukon Quartz Mining Licence (QLM-9902) were set to expire in June 2006, and in recognition of the project development delays, licence amendment applications to extend the licences to June 30, 2016 were filed with the Board and Yukon Government (YG), Department of Energy, Mines & Resources (EMR) in October 2004.

In response to the amendment applications, YG Development Assessment Branch completed a Yukon Environmental Assessment Act (YEAA) screening of the Type A Water Use Licence using the previous EARPGO screening and issued their screening report in March 2005.

YG Development Assessment Branch completed a YEAA screening of the Type A Water Use Licence and Yukon Quartz Mining Licence using the previous EARPGO screening and issued their screening report in March 2005. The Board issued the an amendment to the Type A Water Use Licence in September 2005 (Amendment #2) and YG EMR issued amendments to the Yukon Quartz Mining Licence QLM-0001, Amendment No. 05-001 in December 2005 and Amendment No. 05-002 to change the mill rate to 2,500 today in October 2006.

The Type A Water Use Licence was further amended on April 6, 2006 (Amendment #3) to address an apparent inconsistency in the original licence regarding the milling of sulphide ore.

In response to exceptional precipitation received in the site area in late August 2008 and an imminent release of water from the Water Storage Pond that did not meet licensed effluent quality standards, MintoEx applied on August 25 to the Board for an amendment to the Water Use License QZ96-006 under section 21 (4), c.19 of the Yukon Waters Act. The application to release 350,000 m^3 of water from the WSP using the Metal Mining Effluent Regulations (MMER) effluent discharge criteria was approved and Amendment #4 to the WUL was issued on August 26, 2008.

The melting of significant snowpack accumulations in the winter of 2008-09 required the retention of freshet runoff in the open Pit and prompted concern about stability of the south Pit wall should additional summer precipitation events need to be directed there as well. As a result, MintoEx applied twice again for amendments to the Water Use Licence under the same provision of the Yukon Waters Act in June and in August of 2009, to allow the release of water that would provide additional capacity for such an event. The Yukon Water Board approved Amendment #5 on June 26, 2009, and Amendment #6 on August 11, 2009, each on an emergency basis, which authorized the release of 300,000 m^3 and 705,000 m^3 respectively of water from the site, subject to adjusted effluent quality standards and additional monitoring requirements. Following a review of application QZ09-094 regarding water management at the site, Amendment #7 was issued on March 31, 2011.

1.2.2 Quartz Mining Licence QML-0001

MintoEx holds Quartz Mining Licence QML-0001 which is valid until its expiry date of June 30, 2016.

In 1999, the Yukon Quartz Mining Act (YQMA) was amended and Section 139 of that Act required that all development and production activities related to quartz mining in the Yukon be carried out in accordance with a licence issued by the Minister. In June 1999, MintoEx filed an application with DIAND Minerals for a Yukon Quartz Mining Production Licence, which included a cumulative effects assessment (Access Consulting Group, 1999) for the project to ensure that the provisions of CEAA were met. DIAND issued Yukon Quartz Mining Production Licence QLM-9902 in October 1999 with a licence expiry date of June 30, 2006 (since amended to June 30, 2016).

With Yukon Quartz Mining Licence (QLM-9902) set to expire in June 2006, a licence amendment application to extend the licence to June 30, 2016 was filed with the Yukon Government (YG), Department of Energy, Mines & Resources (EMR) in October 2004. YG EMR issued amendments to the Yukon Quartz Mining Licence QLM-0001, Amendment No. 05-001 in December 2005 and Amendment No. 05-002 to change the mill rate to 2,500 today in October 2006. Subsequently, Quartz Mining Licence QML-0001 was amended to increase the milling rate (and associated mining rate) to 3,200 tpd on July 24, 2008 and again on April 8, 2010 to increase the milling rate to 3,600 tpd. Following the review of the Phase IV Expansion proposal by MintoEx to YESAB in 2010, an amendment to the QML was issued on May 19, 2011 reflecting new mining areas on the site including Area 2 and 118 by open pit and underground methods.

2.0 ADAPTIVE MONITORING AND MANAGEMENT PLAN

2.1 INTRODUCTION

The new Water Management Plan reflected in WUL QZ96-006 Amendment #7 allows Minto Mine to manage water in such a way that allows for successful operation of the Minto Mine and protection of the receiving environment. The Adaptive Monitoring and Management Plan (AMMP) represents a starting point from which MintoEx intends to improve its understanding and management of water at Minto Mine.

The AMMP is an important component of the Water Management Plan (WMP) as presented in application QZ09-094 (Exhibit 1.2). The WMP was developed based on predicted water quality and quantity at the site and the AMMP must measure actual water quality and quantity and test the assumptions that underlie the WMP. This approach is necessary due to the inherent uncertainty involved in predicting conditions that affect water quality at the mine including weather, runoff and water levels in the region in any particular year and interactions between water and the ground surface. The WMP and supporting documents represented a significant effort to better understand and predict the scale and frequency of events as well as their expected impact on operations at Minto Mine. These efforts toward increased understanding will continue and the purpose of this program is to describe how MintoEx will:

- monitor the environment;
- detect changing conditions; and
- react to them appropriately.

The AMMP also provides a framework for re-evaluating key elements of the WMP in a systematic and adaptive way. The adaptive approach will help evaluate and adjust activities in the WMP including:

- when monitoring frequency will increase;
- where monitoring will take place;
- when the mine will discharge water downstream ; and
- when the mine will stop discharging downstream.

The AMMP includes a process for changing the WMP in a systematic and adaptive way. It includes a reporting schedule and mechanisms for incorporating stakeholder input to ensure the principles on which the WMP is approved are being applied as an increased understanding of the mine’s effect on the environment is gained.

2.1.1 Background

This AMMP describes how monitoring at the site will be implemented and changed going forward to reflect the management strategies of the WMP. The basis for the AMMP is the existing Water Quality Surveillance Program in the current Water Use Licence (WUL QZ96-006,

Appendix 3, Part 2). Revisions to this program proposed in this AMMP were based on the following:

- concepts put forward in the WMP;
- stakeholder comments received during the YESAB review process of the Water Management Plan proposal;
- recommendations in the resulting Decision Document; and
- strategies for continuous improvement of water management techniques at Minto Mine.

Minto Mine has been actively improving water management strategies since the mine began construction and operation. These improvements have included retention and diversion structures and treatment initiatives, as well as surface water quality investigations, including a Site Specific Water Quality Objective (SSWQO) study. The data obtained to date during mining provides a much-improved understanding of water quality in the affected watershed. A predictive model has been developed using this water quality data and the water balance from the site (described previously). The assumptions of the WMP must be tested and the accompanying water quality model must be calibrated regularly. In doing so, MintoEx will determine the success of the WMP by continuously asking these two key questions:

- Does the WMP protect the receiving environment; and
- Does the WMP allow the mine to operate successfully;

An improved monitoring program is described below. The monitoring program will be further improved as operational knowledge increases and with continued sharing of stakeholder views. A technical working group was established in May 2011 to facilitate the sharing of information and reporting structures have been established in WUL QZ96-006 Amendment #7 to allow for inclusion of new information. The reporting requirements also provide a framework to revisit and confirm the assumptions that underlie the monitoring program.

2.1.2 Objectives and Guiding Fundamentals

The objectives of the AMMP are as follows:

- to ensure that any water discharged from the site is compliant with both end-of-pipe and receiving environment effluent quality standards as defined in in WUL QZ96-006 Amendment #7;
- to monitor and respond adaptively to water quality conditions in the receiving environment;
- to put forward a reasonable management response to field observations including readily implemented contingency strategies;
- to put forward a management response that is as simple as possible and easily enforceable; and
- to incorporate flexibility into the plan, allowing for integration of new information as it becomes available.

The adaptive management approach for monitoring water quality parameters necessarily includes assessment and reassessment of water management decisions and their effectiveness to achieve the program’s objective of meeting the receiving environment effluent standards. Monitoring program results will be continually assessed for trends in water quality and quantity, both short term and long term, to anticipate and mitigate negative impacts to the receiving environment and to guide water management responses in the field.

The main components of this revised AMMP are:

- revisions to the current monitoring program;
- use of screening instrumentation at Minto Mine to make decisions on discharging to the receiving environment, and confirmation by accredited external laboratory analysis;
- more in-depth assessment of monitoring and performance data (increased frequency and trend analysis);
- increased detail and frequency of reporting related to monitoring results and actions.
- regular calibration of the water balance and water quality models;

- continuous revisiting of WMP assumptions, monthly reporting related to AMMP commitments, and an annual review (and accompanying report) on any proposed changes with rationale based on the monitoring program results.

2.1.3 Changes to the AMMP in 2011

In addition to the principles described above, the AMMP has been modified to meet Part F – Effluent Quality and Standards and Appendix 3 as described in WUL QZ96-006 Amendment #7 issued on March 31, 2011. Since some components of the proposed AMMP were geared towards enforceable actions in the receiving environment (as opposed to effluent *standards* in the receiving environment), many of the decision making tools described have been simplified. MintoEx will modify its approach to water management to meet the intent of the Water Quality Surveillance Program.

MintoEx will still use the information gained through the process of the development of the WMP (water quality and quantity models) in addition to expertise gained at site through several prior discharge periods, to determine whether or not discharge from the site is appropriate. This information will allow for calibration of the models in the WMP.

As required, this revised AMMP includes the following modifications as per Clause 76 of WUL QZ96-006 Amendment #7:

- Sampling for ammonia, nitrite and nitrate has been incorporated into the surveillance monitoring program and nutrient levels will be tested at an external laboratory. Ammonia can be measured on site using a Hach kit. MintoEx will continue its efforts to determine possible methods for measuring nitrite and nitrate on site so that decisions regarding discharge can be informed by this information. Sampling efforts to understand levels of these nutrients throughout the site have been conducted and relationships between the more-easily-determined ammonia and nitrite/nitrate are being examined to determine if ammonia is a valid surrogate for nitrite/nitrate amounts in conjunction with physical monitoring parameters (temperature and pH). As this relationship is better understood, this information will be factored into decisions regarding discharge from the site, recognizing that effluent standards for these nutrients are now in place at both compliance points.

- Selenium and cadmium measurement will occur at site using the newly established environmental laboratory. MintoEx will report on Se and Cd levels throughout the year and effluent standards related to these elements will be adhered to;
- Continuous flow monitoring equipment has been installed at MC-1 in order to better understand the possible scenario of flow occurring at MC-1 but not W2. Decisions as to whether or not discharge is appropriate from the site will consider whether this situation is occurring by measuring water quantity in Lower Minto Creek prior to discharge and documenting the rationale (using the water quantity models) to begin discharging. Detailed monitoring will be employed to determine effects of the discharge on flow conditions as discharge occurs. If conditions that allow for significant flow result in no-flow or low-flow at W2, MintoEx will consider that the water discharged into Minto Creek from the mine site is ultimately reporting to the receiving environment (whether via underground channels to Yukon Flow or otherwise) and consider this fact when determining the effect of mine discharge on the receiving environment. This will be addressed by choosing to perform the required monthly toxicity samples at MC-1 instead of W2.

2.2 AMMP FRAMEWORK AND DEFINITIONS

The AMMP is both a monitoring plan and a management plan that charts actions and changes that may be required to the Water Management Plan over the course of the mine life. MintoEx proposes to report on adaptive measures taken at the site in monthly water quality reports submitted to the Yukon Water Board. A template for concise and clear documentation of actions and observations is provided in Appendix H1.

Figure 2-1 below outlines an annual cycle for review of the AMMP and related components of the WMP as well as interim reporting. Reporting and review time-frames are discussed in more detail below.

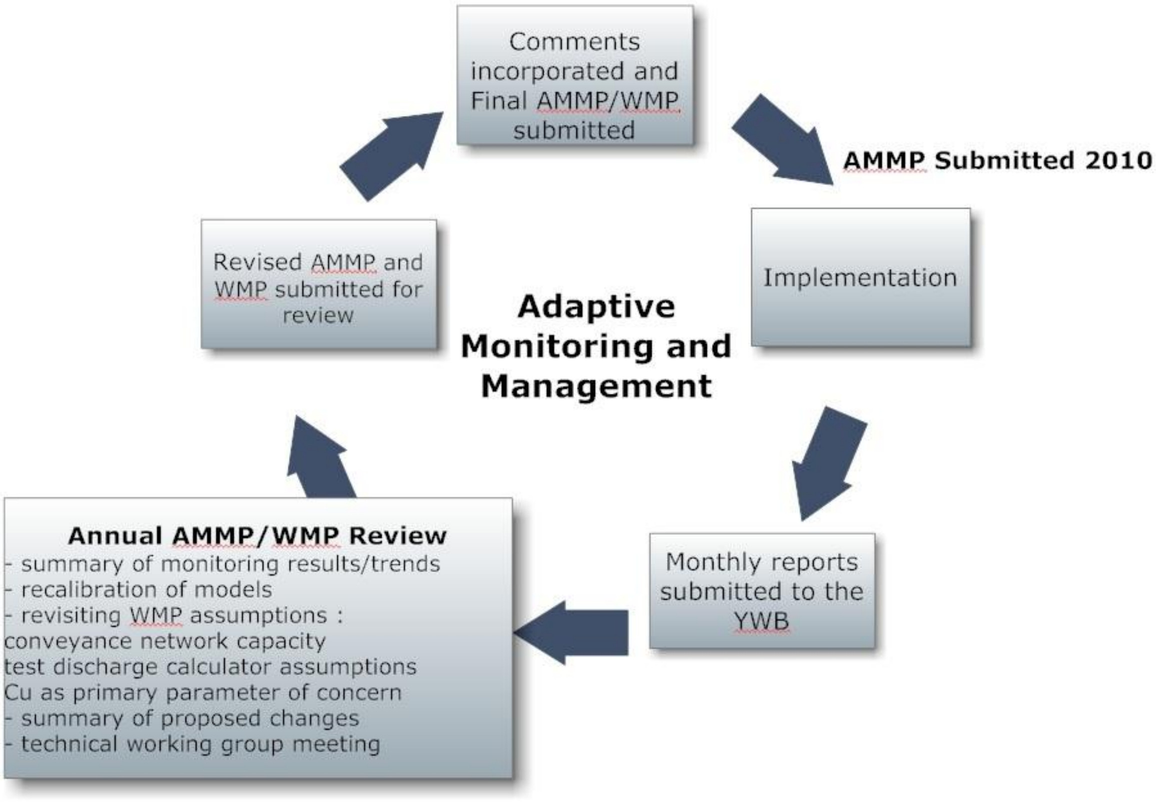


Figure 2-1 - Proposed Annual Cycle for Review of the WMP and AMMP

2.3 DEFINITIONS AND ADAPTIVE MANAGEMENT TERMINOLOGY

In developing the AMMP, clearly defining the terminology used will be important in order to allow for a consistent approach in applying adaptive responses. An understanding the adaptive management plan is essential both within MintoEx and amongst stakeholders.

Event – this term will be used to describe an event for which there is an adaptive response outlined in the AMMP.

Possible Environmental Effect - the assignment of a possible environmental effect to an event helps characterize it in order to develop an appropriate response.

Narrative Trigger – a narrative description of the trigger that initiates an adaptive response. The input information is from the monitoring program and the narrative trigger will describe a quality or testing result recognized as triggering a response.

The first step will be verification of the results. An analysis will be made of the information and a reasonableness-check will be put in place to ensure the results are truly reflective of the current scenario or perhaps a one-off or unlikely result. This may involve re-sampling for verification purposes.

Monitoring staff will provide an analysis so that the cause of the trigger or events leading up to the trigger activation. This will formulate part of the reporting.

Monitoring requirements – monitoring parameters, locations and frequencies for sampling or investigating. Monitoring requirements may change at various stages of the AMMP.

On-site lab testing - this refers to analytical sampling that MintoEx is equipped to perform at the mine and will include total copper (Cu-T) measurable to detectable limits aligned with Canadian Council of Ministers of the Environment (CCME) supported Canadian Water Quality Guidelines (CWQG) for the protection of aquatic life and measurement of total suspended solids (TSS) to levels of 1 mg/l.

External lab testing – this refers to third-party accredited analytical laboratory testing for the full suite of required parameters to appropriate detection limits.

The AMMP will describe a steady-state monitoring program which has been designed to detect changing conditions so that appropriate responses will be activated.

2.4 MONITORING PROGRAM

During the mine life, the scenario of discharging water will be termed an “event” (discussion below) and so monitoring water quality at the mine will typically characterize non-discharging periods. Appendix 1 of WUL QZ96-006 Amendment #7 provides details of the monitoring program and a diagram which shows the location of monitoring stations. As MintoEx expands the project as proposed in the Phase IV expansion (YESAB Project # 2010-0198), stations may be moved or replaced. Updated monitoring station figures will be included in monthly and annual reports as modifications are required.

The aims of the monitoring program are to:

- Build on the already-existing water quality database;

- Continue to develop an understanding of water quality as it moves across the site;
- To closely monitor downstream conditions in order to support the decision making process of whether or not water should be discharged from the mine; and
- Identify water on-site meeting the proposed effluent quality standards.

2.5 MONITORING LOCATIONS

Monitoring stations are listed in Appendix 1 of QZ96-006, many of which are included in the diagram below.

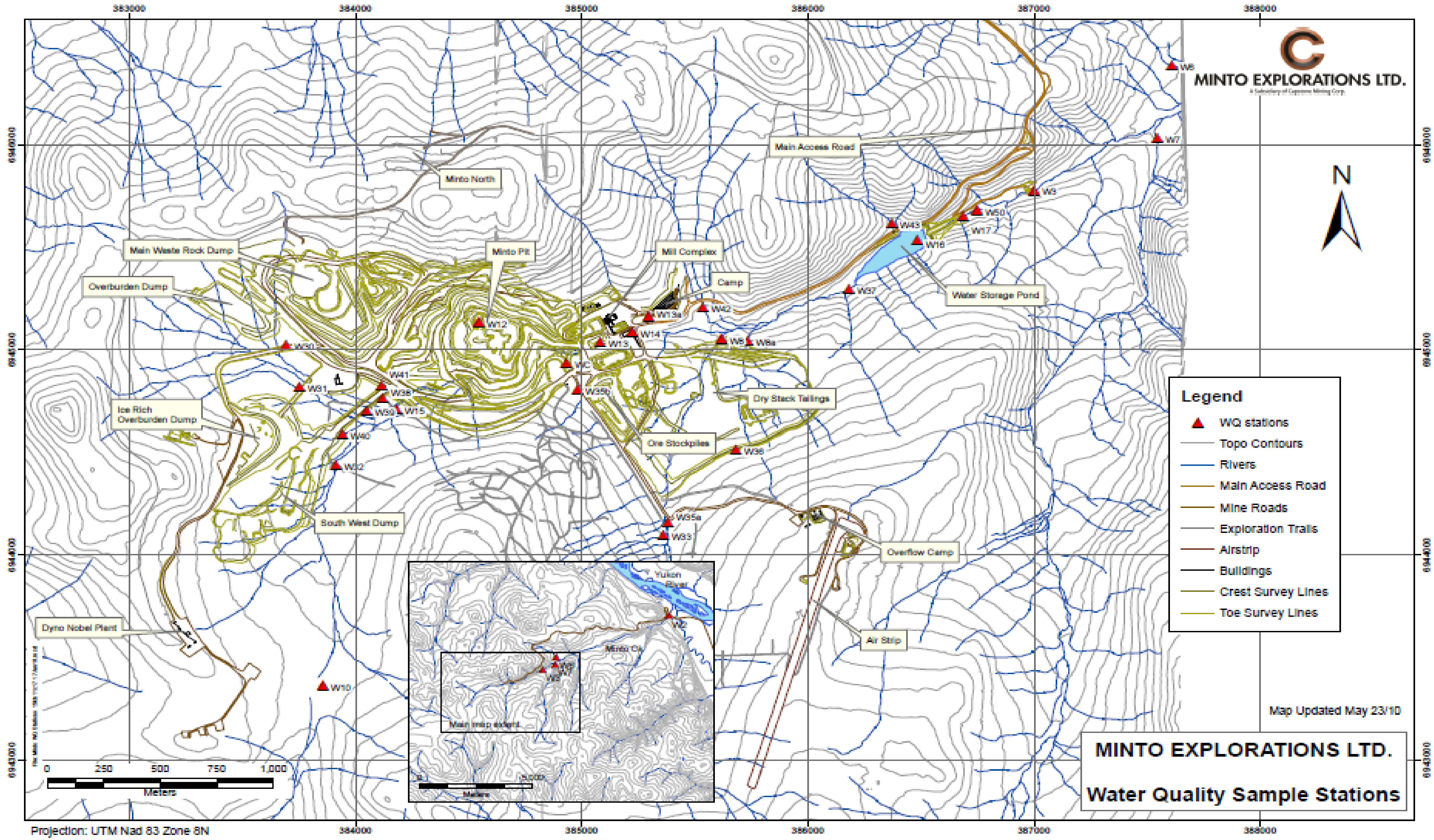


Figure 2-2 Monitoring Network Locations

2.6 MONITORING PARAMETERS

Typical parameters will be measured both in the field and at the external lab including:

- physical measurements (pH, electrical conductivity and temperature) measured in-situ;
- dissolved oxygen will be measured during AMMP events (i.e. when monitoring frequency is Level 2) using a YSI multi-meter;
- Routine parameters (TSS, alkalinity, hardness, etc.);
- Total metals;
- Dissolved metals;
- Nutrients (ammonia, nitrate, nitrite, phosphorus, etc.)
- Dissolved Organic Carbon (DOC)

2.7 MONITORING FREQUENCY

The number of samples and frequency of sampling will be conducted in accordance with Appendix 3, Part 2 of WUL QZ96-006 Amendment #7. The level of monitoring conducted when no discharge is occurring and the site is experiencing normal or expected climatic conditions will be termed Level 1 monitoring. When an AMMP Event is underway, monitoring frequency will increase to Level 2, meaning daily testing. This will be triggered when compliant water is identified on site, i.e. when water meeting the WUL effluent quality standards as per WUL QZ96-006 Amendment #7 is identified. Level 2 monitoring frequency will apply to the source waters, i.e. the collection point from which water may be discharged (W16, W12, W17, W15, WC or WTP) and all stations downstream of that point.

2.8 ADAPTIVE RESPONSES TO DISCHARGE EVENTS

The approach to discharging water from Minto Mine will involve measuring water quality on site, deciding whether or not discharge is appropriate and continually evaluating that decision if discharge is occurring.

One of the main factors MintoEx wished to address in proposing an adaptive monitoring and management plan was the issue of measuring water quality at site. MintoEx will use on-site equipment to measure the parameters listed below. While at the time of this report the lab was not operational, the spectrophotometer was installed in May 2011 and the proposed detection limits presented here are reasonable based on the equipment supplier and on-site laboratory staff with expertise in analytical chemistry. The existence of an on-site environmental laboratory will improve response-time to changing conditions and address the issue of a minimum delay of four days in receiving external laboratory results.

Table 2-1 Parameters to be measured at on-site environmental laboratory, Minto Mine

	Proposed detection limit
Total Aluminum (Al-T)	<0.62 mg/L
Total Cadmium (Cd-T)	0.001 mg/L
Total Copper (Cu-T)	0.001 mg/L
Total Iron (Fe-T)	0.03 mg/L
Total Molybdenum (Mo-T)	0.01 mg/L
Total Selenium (Se-T)	0.001 mg/L
Total Zinc (Zn-T)	0.02 mg/L
Ammonia	0.3 mg/L

2.8.1 Identification of Compliant Water: Discharge Decision Making: Can we discharge?

When water meeting the proposed water use application QZ09-094 effluent quality standards for the end-of-pipe is identified on site through Level 1 monitoring, this will trigger increased monitoring frequency for the purpose of supporting the decision making process, i.e. the decision as to whether or not water can be discharged from Minto Mine to the receiving environment. MintoEx staff will use the on-site laboratory to determine baseline conditions throughout the property and in the receiving environment.

The sequence of events leading up to the decision to discharge water must be clearly articulated. The AMMP framework will be used to guide the decision making process as follows:

Event – Compliant water identified for discharge from the site to the receiving environment. This determination will be made using results collected throughout the site as part of the Water Quality Surveillance Program, Appendix 3, Part 2 (WUL QZ96-006 Amendment #7). These results will be issued by an external laboratory and once agreement betwee the external and on-site laboratories is established, the decision may be based on conditions indicated by the on-site results. Then, a decision must be made whether or not discharge should occur based on the principles of the AMMP and the ability of the discharged waters and water already flowing in Lower Minto Creek to meet the effluent standards at W2. A key feature of an ‘event’ will be documentation of the existing conditions and rationale for decisions related to discharging water from the mine.

Possible Environmental Effects – Discharging water from Minto Mine that does not meet the effluent standards could have negative impacts on the receiving environment. Actions taken (discharging) must align with the objective of meeting the effluent standards and protecting the receiving environment. Potential consequences of discharging water that does not meet the effluent standards to the receiving environment include:

- Avoidance of degraded area by fish – loss of habitat;
- Toxicity to early life stages of fish; and
- Acute toxicity to adult and juvenile fish;

Narrative Trigger – On-site laboratory results for all parameters tested indicate water on site at one of the water conveyance network collection areas meets the proposed effluent quality standards for the end-of-pipe (“compliant” water):

- W15 sump

- WC Confluence Sump
- Water Treatment Plant waters
- WSP waters (W16)

The results will be verified through duplicate samples, external laboratory analysis and increased frequency sampling. If required, the decision to discharge will be based on on-site results.

The circumstances of the trigger activation will be documented and reported.

Monitoring requirements – When there is a desire to discharge water, monitoring frequency will increase to Level 2 at these locations:

- Source waters (one of the above locations)
- W3
- MC1
- W2

MintoEx still intends to make decisions regarding discharge based on water quality results measured on site and notify appropriate agencies of the intent to discharge 24 hours in advance. As indicated above, MintoEx will establish a reasonable agreement between the on-site and external laboratories in advance and adhere to a QA/QC progam as required under WUL QZ96-006 Amendment #7 clause 20.

Since 2006 MintoEx has observed that, at certain times of the year (typically mid to late summer), discharges in Minto Creek at station MC1 (top of canyon) are greater than those just downstream (bottom of canyon) at stations W1 and W2. This suggests that Lower Minto Creek on the floodplain of the Yukon River is an area of substantial groundwater recharge or subsurface water flow. Figure 2-3 depicts this phenomenon where stream flows can be significant at MC1 but much lower (or even zero) at W2.

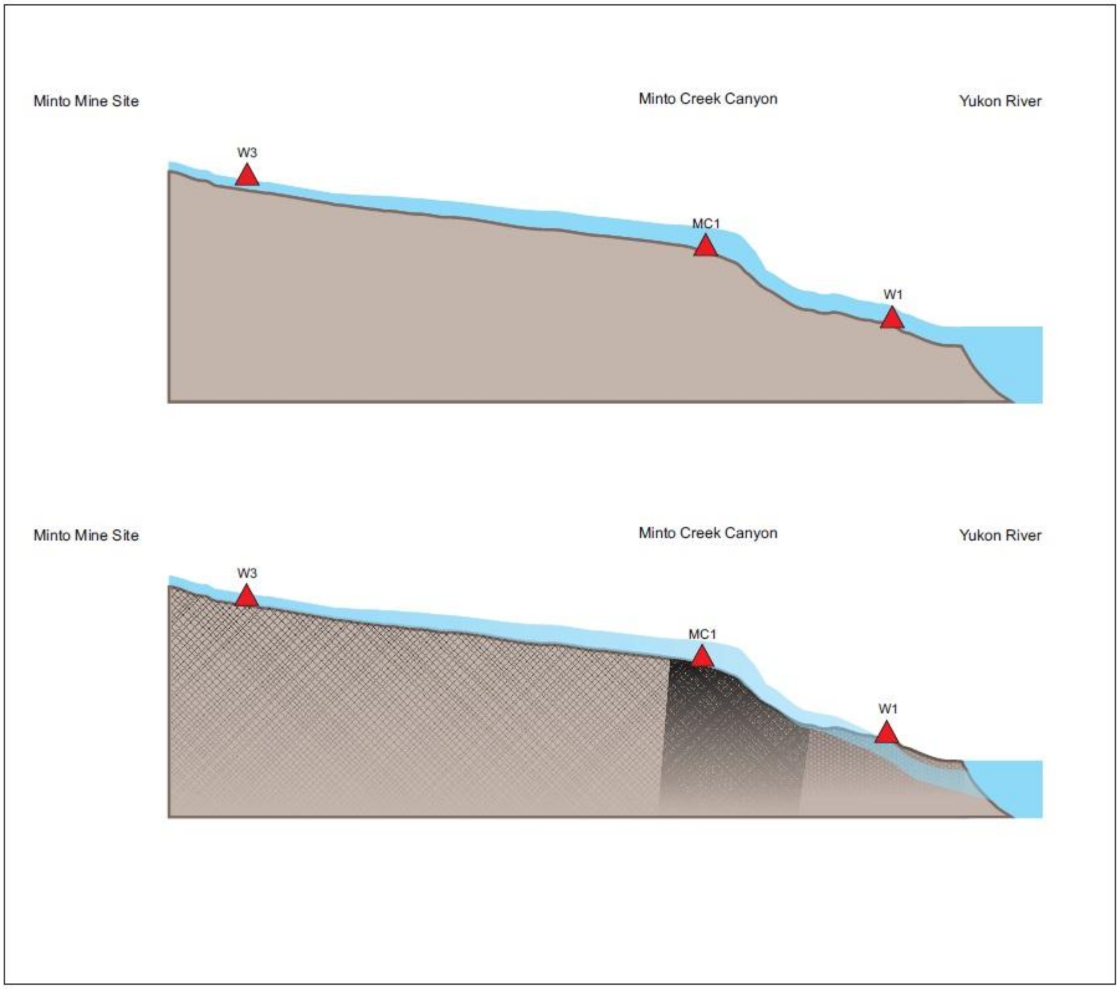


Figure 2-3 Surface and groundwater flow between MC1 and W2

For these reasons, MintoEx, in implementing the AMMP, will review flow logs at MC1 at this juncture in the decision making process regarding discharge. Where this is impractical one of the other locations will be used and rationale provided in associated reporting.

2.8.2 Monitoring During Discharge Events: Decision Making, Can We Continue Discharging?

Event – MintoEx is discharging compliant water downstream based on the laboratory analysis on site and observed climatic conditions.

Possible Environmental Effects – Discharging water from Minto Mine that does not meet the effluent standards could have negative impacts on the receiving environment. Actions taken (discharging) must align with the objective of meeting the effluent standards and protecting the receiving environment. Potential consequences of discharging water that does not meet the effluent standards to the receiving environment include:

- Avoidance of degraded area by fish – loss of habitat;
- Toxicity to early life stages of fish; and
- Acute toxicity to adult and juvenile fish;

Narrative Trigger – Monitoring of surface waters in Minto Creek downstream of the mine site indicates that:

- downstream water quality is starting to degrade or change from the compliant conditions that lead to the positive decision to discharge

Monitoring requirements – The monitoring stations that will be important at this stage are the downstream locations where water quantity and quality will be measured:

- W3: measure discharge volumes continuously and measure water quality daily
- MC1/W1/W2 : measure discharge volumes downstream daily
- W2: measure water quality daily

In effect, the effluent standards will guide all discharge decisions. MintoEx will use information collected during the formation of the Water Management Plan including the water quality and quantity models and the known relationship between TSS and several metal parameters included in the site effluent standards (WUL QZ96-006 Amendment #7) to guide discharge decisions. MintoEx will use the information gained during an investigation of the relationships between TSS and metal concentrations, combined with best management practices to prevent non-protective conditions from occurring with respect to non-conservative parameters (nutrients, temperature). Proactive thresholds will be used to identify scenarios, such as increasing TSS levels that could lead to a discharge scenario where the Potential Effects could occur. It should be noted that the receiving environment compliance point is approximately 8 km from the last point of control at the mine and precipitation events in the area have also yielded increased TSS amounts based on observed conditions in the field to date. During previous discharge events, MintoEx has ensured water quality leaving the site met effluent standards, while water quality downstream at the same time did not meet the effluent standards with respect to TSS. As indicated, MintoEx will manage the site in accordance with the effluent standards in WUL QZ96-006 Amendment #7 and use the information gained during previous discharge periods to inform decisions. Using the lessons learned to date at the site, in conjunction with an on-site environmental laboratory and modelling tools developed as part of the WMP review process, the company is well positioned to undertake successful discharge periods going forward.

2.8.3 Using External Laboratory Results in the Decision Making Process

MintoEx is confident that the approach described wherein several key parameters are measured on site combined with the information gathered during the development of the site water quality and quantity models to guide discharge decisions is sound. At the same time, the receipt of external laboratory analyses will take precedence over the on-site analysis.

Event – MintoEx is discharging compliant water downstream in accordance with the decision process described above. External laboratory results are received and must be interpreted in order to determine if continued discharge is appropriate.

Possible Environmental Effects – Discharging water from Minto Mine that does not meet the effluent standards could have negative impacts on the receiving environment. Actions taken (discharging) must align with the objective of meeting the effluent standards and protecting the receiving environment. Potential consequences of discharging water that does not meet the effluent standards to the receiving environment include:

Avoidance of degraded area by fish – loss of habitat;

- Toxicity to early life stages of fish; and
- Acute toxicity to adult and juvenile fish;

Narrative Trigger – The external laboratory results are received and one of the effluent standards in QZ96=006 has been exceeded

Upon receipt of such results, discharge will stop immediately.

Monitoring requirements – When one of the parameters of concern is exceeded and the receiving environment water is re-sampled, the sample analysis will be requested on a “rush” basis, i.e. the results will be obtained as quickly as possible.

2.9 CONTINGENCY PLANNING

In Table 2-2 Contingency Measures Summary: Adaptive Monitoring and Management Plan below, MintoEx has addressed some of the possible scenarios considered but not directly planned for in the decision making process described above.

Event	**Monitored Item**	**Trigger/Threshold**	**Action**
WATER QUANTITY			
MintoEx, in a given year, implementing proposed Water Management Plan, but in doing so is still not able to remove enough water downstream for operational flexibility due to excessive runoff	Water volumes on site heading toward freeze-up	Water is stored in pit on Nov 1 as a result of storage from the summer months	MintoEx will evaluate the need to increase treatment capacity to meet the Water Management Plan objectives.
WATER QUALITY			
MintoEx , in a given year, monitors water quality as proposed and identifies a primary parameter of concern other than copper.	Log the parameter of concern in the discharge decision making process.	More than three consecutive 'stop-discharge' decisions based on a parameter other than copper will cause an investigation	Evaluate options for optimizing treatment plant or alternative treatment technologies for primary parameter of concern.
EQUIPMENT ISSUES			
Instrumentation required for routine monitoring and/or discharge decision making malfunction.	Flow rate, water quality	Irregular reading, No readings	*Hand-held instrumentation* Purchase redundant equipment, have in stock prior to freshet. *Atomic Absorption Spectrophotometer* • Engage supplier for regular maintenance on atomic absorption. • In the case of malfunctioning, water quality samples will be sent off site for analysis on a "rush" basis.
ANALYTICAL DELAYS			
External laboratory results needed for discharge decision and unexpected delays are experienced	Water quality	Any unforeseen delay in receiving eternal laboratory results	If another laboratory can provide analyses faster, re-sample and send elsewhere. If this scenario is encountered more than twice per year, then investigate other laboratories.

Table 2-2 Contingency Measures Summary: Adaptive Monitoring and Management Plan

2.10 OTHER MONITORING PROGRAMS

In addition to the water quality management and monitoring program described above, MintoEx is in the process of changing related monitoring activities including the implementation of a comprehensive Annual Biological Monitoring Program that has been designed based on the findings to date from the EEM test work, Benthic and Sediment Monitoring Programs (implemented under the original WUL). The nature of the test work for these programs lead to the decision to combine them.

A summary of the programs described in the original WUL and proposed changes is presented below. Detailed plans will be submitted in accordance with the timelines specified in WUL QZ96-006 Amendment #7.

2.10.1 Annual Biological Monitoring

The proposed Annual Biological Monitoring Program will serve to better understand the potential impacts of discharge from the mine site on the receiving environment in Lower Minto Creek. The program will involve studies on algae (periphyton), benthic invertebrates and the fish community. In order to better understand the relationship between water quality and potential impacts on aquatic biota a more intensive stream sediment study will also be undertaken. Aquatic biota sampling will occur in both upper and lower Minto creek.

2.10.2 Fisheries Program

Sampling for effects on fish is not currently a requirement in the WUL. An effects assessment on fish however is a requirement under MMER as part of the EEM program. As with the benthic invertebrate program, the EEM program requires studies conducted every two-three years. MintoEx however will conduct additional fish studies in Minto Creek on an annual basis in order to characterise fish usage of the system (timing, duration and extent) by juvenile Chinook salmon and other species and to monitor possible use of lower Minto Creek by adult Chinook during their spawning period. MintoEx will also support the continuation of an effects level study to determine what concentration of copper in Minto creek water may affect olfaction in juvenile Chinook salmon.

The first year of the program included a study to determine how long individual fish stay in the system. This was determined through a mark/recapture program (using Visible Implant Elastomer (VIE) tags) involving sampling and marking fish every 7-10 days from mid-June to early September, 2010. This also served to quantify use of the fish in the system during the current year. Year to year sampling will involve sampling throughout the open water season (i.e. June-Sept) to characterise year to year usage of the system.

2.10.3 Periphyton Program

Periphyton is a type of algae that attaches itself to stream substrate and is directly affected by physical and chemical changes that occur in a stream over time. Periphyton sampling is not a requirement under the current WUL. MintoEx however will initiate a program to track the influence of mining activity on the periphyton community in Minto Creek. Sampling for periphyton will be conducted annually assessing relative abundance and community composition.

Sampling is relatively easy and will be conducted at the same stations where benthic invertebrates will be collected. Samples will be collected from suitable substrate from a variety of habitat (i.e. pools, riffles) through scraping or brushing. Samples from each respective station will be combined to form one representative composite sample. Once collected samples will be placed in jars and stored in a dark cool location prior to shipping to a plant (algae) taxonomist for identification. As with the benthic program sampling will be conducted in late summer/early fall. Year to year comparisons will be made with respect to community composition, reviewing between year differences and diversity as well as a review of tolerant and/or sensitive taxonomic groups.

2.10.4 Seepage Monitoring Program

The Seepage Monitoring Program has been developed based on observations by the engineer of record for the seepage infrastructure as construction began in 2010. Foundation soils were tested and a ground temperature cable (monitoring equipment) was installed. Some of the thresholds for adaptive responses will require further information, such as the foundation soil testing results and initial ground temperature cable readings. Using this information, baseline conditions will be established and considered along with engineering principles to determine reasonable thresholds for adaptive responses and actions. An outline of the Seepage

Monitoring Program as it is currently understood is described below and qualitative thresholds are described to provide insight into the methodology for establishing adaptive responses. More details will be added and the program will be submitted to the Yukon Water Board as required under WUL QZ96-006 Amendment #7.

2.10.5 Physical Monitoring

Regular physical monitoring should be carried out daily during freshet, during and after significant rainfall events and monthly during the other times. Note that more detail regarding monitoring of the Minto Creek Detention Structure will be submitted as required under WUL QZ96-006 Amendment #7.

- Regular survey of the water level in the MCDS pond.
- Regular monitoring of volumes pumped out of the pond should be completed by Minto staff. This could be completed with survey data or using pump curves.
- Foundation Thawing
    - Once the ground temperature cable (GTC) is installed ground temperatures will be monitored. Regular physical monitoring of structure should indicate major foundation soil distress. Survey hub(s) can be installed if distress is noted to monitor movement rates. (See Establishment of triggers for design and implementation of feasible upgrades to the proposed collection system.)
    - An increase in seepage volume may be an indicator of foundation soils thawing. This would be monitored during regular physical monitoring.
- Hydraulic Gradients
    - Regular survey of the water level in the MCDS pond will provide the necessary data to calculate hydraulic gradient.
- A complete survey of the area (including upstream and downstream of berm and pond) will allow a more precise calculation of hydraulic gradient.

- Contaminant Transport.
    - To be monitored by comparing samples from W16 and samples from downstream of the berm.
    - Following analysis and comparison of sample results from W16 and downstream of the berm, MintoEx will:
        1. identify appropriate performance thresholds for the collection system;
        2. report on findings; and
        3. indicate at this time whether modelling of water quality and loading is required.

2.10.6 Triggers and adaptive responses

- **Foundation Thawing.** If the GTC readings indicate that the foundation soils are thawing regular physical monitoring frequencies will increase.

- **Noticeable slumps/instability in berm**. Slumps/instabilities will indicate foundation soil distress. Regular checks for these indicators will be conducted through regular physical monitoring. Adaptive management responses will depend on size of slump/instability. Minor instabilities (a slump or instability that allows the structure to continue containing water to meet the design intent) would result in installation of survey hubs to monitor movement. If movement rates indicate that a major slump or instability is forthcoming, repair and/or redesign would be required. Major slumps/instabilities (a slump or instability that causes the structure to no longer contain sufficient water to meet the design intent) would require repair. Prior to repair the engineer of record will assess the likely cause(s) of the failure and determine if redesign or design upgrade is required.

- **Little or no ponded water upstream of berm**. Little or no ponding will indicate that the structure is not holding water. Regular checks for ponded waters will conducted through regular physical monitoring and survey data. An initial adaptive management response will be a requirement for investigation into the cause. This investigation could include a review of the existing data, a site visit and possibly a subsurface investigation. Once the data review is complete, the engineer of record will determine a scope of work required to effect repairs and whether redesign is required.

- **Increase in seepage volume**. An increase in seepage volume could be an indicator that something is changing in the foundation soils if no other conditions have changed. Regular checks for seepage volume increases will be conducted through regular physical monitoring. An initial adaptive management response will be to review the data.
- Contaminant transport triggers
    - If samples at W8/W8a indicate higher than normal concentrations of parameters of concern are entering the system upstream, sampling should be completed downstream of the structure. If an unacceptable amount of parameters of concern were found downstream, samples from the water in the Water Storage Pond should be analysed to determine what effects the increased loading is having on the WSP. If it is determined that an unacceptable amount of parameters of concern are entering the WSP, the pumping plan should be reviewed.

2.11 WMP AND AMMP REVIEW MECHANISMS

MintoEx recognizes that the Water Management Plan, including the AMMP must be revisited regularly for the following reasons:

- to ensure objectives of the WMP are being met;
- to update reviewers on successes/challenges encountered in the implementation of the WMP;
- to confirm that water management plan assumptions are being verified;
- to incorporate any changes to CCME Guidelines; and
- to confirm our commitment to/strategy for protecting the receiving environment.

A key element of revisiting the WMP assumptions will be verification of the effluent quality standards as protective of the receiving environment. Conversely, if water quality model re-calibration from routine monitoring demonstrates that the proposed effluent quality standards are overly protective and overly restrictive of operational flexibility, they should be revisited and potentially increased. MintoEx proposes to present its findings and rationale for such changes, if required, in an annual review of the WMP.

2.12 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Currently the QA/QC measures in place related to the Water Quality Surveillance Program include the items below. A QA/QC program will be formalized and submitted to the Yukon Water Board as per WUL QZ96-006 Amendment #7 clause 20:

- collection of duplicate, field blank and trip blank samples (5% of total sample volume);
- calibration of equipment (Oakton pH/Electrical Conductivity/total dissolved solids (TDS) meter, YSI meter and Global flow meter) in accordance with manufacturer’s specifications; and
- ordering of key instrumentation parts in January of each calendar year (dissolved oxygen membranes, pH electrodes, discharge loggers electrical conductivity electrodes, etc.) such that at least one replacement unit is on site by April 1.
- rental of duplicate equipment during high volume sample periods;

The AMMP will incorporate these features and consider others such as duplication of certain field equipment to allow for situations wherein equipment used for critical discharge decision-making is inoperable due to malfunctions, . As well, the spectrophotometer will be calibrated before each use using standard solutions.

2.13 REPORTING

In addition to the mandatory reporting required under the Metal Mining Effluent Regulations, the monthly report provided to the Yukon Water Board detailing water quality and flow data will include updates on the implementation of the AMMP and results from the expanded program in accordance with the sample frequency described in Appendix 3, Part 2, WUL QZ96-006 Amendment #7.

A template will serve as a “check-list”’ on adaptive actions taken, to be completed and submitted with each report with the aim of highlighting actions related to the AMMP for ease of review. In addition to the water quality data, the following will be identified and presented:

- Noticeable trends in changes to water quantity and quality
- Description and detail of any thresholds exceeded and the resulting response ; and
- Any proposed changes to water treatment strategy.

Any exceedence of the WUL discharge criteria will be reported by telephone or email within 24 hours to the inspectors (EMR – Client Services and Inspections and SFN Lands and Resources Department). Details of any exceedence, corrective action/mitigation undertaken and inspectors’ direction will be included in the monthly report.

MintoEx proposes that updates regarding the AMMP implementation be included in the WUL monthly reports currently submitted to the Yukon Water Board.

In addition to the monthly reports, an Annual State of the Environment report will be submitted on March 31 of each year on the previous calendar years activities. It will summarize water management at Minto Mine and present information related to these items of concern using plain language and adhering to a narrative-style report to the extent possible:

- Storage of water at site during the calendar year (volumes, place of storage, duration of storage);
- Quantity and quality of water released from the site;
- Effectiveness of water treatment;
- Quantity and quality of water in Upper Minto Creek;

- Quantity and quality of water in Lower Minto Creek;

- Results of a sediment monitoring program;

- Results of an annual biological monitoring program including an overview of the Environmental Effects Monitoring program which is undertaken as part of MintoEx's obligations under MMER ; and

- An overview of the effectiveness of the site water balance model in predicting site conditions after recalibration.

3.0 REFERENCES

CCME (Canadian Council of Ministers of the Environment), 1999. Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment. Winnipeg

CCME (Canadian Council of Ministers of the Environment), 2010. Canadian water quality guidelines for the protection of aquatic life: Ammonia. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

Government of Canada. 2002. Metal Mining Effluent Regulations. Canada Gazette, Part II. Vol. 136, No. 13. Wednesday, June 19, 2002.

Hallam Knight Piesold Ltd. 1994. *Minto Project, Initial Environmental Evaluation*, Supporting Volume II, Environmental Setting. Prepared for Minto Explorations Ltd. May 1994.

R&D Environmental. 2006. Fisheries Assessment of Minto Creek, September 2006. Prepared for the Access Consulting Group.

R&D Environmental. 2007. Fisheries Assessment of Minto Creek, May, June and August 2007. Prepared for the Access Consulting Group.

Scott, W.B. and E.J. Crossman. 1998. Freshwater Fishes of Canada. Galt House Publications, Oakville, Ontario.

Taylor, B.R. and R.C. Bailey. 1997. Aquatic Effects Technology Evaluation (AETE) Program: Technical Evaluation on Methods for Benthic Invertebrate Data Analysis and Interpretation. AETE Project 2.1.1. 93 p.

Wiederholm, T., A. Wiederholm and G. Milbrink. 1987. Bulk sediment bioassays with five species of fresh-water oligochaetes. Water Air Soil Pollut. 36: 131 – 154.

Yukon Environmental and Socio-economic Assessment Act. May 13, 2003.

MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

APPENDIX H

Description of WUL Sediment and Benthic Monitoring

MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

Sediment and Benthic Monitoring Programs

Minto Mine

SEDIMENT MONITORING PROGRAM

1. Objective

To monitor sediment quality of Minto Creek and to provide data to allow interpretation of the potential influence of the Minto Mine on sediment quality using temporal comparisons, spatial comparisons (control-impact design) and Canadian Environmental Quality Guidelines for sediment (CCME 1999). The study design is summarized in Table 1.

2. Target Habitat, Frequency and Timing

- Sediment sampling to target deposits of fine sediment (silt and clay) in quiescent pools and wetted backwater locations (i.e., depositional locations).
- To be conducted annually in late August or September.

3. Sampling Locations and Replication

- Sediment to be collected from two areas in Minto Creek: upper Minto Creek (near water quality monitoring Station W3) and lower Minto Creek (downstream of water quality monitoring Station W2), and at two reference areas with similar habitat characteristics.
- Five samples per area separated by at least three creek bankfull widths.

4. Sampling Methodology

- Sediment in upper Minto Creek and the matched reference area to be collected using a stainless steel or Teflon spoon or scoop with only the top two centimeters of deposited sediment collected. Each sample to be made up of at least 10 scoops per sample.
- Sediment in lower Minto Creek and the matched reference area to be collected using a petite ponar (samples for particle size distribution characterization) and a hand corer (samples for chemical characterization). Only the top two centimeters of deposited sediment to be collected to form the sample (using a stainless steel or Teflon spoon or scoop for the samples collected by petite ponar and a core extruder and core knife for the sample collected by coring). Each sample to be comprised of three grabs (particle size) or cores (chemistry).
- Supporting water quality measures to include field meter measurement of temperature, dissolved oxygen, specific conductance and pH.

5. Chemical Analysis

- Samples to be submitted to a CALA (Canadian Association for Laboratory Accreditation) accredited analytical laboratory for the analysis of: particle size distribution (gravel, sand, silt and clay), total organic carbon, metals by ICP-MS (Inductively Coupled Plasma-Mass Spectrometry) and/or ICP-OES (Inductively Coupled Plasma-Optical Emission Spectrometry), and total Kjeldahl nitrogen.

6. Data Analysis, Interpretation and Reporting

- Data interpretation to include an evaluation of temporal changes in sediment quality, control-impact comparisons and Canadian Environmental Quality Guidelines for sediment (CCME 1999)
- An annual report is to be prepared detailing the results, analysis and interpretation of the sediment monitoring program. The report will include concise conclusions regarding the potential influence of the Minto Mine on sediment quality of Minto Creek.

7. References

CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment. Winnipeg.

BENTHIC INVERTEBRATE COMMUNITY MONITORING PROGRAM

1. Objective

To monitor the condition of the benthic invertebrate community of Minto Creek and to provide data to allow interpretation of the potential influence of the Minto Mine on the benthic invertebrate community using temporal comparisons and spatial comparisons (control-impact design). This monitoring is to be conducted in addition to benthic invertebrate community monitoring required every three years as part of Environmental Effects Monitoring (EEM) under the Metal Mining Effluent Regulation of the federal *Fisheries Act*. The study design is summarized in Table 1.

2. Target Habitat, Frequency and Timing

- Benthic invertebrate community monitoring to be undertaken in erosional habitat at locations with cobble substrate. The rationale for targeting this habitat is that erosional habitat is the dominant habitat type in Minto Creek and that cobble substrate generally supports greater diversity of benthic invertebrate taxa than sand substrate and thereby may prove greater ability to detect potential mine-related effects.
- To be conducted annually in late August or September.

3. Sampling Locations and Replication

- Benthic invertebrate samples to be collected from lower Minto Creek (in the vicinity of water quality monitoring Station W2), and at a reference area with similar habitat characteristics (substrate texture, water velocity, water depth).
- Five samples per area separated by at least three creek bankfull widths.

4. Sampling Methodology

- Samples to be collected using a Hess sampler equipped with 500 um mesh. Each sample to be a composite of three grabs.
- Samples to be labeled using internal and external labels and preserved using buffered formalin to a concentration of approximately 10%.
- Supporting habitat measures to include substrate characterization (100 pebble count; CABIN 2010), water velocity, sampling depth and creek width (wetted and bankfull).

- Supporting water quality measures to include field meter measurement of temperature, dissolved oxygen, specific conductance and pH, and a supporting water quality sample to be assessed for all analytes specified in the Minto Mine's receiving water quality monitoring program.

5. Laboratory Analysis

- Samples to be submitted to a qualified benthic invertebrate taxonomy laboratory for taxonomy to "Lowest Practical Level" (LPL), which is typically genus or species.
- Benthic sample identification and enumeration methodology to be fully consistent with guidance for federal EEM (Environment Canada 2002, 2011).

6. Data Analysis, Interpretation and Reporting

- Benthic invertebrate community data to be summarized using primary endpoints specified for metal mining Environmental Effects Monitoring (Environment Canada 2011). These are: total benthic invertebrate density, taxon richness, Simpson's Evenness Index and Bray-Curtis similarity index. Additional endpoints such as diversity indices (e.g., Simpson's or Shannon's), taxon density, relative proportions of key taxa and presence/absence of key taxa should be considered to aid in interpretation.
- Data interpretation to include an evaluation of temporal changes in benthic invertebrate community condition and control-impact (effluent exposed versus reference) comparisons. Data interpretation should also consider relationships between benthic invertebrate community condition and chemical condition as well as benthic invertebrate community condition and habitat characteristics.
- An annual report is to be prepared detailing the results, analysis and interpretation of the benthic invertebrate community monitoring program. The report will include concise conclusions regarding the potential influence of the Minto Mine on the benthic invertebrate community of Minto Creek and potential relationships to water quality.

7. References

CABIN (Canadian Aquatic Biomonitoring Network). Field Manual: Wadeable Streams. Environment Canada. March 2010.

Environment Canada. 2002. Revised Guidance for Sample Sorting and Sub-sampling Protocols for EEM Benthic Invertebrate Community Surveys. National Environmental Effects Monitoring Office. December, 2002.

Environment Canada. 2011. Metal Mining EEM Guidance Document. Chapter 4 - Effects on Fish Habitat 2011. Environment Canada. June 2011.

Table 1: Study Design for Minto Mine Sediment and Benthic Monitoring Programs

Component	Frequency	Area	Area type	Target Habitat	Replication	Summary of Methodology
Sediment Quality	annual	Upper Minto Creek	effluent-exposed	depositional	5 stations	Collect whole (bulk) sediment from quescient areas supporting deposited sediment using a stainless steel spoon (top 2 centimeters). Submit samples for particle size analysis, total organic carbon, metals and total Kjeldahl nitrogen.
		Upper Reference	reference	depositional	5 stations	
		Lower Minto Creek	effluent-exposed	depositional	5 stations	Collect whole (bulk) sediment from pools supporting deposited sediment using a ponar grab (for particle size) and a corer (for all other analytes). Submit samples of top 2 centimeters for particle size analysis, total organic carbon, metals and total Kjeldahl nitrogen.
		Lower Reference	reference	depositional	5 stations	
Benthic Invertebrate Community	annual	Lower Minto Creek	effluent-exposed	erosional - cobble substrate	5 stations	Collect benthic invertebrate samples using a Hess sampler equipped with 500 um mesh. Each sample to be a composite of three grabs. Taxonomy to be performed to "Lowest Practical Level" and data to be summarized using the endpoints specified in Environment Canada (2011).
		Lower Reference	reference	erosional - cobble substrate	5 stations	
Supporting Measures	annual	Upper Minto Creek	effluent-exposed	depositional	5 stations	At each sediment and benthic invertebrate station, collect supporting data including GPS coordinates, water depth, creek wetted width, creek bankfull width, substrate characteristics and meter measurements of temperature, dissolved oxygen, specific conductance and pH . At each benthic invertebrate station, also collect supporting water velocity, detailed substrate characterization (100 pebble count) and a water sample for treatment as specified in the Minto Mine's receiving water quality monitoring program.
		Upper Reference	reference	depositional	5 stations	
		Lower Minto Creek	effluent-exposed	depositional and erosional - cobble substrate	5 stations	
		Lower Reference	reference	depositional and erosional - cobble substrate	5 stations	

Environment Canada. 2011. Metal Mining EEM Guidance Document. Chapter 4 - Effects on Fish Habitat: Benthic Invertebrate Community Survey. June 2011.

MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

APPENDIX I

Minto Creek Annual Fish Monitoring Program

MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

Minto Creek Annual Fish Monitoring Program

Prepared by:
Minto Explorations Ltd.

Minto Creek Annual Fisheries Monitoring Program

1. Objective

To monitor, assess and characterize fish usage in Minto Creek and to provide data to allow interpretation of the potential influence of the Minto Mine on the fish community. Focus on the most predominant species that uses the system, Chinook salmon, as well as other species that have previously been encountered (or any new species) will allow an interpretation of both extent and timings of use within this system.

With respect to extent of use, it is known that only lower Minto Creek (below the canyon) is used by fish during the open water season. Further, a natural barrier to fish passage was confirmed during a 2010 study at (approximately) 1.2 km up from the Yukon River. Traps will be placed above this barrier on an annual basis to confirm the extent of use by fish in the system.

Past observations have indicated that the area at the confluence of Minto Creek and the Yukon River is not used by spawning salmon or other species. The annual fisheries program will however, continue to observe for and report on the use of the confluence zone by spawning salmon and other species.

2. Target Habitat, Frequency and Timing

The Fisheries Monitoring Program will conduct monthly sampling throughout the open-water season from late June/ early July through November. Known juvenile habitat will be targeted including eddies, deep pools, and calmer waters with shady areas and/ or woody debris.

Additional fisheries data will be collected every 2-3 years in support of the requirements of the Environmental Effects Monitoring (EEM) Program under the Metal Mining Effluent Regulations (MMER). Years when EEM program is undertaken will be referenced.

3. Sampling Locations and Replication

The locations have been identified and recorded by GPS waypoints from prior efforts. 12-16 Gee Traps will be placed at approximately the same location during each sampling event and allowed a 24 hour soak period.

4. Sampling Methodology

Trapping efforts will include using Gee-type Minnow traps with ¼” wire mesh that will be baited using Yukon River origin Chinook salmon roe. All fish captured during the monthly sampling in the open water period will be identified and enumerated, measured for fork length (mm) or total length (sculpins, burbot), observed for abnormalities, and released at the location where it had been trapped.

Additional supporting information that will be collected includes: GPS coordinates of trapping locations, physical description and photo documentation of sampling locations, in situ water quality (temperature, dissolved oxygen, conductivity, flow) as well as weather conditions at time of sampling.

5. Data Analysis, Interpretation and Reporting

An annual report will be prepared detailing the results of the sampling program. Data analysis will be performed to quantify relative use of Minto Creek and will be reported through determination of Catch Per Unit Effort (CPUE). A description of water chemistry in the receiving environment and mine discharge actions during the open water period will also be reported.

MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

APPENDIX J

Periphyton Monitoring Program

MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

Periphyton Monitoring Program

Prepared by: Minto Explorations Ltd.

Periphyton Monitoring Program

1. Objective

To monitor the condition of the periphyton community of Minto Creek and to provide data to allow interpretation of the potential influence of the Minto Mine on the periphyton community using temporal and spatial comparisons. (control-impact design).

2. Target Habitat, Frequency and Timing

- Sampling will be conducted in a variety of habitat (i.e. pools, riffles) on suitable substrate (i.e. cobble, boulders).
- Sampling will take place once annual in late August/early fall

3. Sampling Locations and Replication

- Periphyton samples to be collected from lower Minto Creek (in the vicinity of water quality station W2), and at a reference area with similar habitat characteristics (substrate texture, water velocity, water depth).
- Three replicate samples will be taken within each habitat type (i.e. pool, riffle)

4. Sampling Methodology

- Samples will be collected from suitable substrate from a variety of habitat (i.e. pools, riffles) through scraping or brushing.

- Samples from each respective station will be combined to form one representative composite sample.

- Samples will be placed in jars, labeled and stored in a dark cool location prior to shipping to a plant (algae) taxonomist for identification.

- Supporting habitat measures to include substrate characterization (100 pebble count; CABIN 2010), water velocity, sampling depth and creek width (wetted and bankfull) and cover description.

- Supporting water quality measures to include field meter measurement of temperature, dissolved oxygen, specific conductance and pH, and a supporting water quality sample to be assessed for all analytes specified in the Minto Mine’s receiving water quality monitoring program.

5. Laboratory Analysis

- Samples to be submitted to a qualified plant/algae taxonomy laboratory for taxonomy to “Lowest Practical Level” (LPL)..

6. Data Analysis, Interpretation and Reporting

- Data interpretation to include an evaluation of temporal changes in periphyton community condition and control-impact (effluent exposed versus reference) comparisons. Data interpretation will also consider relationships between periphyton community condition and chemical condition as well as periphyton community condition and habitat characteristics.

- An annual report is to be prepared detailing the results, analysis and interpretation of the periphyton community monitoring program.

MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

APPENDIX K

Decommissioning and Reclamation Plan – Minto Mine

MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

DECOMMISSIONING AND RECLAMATION PLAN

MINTO MINE, YUKON TERRITORY

Revision 3.2
June 2011

Submitted by Minto Explorations Ltd.

ISSUED FOR REVIEW

DECOMMISSIONING AND RECLAMATION PLAN

Minto Project, Yukon Territory

Submitted by:

Minto Explorations Ltd.

CONTEXT OF THIS DOCUMENT

This third revision of the Decommissioning and Reclamation Plan (the "Plan") is presented for review and will be revised by MintoEx to incorporate reviewer comments. This version is an update to Revision 3.1, submitted to Yukon Government, Energy Mines and Resources in April 2011 and addresses some inconsistencies identified in YG's initial document review. The April 2011 Revision 3.1 document was an integration of the existing Plan on file at the time (Revision 2, 2009) and the conceptual Phase IV Decommissioning and Reclamation Plan, with additional detail to further refine the Phase IV concepts to an acceptable level. It is important to understand that activities associated with Phase IV of the Minto Mine have not yet been constructed and as such there may be changes to designs, or situations encountered during infrastructure development, that impact on the information presented in this document.

This Plan is now considered to be Revision 3.2.

PROJECT CONTACTS

MINTO EXPLORATIONS LTD. c/o Capstone Mining Suite 900, 999 W Hastings St Vancouver B.C. Telephone: (604) 684-8894 Fax: (604) 688-2180 Website: www.capstonemining.com	**C**olleen Roche Manager, Sustainability and Environment Affairs Emailcolleenr@capstonemining.com **John Knapp** General Manager Email: jknapp@mintomine.com
ACCESS CONSULTING GROUP #3 Calcite Business Centre 151 Industrial Road Whitehorse, Yukon Y1A 2V3 Telephone: (867) 668-6463 Fax: (867) 667-6680 Website: www.accessconsulting.ca	**Scott Davidson, M.Sc., P.Geo (BC, NT, NU)** Email: sdavidson@accessconsulting.ca **T. Scott Keesey, B.Sc., CEPIT** Email: skeesey@accessconsulting.ca
EBA ENGINEERING CONSULTANTS LTD. #6 Calcite Business Centre 151 Industrial Road Whitehorse, Yukon Y1A 2V3 Telephone: (867) 668-3068 Fax: (867) 668-4349 Website: www.eba.ca	**Richard Trimble, P.Eng.** Email: rtrimble@eba.ca **Brian Cutts, P.Eng.** Email: bcutts@eba.ca

EXECUTIVE SUMMARY

This closure plan addresses the long-term physical and chemical stability of the site, including reclamation of surface disturbances. A program is presented for site management and monitoring both during implementation of closure and after decommissioning and reclamation measures are completed. Decommissioning and reclamation cost estimates are provided and financial security requirements reviewed.

The Plan has been specifically scoped to fulfill the requirements under the *Yukon Environmental and Socio-economic Assessment Act* (YESAA) for quartz mining projects proposed in the Yukon. The Plan is not intended to address closure of previously permitted infrastructure components which have been addressed in the 2009 Detailed Decommissioning and Closure Plan.

The Minto Project is a copper-gold-silver project located on the west side of the Yukon River approximately 75 km (47 miles) north-northwest of Carmacks, Yukon Territory. The mine site and access road lie within the traditional territory of the SFN and comprises part of land claim settlement parcels R-6A, R-44A (Type A settlement lands) and R-40B. The Company concluded a comprehensive Cooperation Agreement with the SFN on September 16, 1997. This agreement is still in effect but has been amended recently.

The Minto Property is centered at approximately 62°37'N latitude and 137°15'W longitude (NAD 83, UTM Zone 8 coordinates 6945000N, 384000E). The Minto Project consists of 284 claims. There are 120 pending quartz claims, 99 quartz claims and 65 quartz claims under lease. The 100% registered owner of the claims and leases is Minto Explorations Ltd. (The Company). The property is accessible by crossing the Yukon River at Minto Landing. Barge landings have been constructed for ice-free crossing and an ice bridge is used upon freeze-up of the Yukon River.

The following activities are planned as part of Phase IV:

- Development, mining and milling of materials from the proposed Area 2 open pit which contains 3,192 Kt of ore plus 25,980 Kt of waste;
- Development, mining and milling of materials from the proposed Area 118 open pit which contains 88 Kt of ore plus 639 Kt of waste;
- Development, mining and milling of materials from the proposed Area 2 and Area 118 underground areas which contain approximately 1,541 Kt of ore and 341 kt of waste;
- Expansion of the southwest waste rock and reclamation overburden dumps;
- In-Pit deposition of tailings from Phase IV ore feeds (Area 2 and Area 118);
- In-Pit deposition of tailings sourced from Main Pit stockpiled ore following completion of mining in Main Pit;
- Construction of the South Wall buttress in Main Pit;
- Construction of the Mill Valley Fill buttress;

- Extension of the camp pad;
- Operational water management; and
- Decommissioning and reclamation of infrastructure components, as and whenever possible to reduce site liability.

A systematic approach to decommissioning and closure reclamation has been developed for the Minto project. Progressive reclamation measures will be implemented where possible during mine construction and operations. This approach will not only provide valuable reclamation success feedback for use in advanced/final closure, but progressive reclamation will reduce final reclamation liability and costs and shorten the overall reclamation implementation schedule. These progressive efforts will also help reduce slope erosion through physical slope stabilization of revegetation efforts, enhancing ultimate reclamation success.

The primary objectives of the closure and reclamation of Minto Mine are:

- To have a closure planning process that seeks input from the SFN, understands the input received and incorporates the input into closure planning decisions;
- To protect the health of people pursuing traditional activities including hunting, fishing, trapping, camping and collection of plants for food, medicinal or cultural purposes;
- To protect people from safety risks when they are pursuing traditional activities including hunting, fishing, trapping, camping and collection of plants for food, medicinal or cultural purposes;
- To protect the environment (including land, air, water, plants, animals fish and other environmental components and their interrelationships) from long term effects caused by the mine activities and facilities;
- To return the mine site and affected areas to a state similar to surrounding lands so that people can pursue traditional activities the same as they did before mining, including hunting, fishing, trapping, camping and the collection of plants for food, medicinal or cultural purposes;
- To protect the environment from long-term effects caused by post-closure access to the mine area;
- To protect the environment from effects of earthquakes, floods, climate change and other natural events on related mine structures;
- To have effective management and control structures in place during operation, closure and post-closure to provide:
  - Adequate financial resources to carry out all closure activities including plan implementation and long-term activities;
  - Adequate flexibility during closure and post-closure to allow adaptation of activities in order to address unexpected performance and events; and
  - Consideration of the Company’s long-term desire to “walk away” from the site under conditions acceptable to SFN and with adequate resources provided to address long term requirements.
- To minimize long term activities by ensuring long term chemical and physical stability of mining components and disturbed areas;

- To confirm the effectiveness of closure measures by monitoring the site after closure;
- To undertake mine planning incorporating progressive reclamation;
- To provide short and long term slope stabilization and erosion control on linear and non-linear disturbances;
- To ensure the long-term chemical stability of residual mining components and their effects on water quality draining the property;
- To ensuring the long-term physical stability of key structures such as the waste dumps and the diversion and drainage ditches; and
- To work towards a passive closure scenario for most or all mine components.

The Company has adopted a toolbox approach to reclamation methods in order to ensure that the reclamation objectives identified in the previous section can be met. The toolbox approach to reclamation involves investigation into the use of different reclamation methods depending on the specific issue being addressed. The reclamation toolbox for the site is primarily focussed towards reducing metal loadings from mine infrastructure and passive treatment of water quality.

The Phase IV expansion is expected to result in approximately 6 years of additional mine life with active mining in the open pits ending in the third quarter of 2013 and underground mining scheduled to finish in January 2014. Following the end of the underground production, mining will be from ore stockpiles that will continue into 2016. Reclamation of the disturbed areas will be done in a phased approach to match the overall mining schedule and after closure to reflect the reclamation and monitoring effort required. This phased approach to reclamation planning will assist the company in achieving the overall objectives of progressive and final reclamation at the site.

The closure phase of the Minto mine will commence with the cessation of economic mining of the open pit and the milling of ores and stockpiles from the ore zone. Once all mineable ore reserves have been processed, the mill and concentrator will be flushed and the tailings management facility (TMF) will be decommissioned. During the active decommissioning phase, which is expected to last approximately 3 years, the number of personnel required will vary depending on site activities; however, it is expected that as major decommissioning and reclamation tasks are completed the number of site personnel required will decline.

Cost estimation for implementation of the proposed closure measures is the basis for establishing the financial security that will be required on the project. The Phase IV closure cost estimate has been prepared based on the final extent of disturbance for each of the infrastructure units described in this report. Progressive reclamation for much of the site will assist in offsetting the maximum site liability that will be incurred during the operations phase but does not negate the need for estimation of the closure costs.

A closure cost range from $17,045,549 to $17,314,592 is estimated for final closure, based on three separate scenarios for road decommissioning.

TABLE OF CONTENTS

Closure Schedule

List of Figures

List of Appendices

1 Introduction

Minto Explorations Ltd. (The Company), a wholly owned subsidiary of Capstone Mining Corporation (Capstone), owns and operates the Minto Project located 240 km (150 miles) northwest of Whitehorse, Yukon. For the purposes of this closure plan, the "Minto Project" means the mining of the Minto deposit by both open-pit and underground mining methods and related ancillary facilities.

This closure plan (The Plan) addresses the long-term physical and chemical stability of the site, including reclamation of surface disturbances from both existing development and that proposed for the Phase IV Expansion. A program is presented for site management and monitoring both during implementation of closure and after decommissioning and reclamation measures are completed. Decommissioning and reclamation cost estimates are provided.

The Plan is based on the best information available at the present time. A proposed continuation and expansion of the reclamation research program will provide more site-specific information to optimize closure methods. As required in Section 14.3 of QML-0001, this plan will be updated again in two years, and submitted to the Chief for review and approval.

1.1 Closure Philosophy

In keeping with its high standards for environmental and social responsibility, the Company intends to implement an environmentally sound and technically feasible decommissioning and reclamation plan for the Minto mine. Closure planning and the implementation of this phase at a mine site must be undertaken with appropriate environmental care while respecting local laws, Selkirk First Nation (SFN) agreements, and the public interest and ensuring that the Company's high environmental standards are achieved. Necessary environmental protection measures have been adopted in the development of this Plan to ensure that a healthy environment exists after mine closure. This approach is consistent with the Company's corporate policies.

A principle tenet of the philosophy followed during the development of this Plan was to work towards an eventual passive closure scenario, with eventual walk-away closure after long term chemical and physical stability of reclaimed mine components has been demonstrated. This involved an assessment of the key mine components that require mitigation based on the current understanding of materials contained within these components. Mitigation measures have been incorporated into elements of the Plan to address public safety issues and environmental concerns with post closure monitoring and inspections planned to ensure that this objective is met. Once the effectiveness of each mitigation measure is assured, then management of the site can be safely reduced to a level that is consistent with closure objectives. It is anticipated that final determination of the effectiveness of closure measures for passive and eventual walk-away status will be the subject of review and concurrence with regulatory agencies, SFN and the public. Under the Quartz Mining Act (QMA), the company would then apply for a certificate of closure from Yukon Government (YG).

The Company has entered into a Cooperation Agreement (the Agreement) with the SFN. All activities at the site including closure measures are guided by this Agreement. Therefore, a strong working relationship with the SFN forms a foundation for this document. To that end, meetings with SFN related to closure issues have been ongoing since the first version of the Plan, and their comments on closure and other issues raised during ongoing dialogue were considered in the ongoing development of this Plan.

The principle of progressive reclamation is key to the Company's closure philosophy, and reduces the ongoing risk carried by the company by:

- reducing geochemical loading of runoff from mining waste areas,
- stabilizing potential sources of erosion and sediment release;
- initiating slope stability measures to enable reclamation;
- replanting and reseeding disturbed areas not scheduled for rework;
- providing sites for reclamation research trials and serving as an early indicator of reclamation success; and
- reducing the total area requiring reclamation at the end of active mining activities.

Resources required for specific progressive reclamation activities will be incorporated into operational planning, and their completion will be scheduled into yearly operational targets. The schedule for progressive reclamation is dependent upon the progress of mining activities, and is therefore not presented in this closure plan.

To ensure that the overall closure philosophy can be achieved, the following objectives were emphasized during the development of this plan:

- protection of public health and safety;
- implementation of environmental protection measures that prevent adverse environmental impact;
- ensuring land use commensurate with surrounding lands;
- ensuring full consultation with the SFN, so that closure measures are appropriate and supported by the local peoples who are most affected;
- incorporate long term closure measures;
- progressive reclamation measures implemented during mine operations;
- post closure monitoring of the site to assess effectiveness of closure measures for the long term; and
- passive post closure monitoring and management of the site until the former mine presents evidence of an environmentally benign site, in which case a walk-away closure scenario may be realized.

1.2 Scope of Plan

The Plan has been specifically scoped to fulfill the requirements in Section *14.0 Preparation, Approval and Implementation of Closure Plan of the Company's Quartz Mining Licence QML-0001*.

The Plan is intended to address closure of previously permitted infrastructure components which have been addressed most recently in the approved 2009 Detailed Decommissioning and Closure Plan (Revision 2) and closure of the additionally proposed features and disturbances associated with the Phase IV Mine Expansion.

The approach taken in the presentation of this Closure plan is to provide a brief description of each mine component and the closure issues and measures related to that component. Previous work or reports on the project have been referenced without repeating details so that this document is focused on decommissioning and reclamation. An updated list of prior reports on the Minto Mine is presented in Table 1-1.

Table 1-1 Minto Project Information List

Report Title / Topic	Author	Date
Initial Environmental Study of the Minto Project. Prepared for Wright Engineers Ltd.	Division of Applied Biology, B.C. Research	1976
Report to Wright Engineers Ltd. on 1976 Geotechnical Investigations, Minto Project Feasibility Study	Golder and Associates	1976
An Assessment of the Pre-Development Water Quality and Biological Conditions in the Water Shed Around the Minto Orebody	Fisheries and Environment Canada, Environmental Protection Service	1977
The Minto Copper Deposit, Yukon Territory: A Metamorphosed Orebody In The Yukon Crystalline Terrane", An M.Sc. Thesis, Queen's University, Kingston, Ontario, Canada	Pearson, W.N.,	1977
The Minto Copper Deposit, Yukon Territory, A Metamorphosed Orebody in the Yukon Crystalline Terrane. In Economic Geology, Vol. 74, p. 1577-1599	Pearson, W.N., Clark, A.H.	1979
The Minto Project, Yukon, Mineral Inventory Review Minto Explorations Ltd, Vancouver, BC	H.L. Klingmann and J.S. Proc	1994
Minto Project, Initial Environmental Evaluation, Supporting Volume I, Development Plan. Prepared for Minto Explorations Ltd.	Hallam Knight Piesold Ltd.	1994
Minto Project, Initial Environmental Evaluation, Supporting Volume II, Environmental Setting. Prepared for Minto Explorations Ltd.	Hallam Knight Piesold Ltd.	1994
Minto Project, Initial Environmental Evaluation, Supporting Volume III, Socioeconomic Description and Impact Assessment. Prepared for Minto Explorations Ltd.	Hallam Knight Piesold Ltd.	1994
Survey of Firekilled Fuelwood Harvest Potential, Minto Creek, Yukon, Prepared for Minto Explorations Ltd. Vancouver, BC	John Gibson	1994
"Development of the Minto Project Process Design", Project No. 8553-15	Kilborn Engineering Pacific Ltd.	1994
An Impact Assessment of the Minto Project. Memo from the Selkirk First Nations to the Northern Affairs Program	Magrum	1994

Report Title / Topic	Author	Date
Minto Project Prospectus prepared for Minto Explorations Ltd.	Pearson, Hofman and Assoc. Ltd.	1994
Minto Area Archaeology And History - Final Report of the Minto Archaeological Impact Assessment Project	Sheila Greer, Edmonton	1994
Development of the Minto Project Process Design	Kilborn Engineering Pacific Ltd.	1994
Geotechnical Evaluation – Minto Core. Internal report submitted to Minto Explorations Ltd.	Steffen, Robertson and Kirsten Ltd.	1994
Technical Feasibility Study - Thickened Tailings Disposal System – Minto Project - Phase 1. Laboratory Tailings Characterization Tests, Project 94-608	E.I Robinsky Associates Limited, Consulting Engineers	1995
Geotechnical Design Tailings/Water Dam, Minto Project, Yukon	EBA Engineering Consultants Ltd., Edmonton, Alberta, 0201-95-11509	1995
Metallurgical Test Work And Mill Design Criteria", Minto Project, Yukon	H.L. Klingmann	1995
The Minto Project, Yukon, Feasibility Study – May 1995	H.L. Klingmann & J.S. Proc, Vancouver, BC	1995
Minto Project, Initial Environmental Evaluation, Supporting Volume IV, Environmental Mitigation and Impact Assessment. Prepared for Minto Explorations Ltd.	Hallam Knight Piesold Ltd.	1995
Minto Project, Application for Land Use Permit YA5F045. Submitted as reference to the YWB	Minto Explorations Ltd.	1995
Minto Explorations Ltd., Minto Project, Proposed Designs for Big Creek Crossing, Minto Creek Crossing, Yukon River Barge Landings	N.A. Jacobsen, P. Eng., Civil Engineering Consultant Whitehorse, Yukon.	1995
Minto Explorations Ltd., Access Road Design Report	Yukon Engineering Services, Whitehorse, Yukon	1995
Evaluation of Grinding Test work for the Minto Deposit and Recommendations for Grinding Equipment Sizing at 1,500 stpd	Fluor Daniel Wright Ltd.	1995
Environmental Assessment Screening Report and Project Summary: Land Use Permit Application YA5F045 and Water Licence Application MS95-013	Department of Indian Affairs & Northern Development (DIAND) and YWB	1996
Minto Waste Rock Stability Evaluation. EBA File 0201-96-11509	EBA Engineering Consultants Ltd.	1996
Environmental Assessment Screening Report and Project Summary: Land Use Permit Application YA5F045 and Water Licence Application MS95-013	DIAND and Yukon Territory Water Board	1997
Environmental Assessment Screening Report: Minto Explorations Ltd. Minto Property. Whitehorse, Yukon Territory	DIAND and Regional Environment Review Committee	1997
Revised Preliminary Dam Design, Minto Project, YT	EBA Engineering Consultants Ltd., Edmonton, Alberta	1997
Construction Quality Assurance Manual for Waste Dumps, Tailings/Water Dam, Mill Water Pond and Diversion Ditch, Minto Project, Yukon", Project No. 0201-95-11509	EBA Engineering Consultants Ltd., Whitehorse, Yukon	1997
Design Brief Tailings/Water Dam, Minto Project, Yukon Project No. 0201-95-11509	EBA Engineering Consultants Ltd., Whitehorse, Yukon	1997
Minto Project, Application for Water Licence QZ96-006. Submitted to the YWB	Minto Explorations Ltd.	1997

Report Title / Topic	Author	Date
Review of Hydrology for Minto Project	Remi J.P. Allard Rescan Environmental Services Ltd.	1997
Geotechnical Evaluation - Proposed Main Waste Dump - Minto Project - Yukon Territory - 0201-95-11509	EBA Engineering Consultants Ltd., Edmonton, Alberta	1998
Minto Project, Geology, Ore Reserves & Mine Design	H.L. Klingmann and J.S. Proc	1998
Mill Water Pond, Minto Project	H.L. Klingmann and J.S. Proc	1998
Grout Curtain For The Tailings/Water Dam	H.L. Klingmann and J.S. Proc	1998
Minto Explorations Ltd., Minto Project, 6102-01, Design Progress at June 1998. Vancouver, BC	Rescan Engineering Ltd.	1998
Minto Project, Yukon Airborne Geophysics Interpretation, Geological Synthesis and Target Generation	Steffen, Robertson and Kirsten (Canada) Ltd., Bartsch, R.	1999
Cumulative Effects Assessment, Minto Project. Prepared for Minto Explorations Ltd.	Access Consulting Group	1999
Construction Monitoring Report Grout Curtain for Tailings/Water Dam, Minto Project, Yukon. Prepared for Minto Explorations Ltd.	EBA Engineering Consultants Ltd.	1999
Revised Construction Specification Tailings/Water Dam Minto Project, Yukon. Prepared for Minto Explorations Ltd.	EBA Engineering Consultants Ltd.	1999
Minto Project, Annual Report for Water Licence QZ96-006. Submitted to the YWB	Minto Explorations Ltd.	1999
Minto Project, Yukon Airborne Geophysics Interpretation, Geological Synthesis and Target Generation	Steffen, Robertson and Kirsten (Canada) Ltd., Bartsch	1999
Minto Optimization Study: SAG Milling Throughput Studies for a Two-Stage Grinding Circuit	Fluor Daniel Wright Ltd.	1999
Minto Project, Yukon – Site Inspection & Compilation of Environmental Information. Prepared for DIAND, Renewable Resources Waste Management Program	Access Consulting Group	2000
Minto Project, Annual Report for Water Licence QZ96-006. Submitted to the YWB	Minto Explorations Ltd.	2000
Minto Project, Annual Report for Water Licence QZ96-006. Submitted to the YWB	Minto Explorations Ltd.	2001
Minto Project, Decommissioning and Reclamation Plan	Minto Explorations Ltd.	2001
Metallurgical Test Work & Mill Design	Minto Explorations Ltd.	2001
Minto Project, Annual Report for Water Licence QZ96-006. Submitted to the YWB	Minto Explorations Ltd.	2002
Minto Project Summary	Minto Explorations Ltd.	2003
Minto Project, Annual Report for Water Licence QZ96-006. Submitted to the YWB.	Minto Explorations Ltd.	2003
Minto Project, Yukon. Care and Maintenance & Interim Closure Plan. Prepared for Minto Explorations Ltd.	Access Consulting Group	2003
Minto Project, Annual Report for Water Licence QZ96-006. Submitted to the YWB.	Minto Explorations Ltd.	2004
Early Jurassic porphyry (?) copper (-gold) deposits at Minto and Williams Creek, Carmacks Copper Belt, western Yukon. In Yukon Exploration and Geology 2003	Tafti, R. and Mortensen, J.K.	2004

Report Title / Topic	Author	Date
Minto Project, Annual Report for Water Licence QZ96-006. Submitted to the YWB	Minto Explorations Ltd.	2005
Technical Report on the Minto Project, for Sherwood Mining Corporation, July 15, 2005	Orequest Consultants, Cavey, G., Gunning, D. LeBel, J.L., and Giroux Consultants Ltd., Giroux, G.	2005
Technical Report on the Carmacks Copper Project, Whitehorse Mining District, Yukon Territory for Western Copper Corp.	Cavey G., Gunning D., Clegg J.	2006
Report on the Geological Exploration Programs, Results and Perspectives, STU Claims, Hoochekoo Creek Area, Whitehorse Mining District. Internal Minto Explorations report.	Rus, John	2006
An Assessment of Metallurgical Response – Global & Variability Composites	G&T Metallurgical	2006
Minto Project: Updated Projections of Mill Throughput with One Additional Ball Mill (ex. Asarco Silverbell)	DJB Consultants, Inc., (June 2005) with Addendum (June 2006)	2006
Geotechnical Design Ice-Rich Overburden Dump Minto Mine, Minto, YT	EBA Engineering Consultants Ltd.	2006
Minto Project, 2005 Annual Report for Water Licence QZ96-006. Submitted to the YWB	Minto Explorations Ltd.	2006
Minto Geotechnical (Open Pit) Feasibility Study. EBA File: 120017.	EBA Engineering Consultants Ltd.	2006
Detailed Feasibility Study for the Minto Project	Minto Explorations Ltd.	2006
Phase I Water Treatment Contingency Plan	Access Consulting Group	2006
Minto Mine Flow Monitoring Plan	Access Consulting Group	2006
Construction/Operation Plan and CQA Manual, Ice-rich Overburden Dump, Minto Mine, Yukon	EBA Engineering Consultants, Ltd.	2006
Detailed Decommissioning and Reclamation Plan, Minto Project, YT	Access Consulting Group, Minto Explorations Ltd.	2006
Minto Copper Project – Site Hydrology Update	Clearwater Consultants Ltd.	2006
Geotechnical Design Report, “Dry” Stack Tailings Storage Facility, Minto Mine, Yukon	EBA Engineering Consultants, Ltd.	2007
Minto Mine Tailings Management Plan	Access Consulting Group	2007
Environmental Status Report, Skagway Ore Terminal, Summary of Previous Environmental Reports with Recommendations for Future Work	Access Consulting Group	2007
Skagway Ore Terminal, Phase II Environmental Baseline Study Report	Access Consulting Group, Gubala, C.P.	2007
Minto Project, 2006 Annual Report for Water Licence QZ96-006 and QML-0001. Submitted to the YWB and YG EMR	Access Consulting Group, Minto Explorations Ltd.	2007
Environmental Effects Monitoring, First Study Design, Minto Project, YT	Access Consulting Group, Minnow Environmental Inc.	2007
Detailed Decommissioning and Reclamation Plan, Rev.1, Minto Project, YT	Access Consulting Group, Minto Explorations Ltd.	2007
Operation, Maintenance and Surveillance Manual, Dry Stack Tailings Storage Facility, Minto Mine, YT	EBA Engineering Consultants, Ltd.	2007
Minto Project, 2007 Annual Report for Water Licence QZ96-006 and QML-0001. Submitted to the YWB and YG EMR	Access Consulting Group, Minto Explorations Ltd.	2008

Report Title / Topic	Author	Date
Project Proposal and QML Amendment Application; Mining and Milling Rate Increase, Minto Project	Access Consulting Group, Minto Explorations Ltd.	2008
Minto Copper Project - Water Balance Model	Clearwater Consultants Ltd.	2008
Geotechnical Design, Proposed Reclamation Overburden Dump, Minto Mine, Yukon	EBA Engineering Consultants, Ltd.	2008
Preliminary Design, Proposed Southwest Waste Dump, Minto Mine, Yukon	EBA Engineering Consultants, Ltd.	2008
Geotechnical Design, Proposed Southwest Waste Dump, Minto Mine, Yukon	EBA Engineering Consultants, Ltd.	2008
Pre-feasibility Geotechnical Evaluation, Phase IV, Minto Mine	Steffen, Robertson and Kirsten (Canada) Ltd.	2009
Tailings Risk Assessment, Minto Project, Yukon Territory	Steffen, Robertson and Kirsten (Canada) Ltd.	2009
Environmental Effects Monitoring, First Interpretive Report, Minto Project, YT	Access Consulting Group, Minnow Environmental Inc.	2009
Evaluation of the Background Water Quality of Minto Creek and Options for the Derivation of Site-Specific Water Quality Objectives	Minnow Environmental Inc.	2009
Minto Copper Project - Water Balance Model	Clearwater Consultants Ltd.	2009
Reclamation Research Program, 2007 Activities	Access Consulting Group	2009
Reclamation Research Program, 2008 Activities	Access Consulting Group	2009
Minto Project, 2008 Annual Report for Water Licence QZ96-006 and QML-0001. Submitted to the YWB and YG EMR	Access Consulting Group, Minto Explorations Ltd.	2009
Phase IV Waste Management Plan, Minto Mine, YT	EBA Engineering Consultants, Ltd.	2010
Phase IV Development Fisheries and Aquatic Baseline Study Summary, Minto Mine, YT	EBA Engineering Consultants, Ltd.	2010
Environmental Baseline Studies Wildlife Report	EBA Engineering Consultants, Ltd.	2010
Environmental Baseline Ecosystems and Vegetation Report	EBA Engineering Consultants, Ltd.	2010
Phase IV Tailings Management Plan, Minto Mine, YT	EBA Engineering Consultants, Ltd.	2010
Minto Mine – Site Water Balance Update 2010	Clearwater Consultants Ltd.	2010
Minto Mine: Groundwater Baseline Conditions	SRK Consulting Inc.	2010
Minto Project, 2009 Annual Report for Water Licence QZ96-006 and QML-0001. Submitted to the YWB and YG EMR	Access Consulting Group, Minto Explorations Ltd.	2010
Minto Mine Expansion – Phase IV, ML/ARD Assessment and Post-closure Water Quality Prediction	SRK Consulting Inc.	2010

1.3 Statutory and Regulatory Responsibilities

1.3.1 Government Environmental Assessment and Permitting Regime

Versions 1 and 2 of this Plan were developed to meet the regulatory requirements as stipulated in the Company's Water Use Licence and the Quartz Mining Licence. Closure methods and details associated with the Phase IV Expansion have recently been the subject of environmental assessment by Yukon Environmental and Socio-economic Assessment Board as part of the Project Proposal by MintoEx – *Phase IV Mine Expansion, Minto Mine, Yukon Territory, November 2010*. This document is an integration of the closure plans for both the currently approved and Phase IV developments.

The Company has taken a proactive approach towards its regulatory responsibilities by meeting with various government regulatory agencies, boards, and local First Nations. Periodic meetings are held to provide project updates, and consultation with all parties was a key part of the development and review of the Phase IV Expansion proposal. A similar approach is planned for implementation of the Plan.

Prior to implementing the closure measures described in this Plan, meetings will be held with the SFN and the local community to ensure that First Nations and community interests and concerns are addressed and included in the closure planning of the Minto mine. Also prior to implementation of the plan, the YG, Water Resources and Mining Land Use Divisions will be informed of the Company's intentions. Meetings will also be held with Environment Canada, Environmental Protection, Department of Fisheries and Oceans, Environmental Health, and Government of Yukon Departments of Environment and Occupational Health and Safety to apprise regulators of planned site activities. These meetings will ensure that regulatory agencies' concerns with closure implementation are met.

1.4 Regulatory Approvals

Several government agencies and SFN are involved in reviewing, assessing, authorizing and monitoring the Minto Mine. The relevant legal, regulatory and guideline-based instruments include:

- Selkirk First Nation Cooperation Agreement;
- Metal Mining Effluent Regulations (MMER) of the federal Fisheries Act;
- Effluent Characterization;
- Environmental Effects Monitoring;
- Type A Water Use Licence QZ96-006 ("WUL QZ96-006"), issued in April 1998 and including subsequent amendments, and valid until June 30, 2016;
- Type B Water Use Licence MS04-227 ("WUL-B") issued in August 1996 and valid until June 30, 2016;
- Quartz Mining Licence QML-0001 ("QML-0001") issued in October 1999 and subsequent amendments and valid until June 30, 2016;
- Mining Land Use Permit;
- Fish Collection Permits;
- Waste Management Facility Permits:
- Multi-Use Land Treatment Facility Permit;
- Special Waste Permit;
- Commercial Dump Permit; and
- Air Emissions Permit.

In accordance with these instruments, MintoEx has submitted operational and monitoring plans including but not limited to:

- Engineering Plans and a Construction Quality Assurance Manual for the Water Storage Pond dam;
- Spill Contingency Plan;
- Main Waste Rock Dump Design Plan;
- Southwest Waste Dump Design Plan;
- Reclamation Overburden Dump and Ice-Rich Overburden Dump Design Plans;
- Dry Stack Tailings Storage Facility Design and Management Plans;
- Mill Water Pond Design;
- Flow Monitoring Plan;
- Water Treatment Contingency Plan;
- Provisional Designs and Plans supporting Phase IV Development; and
- Decommissioning and Reclamation Plan.

1.5 Document Organization

Section 1 of this document introduces the philosophy and scope for the decommissioning and reclamation plan for the site and the Company's corporate background. Information is provided on the property and its history and a discussion of regulatory responsibilities regarding closure.

Section 2 provides a brief overview of the history of the Minto mine up until the mine opening in addition to a summary of activities associated with the Phase IV expansion.

Section 3 provides a brief summary of the environmental setting for the mine.

Section 4 presents the reclamation strategy for the project, including reclamation objectives and reclamation research planning. The research will focus primarily on revegetation efforts and success.

Section 5 presents the implementation schedule for the plan.

Section 6 outlines the details of the Company's decommissioning and closure plan, and the activities to be followed at closure. The information is presented in a format that briefly describes the mine "reclamation component" and then presents closure issues in the context of physical and chemical stability. Closure measures are then presented in detail and in summary form as the basis for the closure cost estimates.

Section 7 deals with post closure site management plans and activities. This section presents the environmental management measures proposed for the decommissioning and post closure period, and proposes temporary closure issues and measures.

Section 8 provides an updated cost estimate for implementing the closure plan at different times during the life of mine.

Section 9 provides the document closure and signatures.

Section 10 provides report references.

1.6 Acknowledgements

This Plan benefited from input by the following companies:

Access Mining Consultants Ltd. – Developed Revision 1 of this Plan and provided support to Revision 2 including many of the drafting requirements.

Clearwater Consultants Ltd. – provided closure conditions water balance model to support water chemistry predictive modeling for closure conditions.

EBA Engineering Consultants Ltd. – Assisted with development of Revision 2 of this Plan, and developed Phase IV conceptual closure plan which has been incorporated into this revision in addition to providing drafting support and technical feedback on this revision of the report.

Pelly Construction Ltd. – Provided valuable input to unit costing and overall logistics on how closure methods could be implemented.

Selkirk First Nation – Provide ongoing input into the development of closure objectives based on current and potential future use of the project area, and review of all elements of Phase IV closure before and during environmental assessment.

SRK Consulting Ltd. – Provided input into the project description, groundwater hydrologic conditions, geochemical characterization and predictive water chemistry modeling for closure.

2 Project Description

2.1 Project Location and Background

The Minto Project is a copper-gold-silver project located on the west side of the Yukon River approximately 75 km (47 miles) north-northwest of Carmacks, Yukon Territory. The mine site and access road lie within the traditional territory of the SFN and comprises part of land claim settlement parcels R-6A, R-44A (Type A settlement lands) and R-40B. The Company concluded a comprehensive Cooperation Agreement with the SFN on September 16, 1997. This agreement is still in effect, however an amended agreement is being negotiated.

The Minto Property is centered at approximately 62°37’N latitude and 137°15’W longitude (NAD 83, UTM Zone 8 coordinates 6945000N, 384000E). The Minto Project consists of 284 claims. There are 120 pending quartz claims, 99 quartz claims and 65 quartz claims under lease. The 100% registered owner of the claims and leases is MintoEx. The property is accessible by crossing the Yukon River at Minto Landing. Barge landings have been constructed for ice-free crossing and an ice bridge is used upon freeze-up of the Yukon River.

Copper deposits were first discovered in 1970 and claims were staked in 1971. Extensive exploration yielded the first significant drill intersection in July of 1973. The Minto and DEF claims and leases cover an area of approximately 10 square miles.

Preliminary site development was initiated at the property in 1996 and continued during the following decade with the Company commencing operations in October 2007. The ore deposits are mined using conventional open pit truck and loader operations and processed in a mill plant on site. A 200 person camp is presently near capacity with the mine construction management, contractors and support staff.

Figure 2-1 and Figure 2-2 present visual depictions of the general project location within the Yukon and the project area overview.

Table 2-1 provides an overview of the project area and environmental setting information for the study area. This table provides physical project location information, geographic reference, access route, watershed drainage, special designations, and key environmental features within the study area. The information has been extracted from a number of documents, including previous Canadian Environmental Assessment Act (CEAA) and Yukon Environmental Assessment Act (YEAA) screenings, which are all previously summarized in Table 1-1.

Table 2-1 Project Area Overview and Environmental Setting

Project Area Attribute	Description
Region:	Yukon
Topographic Map Sheet:	NTS 115 I/10, 115 I/11
Geographic Location Name Code:	Minto Project
Latitude:	62° 36' N
Longitude:	137° 15' W
Drainage Region:	Yukon River
Watersheds:	Yukon River, Big Creek, Wolverine Creek, Dark Creek, and Minto Creek.
Nearest Community:	Pelly Crossing, Yukon, approx. 33 km north on Klondike Highway.
Access:	Klondike Highway, Barge crossing on Yukon River at Minto Landing, Minto mine access road. Airstrip on site.
Traditional Territory:	Northern Tutchone, Selkirk First Nation peoples. Traditional use for hunting, trapping and fishing.
Surrounding Land Status:	Selkirk First Nation Settlement Lands and Federal Crown Land.
Special Designations:	Lhutsaw Wetland Habitat Protection Area located approx. 17 km NE of Minto Landing (outside the project area).
Ecoregion:	Yukon Plateau (Central) - Pelly River Ecoregion.
Study Area Elevation:	Rolling hills above mine site at 1131 metres to 600 metres at the Yukon River Valley bottom.
Site Climate:	Temp. ranges from –30.9°C (Jan. 1994) to 15.7°C (July.2007). Mean annual temp. of approximately -5.2°C based on site data from a weather station processed to date. Mean annual precipitation at site is 341 mm.
Vegetation Communities:	Riparian, black spruce, white spruce, paper birch, lodgepole pine, buck brush/willow and ericaceous shrubs, feathermoss, sedge, sagewort grassland, mixed, aspen, balsam, and sub-alpine. Discontinuous permafrost is present on site. Site has been subject to recent forest fires.

Project Area Attribute	Description
Wildlife Species:	Moose, caribou, Dall sheep, mule deer, grizzly and black bear, varying hare, beaver, lynx, marten, ermine, deer mouse, fox, mink, wolverine, least weasel, wolf, squirrel, porcupine coyote, muskrat, otter and wood frog. Bird species include: spruce, blue, ruffed, and sharptail grouse, waterfowl, raptors, and a variety of smaller birds.
Fish Species:	In the Yukon River, chinook, coho, and chum salmon, rainbow trout, lake trout, least cisco, bering cisco, round whitefish, lake whitefish, inconnu, arctic grayling, northern pike, burbot, longnose sucker and slimy sculpin; In Big Creek, Chinook and chum salmon, arctic grayling and whitefish species; In Wolverine Creek, chinook salmon, arctic grayling, and slimy sculpins; In Minto Creek and project area watershed (lower reaches only), slimy sculpin, round whitefish, arctic grayling and Chinook salmon. During research in 2010, it was observed that Chinook salmon use the lower reaches of the Creek in a highly transient manner, though it is unlikely that the area is used for spawning or overwintering habitat (further discussion in Phase IV Expansion, Project Proposal).
Known Heritage Resources:	East side of Yukon River in the vicinity of Minto Landing four historic sites designated KdVc-2 (Minto landing), KdVc-3 (Minto Resort), KdVc-4 (Old Tom's Cabin), and KdVD-1 (Minto Creek).

2.2 Current Status

The Minto Mine is currently in full production, but nearing the end of the mining and milling schedule for the Main Pit deposit. Water quality monitoring is conducted in accordance with Water Use Licence QZ96-006. Figure 2-3 presents an overview of current site conditions which generally reflects the site at the completion of Main Deposit mining, and the starting point for Phase IV.

2.3 Planned Phase IV Activities

The following activities are planned as part of Phase IV:

- Development, mining and milling of materials from the proposed Area 2 open pit which contains 3,192 Kt of ore plus 25,980 Kt of waste;
- Development, mining and milling of materials from the proposed Area 118 open pit which contains 88 Kt of ore plus 639 Kt of waste;
- Development, mining and milling of materials from the proposed Area 2 and Area 118 underground areas which contain approximately 1,541 Kt of ore and 341 kt of waste;
- Expansion of the southwest waste rock and reclamation overburden dumps;
- In-Pit deposition of tailings from Phase IV deposits (Area 2 and Area 118);
- In-Pit deposition of tailings sourced from Main Pit stockpiled ore following completion of mining in Main Pit;
- Construction of the South Wall buttress in Main Pit;
- Construction of the Mill Valley Fill expansion;
- Extension of the camp pad;
- Operational water management; and
- Decommissioning and reclamation of infrastructure components, as and whenever possible to reduce site liability.

The open pit mining will be conducted using standard blast and haul open pit mining practices. Milling will be conducted using the existing infrastructure (a conventional crushing, grinding and flotation process plant utilizing standard unit processes and equipment). The plant currently processes 3,600 tpd (metric tonnes per day).

Figures 2-3 through 2-5 show the Phase IV development at Year 0 (Current Conditions), Year 2 (January 2013) and End of Mine life (2016). Additional details and information on the project are contained in the Minto Mine Expansion - Phase IV Project Application submitted to YESAA in August 2010.

3 Environmental Setting

Table 2-1 provides a summary of the key environmental features near the project area. Note that forest fires have affected large parts of the Minto Creek basin and surrounding areas during the past twenty years, and as recently as the summer of 2010. Baseline environmental reports have been prepared to document and describe the existing environmental setting of the site. These baseline reports are listed in Table 1-1. Readers of this document are referred to those reports should additional information be required.

3.1 Closure Water Quality Predictions

The Company has developed a predictive water chemistry model in order to better understand what the potential water quality discharging from the site would be at closure. The predictive water chemistry model is based on site monitoring data and the ongoing geochemical characterization program which includes humidity cells conducted on appropriate material types. A copy of the results of the predictive water quality model for the site is included in Appendix A of this report for both unmitigated and mitigated scenarios. The geochemical characterization (SRK, 2010a) and baseline water quality reports suggest that without mitigations, at closure there will be seasonally elevated metal concentrations for a number of parameters (aluminum, copper and cadmium) with copper being the primary contaminant of concern.

The initial version of the predictive water quality model was developed to predict closure water quality without any closure mitigations applied. This allowed for an understanding of the potential “worst case” water quality that would be seen discharging from the site and also which mine components contributed to the major metal loadings. The water quality model indicated that approximately 79% of the predicted post closure metal loadings were derived from the Southwest Dump (52%), the Main Waste Dump (14%) and the Dry Stack Tailings Storage Facility (13%). This information has been used in the development of the source control closure measures for these facilities that is described in the next sections of this report.

In order to understand the effects of mitigation, the model was revised to simulate the application of engineered covers to the mine infrastructure with significant metal loadings. The long-term performance of the engineered cover systems was assumed to be on the order of an 80% reduction in metal loadings for benches and a 50% reduction in metal loadings for faces. Passive treatment systems were assumed to be seasonally effective with a performance on the order of 75% reduction in metal loadings during the freshet period. A review of literature on passive and semi-passive treatment systems indicates that they can be highly effective at removing metals (>90%) provided they are appropriately designed to address flow fluctuations and potential short-circuiting of the flows (see Section 4.2.2). The assumed performance targets described above are therefore considered achievable based on a review of the available literature on these types of mitigation treatments.

The predictive model shows that the background water chemistry from the undisturbed catchment has the ability to significantly influence seasonal variations in the receiving environment water quality. All of the predicted exceedances of the site water quality objectives are controlled by undisturbed catchment background water quality concentrations with the exception of cadmium (May and September) and mercury (July). The magnitude of the cadmium concentration predicted for the months of May and September is below the revised Canadian Council of Ministers' of the Environment (CCME) cadmium criteria that are currently being considered for acceptance by that organization. Mercury is not used in the Minto processing and it is believed that any detections of this element are related to naturally occurring sources of mercury. Additional details on the predictive model and the results of the various scenarios considered for this project are contained in Appendix A.

4 Reclamation Planning

This section of the Plan provides reclamation objectives and the overall reclamation strategy for the Minto site. Also provided is information regarding planned reclamation, revegetation research programs and details and observations on reclamation and revegetation to date. The Company is committed to implementation of reclamation methods that will mitigate potential adverse effects to the receiving environment that have been predicted by the water quality model.

A systematic approach to decommissioning and closure reclamation has been developed for the Minto project. Progressive reclamation measures will be implemented where possible during mine construction and operations. This approach will not only provide valuable reclamation success feedback for use in advanced/final closure, but progressive reclamation will reduce final reclamation liability and costs and shorten the overall reclamation implementation schedule. These progressive efforts will also help reduce slope erosion through physical slope stabilization of revegetation efforts, enhancing ultimate reclamation success.

The use of active treatment is discussed at the end of this section. Active treatment is considered a worst-case final fall-back mitigation to potential water quality impacts from the site and should be utilized only if the mitigative measures described in Section 4.2 are not effective in reducing metal loadings to the receiving environment.

4.1 Reclamation Objectives

The primary objectives of the closure and reclamation of Minto Mine are:

- To have a closure planning process that seeks input from the SFN, understands the input received and incorporates the input into closure planning decisions;
- To protect the health of people pursuing traditional activities including hunting, fishing, trapping, camping and collection of plants for food, medicinal or cultural purposes;
- To protect people from safety risks when they are pursuing traditional activities including hunting, fishing, trapping, camping and collection of plants for food, medicinal or cultural purposes;
- To protect the environment (including land, air, water, plants, animals fish and other environmental components and their interrelationships) from long term effects caused by the mine activities and facilities;
- To return the mine site and affected areas to a state similar to surrounding lands so that people can pursue traditional activities the same as they did before mining, including hunting, fishing, trapping, camping and the collection of plants for food, medicinal or cultural purposes;
- To protect the environment from long-term effects caused by post-closure access to the mine area;
- To protect the environment from effects of earthquakes, floods, climate change and other natural events on related mine structures;
- To have effective management and control structures in place during operation, closure and post-closure to provide:
  - Adequate financial resources to carry out all closure activities including plan implementation and long-term activities;
  - Adequate flexibility during closure and post-closure to allow adaptation of activities in order to address unexpected performance and events; and
  - Consideration of The Company's long-term desire to "walk away" from the site under conditions acceptable to SFN and with adequate resources provided to address long term requirements.
- To minimize long term activities by ensuring long term chemical and physical stability of mining components and disturbed areas;
- To confirm the effectiveness of closure measures by monitoring the site after closure;
- To undertake mine planning incorporating progressive reclamation;
- To provide short and long term slope stabilization and erosion control on linear and non-linear disturbances;
- To ensure the long-term chemical stability of residual mining components and their effects on water quality draining the property;
- To ensuring the long-term physical stability of key structures such as the waste dumps and the diversion and drainage ditches; and
- To work towards a passive closure scenario for most or all mine components.

The overall goal of closure at the Minto site is to leave the area as a self-sustaining ecosystem, ensuring that land use after closure is compatible with the surrounding lands, and that the site vegetation returns to a state as near as possible to that in existence prior to mining activities. Operations phase material characterization programs and the application of passive mitigation treatments such as engineered covers to reduce metal loadings from mine infrastructure components are the primary means by which the Company proposes to achieve this goal.

These closure objectives are reflective of the closure objectives laid out for the licensee to achieve in Schedule B of the Quartz Mining Licence QML-0001 "Terrestrial Reclamation Standards for the Minto Mine". These standards were derived from the YG's Reclamation and Closure Policy as well from a submission from the SFN Lands and Resources Department which represents the interests of SFN members.

4.2 Reclamation Toolbox

The Company has adopted a toolbox approach to reclamation methods in order to ensure that the reclamation objectives identified in the previous section can be met. The toolbox approach to reclamation involves investigation into the use of different reclamation methods depending on the specific issue being addressed. Most of the methods in the reclamation toolbox are standard practice (e.g. recontouring, seed and fertilizer application, scarification of compacted surfaces) and do not require detailed explanation of their application.

The remainder of this section describes toolbox techniques and methods that are specific to addressing potential project effects on water quality. These techniques and methods focus primarily on passive methods of reducing metal loadings to the receiving environment. The design and application of these reclamation measures will be dependent on the results of ongoing reclamation research and field trials that are to be conducted during mine operations.

4.2.1 Source Control

Source control is intended to be the primary control for the reduction of metal loadings to the receiving environment through limiting the access of water to materials known to have metal leaching issues. Source control includes such measures as operational characterization and materials handling programs, sub-aqueous disposal, engineered cover systems and encapsulation. Source control measures that are proposed for Minto Phase IV will primarily be a combination of operational characterization and materials handling programs, sub-aqueous disposal, engineered cover systems and passive water or semi-passive treatment strategies. Many of these strategies will be refined through the reclamation research program, which is further detailed in Section 4.6.1.

4.2.1.1 Operational Materials Characterization and Materials Handling Plans

Materials characterization allows mining companies to understand the different ore and waste material types present at a site and develop special handling plans based on any identified environmental concerns associated with each material type. Minto tests all of its development rock in advance of the materials being removed from the active mining face. The waste rocks are characterized based on the acid rock drainage potential and the contained copper content.

Waste Rock

The use of copper content for the development of the waste rock classification system is supported by the association of increased abundance of copper sulphide mineralization with increasing mineralization of the deposit. A review of the geologic database indicates that over 90% of the total contained metals within the geological materials at this site occur within materials with a copper content of greater than 0.1%. It should be noted that the lack of materials characterization and handling programs during the initial phases of mining at the site resulted in potential metal leaching material being placed into the waste rock dumps which have a larger surface area. Geochemical characterization work conducted by SRK in support of Phase IV identified the need for materials characterization and handling program to ensure that waste materials with the potential for metal leaching could be identified and stockpiled or disposed of in an appropriate manner.

Material handling plans are used to instruct the mining operation crews as to where the different rock classes may be placed. Minto has an established materials handling and classification system in order to identify ore and waste during operations. The current Minto waste materials handling procedure is summarized as follows:

- Drill cuttings from every blasthole are sampled, bagged, tagged, and sent for to the Assay Lab prior to blasting;
- A representative sample of the cuttings is assayed using atomic adsorption (AA) to determine the metal content: The Minto Assay Lab, under supervision of the Chief Assayer, has the ability to conduct copper, oxide, and silver assays;
- The assay results are sent to the Geology Department for interpretation;
- The Geology Department plots the results spatially, then draws polygons enclosing holes with similar assay results to identify regions of similar average grade;
- After blasting, the aforementioned polygons are laid out in the field by the Mine Surveyor working with the Production Geologist in order to inform Mine Operations of where the materials within a polygon are to be taken;
- Field layout is done with using stakes and flags of various predefined colors for ore bearing materials;
- Ore and waste are loaded out and dispatched to the appropriate locations based on the aforementioned flags;
- These locations are communicated to foremen and operators by the Production Geologist and under the direction of the Mine Foreman.

The current Minto materials handling procedure will be expanded during Phase IV development to include the identified waste categories. Table 4-1 contains the waste rock material classifications and handling plans that are proposed for use during Phase IV with the exception of the Area 1 pit buttress which is required to be constructed at the start of Phase IV.

Table 4-1 Waste Rock Classifications and Handling Plans

Material	Estimated Volume (Mm^3)	Handling Plan
Waste rock with no copper content	8.77	Material to be used for general construction fill at the site. No neutral metal leaching expected to occur.
Waste rock with contained copper content of less than 0.1%	0.36	Material to be placed into the waste rock dump or backfilled into the Area 118 pit. Minor neutral metal leaching may result from this material but is not expected to be significant due to the low metals content
Waste rock with a contained copper content from 0.1% to 0.3%	1.2 Mm^3 - volume	Material to be disposed with tailings into the Area 1 or Area 2 pit or else stockpiled in the Grade Bin Disposal Area for subsequent disposal at closure.
Waste rock with a contained copper content from 0.3% to 0.64%	1.35 Mm^3 - volume	Low grade ore material which will be milled at the end of mining.
Waste rock classified as Potentially Acid Generating based on geochemical characterization program	unknown	Material to be simultaneously disposed with tailings into the Area 1 pit for subsequent sub-aqueous disposal at closure.

The estimated volume of each waste rock material classification is based on the geologic block model for the site. This information shows that the Grade Bin Disposal Area (GBDA) will receive 2.55 Mm^3 of the total estimated 2.91 Mm^3 of waste rock with a copper content greater than 0.1%. The implementation of a materials handling program during Phase IV will allow the Company to segregate potential metal leaching material into the GBDA as opposed to the larger southwest waste dump. This will result in a reduced footprint and associated metal loadings during the operations phase.

Overburden

Overburden segregation is required for mine sites where there is a need to ensure that waste materials generated by stripping and other development activities are preserved for future reclamation activities. The implementation of source control at the Minto Mine will require a large volume of fine-grained materials for engineered waste cover systems. The reclamation overburden excavated from existing operations at the Minto mine have primarily been a silty sand with some amounts of fine grained materials. Segregation of overburden to date has only involved disposal of ice-rich material into a designated dump to minimize potential stability issues. No other efforts to segregate overburden have been conducted in the existing Reclamation Overburden Dump (ROD). A summary of the grain-size distribution from historical investigations conducted by EBA Engineering Consultants Ltd. (EBA) at the site are included in Appendix B and includes boreholes from the existing ROD.

The results of field investigations conducted in the Area 2 pit footprint show that approximately 50% of the overburden (approximately 1.89 Mm^3) to be stripped during Phase IV will be fine grained (silty or clayey) materials which will be suitable for cover construction. Appendix B contains the borehole logs and grain-size analyses for samples from the holes within the Area 2 pit footprint. Overburden stripped as part of Phase IV will be hauled to the Reclamation Overburden Dump (ROD) and placed into clearly defined sections of the dump based on the observations of the characteristics of materials observed in the digging face. Additional details on the fine-grained and coarse grained sections of the overburden dump are included in the Phase IV Waste Management Plan prepared by EBA (2010).

Supervision and testing of the overburden stripping will be required in order to achieve the required material segregation.

Samples of the material being shipped to the fine grained portion of the ROD will be collected and submitted for grain-size analysis to better characterize the materials for their use in cover construction. The frequency of sampling should be sufficient to provide information on major sources of fine-grained materials placed into this portion of the dump. It is anticipated that the total number of samples required to accomplish this will be from two to three hundred depending on the actual volume of fine-grained materials encountered during stripping.

4.2.1.2 Sub-aqueous Disposal

Sub-aqueous disposal involves the placement of materials underwater in order to their limit exposure to oxygen. This method of source control can be very effective given that the dissolved oxygen content of water is approximately 10,000 times less than for materials that are located above water.

The Company intends to use this method of source control for materials identified in Table 4-1 and also for tailings generated from milling following closure of the Dry Stack Tailings Storage Facility.

Flooding of waste rock in a pit lake will result in some initial flushing of metals as the materials become wetted but this can be actively treated prior to water being discharged from the pit. Once the waste rock and tailings within the pit has become flooded the movement of water through the flooded materials becomes controlled by diffusion which act to limit metal leaching.

Over time, the development of a fine sediment layer on the surface of flooded materials helps to seal off the materials and further limits their ability to contribute to metal loadings. The period immediately following the placement of soil covers onto waste dumps will potentially contribute to the development of sediment layers until such a time as vegetation becomes well established.

4.2.1.3 Engineered Cover Systems

Engineered cover systems are designed to reduce water infiltration into materials that are known to have either acid rock drainage or metal leaching potential. The use of cover systems in cold climates is an area of active study by the Mining Environment Neutral Drainage (MEND) program and MEND Report 1.65.1a (MEND, 2009) and 1.65.1b (MEND, 2010) contain considerable background literature on dump design considerations in addition to numerous examples of cover systems. The level of information available for each of these cover system varies and prevents a detailed comparison between these sites and the Minto Mine; however, these types of covers have been shown to work. Acid rock drainage is not considered to be an issue at the site; however, oxidation of sulphidic mineralization present in non-acid generating waste materials can result in increased metal loadings to the receiving environment due to the presence of copper bearing minerals in the waste.

The need for engineered cover systems at the Minto mine are based on the predictive water quality model developed for the site. The predictive model has been developed using conservative assumptions and as such it is considered to provide worst-case water quality predictions for the site at closure. This section describes two different styles of engineered covers that have been successfully applied at minesites and landfills in cold climates.

The infrastructure units that have been considered for source control are identified in Table 4-2 which also contains a summary of the design surface areas for these units at the Minto mine. This table shows that the majority of the surface area of these infrastructure units is associated with waste dump benches. The relatively large amount of dump benches compared to dump faces indicates that the application of engineered covers as a means of source control should be effective in reducing metal loadings to the receiving environment. The final surface of each waste dump can be controlled through final engineering design and effective construction of mitigative measures during operations to assist in water management. Select portions of the final dump surface may also be recontoured as required in preparation of the cover placement.

Table 4-2 Minto Mine Waste Dump and Tailings Facility Surface Areas

Area	Total Surface Area (m^2)	Bench Area (m^2)	Dump Face Area (m^2)	Percentage Benches
Dry Stacked Tailings Storage Facility	380,000	310,000	70,000	81.6%
Southwest Waste Dump	740,000	653,000	87,000	88.2%
Main Waste Dump	435,000	278,100	156,900	63.9%
Mill Valley Fill Expansion	102,000	80,100	21,900	78.5%

Store and Release (Evapotranspiration) Covers

Store and release or evapotranspiration (ET) covers have been successfully installed in the Yukon at the former Brewery Creek mine (Blue Dump) and are being tested as part of closure planning at the Faro Mine Complex. Monitoring information for the ET cover installed at the Blue Dump is approximately 7% annual infiltration in the 5 years since the lysimeter was installed.

The design of this type of cover system is based on water being stored in the soil until it can be transpired by vegetation or evaporated from the surface. There are two primary types of these covers:

- Monolithic – a single vegetated soil layer designed to retain water; and
- Capillary – a fine-grained soil layer overlying a coarse grained layer. The coarse grained layer acts as a capillary break with material below to address water that does seep through the cover and is not uptaken by vegetation

The average and calculated precipitation, lake evaporation and evapotranspiration rates for the Minto mine are shown in Table 4-3 (Clearwater, 2010).

Table 4-3 Climatic Information for Cover System Evaluation at the Minto Mine

Parameter	Calculated Average Annual Value	Average 2007 to 2009
Precipitation	341.4 mm	336.6 mm
Lake Evaporation	430.0 mm	440.7 mm
Evapotranspiration	215.0 mm	201.6 mm
Site Precipitation - Evapotranspiration	126.4 mm	135.0 mm

Table 4-4 shows the seasonal distribution of precipitation, evapotranspiration and evaporation for the site. This table shows that rainfall accounts for approximately 197.3 mm of the total precipitation occurring at the site.

Table 4-4 Seasonal Distribution for Relevant Climatic Variables at the Minto Mine

Month	Precipitation (mm)	Snowfall (mm)	Rainfall (mm)	Lake Evaporation (mm)	Evapotranspiration (mm)
April	16.4	13.0	3.4	12.0	6.0
May	24.2	0.0	24.2	83.0	41.5
June	40.0	0.0	40.0	119.0	59.5
July	57.7	0.0	57.7	112.0	56.0
August	41.7	0.0	41.7	80.0	40.0
September	30.1	0.0	30.1	24.0	12.0
October	29.0	29.0	0	0.0	0.0
November	27.0	27.0	0	0.0	0.0
December	23.6	23.6	0	0.0	0.0
January	21.9	21.8	0.1	0.0	0.0
February	16.4	16.4	0	0.0	0.0
March	13.7	13.6	0.1	0.0	0.0
Total	341.7	144.4	197.3	430.0	215.0

A comparison of Table 4.3 and 4.4 shows that the rainfall value for the site is less than the observed evapotranspiration based on the available record which indicates that water stored within the soil should be able to be successfully transpired by vegetation. The presence of frozen ground conditions which occur in this area from approximately October through May of each year further reduces the amount of rainfall that would infiltrate into the soil cover. Based on this review, the climate data supports the choice of a store and release type of cover system as a source control measure option at the Minto mine.

Store and release cover systems have a design thickness determined by the required storage capacity of the soil layer. Higher contents of fine-grained materials within the soil layer increase the water storage capacity of the cover. The thickness of a store and release cover needs to be sufficient to retain moisture within the plant rooting zone but not too deep that the water is not available for evapotranspiration to occur. Reclamation research into vegetation species in the area of the Minto Mine indicates that the rooting depth for vegetation in this area typically ranges from 0.25 to 0.35 m.

For costing purposes it is assumed that a soil cover of approximately 0.5 m will be required for the store and release cover systems. Refining the thickness for the final soil cover requires the previously mentioned additional grain-size information from soils stripped during Phase IV in order to ensure the design provides the necessary cover system performance. Further refinement of the cover system design will be determined through a review of operational trials under the reclamation research program conducted during Phase IV. Additional detail on these trials is provided in Section 4.6.1.

Low Permeability (Barrier) Cover Systems

Low permeability or barrier cover systems make use of a compacted or low permeability layer to minimize infiltration into the underlying media. The former Arctic Gold & Venus minesites are northern examples of these types of cover systems. Water that infiltrates into the cover flows through the soil as shallow groundwater before seeping from the base of the cover system. The construction of these types of cover systems requires an abundant source of clay-rich borrow materials which are not readily available at the Minto Mine. The use of geosynthetics and other synthetic materials is possible for creating low permeability layers in areas where there is insufficient fine-grained borrow materials; however, the use of synthetic materials to create a low permeability cover layer at the site is not considered to be feasible for this site due to:

- The large surface area that could potentially require covering under the source control program;
- Logistic concerns associated with placement of these materials onto the surface of the waste dumps;
- Insufficient local volumes of suitable fine grained materials for constructing the low permeability barrier layer; and
- The cost of synthetic liners can range on the order of $12-$15 per square metre of installed liner which is seen as being cost prohibitive.

Frozen Base Cover System

Thermal modeling of the DSTF by EBA has shown that the current construction practices and placement schedules are able to promote freezing of the placed tailings. Cover trials will be initiated on the DSTF in order to determine if the same placement practices can be used to promote frozen granular soils. Should this be shown to be feasible then there is potential for the development of a frozen soil cover system on the surface of the DSTF. The cover thickness would be designed to ensure that the bottom layer of the cover was maintained in a frozen state in order to minimize infiltration. The annual active layer would be entirely within the upper soil layer of the cover.

Construction Compaction of the Waste Rock Dump for Closure Considerations

The surfaces of the waste dumps are already substantially compacted as a result of trafficking by the heavy mining equipment during dump construction. This operational compaction is considered to be favourable for closure in that it will greatly assist in reducing infiltration into the dumps and should enhance the performance of the store and release cover during the initial stages of vegetation development on the covers. The Phase IV WMP (EBA, 2010) contains additional information on the construction specifications for the final surface of the waste rock dumps. These specifications include:

- Construction of the final surface to an approximate grade of 2% to promote shedding of water from the dump surface;
- Maximizing trafficking of the surface of the dump by the mine construction fleet in order to better ensure compaction of the dump surface; and
- Additional compaction will be conducted as required since the proposed materials for the cover system construction are not filter compatible with the waste rock in an uncompacted state.

At closure, the surface layer of the dumps will not be scarified but instead be retained as a compacted layer in order to assist with minimizing infiltration into the dumps. Additional waste rock placement and compaction of dump surfaces will be conducted as required to minimize ponding in advance of cover system installation following physical examination of the dump surface.

4.2.2 Passive Treatment Systems

There are a number of areas at the site where passive treatment systems can be installed to provide tertiary treatment of water draining from the minesite. There are a number of means by which passive treatment can be achieved at the site and these are described in greater detail in the sections below.

4.2.2.1 In-pit Treatment

The Area 1 and Area 2 open pits will be flooded at closure and will act as large sedimentation ponds in the post-closure period. The use of the pits for the removal of suspended solids will act to reduce potential total metal loadings to the receiving environment. The open pits will also allow for some natural attenuation and removal of metals from the water column based on the results of investigations on in-pit lakes at other mine-sites. The potential in-pit treatment of site water has not been included in the current predictive modelling conducted for the closure of the site.

Completely passive mechanisms for water quality improvements in pit settings may include:

- Particle settling to remove suspended solids in runoff waters.
- Oxygenation of constituents in seepage by exposure of collected water to the atmosphere. Oxygenation of iron or manganese contained in waste rock or tailings seepage can lead to precipitation of iron or manganese oxides, which will provide a sorption-based removal mechanism for some trace metals including copper.
- Algal or other photosynthetic microbial sorptive removal of dissolved metals by sorption on organic biomass. Naturally pit lakes will develop some photosynthetic biomass, which in a low-productivity

catchment such as that absorbed at Minto Mine will be low nutrients and consequently this mechanism will be limited unless enhanced by nutrients. The use of pits as pretreatment sites for semi-passive treatment vessels could be done especially during the transition from active water treatment to passive closure. Two approaches that make sense and could be combined include:

- Addition of organic reagents and/or alkaline reagents to the pits to create an anaerobic zone in the lake where metal removal in reductive forms, including metal sulphides or reduced metal oxides, is encouraged. Typically a combination of carbon sources is utilized to achieve both rapid formation of reductive conditions (carbon sources such as sugars and alcohols), and sustained maintenance of reductive conditions (carbon sources such as wood chips and other biomass forms).
- Addition of nutrients including nitrogen and/or phosphate will enhance the development of a photosynthetic algal or microbial population in the lake, which will provide both a direct removal by sorption on biomass, as well as sustaining anaerobic conditions in the deeper part of the lake as the photosynthetic biomass decays, acting as a sustainable mechanism for anaerobic conditions in the lake bottom.

Examples of the pre-treatment of pit lakes for metals removal include:

- The Anchor Hill pit at the Gilt Edge Mine in South Dakota, which had ice-covered conditions for more than 5 months of the year, where alkaline reagents and multiple organic sources including wood chips, alcohols and sugar syrups were added. Greater than 90% removal of metals including copper were achieved and sustained for several years.
- The pit lake at the Barite Hill Mine in South Carolina, alkaline reagents and multiple organic sources including wood chips, alcohols and sugar syrups were added. Greater than 99% removal of most metals including copper was achieved.

4.2.2.2 Passive Treatment Wetlands

Treatment wetlands are an effective passive water treatment technology that is used in a number of areas to help improve the water quality of impacted systems. Treatment wetlands act as metals sinks through precipitation or complexing of metals under anaerobic conditions. They also act as a filter for suspended solids or colloidal precipitates which might remain suspended through pit lake settling. Wetlands are not intended to be a permanent "walk-away" solution to water chemistry issues at a site but can provide effective passive treatment on the timeframe of 100 or more years. The Cone Mine, Kendhill, Mount Washington, Silver Queen, and McLean Lake are sites where wetland treatment has been shown to be effective in reducing metal loading.

Treatment wetlands require a footprint that is dependent on the volume of flow to be treated. As a rule of thumb, a treatment volume of 3.28 to 6.57 m^3/day per square metre of wetland has been found to be acceptable based on a review of documented passive treatment wetland systems (INAP, 2010). Areas that have been identified as potential locations for construction of passive treatment wetlands include the:

- Area 1 pit discharge area;
- Existing Mill Pond area; and
- Existing Water Storage Pond Dam location.

The Area 1 pit will be a shallow lake following placement of tailings and there is potential to construct a treatment wetland in the discharge channel area. The mill pond area will receive discharge from the Area 1 and Area 2 pits and has sufficient flat ground to allow for construction of a passive treatment wetland. The existing Water Storage Pond Dam is located at the lowest point on Minto Creek and a portion of the existing footprint facility could in theory be converted into a smaller treatment wetland, although, there is insufficient footprint at this location to treat all site flows given the sizing guidance presented above. The materials used to form the wetland cells could also include wood chips or a semipassive addition location for soluble carbon sources, to enhance the anaerobic conditions formed in the wetland. The Mike Horse mine in Montana is an example site where alcohol was added to a wetland system to sustain anaerobic removal mechanisms through ice-covered winter conditions.

The predictive model for the site is based on the construction of passive treatment systems at the sites of the existing Mill Pond and the Water Storage Pond Dam. There may be better locations downstream of the minesite for the construction of a passive wetland treatment system; however, these have not been included as potential options since they are located outside of the current SFN Lease Agreement.

4.2.2.3 Permeable Reactive Barriers

Permeable reactive barriers (PRB’s) are installed vertically in trenches and may involve cut-off walls for funnelling of groundwater to the permeable barrier. PRB’s utilize a variety of different media for the reactive barrier (e.g. limestone, municipal wastes, bauxol, zero valent ion, compost and molasses) which can influence the construction cost. The design life of the reactive media in a PRB system is typically on the order of 20-30 years depending on the treatment requirements. Refreshing of the reactive media would then be required in order for the system to continue to provide passive treatment in an effective manner.

4.2.2.4 Biological Reactors

Biological reactors use the degradation of organic materials for the purposes of treatment and often involve installation of the treatment materials into lined trenches or pond systems. These systems have been used in mining applications to treat groundwater discharges from underground workings and also for shallow groundwater systems. Treatment media for biological reactors in the documented studies are often derived from local municipal and industrial waste sources; however, it would be necessary to determine whether these sources exist in the local area or can be sourced and transported to site in a cost effective manner. Wood chips or peat are local products that could be utilized. These systems could also be operated in a semi-passive mode where an alcohol tank can be set up to drip into the influent end of the biological reactor, and only require infrequent refilling.

Construction of a biologic reactor at the portal would require that the portal discharge collected and channelled into the biological reactor system. This would most probably require installation of impermeable barriers and piping to direct flows to the biological reactor system. A biologic reactor would not be able to effectively treat any deeper groundwater derived from the portal seepage. The design life of biologic reactors is typically on the order of 20 to 30 years at which time the reactive media needs to be refreshed or a semi-passive operational mode could be alternatively operated.

4.3 Active Water Treatment

As per the stated reclamation objectives, the Company is committed to trying to close out the Minto Mine in a manner that does not require the long term use of active water treatment to achieve discharge criteria. The application of the source control mitigation measures described in the preceding sections should be successful in reducing metal loadings from the waste dumps on site; however, it is realized that there will be the need to actively treat water during the immediate post-closure period while revegetation of the cover systems and reclaimed areas becomes established. It is currently estimated that a total of 4 years of active treatment will be required following closure of the site.

The Company currently operates a water treatment plant at the site which has been shown to be successful in reducing metal loads to a level where it is possible to directly discharge the treated water into the receiving environment.

4.3.1 Water Treatment Plant

In July, 2009 MintoEx submitted a Water Management Plan to EMR as required under Amendment 5 to the water use licence (QZ96-006). A water treatment plant design accompanied that application and the plant construction was completed in 2010. No issues related to disposal of the sludge have been identified and any sludge generated from this facility during the closure period will be disposed of into an approved disposal facility.

4.4 Reclamation to Date

To date there has been little opportunity to conduct final reclamation measures at the various infrastructure units on site due to the discovery of several new ore deposits that have given way to the Phase IV permit application and uncertainty around the final mine footprint. However, where possible, progressive reclamation has been conducted to address water management and aesthetic objectives. For example, in 2009 the Company conducted reclamation activities on exploration roads and drill pads, particularly in erosion-sensitive areas that can potentially impact surface run-off water quality. Reclamation of disturbed areas along the access road and at Big Creek in the vicinity of the Big Creek Bridge was completed between May 6 and May 10, 2000. This reclamation has been successful when compared against the reclamation objectives, as noted in previous annual reports for the Type B Water Use License, submitted by the Company. Revegetation and fertilizer mixtures for this effort are known and the seeded areas are monitored for revegetation success. This information will be used to assist with planned progressive reclamation measures, reclamation research, and measures for final closure.

4.5 Natural Revegetation

Overall reclamation is therefore expected to be successful with seeding and natural revegetation complimenting each other.

The project area was first disturbed by the construction of trails and trenching which was done as part of exploration programs on the property from 1971 to 1976. Natural revegetation has been effective in largely covering these disturbed areas in the 35 years since the area was first disturbed. For example, prior to construction activities in 2006, the airstrip was almost completely re-vegetated and required extensive clearing in preparation for re-commissioning. Other areas that have seen significant natural revegetation on the site (some of which are now re-disturbed by current construction activities) include areas adjacent to the WSPD centerline, old borrow sources, and the cleared right-of-way of the main access road.

The primary colonizing plant species now found around the mine site are willows and graminoids. The extent of recolonization at each location is dependent on local conditions, including soil conditions (type and moisture content) and aspect. Generally, revegetation is occurring more extensively next to undisturbed areas and on linear disturbances.

4.6 Reclamation Research

An important component of the reclamation planning process is ongoing reclamation research with the objective of developing the methods required to implement a successful reclamation program. Reclamation research will focus primarily on the revegetation aspect of reclamation, as the success of this element of a reclamation plan is closely linked to site specific conditions such as soil characteristics, climatic variables and existing vegetation populations. Other aspects of mine site reclamation including recontouring and erosion stabilization techniques are well established and are less reliant upon site-specific research for success.

Documentation of natural revegetation successes is ongoing during current reclamation research activities as documented in the annual reclamation reports. Information developed on site will be supplemented with information obtained from other mine reclamation programs in the Yukon and other jurisdictions. Considerable research has been carried out into the reclamation and revegetation of disturbed lands in the Yukon, including operating and abandoned mines, and mineral exploration sites. Much of this information is in the public domain and is well presented in the guidance document *Mine Reclamation in Northwest Territories and Yukon* (INAC, 1992.)

The true benefits of reclamation research will be realized if the information obtained and knowledge gained is incorporated into larger scale reclamation projects as quickly as possible.

4.6.1 Engineered Covers

Engineered cover systems are proposed in order to reduce metal loadings to the receiving environment. Investigations into engineered cover system design for application at the Minto mine will be evaluated using field trials conducted under the reclamation research program. The Main Waste Dump is not scheduled to receive any additional materials during Phase IV and it will be possible to progressively reclaim a portion of this facility during the mine operations phase. The proposed reclamation research on engineered covers will involve the assessment of the cover system thickness, the need for organic amendments, and whether a monolithic or multi-layer cover system is required at the site to effectively reduce metal loadings. The results of field trials such as this will be used in developing an appropriate detailed design for cover systems to be installed on other site infrastructure.

The reclamation research program for engineered covers will involve the establishment of field trials at the site to evaluate and refine cover system design. The trials will involve the installation of field lysimeters to monitor infiltration through the different cover systems. At this time field trials are proposed for evaluation of the following possible cover design configurations:

- Monolithic soil cover consisting of fine grained material with target thicknesses of 0.25 m and 0.5 m;
- Multi-layer soil covers consisting of 0.1 m of coarse grained materials overlying a 0.25 m layer of fine grained materials.
- A control lysimeter with no soil cover.

The field trials will be constructed during the summer of 2011 and will be situated on an unused portion of the Main Waste Dump (MWD). This will mean that the monitoring of these lysimeters is not interrupted by operational requirements. The use of the MWD also allows for the construction of larger cells than could be achieved in other portions of the site. The final design of the lysimeters will be field fit based on the final location selected for the trials and with the following specifications applied:

- the surface of the dump selected for field trials will be sloped to a grade of approximately 2% which is consistent with the closure information contained in the Phase IV Waste Management Plan;
- the lysimeters will be lined with an impermeable liner to ensure that there are no seepage losses into the dump;
- samples of the materials used to construct the lysimeters will be collected for grain-size analysis;
- the level of compaction of the materials placed into the lysimeters will be measured using a nuclear densometer in order to determine the bulk density of the placed materials;
- a drainage collection system will be installed into the downgradient face of the lysimeter to collect seepage waters;
- the lysimeters shall be seeded and fertilized in order to establish vegetation and monitor evapotranspiration; and,
- The volume of water collected by the system will be recorded on a weekly basis with additional monitoring of seepage volumes recorded at a higher frequency to understand the effects of precipitation events on cover system performance.

Additional instrumentation will be installed into the lysimeters in order to obtain in-situ measurements on soil moisture within the lysimeters. The monitoring frequency for this instrumentation will be weekly with several periods of daily monitoring conducted following precipitation events to understand the drainage characteristics of the fine-grained layers. Site meteorological information will be used in the interpretation of the monitoring data from the lysimeters.

4.6.2 Growth Media

The natural vegetation found on undisturbed sites around the mine generally provides information the underlying soil properties, including texture, drainage, and pH, and the level of available nutrients that presently occur at the site. A soil sampling program was initially conducted in the project area during 1994 as described in the original environmental assessment report. The results of this program provide the basic information required for reclamation planning. Additional soil sampling on disturbed sites will be completed as part of ongoing reclamation research in order to determine areas of localized nutrient deficiencies.

Plants require, as a minimum, a medium that will allow roots to penetrate, that will retain adequate moisture and that contains suitable levels of nutrients for successful growth. Diamond drilling done in the 1970's indicated that the Area 1 pit is covered by up to 60 m of overburden. Ice rich materials are present to the south in an area where permafrost depths are estimated to be approximately 18 m based on borehole logs in the area. The overburden from Area 1 generally consists of silt and fine sand with varying amounts of organic material and occasional layers of peat and gravel. The thickness of overburden required to retain water will be confirmed by trial, as the depth of growth media placed will be varied and soil moisture measurements compared with revegetation success on the various plots will suggest an optimum depth of overburden placement for revegetation measures. Annual summaries of reclamation research and related activities are compiled in the Water Use Licence Annual Report submitted to the Yukon Water Board (YWB) on July 31 of each year beginning in 2007.

4.6.3 Revegetation Trials

The revegetation trials are designed to determine the best methods of restoring the Minto mine site footprint to a functioning and self-sustaining ecosystem. Four important components of a revegetation process that are being examined presently or proposed are briefly described below and other related considerations are further discussed.

1. Practical seed mixes - while it is known what seed types have been used at the site previously and what types of plants have been naturally re-vegetating the site, further reviews and investigations are necessary to confirm the appropriate seed mixes that should be used in conjunction with different soil covers. The ultimate seed mixtures will be developed using:
    - knowledge of the naturally occurring vegetation and soil conditions;
    - an inventory of naturally occurring seed sources on site;
    - results from revegetation activities to date;
    - existing literature on regional revegetation science; and
    - information gained from revegetation test plot trials on site (see below).
2. Engineered covers - different plant varieties and species, tailings characteristics, cover designs and other environmental conditions are all factors influencing uptake of metals by plant tissues. Sampling of plant tissues from the tailings test plots will be conducted to assist in designing the

revegetation program, and existing literature and research regarding plant metal uptake and animal foraging patterns will be incorporated into the seed mix design.

3. Transplanting and collection of seeds of local plants that have been noted, during monitoring, to have colonizing potential (especially trees, shrubs and nitrogen fixing legumes). The creation of vegetation islands can also enhance natural succession.
4. Utility of soil amendments - such as peat, wood fibre or mulches need to be investigated for usefulness in areas where soils are deficient or unstable.

The establishment of an initial ground cover of graminoids (all grasses and grass-like plants, including sedges and rushes) has historically been viewed as a desirable objective on most disturbed areas to stabilize slopes and control soil erosion. To date, test plots have been typically small and optimum conditions may apply. The information obtained from test plots will be applied to future reclamation areas 1 ha or larger in size. Overburden soils will be tested, transported and prepared for seeding/planting, all steps and information will be documented. Vegetation growth will be assessed in a standardized way (see revegetation plot survey form) each summer. The successes from the trial plot program will be transferred to more progressive reclamation efforts that will provide a large-scale opportunity for refinement of reclamation and revegetation techniques and measures.

In the larger, more open disturbed areas at the mine site (borrow areas, mill, and camp site area), where natural seed sources are less available, the seeding/planting of indigenous shrub species (primarily willows, birch and alders) may be required to encourage the later several stages of plant succession on these sites. Shrub species would be planted concurrently with the revegetation plot trial plantings.

Evidence indicates that revegetation by the seeding of sod-forming grass species will inhibit the invasion of the area's natural colonizing species by competing for space, light, nutrients, sunlight and moisture (Craig, et al., 1998). Seeding predominantly with native species should aid in ensuring that the later successional stages of vegetative cover appear and competition is reduced as local grasses coexist with the other local plants and communities will naturally evolve.

However, even though nutrient uptake by northern native seed varieties on nutrient deficient soil is usually more effective than nutrient uptake by southern agronomic species. Seeding with agronomic species at the Minto mine site may be required because of the high cost and limited availability of northern native revegetation species.

The revegetation research work initiated at the Minto Mine during the 2007 season marked the commencement of a multi-year reclamation research program that will provide critical site-specific information to guide successful decommissioning and reclamation of the site. The program continued in 2008, 2009 and 2010 as summarized in this report. The following refinements are designed to enhance and expand the reclamation program, and cover both the established revegetation research program, and additional reclamation research areas recently identified.

The revegetation research component of the reclamation research program will continue with some modifications and expanded elements, as described below:

1. Continuation of late summer monitoring of the revegetation test plots and the progressive reclamation sites so future collection of data from test plots is consistent and all necessary information is gathered.
2. During monitoring, aggressive invasive plant species will be identified, documented and removed immediately. Awareness of territorial weed species and control guidelines need to be heightened, so these plants do not become established.
3. In order to further evaluate the soil conditions in the area, soil samples will continue to be collected from each of the revegetation test plots (control and treatments). Soil samples of trial plots will be taken from the centre of each plot. The larger progressive reclamation sites need several soil samples to determine soil variability across site.
4. These soil samples will continue to be analyzed, using the same tests for: soil pH, fertility parameters, metal concentrations and texture, so soil chemical changes can be monitored and easily compared among plots.
5. Soil sampling off site is needed to provide a background mineral profile of the local undisturbed ecosystems. Some of the permanent ecological plots already established can be used for these offsite controls.
6. Reapplication of seed mix with the addition of mulch to the existing progressive reclamation area on the south side of Water Storage Pond Dam, to test reapplication effectiveness.
7. Shrub species commonly used as wildlife browse, will be analyzed for concentrations of metals that are potentially toxic. As with soil samples, a background profile of metal attenuation will be determined. So, plant tissue samples will be taken offsite from local, but undisturbed areas to be used as a reference. When shrubs have been established on overburden cover their metal uptake can then be compared to reference data.

The revegetation component of the reclamation research program will be expanded in the following ways:

1. Trial plots will be established on the tailings surface as required in the April 2010 DRP approval letter (YG EMR) to test cover depths, effectiveness of capillary breaks and other treatments. This will start this spring (2011) once an appropriate area has been developed to final grade, and should incorporate cover design research work described in this document.
2. The inventory of overburden materials underway will include nutrient capacity in any analysis moving forward. This will help in reclamation planning for the type of and depth of soil cover to be used on revegetation areas.

3. Soil cover plots will be tested for revegetation potential at different growth medium depths and cover designs. Evapotranspiration rates can be assessed for different plants as well as their growth success.
4. Any additional trial plots will be established with more distance between treatments and controls to decrease influences and error (i.e. windblown cross-seeding.)
5. Test sites need to be highly visible and signed so they are not destroyed during mining activities. A map of trial plot locations and an explanation of reclamation importance could also be posted on camp bulletin boards.
6. Revegetation research will be expanded beyond grasses to larger, later successional shrub/tree species. Establishment of these species in the revegetation program will enhance the natural succession. This will involve a combination of:
    a. Local stock collection and transplanting trials;
    b. Local seed collection and broadcasting and propagation trials; and
    c. Live planting for erosion control
    d. Preferred aspect and slope conditions for different plants
7. Identify nearby areas for native vegetation seed and stock collection. Areas slated for clearing need to be inspected so suitable plants can be salvaged. A general inventory of indigenous plant communities in the area was conducted in 2010 as a component to the Minto Mine Ecosystem Mapping program (Access Consulting Group), this information can be used to locate naturally occurring shrub or tree species that could be used in transplanting /seeding trials. Seed collection and propagation should commence this fall (2011) as part of the expanded revegetation research program.
8. Vegetative erosion control methods will be field tested on site - they can provide a cost effective alternative to synthetic or other manufactured products. Grass seeding of slopes is an immediate step towards stabilizing soils on steep slopes, however live shrub/tree plantings are more effective at reducing soil/cover erosion on steeper slopes and gullies.
9. Nitrogen fixing flora will be included as a critical component of revegetation prescriptions, so soils are not depleted of plant available nitrogen. Native species that are nitrogen-fixing candidates for seed collection are:
    - Arctic lupine (Lupinus arcticus)
    - Yellow locoweed (Oxytropis campestris)
    - Hedysarum alpinum; and
    - Alder (Alnus sp.)

    Agronomic species include alfalfa and clover.

Based on the specific reclamation research results to date, and on a review of other reclamation and trial projects – the following will guide reclamation activities during progressive and final closure:

1. Chemical analysis of soils indicate that the overburden soils are deficient in macronutrients (Nitrogen, Carbon, Phosphate and Potassium), but have adequate micronutrients (Copper, Iron, Manganese, Molybdenum, Zinc). It is recommended that soils be amended with fertilizer and/or mulched to promote grass/plant growth after seeding.
2. The nutrient uptake by northern native seed varieties on nutrient deficient soil is usually more effective than nutrient uptake by southern agronomic species. Seeding with agronomic species over most disturbed areas at the Minto mine site may be required because of the high cost and limited availability of northern native revegetation species.
3. Where additional areas at the mine may be targeted for progressive reclamation, seed and fertilizer treatments should be formulated based on the monitoring results of the revegetation trials to date. Two seed mixes are recommended below:
   - a dry area seed mix, which would be applied to most disturbed sites in the area, and
   - a wet area seed mix for riparian sites.

<u>Dry Area Seed Mix</u>

Species	Botanical Name	Application Rate (kg/ha)	Percentage
Violet Wheatgrass	*Agropyron violaceum*	12	40.0
Sheep Fescue	*Festuca ovina*	7	23.3
Rocky Mountain Fescue	*Festuca saximontana*	7	23.3
Glaucous Bluegrass	*Poa glauca*	4	13.4
Total		**30**	**100**

<u>Wet Area Seed Mix</u>

Species	Botanical Name	Application Rate (kg/ha)	Percentage
Violet Wheatgrass	*Agropyron violaceum*	16	53.3
Fowl Bluegrass	*Poa palustris*	8	26.7
Tufted Hairgrass	*Deschampsia caespitosa*	6	20.0
Total		**30**	**100**

In addition to each grass mix, a nitrogen-fixing plant species will be added. If native species Yellow locoweed (*Oxytropis campestris*) and Arctic lupine (*Lupinus arcticus*) are available they can be applied at 2 kg/ha. Agronomical species Medicago sp. (Rambler or Drylander) and Alsike clover at can also be applied at 2 kg/ha. Rhizobium inoculant is needed for these legume seeds.

4. Topsoil and logs (coarse woody debris) should be salvaged during stripping and clearing and stockpiled to the side. The topsoil as well as being a seed bank, contains microfauna and fungus necessary for nutrient cycling. The logs are carbon/moisture reservoirs and provide habitat and preferable re-growth microsites. This material is needed to jump start soil-building processes and to accelerate revegetation growth.
5. Vegetation islands of shrubs, trees and coarse woody debris act as a seed banks, attract wildlife which transport seeds and nutrients into the grassed area and speed up vegetation succession. Vegetation islands should be incorporated into both the revegetation research program and the larger scale progressive reclamation efforts. Retention of islands of vegetation where possible within the Minto Mine future expansion plans will enhance landscape diversity and accelerate vegetation succession after mine closure.
6. Local shrub/tree species can be salvaged and planted on corresponding aspects. Use ecosystem polygons already mapped to assist in finding local plant stock, and in determining species adapted to particular aspects and conditions.

4.6.4 Passive/Semi-passive Water Treatment

Testing of passive and semi-passive water treatment approaches at Minto will have the following objectives and methods:

1. Validation of mass loading reduction by passive systems:

   Test cells of wetlands with anaerobic zones and wetland plant zones are proposed in order to determine the potential removal rate of metals as a function of surface area and retention time. The treatment test cells would be constructed to be able to take water pumped from the current treatment plant influent feed and pretreat this water prior to being allowed to gravity flow back into the pre-treatment storage pond.

   The treatment cell would have a vegetation zone with wetland species that are common to the Minto area. This would be an upflow cell approximately 1 meter thick with year-round flow. Overflow from this cell would be routed into test cells with mixtures of locally available coarse media (clean gravel) and organic media such as wood chips or peat. These cells would test the anaerobic removal rates as a function of retention time within the media, as confirmed by tracer injection.

2. Evaluation of pit lake pretreatment:

   A deep lined trench or similar open water structure would be filled with mine water and inoculated by sediment from local bogs or wetlands. A carbon source would be added to the pit and annual water exchanges will be allowed in the spring time to mimic freshet inflows. Water would be allowed to exit through a gravel bank (with possible mixed wood chips) which would allow filtration as well as development of sulphate reducing bacterial activity on the surface of the gravel, similar to a biological reactor. Monitoring would be performed to evaluate open water removal rates and removal rates through the gravel bank.

5 Implementation Schedule

The Phase IV expansion is expected to result in approximately 6 years of additional mine life with active mining in the open pits ending in the third quarter of 2013 and underground mining scheduled to finish in January 2014. Following the end of the underground production, mining will be from ore stockpiles that will continue into 2016. Reclamation of the disturbed areas will be done in a phased approach to match the overall mining schedule and after closure to reflect the reclamation and monitoring effort required. This phased approach to reclamation planning will assist the company in achieving the overall objectives of progressive and final reclamation at the site.

Some of the key reclamation events are highlighted in the following timeline:

2011

- Mining of the Area 1 Pit is completed in early April and tailings begin to be placed in pit later in the year;
- Cover trials established on tailings surface.

2012 and 2013

- Simultaneous disposal of higher copper content (Grade Bin 0.1 to 0.3) waste material into Area 1 Pit with tailings.
- Dry Stack Tailings Storage Facility will no longer be required for tailings and this facility will be reclaimed. Monitoring of the reclaimed DSTSF will commence to verify effectiveness of closure on reductions in source loadings.

2014

- Commence reclamation of the main waste dump, southwest main dump and the ice rich overburden dump; and
- Commencement of Relocation of Grade Bin Disposal Area materials into Area 1 Pit.

2015

- Continued reclamation of the main waste dump, southwest main dump and the ice rich overburden dump; and
- Continued relocation of Grade Bin Disposal Area materials into Area 1 Pit.

2016 Start of Final Closure

- Processing of stockpiles is completed and reclamation of ore stockpile footprints begins;
- End of Phase IV milling;
- Continued reclamation of the Area 118 Pit, main waste dump, and southwest waste dump; and
- Flooding of the Area 1 and 2 Pits.

2017

- Decommissioning of mill and other site infrastructure not required for closure;
- Construction of passive treatment wetland in the area of the mill pond;
- Ongoing site reclamation activities where still required; and
- Beginning of closure phase active water treatment.

2018

- Reclamation of the Mill Valley Fill;
- Continued closure phase active water treatment;
- Final site discharge channel construction;
- Completion of site reclamation activities; and
- Beginning of post-closure period monitoring program.

2019

- Continued closure phase active water treatment.

2020

- Scheduled end of closure period active water treatment.

2030

- Scheduled end of post closure period monitoring program.

Active water treatment at the site is expected to be required for a period of three months per year for a total of four years post closure (2018-2021). During the period of active treatment, metal levels will be treated in the plant and settling time will allow Total Suspended Solids levels to decrease further following treatment and prior to discharge. Monitoring would identify potential issues for the following year and a decision would be made at that time as to whether continued treatment is required.

The water treatment plant will remain at the site until it can be shown that no additional active water treatment is required and that the cover and passive treatment systems are operating effectively. The Company believes that its plan of source reduction and passive treatment will be effective in achieving effluent discharge criteria for the project; however, active treatment of water remains as a final fall-back solution should it be deemed necessary.

6 Closure Measures for Site Reclamation Units

This section contains the proposed reclamation methodologies that will be applied to the different reclamation units present at the site. Each sub-section contains a description of the area in addition to discussion of the closure issues that help govern the closure methodologies chosen for that unit. References to previous reports or supporting documentation are also contained in each sub-section.

Figure 2-3 provides a general arrangement plan for current site conditions to the end of July 2010 while Figure 2-5 presents the overall site plan at the end of the Phase IV expansion project. Figure 2-5 also provides a general summary of the various closure measures proposed for the reclamation units that will be present at the end of mining under the Phase IV application. This figure also identifies the currently proposed timeline for conducting the reclamation works at the site. Figure 6-1 shows the final site water management plan for the site based on the currently proposed closure plan.

The disturbed area has been divided into reclamation units as follows:

- Waste Rock And Overburden Dumps;
- Ore stockpiles;
- Open Pits;
- Underground Workings;
- Dry Stack Tailings Storage Facility and Diversion Structures;
- Haul Roads;
- Water Storage Pond Dam;
- Mill and Ancillary Facilities;
- Mill Pond;
- Access Road; and
- Miscellaneous Components.

Table 6-1 contains a summary of the expected site disturbance associated with each reclamation unit at the end of Phase IV mine life. This table lists the reclamation components and sub-components, the total area expected to be disturbed by each unit during the construction and operations phases and the final surface area of the reclamation unit that will require reclamation. The areas to be reclaimed contained in the table are based on three dimensional models of the facilities and as such reflect the actual areas as opposed to the disturbed footprint which does not account for slope.

The access road has been treated in the same fashion as the 2009 Closure Plan since the final reclamation of that unit is subject to ongoing discussion between the Company and SFN. Three different closure scenarios regarding the access road are considered, and each affects the component and total reclamation areas differently, depending upon the final closure option selected. Section 6.10 discusses these scenarios and associated reclamation measures further.

It is estimated that a total of 316.0 hectares will be disturbed by the end of Phase IV mine development. The scheduling of the reclamation activities during Phase IV allows for a significant amount of the site to be progressively reclaimed during the mine operations phase.

Table 6-1 Estimated Area of Disturbance Requiring Reclamation

Reclamation Component	Surface Area Requiring Reclamation (ha)	Area Reclaimed Progressively (ha)	Area Requiring Reclamation at Final Closure (ha)
Main Waste Dump	43.5	0	43.5
South West Dump	74.0	0	74
Ice-Rich Overburden Dump	34.5	1.2	33.3
Reclamation Overburden Dump	30.0	0	30
Ore Stockpile Areas	15.7	0	15.7
Overburden and Waste Rock Dumps	197.7	0	196.5
Open Pit	5	5	**0**
Haul Roads	13.0	0	**13.0**
Portal Area	2.0	0	2
Tailings Area	41.3	10.3	**31**
Water Storage Pond Dam (including 4.7 ha impacted by impounded water)	6.0	0	**6.0**
Mill and Ancillary Facilities (Including MVF surface)	10.5	0	**10.5**
Access Road (extent of access road reclamation to be determined with SFN)	26.2	0	**Scenario 1** (No Deactivation)
			Scenario 2 (Deactivation From Mine Site to Minto Creek Crossing)
			Scenario 3 (Complete Access Road Deactivation)
Explosives Plant site	2.6	0	2.6
Mine Camp	2.2	0.6	1.6
Air Strip	n/a	n/a	n/a
Mine Contractor Laydown	2.5	0	2.5
Exploration Sites and Trails	n/a	n/a	n/a
Land Treatment & Solid Waste Facilities	1.0	0	1.0
Miscellaneous Components Subtotal	**8.3**	**0.6**	**7.7**
Total	**316.0**	**17.5**	**Scenario 1**
			Scenario 2
			Scenario 3

Information Table 6-2 contains a summary of the different reclamation components, the identified environmental concern and the mitigation measures that will be applied to the component in order to meet the end land use objectives of the site.

Table 6-2 Summary of Main Reclamation Component Mitigation Measures Applied to Achieve Reclamation Objectives

Component	Environmental Concern	Mitigation Measures	Rationale
Main Waste Dump	Metal leaching and nutrient loadings	Compaction to minimize infiltration Engineered soil cover system for source control	Surface compaction and cover system installation to reduce infiltration and subsequent metal loadings in order to achieve receiving environment water quality objectives.
Southwest Waste Dump	Metal leaching and nutrient loadings	Compaction to minimize infiltration Engineered soil cover system for source control	Surface compaction and cover system installation to reduce infiltration and subsequent metal loadings in order to achieve receiving environment water quality objectives.
Grade Bin Disposal Area	Metal leaching from higher copper content waste rock	Consolidation of high copper content materials into single dump. Sub-aqueous disposal to minimize exposure and reduce metal flux from oxidation of sulphidic mineralization.	Long term metal loadings from these materials associated with oxidation of copper sulphide mineralization. Sub-aqueous disposal will reduce exposure of sulphidic mineralization and prevent increased loadings over the long term.
Ore Stockpiles	Metal leaching	Ore stockpiles to be milled as part of Phase IV milling plan.	Milling of low grade stockpiles eliminates the need for cover systems at these locations.
Dry Stacked Tailings Storage Facility	Metal leaching and nutrient loadings	Engineered soil cover system for source control.	Cover system installation to reduce infiltration and subsequent metal loadings in order to achieve receiving environment water quality objectives.
Mill Valley Fill	Metal leaching and nutrient loadings	Use of low copper content waste for construction Installation of a soil cover to reduce metal loadings.	Cover system installation to reduce infiltration and subsequent metal loadings in order to achieve receiving environment water quality objectives.
Area 1 Pit	Metal leaching	Backfilling with tailings and waste rock. Flooding to reduce metal fluxes. Possible in-pit pretreatment and passive treatment wetlands at outflow areas.	Minimize exposure to oxygen of sulphidic mineralization exposed from mining.
Area 2 Pit	Metal leaching	Backfilling with tailings and flooding to reduce metal fluxes. Possible in-pit pretreatment and passive treatment wetlands at outflow areas.	Minimize exposure to oxygen of sulphidic mineralization exposed from mining.
Area 118 Pit	Metal leaching	Backfilling with waste rock and installation of a vegetated soil cover	Minimize exposure to oxygen of sulphidic mineralization exposed from mining.
Site Drainage	Metal, TSS and nutrient loadings	Active water treatment for period of 4 years following closure Passive wetland or biologic treatment system construction at location of Mill Pond and Water Storage Pond Dam	Active water treatment will be required during initial closure period while cover and passive treatment systems are constructed and commissioned. Passive treatment systems provide additional improvements in water quality while also increasing post closure biodiversity.
Contingency in the event that proposed mitigation measures are not effective			
Site Drainage	Metal, TSS and nutrient loadings	Active water treatment using existing treatment system	Active water treatment system has been shown to be effective at achieving receiving environment water quality objectives. System will remain in place as ultimate site contingency.

6.1 Waste Rock and Overburden Dumps

This section addresses the reclamation of the waste rock and overburden dumps at the site which include the following reclamation units:

- main waste dump;
- southwest waste dump;
- ice-rich overburden dump;
- reclamation overburden dump; and
- Bin 0.1 to 0.64 waste stockpile.

The main waste dump and southwest waste dumps are existing mine infrastructure that contain unclassified waste rock generated during earlier mine development. This material was not segregated by copper content and as a result contains some higher copper content materials with metal leaching concerns. Engineered cover systems to reduce metal loadings from these infrastructure units is proposed based on this factor.

6.1.1 Main Waste Dump

The main waste dump (MWD) is located immediately northwest of the open pit, and has been constructed in sequential lifts as materials are extracted from the Area 1 pit. Figure 6-2 and Figure 6-3 show plan and profiles for the MWD. The MWD has been constructed according to EBA's Geotechnical Evaluation – Proposed Main Waste Dump, Minto Project, Yukon (EBA, 1998) which addresses physical stability design considerations such as maximum credible earthquake criteria so the likelihood of major failure of the facility is deemed to be low. Annual inspections of the MWD have taken place as per Section 9.3.2 of the Quartz Mining Licence QML-0001 and no physical stability issues have been identified to date. The MWD is not expected to receive any additional waste material as a result of Phase IV.

Waste materials placed in the facility contain copper concentrations ranging from 0–0.64% since the majority of the MWD was constructed prior to the development of specific material handling plans based on the copper content. Geochemical characterization of the materials as part of permit requirements has shown that the materials do not present an acid rock drainage concern. The average NP/AP ratio of materials placed into the MWD is 48.5 with an average paste pH of 8.61 (MintoEx, 2009). Neutral metal leaching has been identified as being a potential chemical concern associated with closure of this reclamation unit based on the ongoing geochemical characterization program (SRK, 2010a) for the mine.

The proposed reclamation of the MWD will involve addressing physical stability concerns with geochemical concerns being addressed as part of the site-wide source control program described in Section 4 of this report. The slope of each lift will be reclaimed as per Figure 6-4, which shows typical reclamation measures of a dump slope. Slope crests will be rolled over using a tracked dozer with recontouring conducted in areas where the dump faces are greater than the long term angle of repose.

Geochemical characterization of the waste materials previously disposed of in the MWD has shown that the materials do not present an acid rock drainage concern. Neutral pH metal leaching has been identified as being a potential geochemical concern associated with closure of the dump based on the ongoing geochemical characterization program (SRK, 2010) for the mine. Initial estimates from the predictive water quality model suggest that up to 14% of the post closure metal loadings will be associated with the MWD (Appendix A) prior to mitigation.

Bench surfaces of the MWD will be covered with either a soil cover or an engineered cover with the choice of the final cover being based on the need for source reduction for metal leaching into the environment. Prior closure plans for this unit had proposed a soil cover thicknesses of 0.25 m for placement onto the MWD. The 0.25 m thickness is being re-evaluated based on the results of the predictive closure water quality model and the identified need for implementing source control. The current thickness of the engineered soil cover has been estimated at 0.5 m and will be refined based on reclamation research and operational field trials into the closure cover system.

The surface of the MWD shall not be scarified prior to placement of the cover as infiltration into the dump materials is not considered desirable based on the potential for neutral metal leaching of the waste materials. Compaction of the surface of the dump is considered to be favourable towards the intent of reducing infiltration.

Reclamation overburden will be loaded with an excavator and hauled by trucks from the reclamation overburden dump. Overburden will be placed with the trucks and further spread with a low ground pressure dozer. Compaction of the cover during spreading will be minimized by the use of low ground pressure equipment, however, areas observed to have compaction will be ripped to reduce compaction effects prior to seed and fertilizer application.

Should portions of the MWD be deemed to not require source control, then these areas will have a growth media layer of approximately 0.25 m thickness applied to cover the waste rock followed by application of an approved reclamation seed mixture and fertilizer. The faces of the MWD will not be subject to source control and will have a soil cover placed at closure to allow for revegetation. The target thickness of the soil cover on the faces of dumps is 0.25 m, however some slope areas may receive less than 0.25 m due to the operational logistics of spreading soil covers on slopes. The current reclamation seed mixture and fertilizer application rates contained in the 2009 Closure Plan for the Minto mine will be followed unless ongoing reclamation research programs show that changes to these are warranted.

A trial reclamation plot was established on a slope of the MWD. Direct application of seed onto a trial plot on the first lift of the MWD already graded to final slope was attempted in fall 2008. The amount of fine material and acceptable nutrient levels allowed the establishment of a vegetative cover (80%) suggesting that direct seeding onto parts of the final dump will meet the final revegetation objectives for the facility.

6.1.2 Southwest Waste Dump

The southwest waste dump (SWD) is located to the south of the MWD and was designed by EBA in 2008 in order to optimize operations and provide additional storage areas for waste rock and non-ice-rich overburden material. Construction began shortly after the design approval in October 2008 and is currently being developed as per the EBA report entitled Geotechnical Design, Proposed Southwest Waste Dump (EBA, 2008). The Phase IV expansion of the SWD will be constructed in accordance with the Waste Management Plan (EBA, 2010a) which outlines the design criteria for this unit. The dump has been constructed in progressive lifts with ongoing monitoring of the stability of the SWD being conducted as recommended in the design report through a combination of visual inspections, deformation surveys and monitoring instrumentation (piezometers, ground temperature cables and survey hubs).

The majority of waste rock scheduled for surface disposal as a result of Phase IV will be placed into the SWD with the exception of higher copper content waste materials which will be stockpiled in the Area 1 open pit. Figure 6-5 and Figure 6-6 show plan and sections of the proposed SWD following the end of Phase IV. The sections show that some of the original portions of the SWD constructed as part of the currently approved mine workings are covered as a result of the expansion of this unit. The covering of the older portions of the SWD, which are potentially known to contain higher copper content waste rock materials, will help to reduce potential metal loadings from these materials.

The SWD is estimated to receive approximately 6.44 Mm^3 of waste materials with copper content less than 0.1% from the Phase IV development. Waste materials placed into the portions of the SWD constructed prior to Phase IV contain varying concentrations of copper as this portion of the facility was constructed prior to the development of specific material handling plans based on the copper content of the waste. The portions of the SWD constructed as part of Phase IV will only contain waste rock with less than 0.1% copper content. Segregation and special handling of waste materials with greater than 0.1% copper content will help reduce potential geochemical concerns associated with neutral metal leaching.

Geochemical characterization of the waste materials intended to be disposed of into the SWD has shown that the materials do not present an acid rock drainage concern. Neutral pH metal leaching has been identified as being a potential geochemical concern associated with closure of the dump based on the ongoing geochemical characterization program (SRK, 2010a) for the mine, however exclusion of the higher copper content waste materials will help to reduce the geochemical concerns. Initial estimates from the predictive water quality model suggest that up to 52% of the post closure metal loadings will be associated with the SWD (Appendix A) prior to mitigation.

Bench surfaces of the SWD will be covered with either a soil cover or an engineered cover with the choice of the final cover being based on the need for source reduction for metal leaching into the environment. Prior closure plans for this unit had proposed a soil cover thicknesses of 0.25 m for placement onto the SWD. The 0.25 m thickness is being re-evaluated based on the results of the predictive closure water quality model and the identified need for implementing source control. The current thickness of the engineered soil cover has been estimated at 0.5 m and will be refined based on reclamation research and operational field trials into the closure cover system.

The surface of the SWD shall not be scarified prior to placement of the cover as infiltration into the dump materials is not considered desirable based on the potential for neutral metal leaching of the waste materials. Compaction of the surface of the dump is considered to be favourable towards the intent of reducing infiltration.

Reclamation overburden will be loaded with an excavator and hauled by trucks from the reclamation overburden dump. Overburden will be placed with the trucks and further spread with a low ground pressure dozer. Compaction of the overburden during spreading will be minimized by the use of low ground pressure equipment, however, areas observed to have compaction will be ripped to reduce compaction effects prior to seed and fertilizer application.

Should it be determined that portions of the SWD do not require source control, then a growth media layer of approximately 0.25 m thickness will be applied to those areas to cover the waste rock followed by application of an approved reclamation seed and fertilizer. The faces of the SWD will not be subject to source control and will have a soil cover placed at closure to allow for revegetation. The target thickness of the soil cover on the faces of dumps is 0.25 m, however some areas may receive more than 0.25 m due to the operational logistics of spreading soil covers on slopes. The current reclamation seed mixture and fertilizer application rates contained in the 2009 Closure Plan for the Minto mine will be followed unless ongoing reclamation research programs show that changes to these are warranted.

6.1.3 Ice-Rich Overburden Dump

The ice-rich overburden dump (IROD) is the furthest west reclamation unit on the site and has been constructed immediately upgradient of the SWD. A toe berm has been constructed from waste rock to retain the ice-rich overburden and prevent migration of the material downslope as ice in the stockpiled materials melt. The IROD has been constructed according to EBA’s Geotechnical Design, Ice-Rich Overburden Dump, Minto Mine, Minto YT (EBA, 2006) and has been inspected since as per the Quartz Mining Licence (QML-0001, Section 9.3.2) with no stability issues identified to date. Physical stability of the IROD is the primary closure concern given the ice-rich nature of the materials placed into this unit.

Materials from the IROD will be used as a source for growth media during reclamation of the SWD. Reclamation of the IROD will involve the placement of a 0.25 m layer of overburden on the toe berm as this unit is not deemed to require source control. This material will cover the uppermost 75% of the slope, leaving the furthest downslope area of the toe berm (where it contacts the original ground surface) uncovered to allow moisture seepage as per the construction design. This will avoid raising the phreatic surface inside the IROD.

Any overburden remaining in the dump after closure and reclamation has been completed will be resloped to less than 2.5H:1V and revegetated. Revegetation test plots were established on the toe berm in 2007. Final revegetation seed mixtures and fertilization requirements for the IROD will depend on trial and natural revegetation success in this area.

6.1.4 Reclamation Overburden Dump

The reclamation overburden dump (ROD) is located to the west of the MWD and north of the SWD. The ROD will be expanded as a result of Phase IV in order to stockpile reclamation materials stripped during construction and development of site infrastructure (eg. Area 2 and 118 open pits, Mill Valley Fill). The existing portions of the ROD have been constructed in accordance with EBA's Geotechnical Design, Proposed Reclamation Overburden Dump, Minto Mine, Yukon (EBA, 2008). The proposed expansion of the ROD will be constructed in accordance with EBA's Phase IV Waste Management Plan (EBA, 2010a) which outlines the design criteria for this unit. It is estimated that a total of 2.78 Mm^3 of overburden will be placed into the ROD as part of the Phase IV development activities.

The overburden materials stockpiled in the ROD will be used as a source for growth media during reclamation of other units at the site. Any overburden remaining in the ROD after closure and reclamation has been completed will be resloped to less than 2.5H:1V and revegetated.

6.1.5 Grade Bin 0.1 to 0.3 Disposal Area

All materials with less than 0.3% copper will be considered as waste. The Grade Bin Disposal Area (GBDA) will contain waste rock with a copper content from 0.1% to 0.3% and will be temporarily located within the footprint of the SWD. The GBDA was originally intended to be placed onto the Area 1 pit buttress but stability analyses indicated that this would not be possible. Design work will define the location of the temporary stockpile. It is anticipated that there will be a total volume of approximately 1.2 Mm^3 of material with copper grades ranging from 0.1 to 0.3%.

This waste material contains the majority of the copper present within the waste and has been identified as having the potential for neutral metal leaching. Geochemical characterization of this waste material also indicates that there is some sulphidic mineralization present. Sub-aqueous disposal of this material is favourable to control metal leaching potential.

At closure the materials in the GBDA will be transported into the Area 1 pit for flooding. The rehandling of the remaining GBDA materials into the Area 1 pit may be conducted during winter months when there is less concern with trafficking the surface of the deposited tailings due to frozen ground conditions.

The sulphide stockpile pads were constructed from waste rock according to design criteria set out in EBA's Waste Rock Stability Evaluation, Minto Project, Yukon (EBA, 1996). The stockpile pads on site are designed in accordance with the recommendations in "Mined Rock and Overburden Piles Investigation and Design Manual" published by the BC Mine Waste Rock Pile Research Committee. In accordance with the above mentioned manual, all stockpile pads on site are designed to be stable up to a seismic event which results in peak ground accelerations which have a 10% probability of exceedance in 50 years. The ore stockpiles have been inspected annually as per the Quartz Mining Licence (QML-0001) and there have been no issues identified to date.

The footprint of the GBDA will be closed as per the rest of the of the SWD.

6.2 Ore Stockpiles and Pads

The Phase IV mine plan includes the milling of all stockpiled ore prior to final closure. The following stockpiles at the site will be treated in this fashion and therefore are not deemed to be an issue at closure:

- high grade sulphide ore stockpile and pad (located south of the mill); and
- low grade sulphide ore stockpile and oxide ore pad (located between the pit and the MWD).

Reclamation of the stockpile pads will be conducted following the completion of milling of stockpiled ore materials. Compacted portions of the pads will not be scarified to promote drainage as the geochemical characterization program indicates that there is potential for neutral metal leaching from these materials. The pads will have a 0.25 m soil layer of growth material applied followed by application of seed and fertilizer.

6.3 Open Pits

Phase IV will involve the development of the Area 2 and Area 118 open pits. The Area 1 open pit, formerly referred to as the Main Pit, will be mined out during 2011 and has been included in this plan based on the planned deposition of tailings and waste rock into this unit. Figure 6-7 and Figure 6-8 show a plan view and section through the Area 1 Pit and Area 2 Pit along with information on waste rock and tailings deposition into these pits.

6.3.1 Area 1 Pit

The Area 1 pit encompasses the original drainage channel for Minto Creek. The Area 1 pit is being excavated according to the Company's Open Pit Design Plans (MintoEx, 2006). The north wall of the pit is benched in competent bedrock while the south wall is composed of bedrock and ice-rich overburden. Instability in the ice-rich overburden of the south wall is currently being monitored. Despite partial covering of the south wall with a thermal insulating medium during operations, slumping of the south wall was observed during summer 2009. Stability monitoring of the pit is part of ongoing mine operations and is not deemed to be relevant to the post closure phase of the project. Acid-base accounting indicates that the open pit wall rocks are net neutral to slightly acid consuming (non-acid generating). Results to date (SRK, 2010a) indicate that the open pit wall geochemistry is consistent with the initial geochemical predictions put forward in the original geochemical characterization report (Mills, 1997).

The open pit was exhausted of ore during April 2011 and the current Phase IV schedule calls for placement of tailings into the Area 1 pit starting later in 2011. A buttress will be constructed to ensure the stability of the southern wall of the pit. Figure 6-9 shows a plan of the buttress.

Waste rock materials with copper content from 0.1% to 0.3% will be deposited into the Area 1 Pit simultaneously with the thickened tailings. During the operations period the storage capacity of the flooded pit will be sufficient to accommodate the design storm volume of 700,000 m^3 which is required by current site permitting. Following the end of the simultaneous waste rock and tailings deposition, the Area 1 pit will be backfilled to less than 8 metres below the final spillway invert elevation.

The completion of tailings deposition into the Area 1 pit occurs while the mine is still in operations and construction of a final discharge channel from the pit to Minto Creek will not be possible until the end of milling activities currently scheduled for early 2016. Excess water accumulated in the Area 1 pit prior to the construction of the discharge channel will be either:

- Subject to treatment in the water treatment plant and discharged to the receiving environment; or
- Pumped into the Area 2 pit to accelerate flooding of that unit.

Waste materials from the GBDA will be disposed of in the Area 1 pit following the end of milling activities at the site when it has been determined that the design storm storage capacity is no longer required. The pit will then be allowed to flood in order to cover the deposited tailings and waste rock. Water quality in the Area 1 pit will be monitored during flooding and the water treatment plant will be in place so that water can be treated prior to release off-site.

Figure 6-10 shows a plan view identifying the water management plan that will be implemented for drainage of the pits. At closure, approximately 55% (10.6 ha) of the open pit walls will remain exposed above water following flooding of the Area 1 pit. Prior to flooding, any accessible benches in the pit excavated in overburden will be scarified to encourage natural revegetation, but no additional reclamation work will be done on the open pit high walls. Boulders, up to 1 m in size, will be placed on all potential access routes to prevent uncontrolled human access to the pit.

Due to local topography the Area 1 pit will daylight on the east side and the pit discharge channel will be constructed in this area. A passive treatment wetland, as described in Section 4.2.2.2, will potentially be constructed as part of the outflow area from the pit into the discharge channel. This will act to polish water as it exits the pit, after having been subject to settling in the pit lake water column, and possibly to additional in-pit treatment, as outlined in Section 4.2.2.1. The sides of the discharge channel will be constructed to ensure that wildlife are able to avoid becoming trapped. The discharge channel from the Area 1 pit will be routed to the east through the mill pad and across the MVF. The Area 1 discharge channel will be designed to accommodate the Probable Maximum Flood (PMF) event for the entire catchment area upstream of the Area 1 pit. Figure 6-11 shows details of the drainage channels for the Area 1 pit.

6.3.2 Area 2 Pit

The Area 2 Pit is located to the west of the Dry Stack Tailings Storage Facility and does not intersect any existing surface drainage channels. The Area 2 open pit will be constructed using standard drill and blast mining techniques with the proposed excavation occurring primarily in competent bedrock. Some of the upper benches will be excavated into overburden and there is the potential for shallow surficial instability to occur in the overburden unit. Any areas of instability noted during operations will be addressed during subsequent updates of this document. Acid-base accounting indicates that the open pit wall rocks are net neutral to slightly acid consuming (non-acid generating).

The Area 2 pit will be used to store tailings once the Area 1 pit has been filled to its design capacity, with the final elevation of tailings in the Area 1 pit being approximately 765 m (Figure 6-8). Following the cessation of operations, the Area 2 pit will be flooded until it overflows into the engineered drainage channel. The Area 2 pit lake will have an approximate depth of 35 m following flooding.

Due to the limited topography in Area 2 pit it is estimated that approximately 20% of the open pit walls will be exposed following flooding of this unit. The proposed Area 2 pit will spill to the north at an elevation of approximately 801 m. The conceptual spillway invert elevation is estimated to be at approximately 800 m but the final invert elevation will be determined following development of that portion of the pit. Figure 6-10 and Figure 6-12 show details of the Area 2 pit drainage channels. The Area 2 discharge channel will be designed to accommodate the Probable Maximum Flood event for the entire upstream catchment area.

Prior to flooding, any accessible benches in the pit excavated in overburden will be scarified to encourage natural revegetation, but no additional reclamation work will be done on the open pit high walls. Boulders, up to 1 m in size, will be placed on all potential access routes to prevent uncontrolled human access to the pit. A wetland complex as described in Section 4.2.2.2 will be constructed as part of the outflow area from the pit leading into the discharge channel. This will act to polish water as it exits the pit, after having been subject to settling in the pit lake water column, and possibly to additional in-pit treatment, as outlined in Section 4.2.2.1.

The existing Southwest Diversion Ditch will be diverted into the Area 2 Pit at closure. The Company will evaluate whether pumping water into the Area 2 pit is required in order to accelerate flooding at closure. Pumping into the Area 2 pit is currently considered a favourable measure to submerge non-acid generating sulphide materials that are exposed as a result of the mining operations in this area. Accelerated flooding of the pit will act to reduce the oxidation of any exposed materials in the pit walls resulting in lower overall metal loadings due to less soluble secondary weathering products being produced from sulphide oxidation.

6.3.3 Area 118 Pit

The Area 118 pit is located upslope and to the west of the Area 2 pit and will be mined during 2012. The Area 118 open pit will be constructed using standard drill and blast mining techniques with the proposed excavation occurring mostly in competent bedrock. The upper benches will be excavated into overburden and there is the potential for shallow surficial instability to occur in the overburden unit. Any areas of instability noted during operations will be addressed during subsequent updates of this document. Acid-base accounting indicates that the open pit wall rocks are net neutral to slightly acid consuming (non-acid generating).

The Area 118 pit is intended to be backfilled with approximately 0.3 Mm3 of waste rock sourced from the Area 2 Pit and underground workings during the operations phase of the project. The waste rock for backfilling of this unit will have a copper content <0.1%. Due to topography only a small portion of the overall pit walls will be exposed at closure following backfilling of this unit. The waste rock will be covered with a soil cover which will be used as the reclamation growth media to revegetate the pit. A thickness of 0.25 m has chosen for the revegetated overburden cover on the waste rock as this unit does not require source control.

A discharge channel will be constructed from the low point of the Area 118 pit to direct flows into the Area 2 pit during the post closure period in the event that there is discharge from the pit during the post closure period. The need for this channel will be reviewed based on hydrogeologic information collected during the mine operations phase and this component will be addressed in subsequent revisions to this plan.

6.4 Underground Workings

The proposed Phase IV mine plan includes underground mining below the Area 2 and Area 118 open pits. Development includes a decline for underground access which will require surface overburden excavation to expose bedrock prior to drilling and blasting of the portal (Figure 6-13). It is estimated that approximately 1,541 kt of ore and 341 kt of waste will be excavated from underground mining.

The proposed mine plan includes disposal of waste materials by backfilling into the underground workings. During the initial development of the ramp waste rock will be stockpiled on surface until there is sufficient void underground that can accommodate this backfill. Alternatively waste rock may be disposed of within the mined out Area 118 open pit. Final disposal location of waste rock will take into consideration the geochemical characteristics of the waste rock.

To date, geochemical characterization for the underground waste rock recovered from core samples show that underground waste rocks are similar in geochemical properties to waste rock from Area 2 and Area 118 open pits.

Upon completion of underground mining, the underground workings will be allowed to flood. Recent hydrogeologic investigations (SRK, 2010b) indicate that in the post closure period the groundwater table will not rise sufficiently to result in water discharging at the surface. In Accordance with the Yukon Quartz Mining Act, at the completion of mining the portal to the underground workings will be sealed, preventing access by people and wildlife. The ventilation raise will also be sealed to prevent access.

The portal area will be backfilled and recontoured to a stable and natural slope. This will be followed by the application of appropriate seed and fertilizer to restore vegetation to the area.

6.5 Haul Roads

The haul roads on the site radiate out from the open pit to the mill, the ore stockpiles, the waste rock dumps and the ice-rich overburden dump. Haul roads, site roads and the main access road will be subject to standard road decommissioning and reclamation measures at closure, including culvert excavation, drainage recontouring, slope stabilization and surface scarification. Regrading/contouring of the roads will ensure that runoff sheds off the road surface and does not become ponded.

Site reclamation experience indicates that road surfaces are not expected to require seeding, only surface scarification in order to encourage natural revegetation. Sediment management measures will be installed where drainage channels have been re-established in order to prevent sediment from entering streams while revegetation occurs. Short term sediment management measures may include installation of silt fencing and enviro-matting at select sites until vegetation becomes established.

6.6 Dry Stack Tailings Storage Area and Diversion Structures

Currently, the tailings from the Minto milling process undergo a dewatering process using ceramic filters before being conveyed by truck for spreading and compaction in the Dry Stack Tailings Storage Facility (DSTSF). Construction of the facility is in accordance with EBA's Geotechnical Design Report, Dry Stack Tailings Storage Facility, Minto Mine, Yukon (EBA, 2007). Further details on the tailings handling procedures are available in the Company's current Tailings Management Plan (TMP) and the related Operations, Maintenance and Surveillance Plan (OMS) for the facility. The proposed reclamation measures for the DSTSF are presented in Figure 6-14.

The DSTSF is located on a bench to the south of the mill and upslope from the Minto Creek channel. The facility is being constructed as per the specifications provided in the TMP and overseen by the Engineer of Record (EBA). A quality control program is in place wherein field compaction is regularly verified using a nuclear densometer. Monitoring of the stability of the stack has been conducted through daily visual inspections and through monitoring the installed instrumentation (piezometers, ground temperature cables and settlement monuments). Regular field visits and an annual geotechnical inspection are conducted by the Engineer of Record as required under the Quartz Mining Licence QML-0001 (Section 9.3.2).

Monitoring of the DSTSF has shown that there has been recent movement of the facility at a rate of between 3 to 4 mm/day. Monitoring of the movement of the facility will be ongoing during the operations phase and potential revisions to the closure methodology for this reclamation unit will be addressed in subsequent updates of this report. The proposed Mill Valley Fill which is described in the next section has been designed to buttress the DSTSF and mitigate movement of this facility.

The Company submitted a risk assessment report on the DSTSF to the Department of Energy Mines and Resources (EMR) in March 2009 (SRK, 2009b). The report evaluated all conceivable failure modes for the facility using the Failure Modes and Effects Analysis (FMEA) method. The report recognizes the lowered physical risks associated with the DSTSF versus a conventional slurried tailings impoundment and noted that the regulatory requirements necessary to mitigate risks are currently in place.

Existing design components (upstream diversion ditches, finger drains and a toe berm) are currently intercepting and diverting surface runoff from upslope and filtering seepage from below the area. Field observations show that the current diversion structures will need to be enhanced at closure to ensure water is successfully captured and routed around the facility (Southwest Diversion Ditch) and have a drainage channel designed and constructed across the surface and face of the facility to direct run-on water of the reclaimed facility.

Geochemical characterization of the tailings has indicated there is no acid-rock drainage potential in this reclamation unit, however neutral metal leaching of copper and other elements has been identified. Closure measures for the DSTSF will focus on reduction of source loadings from the facility in addition to ensuring the physical stability of the facility. Managing water movement in and around the DSTF is seen as the key factor in the design of closures measures. The compacted tailings have a low permeability due to the mechanical compaction of the tailings following placement and spreading in the facility. Infiltration of precipitation and run-on water is not expected to have a significant influence on the DSTSF and surface grading will be utilized during the closure phase to assist in the shedding of water from the surface.

The design of an engineered cover for the flat surface of the DSTF to prevent water infiltration into the tailings surface will be required based on the identified concern over neutral pH metal leaching from this facility. The cover system will be designed to accommodate some run-on water bypassing the diversion structures which are located upgradient of the DSTSF. If required run-on water will be diverted away from the face of the DSTSF by a run-on diversion ditch to minimize the potential for erosion on the face of the DSTSF. Thermal monitoring of the DSTF by EBA has shown that the tailings are completely frozen. This indicates that it may be possible to design and construct the final soil cover on the surface of this facility to include a frozen basal layer. The seasonal active layer of the cover system would be completely within the soil cover which would eliminate water contact with the tailings resulting in reductions to predicted metal loadings.

The DSTSF will be subject to source control and will have a soil cover of approximately 0.5 m thickness placed during closure of the facility. The thickness of the soil cover on the face of the DSTSF may, in some areas, be less than 0.5 m due to the operational logistics of spreading soil covers on slopes and the current practice of waste rock placement onto the face to prevent erosion control. The current reclamation seed mixture and fertilizer application rates outlined in Section 4 will be followed unless ongoing reclamation research programs show that changes to these are warranted.

6.6.1 DSTSF Diversion Structures

The south diversion ditch (SDD) is the primary diversion structure and is used to convey flow from the original tributary channel that previously ran through the DSTSF into the mill water pond. This SDD is presently constructed to convey the calculated 1 in 200 year flood event for the drainage. During closure the SDD will be widened and deepened to ensure that it has adequate flow capacity for the post closure period. The operations Water Management Plan bypass of the SDD around the Area 2 pit will be decommissioned allowing the SDD to spill into the Area 2 pit. This change in closure water management reduces the post closure length of the SDD by approximately 50% compared with the existing ditch length.

At closure the tailings diversion ditch (TDD) will be reconstructed to route drainage into a drainage channel across the surface of the DSTF. The final surface of the DSTF will be constructed in order to promote drainage of surface water to the drainage channel.

6.7 Mill Valley Fill

The Mill Valley Fill (MVF) is located immediately downslope of the DSTSF and was designed to buttress the DSTSF due to stability concerns identified through the instrumentation monitoring program at the site. The MVF will also allow for expansion of the camp pad and establishment of surface laydown areas during the operations phase. The MVF will be constructed from 1.3 Mm^3 of waste materials with Grade Bin 0 waste materials (no copper content) in order to limit the potential for neutral metal leaching into the receiving environment. Figure 6-15 and Figure 6-16 show the design plan and profile for the MVF.

Closure of the MVF will be conducted at the end of Phase IV milling and will involve the removal of any temporary building and materials stored in the laydown areas. The location of the MVF in the main valley of Minto Creek means that it will be necessary to route the main site discharge channel through the footprint of the MVF. Figure 6-17 and 6-18 show details on the drainage channel through the MVF. The main site discharge channel will be designed to accommodate the PMF event for the entire upstream catchment area. Evaluation of the potential for the main site discharge channel to influence the geotechnical stability of the DSTSF will be evaluated during detailed design. The cost of the spillway design and associated geotechnical stability evaluation has been included in the closure costing for this unit. It is important to understand that the detailed design and associated geotechnical evaluations for this channel are not able to be finalized until after this facility has been constructed so that as-built conditions can be used.

Recontouring of areas of the MVF not required for channel construction will be conducted in order to establish final drainage runoff patterns. The surface of the MVF is currently not expected to require source control so it will be covered with 0.25 metres of growth media prior to application of seed and fertilizer.

6.8 Water Storage Pond Dam

The location of the Water Storage Pond Dam relative to the other site development is shown in Figure 2-3, and reclamation/decommissioning plans for the Water Storage Pond Dam are shown in Figure 6-19. The water dam on Minto Creek provides water retention for mill processes and various site uses during operations and is considered to be the furthest downstream point for discharge control at the site. The original project proposal initially predicted that excess water would meet the Water Use Licence (WUL) effluent criteria and be discharged passively to Lower Minto Creek over the dam spillway. Operational experience based on heavy precipitation and snowpack years has shown that a water treatment plant, as per the current site Water Management Plan, is required. The treatment plant was installed and operational during the second quarter of 2010 and will remain in operation until WUL criteria can be achieved.

It is now envisioned that the dam will remain in place until such time that the water quality at the site has stabilized to the satisfaction of stakeholders. In the interim it will act as a settling pond where turbid runoff waters will undergo retention, monitoring and treatment if required. The current water treatment plant located near the Mill Pond will be relocated to this area during closure in order to allow for active treatment as required.

Once the water quality in Minto Creek reaches the acceptable effluent criteria, water will be allowed to move into the creek over the dam spillway for the remainder of the open flow season. The dam would then be decommissioned with any sediment in the facility being excavated and hauled to a suitablewaste rock dump for disposal.

Predictive water chemistry modeling has identified a need for ongoing treatment of water at the site. This area will be converted into a passive treatment system such as a treatment wetland, permeable reactive barrier or some combination of these two. The hydrologic design standards for modification of the Water Storage Pond Dam will be the Q200 flow unless other standards are found to be warranted during detail design of the wetland.

Physical stability of the Water Storage Pond Dam will be ensured during post closure by regular geotechnical inspections. In the most recent inspection report, the engineer of record has recommended a review of the surveillance data collected to date in order to assess the dam's performance (EBA, August 2009). It is expected that the dam will be removed during the initial post closure period.

6.9 Mill and Ancillary Facilities

This section addresses the decommissioning measures for the mill and the ancillary facilities in the immediate vicinity that support the milling activities. The facilities addressed in this section include:

- Mill building;
- generator building;
- concentrate shed;
- tailings filter building;
- mill water pond;
- mill reagents and chemicals; and
- contractor's shop and work area.

Figure 6-20 shows details on the closure measures for these facilities. Physical stability concerns for these structures at closure will be mitigated by their disassembly and removal from the site with the exception of the mill water pond which will require earthworks to mitigate physical stability issues. Environmental concerns for these areas will arise primarily from contamination of surrounding soils by fuel, chemicals or other wastes. Such instances will be documented through an environmental audit, conducted upon the completion of milling activities. Any contaminated soils identified will be remediated on site at the site's approved land treatment facility, and any recyclables and/or special wastes will be removed from the solid waste facility. Closure plans will be submitted to YG Environment prior to the final decommissioning of the land treatment facility and the solid waste facility.

A salvage program will be conducted towards the end of mine life to minimize the volume of scrap generated by the decommissioning of these facilities that will require in-situ disposal. It is expected that removal of these facilities, namely the camp and explosives plant site, will be done by auction or contractor for salvage value.

The reclaim line and all above ground power cables and overhead power line gear will be salvaged. Any buried services such as piping and wiring will remain buried. Concrete footings will be broken down to slightly below grade as required and covered with fill. Recontouring of areas will also be conducted as required in order to establish final drainage runoff patterns. Culverts will be removed and pertinent areas will be covered in approximately 0.5 metres (unless otherwise noted) of growth media prior to application of seed and fertilizer.

6.9.1 Mill Building

Closure measures for this reclamation unit will include the removal of salvageable mill components, such as the ball and SAG mills and other milling-related equipment within the structure. It is anticipated that the building and steel framework will also be salvageable and that there will be minimal materials requiring disposal onsite. Any recyclable materials will be shipped to an appropriate recycling facility and all wastes will be disposed of either in the site solid waste management facility or an approved offsite disposal facility.

The concrete foundations and building footprint will be reclaimed in the manner described at the start of this section. The toe slopes of the fill at both the mill and the campsite pads will be recontoured to assume a more rounded slope, limiting erosion as much as possible. The angle and subsequent stabilization/revegetation measures will be contingent upon reclamation research findings from variable slope trial plots.

6.9.2 Generator Buildings

The generator buildings will be removed from the site after the power hook-ups are disassembled. Site reclamation of the area occupied by the generator buildings will be conducted in the same manner described for the camp area.

6.9.3 Concentrate Shed

The concentrate shed will be dismantled and removed for sale or salvage at the end of mine life. The remaining concrete footings will be broken down to slightly below grade and covered in fill material. Recontouring will also be conducted as required in order to establish final drainage runoff patterns and areas being reclaimed will be covered in 0.25 metres of growth media and revegetated using the approved reclamation seed mixture.

The southwest corner of the foundation may require complete removal to facilitate the excavation of the reclaimed drainage channel for Minto Creek in the vicinity of the mill water pond. This section of the foundation would be broken down and pushed into the interior of the remaining footings area, and all footings will be collapsed inward and buried with fill prior to surface reclamation.

6.9.4 Tailings Filter Building

The tailings filter building and associated tailings handling infrastructure (conveyors, etc.) will be dismantled and removed for sale or salvage at the end of mine life. Any recyclable materials will be shipped to an appropriate recycling facility and all wastes will be disposed of in an appropriate disposal area, either the site solid waste management facility or an approved off site disposal facility.

Concrete footings will be broken down to slightly below grade and covered in fill material. Recontouring will also be conducted as required in order to establish final drainage runoff patterns and areas being reclaimed will be covered in 0.25 metres of growth media prior to application of seed and fertilizer.

6.9.5 Mill Water Pond

The mill water pond is a geosynthetic lined pond, constructed according to EBA's Final Preliminary Design – Mill Water Pond, Minto Property, Yukon Territory (EBA, 1997). Together, the mill water pond and the Water Storage Pond Dam contain enough water to make process water for milling activities, supplementing water from the pit dewatering wells and mill groundwater well.

The mill pond will be left in place as an interim holding area for water entering the water treatment plant during the initial closure period. Some clean up of the mill pond may be necessary in order to prevent degradation of storm water entering the mill pond from the pit. Current water quality in the mill pond is within federal Metal Mine Effluent Regulations criteria but does not meet the WUL QZ96-006 effluent criteria for discharge.

Figure 6-10 and 6-18 shows the planned reclamation activities for the section of Minto Creek presently entering and exiting the mill water pond. The existing culvert upstream of the mill water pond will be excavated and removed. In order to withstand the Probable Maximum Flood flow, a conveyance channel will be constructed through the present alignment of the mill water pond.

The area of the mill pond will be evaluated to determine whether there is potential for construction of a passive treatment wetland to reduce the potential for water quality effects in the post closure period. The requirement for the passive treatment wetland will be determined based on the results of reclamation research on source control to reduce metal loadings from site infrastructure. Progressive reclamation and post closure monitoring of the DSTSF during Phase IV operations will also be used to help evaluate the need for a passive water treatment facility in this area.

6.9.6 Mill Reagents and Chemicals

Following the end of milling operations any unused mill reagent supplies will be returned to the supplier for credit. It is anticipated that all reagent product at the site will be properly contained/stored so that no product will be considered as special waste. A closure inventory/investigation of reagents and hazardous materials on site will be conducted upon the cessation of milling activities. Should some product's containment be deemed suspect upon the closure inspection, that volume of materials will be added to an inventory of special wastes. As such, the material will be stored under the Company's Special Waste Permit # 43-040, and removed from the site for disposal in a permitted facility by a licenced contractor with other special wastes on site.

It is expected that the mine's inventory of hydrocarbon products will be consumed during the closure activities. Fuels and lubricants will be required during the implementation period of the closure plan following the end of milling activities. The inventory remaining on site once all activity has ceased will be removed from the site by one of three methods:

- returned to the original supplier for credit wherever possible;
- sold to a third party user; or
- trucked to an authorized disposal agency to be recycled or destroyed.

It should be noted that the operation of diesel powered vehicles and any electrical generators used on site will provide the Company with a method of reducing remaining inventory of diesel fuel as the mining operations cease. Gasoline will be similarly removed, and any remaining inventories of diesel and gasoline will be returned to suppliers or sold based on wide spread local use.

The propane supplier will remove the propane tanks. Associated propane delivery lines at the camp will be removed and disposed of in a manner similar to that of the gasoline and diesel fuels.

Other hydrocarbon products that are present at the mine site are primarily hydraulic fluids, lubricating oils, greases, antifreeze, and solvents packaged in either 1000 litre bulk cubitainers, 205 litre drums or smaller packaging. In most cases the remaining inventory of these materials will be returned to the original suppliers for reuse or sold to other third party users in the local area. In certain circumstances, specialized products may have to be disposed of through a licenced waste disposal firm. It is anticipated that the volume of materials requiring disposal as special waste will be limited.

Any fuel storage areas and refueling stations, once decommissioned, will be assessed for hydrocarbon contamination of the underlying soils. A formal site assessment to identify hydrocarbon contaminated soils in other portions of the site will be conducted as part of the closure program and any soils identified by this assessment will be excavated and transported to the company's permitted Land Treatment Facility (LTF).

It is anticipated that landfarming of soils in the LTF will be required for a period of several years following the completion of closure activities at the site.

6.9.7 Contractor's Shop and Work Area

The mining contractor's area, constructed on site adjacent to the toe of the MWD, serves as the base of operations for the mining contractor during active mining activities. At closure, the buildings in this area will be dismantled and removed, and any scrap will be recycled or hauled to the onsite permitted Solid Waste Facility.

Physical stability will not be a concern at closure for this area. This is a low elevation pad and will only require proper erosion control at closure. Environmental concerns for the contractor's shop and work area will arise primarily from contamination of surrounding soils by fuel, chemicals or other wastes. Such incidents will be documented through an environmental audit, conducted upon the completion of milling activities. Any contaminated soils identified will be remediated on site at the site's approved land treatment facility, and any recyclables and/or special wastes will be removed from the solid waste facility. Closure plans will be submitted to YG Environment prior to the final decommissioning of the land treatment facility and the solid waste facility.

6.10 Main Access Road

The main access road to the property was constructed in 1996 and 1997. This road was constructed to facilitate 26-ton ore concentrate truck traffic. The road was constructed by cut and fill methods with a road width of 8 meters and associated ditch drainage and culvert installations. Figure 2-2 shows the alignment of the main access road. The Company expects that the determination of the extent to which the main access road is deactivated will be made in consultation primarily with SFN and secondarily with local trappers, the community, and government regulators. This closure plan presents three options for road reclamation.

1. No road deactivation;
2. Road deactivation from Minto Creek to the mine site; or
3. Deactivation of the entire road.

In making a final decision about closing the main access road, consideration will also be given to the potential requirement for equipment access. Despite the identified closure timing and schedule, final access road removal (if selected) would only be undertaken once it is concluded that the site is stable and there is no need for heavy equipment access to the site.

The primary consideration for the physical stability of the main access road at closure will be slope stability where culverts have been removed and drainage channels have been established through the road alignments. Siltation of streams could occur during culvert removal and slope stability work. The road will be inspected during an environmental audit to take place at the end of mine life to identify any spills or contamination that was not addressed during operations. The results of the audit would be shared with and/or conducted by SFN Lands and Resources Department so that a scope of work for closure could be jointly developed.

Should one of the two options involving deactivation of the road be chosen, then standard road decommissioning and reclamation measures at closure, including culvert excavation, drainage recontouring, slope stabilization and surface scarification will be applied.

Culvert removal work will be conducted in the late summer/early fall when flows are low or non-existent. Culvert removals and bank recontouring works at locations where there is still flow will include pump around or flow diversions to ensure that work is done in the dry and silt loads are not added to stream systems. Regrading/contouring the roads will ensure that runoff sheds off the road surface. The road surfaces are not expected to require seeding, only surface scarification to encourage natural revegetation.

The removal of culverts at stream crossings which are fish bearing is of primary concern. At these stream crossings, the roadbed would be cut down to the culvert and original streambed elevation with side slopes brought back to 2H:1V. Material removed during culvert removal will be spread loosely on adjacent road surface to promote revegetation. The stream channel would be stabilized as required and slopes revegetated. The Big Creek bridge and all culverts will be removed once all heavy equipment has been removed from the mine and closure activities have been completed in the upper Minto Creek basin.

The disturbed footprint of the access road occupies only a portion of the cleared right-of way. Site experience shows that vegetation should re-establish itself in the 30 m wide right-of-way during the life of mine and only remedial revegetation work will likely be required. The preferred methodology is to encourage natural revegetation to occur, after first preparing the road surface by recontouring and scarifying. Temporary sediment management measures such as silt fencing will be installed as required in order to minimize sediment transport during establishment of a vegetative cover. Figure 6-21 shows the reclamation measures for the access road.

6.11 Miscellaneous Sites and Facilities

This section addresses the decommissioning measures for miscellaneous facilities and sites around the property. These facilities include:

- mine camp and related infrastructure;
- airstrip,
- exploration sites and trails;
- land treatment facility;
- solid waste facility
- explosives plant site; and
- site roads.

Figure 6-20 shows details on the closure measures for the camp area. Closure measures will focus on long-term physical stability of these areas following closure and ensuring that any areas of contamination are identified and remediated in an appropriate manner. The physical stability of these structures/areas at closure will be mitigated for the most part by either:

- disassembly and removal from the site; and/or
- recontouring and revegetation of the area.

Environmental concerns for these areas will arise primarily from contamination of surrounding soils by fuel, chemicals or other wastes. Such incidents will be documented through an environmental audit, conducted upon the completion of milling activities. Any contaminated soils identified will be remediated on site at the site’s approved land treatment facility, and any recyclables and/or special wastes will be removed from the solid waste facility. Closure plans will be submitted to YG Environment prior to the final decommissioning of the land treatment facility and the solid waste facility.

A salvage program will be conducted towards the end of mine life to minimize the volume of scrap that will require in-situ disposal. It is expected that removal of these facilities, namely the camp and explosives plant site, will be done by auction or contractor for salvage value.

Buried services such as piping and wiring will remain buried. Concrete footings will be broken down to slightly below grade, where required, and covered with fill. Recontouring of areas will also be conducted as required in order to establish final drainage runoff patterns. Culverts will be removed and pertinent areas will be covered in 0.25 metres of growth media prior to application of seed and fertilizer.

6.11.1 Mine Camp and Related Infrastructure

In 1999 the Company completed construction of a camp for mine staff that included living quarters for 42 persons – a seven-unit accommodation/kitchen/diner/change room complex. In 2006, the camp was expanded by the addition of trailers and other construction to provide capacity for 140 persons, including an office complex. The facility provides a potable water supply (drilled groundwater well, 1998), gas-fired heat, a local power supply, and sewage disposal to two adjacent septic fields. Several structures behind the facility house the fuel supply to the furnaces, relay power from a diesel electrical generator, and pump fresh water. Part of the Phase IV expansion plan is to expand the camp facilities through expansion of the Camp Pad onto the surface of the Mill Valley Fill to increase the total camp capacity.

Upon closure, the septic tanks will be pumped out and the waste will be hauled to an approved disposal facility, as during operations. The remaining tanks will be crushed and infilled with general fill material before being covered with 0.25 m of overburden and revegetated. The remaining infrastructure (i.e. piping and related materials, including the septic field) for the two systems would remain buried.

Closure measures for the campsite include disassembly of the camp trailers and related infrastructure. All salvageable material will then be removed from the site. The remaining campsite landing will be scarified and recontoured, as required, to establish drainage patterns and then covered with 0.25 m of growth media and revegetated. Seed mixtures and fertilization specifications will be based on both revegetation trials and natural revegetation observations and success.

6.11.2 Airstrip

The airstrip area was noted to be subject to colonization by natural vegetation during a period of project inactivity from 1997 to 2005. Based on these observations, reclamation of the airstrip will focus on scarification of compacted surfaces. Natural revegetation will be allowed to occur in order to minimize the introduction of non-native species. Seeding of this reclamation unit is not deemed to be required as there is minimal erosion potential of the airstrip.

6.11.3 Exploration Sites and Trails

Current exploration activities being conducted on the site operate under a Class III Mining Land Use Authorization and are subject to specific closure measures as identified in the Class III Authorization. These measures will be implemented as required by the exploration crew, and are not subject to closure planning in this plan.

6.11.4 Land Treatment Facility

The Minto land treatment facility (LTF) is located near the airstrip in an area originally excavated on bedrock for an equipment laydown area. This facility is permitted by YG, Department of Environment, and Environmental Programs Branch under Permit #24-204 to treat a maximum volume of 700 m^3 of hydrocarbon contaminated soil. Contaminated soils from fuel/oil spills during operations will be treated in this facility to appropriate levels of remediation before being used as industrial fill as per permit requirements.

The closure of this facility is subject to the submission of a formal Closure Plan to YG, along with sampling results which demonstrate the final concentrations of contaminants in the soil being treated. It is expected that upon final closure of the entire site, dismantling and decommissioning activities may reveal or result in soil contamination requiring the relocation of contaminated soil to the LTF and an undetermined number of months of treatment to achieve desired remediation levels. As such, the LTF Closure Plan and final sampling results will be prepared and submitted some time after final closure of the mine site has begun.

Generally, once the desired contaminant levels have been reached in the final volumes of treated soil, and the Closure Plan has been approved by YG, the soils will be spread at approved locations at the site, recontoured in place and revegetated. If required, additional overburden may be hauled and used as cover material and growth media for revegetation.

6.11.5 Solid Waste Facility

Under Commercial Dump Permit # 81-005, issued to Minto Explorations Ltd. by YG, Department of Environment, Environmental Programs Branch, MintoEx has established a Solid Waste Facility adjacent to the Land Treatment Facility near the airport that includes:

- a burning pit for wood and paper waste;
- construction waste disposal area;
- metal and rubber tire disposal areas; and
- incinerator ash disposal in old exploration trenches.

The solid waste facility will receive construction and operational waste throughout the operation of the mine, as permitted. At closure the area will be covered by fill and compacted in ‘lifts’ as per common landfill practice.

Scrap equipment will be stored in various lay down areas ("bone yards") located on site and along the access road, including primarily scrapped equipment stored to be utilized on the mine site as a source of spare parts or good recyclable scrap material. Salvageable material from these sites will be sold as scrap and removed from the site at closure. Material that has no scrap value will be disposed of in the solid waste facility. Prior to disposal in the landfill, all of this material will be examined to ensure that all hazardous materials are removed.

Any hazardous materials identified in these areas will be removed and shipped off site to a licenced waste disposal site, along with other stored hazardous or special wastes, as permitted under the company's Special Waste Permit # 43-040.

The submission of a formal Closure Plan to YG for the solid waste facility will be required at final closure. The formal closure plan will document the conditions and materials at final closure. Preceding the final reclamation of this facility, tires and salvageable scrap metal will be hauled off site for salvage/recycling. Once the closure plan is approved by YG, the facility will be covered by two compacted lifts of 200 mm thick compactable soil material obtained from local borrow sources. The cover material will be graded to prevent pooling of precipitation runoff and to encourage the shedding of water. The site will then be revegetated using a suitable seed mixture.

6.11.6 Explosives Plant Site

The ANFO explosives (ammonium nitrate – fuel oil) production area is comprised of the production plant and AN bag storage and powder magazine storage areas, located near the drainage boundary southwest of the mine site (see Figure 1-3)

At closure, unused explosives that remain on site will be returned for credit and the explosives magazines and other equipment will be returned to the explosives supplier. The septic system at the site will be pumped of contents, broken down and backfilled. Fuel-contaminated soils will be excavated and hauled to the land treatment facility for remediation. Disturbed areas will be recontoured as required and covered with 0.25 m of overburden or growth media prior to application of seed and fertilizer. Seed mixtures and fertilization specifications will be based on both revegetation trials and natural revegetation observations and success.

6.12 Mine Roads

All mine roads will be subject to standard road reclamation measures previously described in the haul roads and main access road sections of this report.

6.13 Adaptive Management Planning

The Minto project is subject to a number of operational monitoring programs, including but not limited to:

- Water Quality Surveillance for site and receiving waters;
- Physical Stability Monitoring of various site structures;
- ABA Testing;
- Water Monitoring;
- Tailings Stability Monitoring; and
- Geotechnical Inspections.

Data from these programs has been and will continue to be collected under these programs during the closure period with similar requirements to those in effect during the operational life of the mine. Section 7.0 of this report proposes the continuation (and progressive scaling back) of the majority of these monitoring initiatives during the period of active reclamation and through the post-closure period when there is minimal site presence.

The closure measures in the previous sections have been developed and proposed based on the most up to date information collected at the site, and on the best interpretations of this data, with respect to the projected conditions on site at final closure. Changes to the Plan will be required as conditions continue to change as the site progresses through operations and closure. The periodic revisions to this Plan as per the QML schedule will address these changing conditions moving through operations, but as closure activities progress and monitoring on the site continues, planning mechanisms that can account for and react to changes to the expected conditions governing the closure measures need to be in place.

Adaptive management planning (AMP) is a recognized and effective way to ensure that changing conditions during closure are not subject to static reclamation initiatives, and that closure programs can be adapted to these conditions to achieve desired performance. The Company is committed to AMP in the context of closure of some of the higher risk features on the site. The Company sees the continued application of AMP for the following mine components/conditions:

- **Tailings Storage Facility** – an operational adaptive management program has been proposed for the Tailings Storage Facility in the Tailings Management Plan, based on data collected through the monitoring initiatives proposed in the same document. The AMP for this facility focuses on the physical and chemical stability of the tailings materials. Current monitoring of the DSTSF indicates that the facility is subject to movement and the Mill Valley Fill (MVF) was designed as a buttress to mitigate this movement. Monitoring wells to allow for sampling of seepage from the DSTSF will be installed when the MVF is constructed.

The continuation of a monitoring regimen into the post closure period after tailings placement has ceased and closure measures have been applied to the facility will provide further information for the comparison of the closure measures against the expected performance. This evaluation will be used to modify the proposed closure measures for the various site infrastructure.

- **Metals Leachate/Acid Rock Drainage Issues (ML/ARD**) – Acid Base Accounting (ABA) and representative ML testing is currently being conducted under the water license ABA Testing Program. This is a comprehensive testing program that will characterize both the waste rock and tailings materials during the entire mine life. The results of this program will be used to continue to guide the placement of waste materials during operations, ensuring that materials with acid generating potential are not used for general construction materials. The Company will specify distinct areas for any such material within the waste storage areas, such that should alternate closure measures be required for this material, they will be readily accessible and accurately delineated. This operational information, coupled with the proposed closure monitoring of the waste storage areas, will be used in preparing and implementing an Adaptive Management Plan for ML/ARD issues site wide, to be prepared and ready for implementation at closure.

- **Groundwater** – The monitoring program for groundwater is intended to provide a better understanding of the groundwater flow regime at the site. The results of groundwater monitoring conducted at existing wells will be evaluated periodically to determine whether there is a need for additional monitoring locations to be installed at the site.

General Reclamation Measures

- **Reclamation Cover Material** – The tracking of the volumes of overburden materials excavated and stockpiled conducted in the course of prudent operational management and required under the Water Use License Physical Monitoring Program will provide a running indication of the quantity of overburden available for reclamation growth medium. The Phase IV development involves the excavation of a significant volume of overburden which is adequate for reclamation of each of the different units on site. If at any time in the closure process the overburden requirements exceed the stockpiled inventory by more than 100,000 cubic metres, the Company will add the cost of mining overburden to the closure liability estimate. In addition, subsequent versions of this report will consider the results of the reclamation research program, which at the time of closure will have provided significant insight into the quality and quantity of growth medium required to achieve the objectives of the revegetation/reclamation planning.
- **Contaminated Soils** – the LTF is permitted for the treatment of soils and allows for the removal of hydrocarbon contamination. This process is not effective for the removal of metal contamination, and given the present condition and the confirmed geochemical signature of area surficial soils, it is likely that some of the materials treated will have metal contamination that would designate it as special waste. This has been confirmed by recent testing of materials in the LTF. This material, once successfully treated for hydrocarbons, could be placed in one of the waste storage areas (tailings, waste rock or IROD storage areas) and reclaimed in keeping with the implemented measures at that location, as metal concentrations in materials at these locations will likely be similar or higher. This approach has been approved by YG Environmental Programs in the past at closed sites. The adaptive management plan will refine these measures based on remediation success leading up to the post closure period.

These adaptive management plans will be developed and refined over the operational life of the mine with the goal of having them finalized for implementation at closure. They will be modelled on accepted AMP features, such as performance monitoring programs, threshold levels for data from the monitoring programs and associated triggers for action items, and response actions for expanding or refining the monitoring initiatives, implementing extended closure measures, and/or conducting further studies to develop mitigation measures for conditions that are divergent from those expected.

7 Post Closure Site Management

The closure phase of the Minto mine will commence with the cessation of economic mining of the open pit and the milling of ores and stockpiles. Once all mineable ore reserves have been processed, the mill and concentrator will be flushed and the tailings management facility (TMF) will be decommissioned. During the active decommissioning phase which is expected to last approximately 3 years, the number of personnel required will vary depending on site activities; however it is expected that as major decommissioning and reclamation tasks are completed the number of site personnel required will decline.

It is expected that a Water Use Licence or amendment will be required for the decommissioning phase of the operation as water use will continue on a limited basis and wastewater will be released from the WSPD in a controlled fashion, either treated or passively depending on the monitoring results. Decommissioning of the Big Creek Bridge along the main access road will be subject to community consultation and this activity may also require a Water Use Licence. The continued need for a Water Use Licence following the decommissioning phase will be dependent on site conditions, performance of closure measures in achieving stated objectives and legislated requirements. Post closure management and monitoring of the site will be guided to some extent by the Water Use Licence, quartz mining licence or other permit requirements, the performance of physical structures remaining on site and the ability of achieving and demonstrating long-term compliance with existing waste discharge standards.

Once overall closure performance has been demonstrated for all aspects of decommissioning, the necessity of maintaining licences or permits will be re-examined. At that point a Certificate of Closure, under the Quartz Mining Act would be requested. The following section provides a general outline of the site management approach that will be taken at the Minto mine during the closure phase.

7.1 Organization, Site Access & Security

A number of personnel will be required on site to implement the various decommissioning and closure tasks. Generally these tasks entail closure of mine workings, regrading of waste rock and overburden piles, decommissioning of the TMF, removal of the Water Storage Pond Dam, salvage and removal of infrastructure, equipment and reagents, decommissioning of access roads and reclamation and revegetation of disturbed lands. These activities would be undertaken on a seasonal basis and directed by an onsite manager responsible for decommissioning and reclamation of the Minto mine.

During site decommissioning, it is anticipated that at least a portion of the existing camp accommodations would remain on site to support site personnel. It is anticipated that during the initial post closure phase, site security requirements will continue with a caretaker remaining on site following seasonal closure of the site. A site inspection schedule will continue for the period of closure implementation (3 years) and then move into a post closure monitoring period (12 years) for a total of 15 years. Security personnel will no longer be required once decommissioning and reclamation activities are completed on the property. Once the majority of physical reclamation works are performed on the site, the number of employees or contractors required will be reduced. The Company is committed to having SFN members employed during implementation of the Plan and will continue to work with SFN to optimize long term closure monitoring requirements.

The main access road, barge landings and property security gate will be maintained during implementation of the post closure phase. Site access along the main road, barge support and Big Creek Bridge will be required for personnel and truck haulage requirements to and from the site. The security gate and fencing will be maintained while the main access road is in use. Decommissioning and reclamation of various haul and site access roads will be completed once closure measures have been completed at each facility and site access is no longer required.

Once decommissioning activities are completed onsite, and following a period of post closure monitoring, a determination will be made about whether to permanently close the main site access road. This decision will be made in conjunction with SFN as the access road lays within SFN Category “A” settlement lands. Closure of the main access road is expected to be consistent with the plan's closure philosophy; however, it is recognized that the performance of physical reclamation of the site must be assured before a final determination of the main access road closure is made. Government regulators and the local trapper will also be consulted regarding decommissioning plans for the road.

7.2 Supervision and Documentation of Work

All decommissioning and reclamation works shall be supervised to ensure that works are constructed according to their design and that the work is properly carried out and documented. The project manager or the construction supervisor will be responsible for supervising all closure works. Daily inspection procedures would be completed to document work progress, deficiencies and completion. Existing plans for spill response or other site internal procedures for fuel handling, waste disposal, fire control and suppression, health and safety and environmental management systems would be used, developed and followed as necessary.

Environmental inspections and tests conducted prior to the implementation of closure measures would be used to confirm areas requiring clean up.

For the WRD and TMF, plans for all earth works and inspections would be prepared and submitted to the YWB and EMR for review prior to construction. These plans would be submitted in a timely manner to facilitate agency review and Board approval prior to implementation. A competent engineer following standard quality control and assurance procedures would inspect and document this construction work. As-built plans and drawings would be completed and the results of the closure work completed on the removed water dam and tailings management facility documented in a final DRP report. This report would then be submitted to the YWB and regulatory agencies upon completion of closure activities.

A competent environmental practitioner following standard quality control and assurance procedures would design, direct and document the following restoration work. For the Big Creek Bridge removal and Minto Creek culverts, plans for all restorative works would be prepared and submitted to the YWB prior to decommissioning. A summary report of the works would then be prepared and submitted to the YWB and regulatory agencies upon completion of closure activities.

Upon completion of the decommissioning and reclamation works, a final site plan report (summary text and drawings) would be prepared to outline the facilities or works remaining on the site following closure. This plan would identify the location of buried concrete structures or scrap and landfill disposal areas. It is expected that this plan would accompany an Application for a Certificate of Closure under the *Yukon Quartz Mining Act*.

7.3 Mine Records

As noted in the previous section, all decommissioning and reclamation works would be documented. Active Mining period records showing the extent of open pit workings would be retained by the Company. Other site records, files and plans would also be archived at the site. Where plans or drawings are required for mine safety reasons, these plans would also be submitted to government mine safety offices. As-built reports for structures completed for closure and the final site closure report would be retained for record by the Company and submitted to government agencies and boards.

7.4 Compliance Monitoring and Reporting

Environmental compliance monitoring, internal monitoring of earthworks and independent geotechnical inspections are presently ongoing at the property. The environmental monitoring at the Minto mine employs several types of scheduled periodic inspections to ensure that the facility is meeting environmental performance objectives and complying with appropriate regulatory standards. These inspections entail:

- scheduled inspections of the waste rock and overburden storage areas, tailings management facility, water retaining structures and mine components to monitor environmental performance;
- scheduled water quality sampling and flow measurements of effluent streams and local receiving water streams;
- scheduled receiving water programs for benthic invertebrates, stream sediments and fish to monitor downstream environmental quality;
- scheduled piezometric monitoring of water levels in wells and the spillway structure at the Main Water Pond Dam (if still in place);
- monitoring of other instrumentation installed in the DSTSF as per the Tailings Management Plan (thermistors, survey hubs, etc.);
- annual inspections of the TMF by a qualified geotechnical engineer, diversion channel, waste rock and overburden storage areas, and Main Water Pond Dam for structural stability; and
- scheduled environmental tours and audits of the property by the Company staff to look for environmental hazards and site stability. The Company will endeavour to invite various Government agencies' representatives as part of the environmental inspections.

At present, site personnel undertake the scheduled environmental monitoring and inspection programs with the exception of annual geotechnical inspections and the benthic invertebrates, stream sediment and fish monitoring programs, which are conducted by qualified professionals. All results are reported to the YWB, and YG EMR as monthly or annual reports.

During the active closure phase environmental and physical compliance monitoring and inspections will continue as required by the present Water Use Licence or Quartz Mining Licence monitoring programs utilizing site-based personnel. It is expected that the amount of environmental and physical monitoring and inspection (frequency and quantity) will decline once all closure measures are implemented. The approach to closure monitoring will be to continue with the present licence monitoring and inspection programs until decommissioning and reclamation measures have been completed and then reduce the frequency of site monitoring and the number of monitoring stations over time as satisfactory closure performance is confirmed. Revisions to the current Water Use Licence requirements will be required upon closure to authorize the proposed monitoring programs.

The schedule for monitoring programs planned for the 15-year period immediately following cessation of active mining and milling operations are presented in Table 7-1. For the first 5 years following the cessation of mining, routine environmental monitoring will be completed to demonstrate the effectiveness of closure measures and their performance. Year 6 to 10 monitoring frequencies would be reduced to periodic inspections, with a further reduction of frequency for years 11 to 15. The purpose of these periodic inspections would be to ensure that waste discharges remain compliant, downstream receiving waters meet current Canadian Council of Ministers' of the Environment (CCME) Guidelines for the Protection of Freshwater Aquatic Life, and physical structures are performing as designed. Should these inspections identify issues of concern, then plans would be developed to address the concerns.

Based on the results of site monitoring for the 15-year post closure monitoring period and discussion with the SFN and the appropriate regulators the need for and the frequency of additional site monitoring will be determined. If the results from monitoring indicate that the site is stable with acceptable geotechnical and environmental performance, then the Company would propose to decrease the frequency of monitoring further. If the results from monitoring indicate there are concerns with either geotechnical conditions or environmental issues, then the site would continue to require more frequent monitoring than otherwise proposed and possibly additional remedial work would be proposed.

As previously mentioned, the Company is interested in having the SFN participate actively in both the closure activities and in post-closure monitoring. The Company will work directly with SFN in this regard.

Environmental monitoring and inspections conducted during the post closure period (years 4-15 after cessation of mining) will be undertaken by periodic visits to the site. Access to the property for post closure monitoring would be via ATV, snowmobile, and/or helicopter if the road is decommissioned.

Table 7-1 Post Closure Monitoring Program

Site	Description	UTM Location (m) Zome 8		Year 1-5 Frequency						Year 6-10 Frequency					Year 11-15 Frequency				
		Easting	Northing	Surface Water	Ground Water	Sediment	Benthos	Flows	Other	Surface Water	Ground Water	Sediment	Benthos	Other	Surface Water	Ground Water	Sediment	Benthos	Other
Receiving Water Stations																			
W-2	Mainstem Minto Creek directly u/s Access Road Crossing	392616	6948477	W		A	BA	DCR, W		Q		BA	BA		A		A	BA	
W-3	Mainstem Minto Creek 50 m d/s toe of Dam (Final Point of Discharge)	386747	6945682	W		A	BA	DCR, W		M		BA	BA		Q		A	BA	
W-6	Tributary to Minto Creek	387544	6946420	Q		A	BA	Q		Q		BA	BA		A		A	BA	
W-7	Tributary to Minto Creek	387504	6946069	Q		A	BA	Q		Q		BA	BA		A		A	BA	
W-10	Mainstem Minto Creek (south fork at headwaters)	383348	6943654	M				M		Q					A				
Mine Site Stations																			
W-11	Waste Rock Dump Seepage	384106	6944887	M						SA					A				
W-12	Discharge from Open Pit	384819	6944991	M						SA					A				
W-13	Mill Water Pond Discharge	385111	6945061	W2						SA					A				
W-15	Minto Creek, downstream of the overburden dump, just upstream of Open Pit	384286	6944754	M						SA					A				
W-16	Main Water Storage Pond Discharge (or Main Water Storage Pond if not discharging)	386538	6945573	W*							NLA					NLA			
W-17	Main Water Storage Pond Dam Seepage	386615	6945645	M*							NLA					NLA			
W-18	Low-Grade Ore Pad Seepage	386615	6945071	M*						SA*					A*				
W-8	Alternate Tailings Area Seepage/Runoff	384514	6945067	M*						SA*					A*				
W-8A	Tailings Seepage/Runoff	385620	69455071	M*						SA*					A*				
Physical Inspection Elements																			
	Water Dam	-	-						A*					NLA					NLA
	Tailings Area	-	-						A					A					A
	Diversion Ditches	-	-						A					A					A
	Waste Rock Dump	-	-						A					A					A
	Ice-Rich Overburden Dump	-	-						A					A					A
Environmental Inspection Elements																			
	Revegetation Inspection	-	-						A					A					A
	Wildlife Use Survey	-	-						A					A					A

* Unless structure has been decommissioned / reclaimed

Frequency Description

W	Weekly	Q	Quarterly	BA	Bi-annually
W2	Every 2 Weeks	SA	Semi-annually	NLA	No longer active
M	Monthly	A	Annually	DCR	Daily Continuous Record during open season

During the post closure period, reporting on all environmental and inspection programs carried out on the property will continue. These reports will be filed with the YWB, and EMR in accordance with conditions contained in the Water Use Licence, Quartz Mining Licence and other operating permits and approvals as they are.

Company personnel responsible for the management of the Minto mine would continue to meet with regulatory agencies, SFN, and the community (Pelly Crossing) on an as-needed basis to keep interested parties appraised of decommissioning activities and the results of post closure monitoring.

It is expected that a review of the environmental performance of the mine following closure would be made with EMR and other interested parties. Once this review is completed, the Company would apply to the Minister of EMR for a Certificate of Closure for the Minto mine under the Yukon Quartz Mining Act Mine Production Regulations. The Certificate of Closure will confirm that the Company has fulfilled their closure obligations for the site.

7.5 Long Term Maintenance

Provisions for maintenance of reclamation tasks such as erosion control and maintenance seeding have been included as part of the long-term closure requirements. Based on physical inspections and monitoring, maintenance works will be planned for and conducted as required to meet closure performance standards and objectives.

7.6 Temporary Closure

Temporary closure is defined in both the Quartz Mining License QML-0001 and the Water Use License QZ96-006 as the status of the project if no ore is processed through the mill for six consecutive months following start-up.

The Company’s priority during any temporary closure scenario is to ensure that the site remain geochemically and physically stable, and monitored in compliance with applicable licenses and legislation. Generally, this will include both initial stabilization and then ongoing routine monitoring and maintenance of the site infrastructure and facilities. The current Water Use Licence QZ96-006 contains a temporary closure monitoring schedule (Part H – Interim Closure) that forms the basis for the proposed temporary closure monitoring plan. It has been augmented to include planning for project elements that were not in place and therefore not subject to the interim closure period monitoring, such as the mill, WSPD, water treatment plant, mill water pond, waste dumps, tailings storage area, and the explosives storage facility.

Table 7-2 provides a summary of the various project components and the inspection and maintenance activities for use during any temporary cessation of mining activities. The cost of temporary closure is estimated to be approximately $4,000,000.

Table 7-2 Summary of Care and Maintenance Activities and Surveillance Program during Temporary Cessation of Mining Operations

Project Component	Area of Interest	Care/Maintenance Activities	Monitoring Activities	Monitoring Responsibility	Monitoring Timing/Frequency
Open Pit	Water Management/Treatment Physical Stability	Maintain creek diversion around pit Treat excess pit water and transfer to WSP Restrict access to hazardous areas with physical barriers Maintain perimeter ground interceptor wells if necessary	WUL Physical Monitoring Program	Caretaker	As per WUL
			Water Quality Monitoring for Treatment	Water Treatment Technician	As required
			Geotechnical Inspection of Creek diversion	Engineer	Annual
Underground Workings	Water Management	If dewatering continues, water will be managed/treated as required with site plant.	WUL Water Quality Surveillance Program	Caretaker	As per WUL
	Physical Stability	Restrict Access to hazardous areas with physical barriers and signage	WUL Physical Monitoring Program	Caretaker	As per WUL
Ore Stockpiles High Grade	Physical Stability	Reduce High Grade Stockpile Inventory	n/a	n/a	n/a
	Geochemical Stability	Monitor for seepage	WUL Water Quality Surveillance Program	Caretaker	As per WUL
Ore Stockpiles Low Grade	Physical Stability	Monitor for stability	WUL Physical Monitoring Program and Annual Geotechnical Inspection	Caretaker	As per WUL
	Geochemical Stability	Monitor for seepage	WUL Water Quality Surveillance Program	Caretaker	As per WUL
Waste Rock and Overburden Dumps	Physical Stability	Runoff/Erosion/Sediment control, as required. (Progressive reclamation will occur during operations)	WUL Physical Monitoring Program	Caretaker	As per WUL
			Geotechnical Inspection	Engineer	Annual
	Geochemical Stability	Monitor for seepage	WUL Water Quality Surveillance Program	Caretaker	As per WUL
Tailings Storage Facility	Physical Stability	Surface water diversion structure repair/maintenance, as required Runoff/Erosion/Sediment control, as required. Dust Control, as required. (Progressive reclamation will occur during operations)	Visual inspection elements of Monitoring Program from Tailings Management Plan (TMP) WUL Physical Monitoring Program	Caretaker	As per TMP
			Geotechnical Inspection from WUL and TMP	Engineer	Annual
	Geochemical Stability	Monitor for seepage and water quality	WUL Water Quality Surveillance Program and TMP Monitoring Elements	Caretaker	As per WUL
Mill and Camp Site	Buildings, Equipment, and Infrastructure Physical Stability	Concentrate removed from site Secure buildings and maintain necessary equipment onsite for resumption of milling Inspect for site stability	Visual inspection periodically for signs of instability	Caretaker	Monthly
			Structural Inspection	Engineer	Twice Annually
	Mill Pond Physical Stability	Maintain pond liner, repair as required. Maintain culverts.	WUL Physical Monitoring Program	Caretaker	As per WUL
Water Dam	Water Management Physical Stability	Maintain spillway and structure as required based on geotechnical inspections. Monitor pond levels and water quality. Maintain spring/early summer pumping drawdown equipment.	WUL Physical Monitoring Program	Caretaker	As per WUL
			Geotechnical Inspection	Engineer	Annual
	Geochemical Stability	Monitor for seepage water quality	WUL Water Quality Surveillance Program	Caretaker	As per WUL
Explosives Facility	Physical Stability	Remove bulk explosives from site. As required, repair and replace infrastructure	Visual inspection periodically for signs of instability.	Caretaker	Monthly
Barge Landing	Access to Yukon River	As required, granular upgrade to landing site.	Visual inspection periodically for signs of instability.	Caretaker	Weekly
Access Road and Surface Drainage	Entire Route	As required, surface grading and granular amendments, ditch and culvert maintenance.	Visual inspection periodically for signs of instability/erosion	Caretaker	Weekly and after heavy precipitation events
Entire Site	Physical Stability	Runoff/Erosion/Sediment control, as required. Road/culvert maintenance as required. (Progressive reclamation will occur during operations)	WUL Physical Monitoring Program	Caretaker	As per WUL
			Geotechnical Inspection	Engineer	Annual
	Water Quality/Management	Retain Water Treatment Plant and Operators Maintain storm water diversion systems Continue seasonal water treatment as required for excess pit and site water	Undertake expanded temporary closure monitoring and submit to the YWB pursuant to Water Use Licence QZ96-006 (see Tables 7-4 and 7-5 for expanded monitoring program sites and schedule.) Continue required monitoring under Metal Mining Effluent Regulations (MMER)	Caretaker	As per WUL and MMER
	Security	Full time site caretaker will check, repair and replace as required: precautionary signage security gate – installed on Access Road at Main Dam	Site Inspection and Security Monitoring of all infrastructure and site elements	Caretaker	Daily: Inspection Sheets included in Annual Reporting
	Miscellaneous Infrastructure	Shut down and winterize camp, except for caretaker facilities Inspect power line	Site Inspection and Security Monitoring of all infrastructure and site elements – report any changes to stability/condition of miscellaneous infrastructure.	Caretaker	Daily: Inspection Sheets included in Annual Reporting
	Reporting	Prepare and submit annual report to the Yukon Water Board pursuant to Water Use Licence QZ96-006, including details of temporary closure activities and monitoring. Prepare and submit annual report to YG Mineral Resources Branch pursuant to the Quartz Mining License QML-0001, including details of temporary closure activities and monitoring. Prepare and submit quarterly monitoring reports to Environment Canada under MMER.		Minto Explorations Ltd.	Annually, by July 30 Quarterly, Online RISS Registry

7.6.1 Physical Stability and Geochemical Stability

Stabilization of site works during any temporary closure will be based on a continuation of efforts during operations to ensure construction and performance of facilities in accordance with their engineered designs. At this stage in the mine's life, many operational monitoring and research programs are underway to better understand the site and achieve physical and geochemical stabilization through such measures as:

- resloping and crest rolling to reduce slope angles on the waste dumps;
- grading and contouring to direct surface water away from steeper slopes to reduce erosional impacts;
- planting live willows in appropriate places throughout the site to help control erosion and reduce sediment in surface runoff water;
- covering potentially unstable areas with overburden and revegetating to establish a stable cover, again reducing erosional impacts; and
- augmenting revegetation efforts with bioengineering (planting of live cuttings/seedlings) efforts.

Site infrastructure, including buildings and process machinery, will be emptied/drained of hazardous reagents and process fluids where appropriate and stabilized for temporary closure based on recommendations from mechanical and chemical suppliers, contractors and engineers. This includes the removal of all hazardous wastes, including waste hydrocarbons, coolants, lubricants, mill reagents, and process chemicals. The bulk explosives inventory will be removed from site and explosives storage containers and facilities will be inspected regularly.

The significant exception to these activities will be water management and treatment infrastructure and reagents, which will remain in place and operational as required to maintain effluent quality compliance during any temporary closure. Water management and treatment activities will be continued in accordance with the existing Water Management Plan (MintoEx, 2009).

Temporary decommissioning of the rest of the infrastructure will only be conducted to a level whereby the infrastructure and systems are ensured to be stable in the short term (3 years) and such that mining and milling operations can be resumed in a timely manner should the decision be made to emerge from temporary closure to transition back into operations. The temporary decommissioning measures will include the following:

- the retention of essential equipment/assets onsite to maintain infrastructure; and
- the storage of reagents and other hazardous materials (not waste) in competent primary and secondary containment, to ensure compliance with applicable legislation.

7.6.2 Security and Monitoring

Uncontrolled access to the mine site could pose a risk to the public and to the site assets. As such, a full-time caretaker/monitor (at least 2 individuals trained for cross-shift) will be housed onsite in a serviced portion of the existing camp. Site equipment (grader/loader) and vehicles will be kept onsite for caretaker use in care and maintenance activities. Contingency equipment will also be kept onsite should more intensive earthworks be required during the temporary closure period.

A security gate shall be installed on the main access road adjacent to site in the event of the site being placed in temporary closure. This is a steep cut and fill location that will prohibit vehicle access around the gate. Snowmobile/ATV access cannot always be controlled, but warning signs will be erected indicating the risk of entry to the site at the main gate and at key locations around the site. Site buildings will be locked and secured.

The main access road will be maintained for caretaker and emergency access with equipment retained on site. Previous periods of inactivity at the site have shown that the access road remains relatively stable and allows access to site with little maintenance requirements. In winter, contractors will establish the ice road across the Yukon River at Minto Landing. In the summer the barge will be used only on an as needed basis during temporary closure, with a smaller boat being used when required for ferrying caretakers. Caretakers will remain at the site during periods when the ice bridge is not accessible.

The caretaker(s) will be responsible for:

- regular inspections (Table 7.2) of the site to observe and document the condition of and note any changes in site security and public safety measures, infrastructure, mine works, etc., and to document any newly emerging environmental or public health and safety issues.
- conducting routine physical monitoring activities;
- regular water quality and flow monitoring and treatment if necessary (a skilled operator may be necessary to operate water treatment plant);
- submitting of inspection and monitoring reports to managers on a regular basis;
- respond to any security/safety issues as required; and
- conducting routine site maintenance and basic repairs to infrastructure and works as required (snow removal, culvert and road maintenance, building maintenance).

Site inspections and monitoring will be conducted by vehicle when seasonally possible. During winter, some sites may only be accessible by snowmobile as snow removal will not be reasonable at all locations. Inspection results will be documented in an approved format. Any reports of changes in the physical status of any part of the site may warrant a follow-up investigation by managers and/or professional personnel.

The Company’s Water Use Licence contains a comprehensive Physical Monitoring Program which the licensee must conduct and report upon on a regular basis. This program includes regular visual inspections (Table 7.2) of the following structures at different frequencies, varying from daily to annually:

- Water Storage Pond Dam;
- Mill Water Pond;
- Waste Rock and Overburden Dumps; and
- Diversion Ditching.

In addition, the Company's Environmental Monitoring Plan further commits to structural monitoring of the elements listed above. These programs will continue in the event of any temporary closure, with results to be included in annual reporting under the water license.

Should temporary closure occur prior to the reclamation of the dry stack tailings facility then the monitoring program for the physical stability of the tailings pile as presented in The Company's Tailings Management Plan will be followed. Without ongoing tailings placement, the visual inspection elements of the stack stability monitoring will be conducted by the site caretaker, with any stability-related issues reported to the engineer immediately.

Some elements of the monitoring program (geotechnical and structural inspections and non-routine water quality and biological monitoring) will be conducted by appropriate professional personnel, and results of these inspections will be included in the annual reports and other required submissions.

Monitoring stations for the water quality surveillance program during any temporary closure are the same as those required during operations, as shown in Figure 6-2.

7.6.3 Reporting

All monitoring and inspection data collected during a temporary site closure will be compiled and submitted according to the required annual reporting timeframes for both the Water Use Licence and the Quartz Mining Licence.

8 Closure Costs

Cost estimation for implementation of the proposed closure measures is the basis for establishing the financial security that will be required on the project. The Phase IV closure cost estimate has been prepared based on the final extent of disturbance for each of the infrastructure units described in this report using a Net Present Value approach. Progressive reclamation for much of the site will assist in offsetting the maximum site liability that will be incurred during the operations phase but does not negate the need for estimating closure costs.

The tables of estimated costs to implement the decommissioning and reclamation measures described in this report are presented in Appendix C. The costing has been prepared to provide an estimate of closure plan implementation for 2011 (Year 0), 2013 (Year 2) and End of Mine Life. The salvage value of certain components of the mine is expected to offset some of the costs of implementing this closure plan. A salvage value of 50% has been used for the mill and ancillary facilities.

The calculation of rates for determination of closure costs is based in part on those included in the 2009 Detailed Decommissioning and Reclamation Plan and those calculated specifically for Phase IV.

The costs have been developed using a combination of current unit rates for available Yukon contractors' equipment, and custom unit rates specific to the project. These custom rates were prepared with input from the mine construction heavy equipment contractor and based on their experience on site during the construction activities, considering such factors as:

- haul distance;
- road grade; and
- material handling.

The unit costs have been applied to levels of effort in sufficient detail to allow thorough scrutiny by the reader. As such, equipment rates have been used where the level of effort is well understood, and in other cases, unit area or volume rates have been employed.

An annual inflation rate of 1.5% was applied to the base case unit rates in order to determine the cost of implementing the conceptual closure measures described in this plan. This inflation rate is consistent with the use of a review of published inflation rates for the Yukon.

- Table 8-1 provides a summary of the unit rates used in the calculations;
- Tables 8-2a-c contain a summary of cost estimates prepared for Year 0, Year 2 and End of Mine;
- Tables 8-3 to 8-10a-c provide closure cost estimates for the specific site development reclamation components;
- Tables 8-11a-c provides closure cost estimates reclamation research and revegetation activities;
- Tables 8-12a-c outline costs associated with the site management during closure implementation and presents post closure costs for compliance monitoring and maintenance for the entire projected 15 year active closure and post closure monitoring life; and
- Table 8-13a-c present costs for various supporting studies as outlined in the closure measures Section 6.

The closure measures presented in this plan have been prepared at a conceptual level of engineering. It is recognized that a certain level of detailed engineering will be required for major closure activities including, dam removal, and conveyance or diversion ditches. The approach is to ensure that closure measures are sound and have undergone review before detailed engineering is undertaken. Detailed engineering is planned for major works prior to implementation.

For the purposes of closure costing an estimate of 7% of the capital cost of each closure measure was used for typical project management and engineering costs.

A closure cost range from $12,667,179 to $12,930,414 is estimated for the current site conditions, based on three separate scenarios for road decommissioning. The End of Mine closure cost estimate ranges from $17,045,549 to $17,314,592.

8.1 Financial Security Updates

YG has developed a policy respecting mine site reclamation and closure with one of the stated principles being “adequate security must be provided by the project proponent at each stage of mine development reclamation and closure consistent with the requirements of relevant legislation and Yukon financial security guidelines” (YG, 2006). Typically requirements for mine security bonding are conditions of the

Type A Water Use Licence or Yukon Quartz Mining Production Licence. The Company intends to adhere to the principles for mine reclamation and closure and security requirements in accordance with YG's policy which identifies that the security estimate be updated every second year.

The Company and YG will jointly determine a schedule for security payment scheduling.

The Company will discuss road decommissioning requirements with the SFN, which will ultimately refine the final closure costs associated with the access road decommissioning.

9 Limitations of Report

This report has been compiled based on information provided by a number of different sources. The report and its contents are intended for the sole use of Minto Explorations Ltd. (Minto) and their agents. Access Consulting Group and EBA Engineering Consultants do 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 Minto, 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.

10 Closure

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

Access Mining Consultants Ltd.

ISSUED FOR REVIEW

Scott Davidson, M.Sc., P.Geo. (BC, NT, NU)
Senior Project Manager
p. 867.668.6463
e. sdavidson@accessconsulting.ca
mailto:

EBA Engineering Consultants Ltd.

ISSUED FOR REVIEW

Brian Cutts, P.Eng.
Senior Geotechnical Engineer
Pacific Region
c. 250.505.4467
e. bcutts@eba.ca

ISSUED FOR REVIEW

ISSUED FOR REVIEW

Reviewed by,
J. Richard Trimble, M.Sc. (Eng.), FEC, P.Eng.
Principal Consultant – Arctic Region
EBA Engineering Consultant Ltd.
p. 668-2071 x 222
e. rtrimble@eba.ca

References

Access Consulting Group. 2004. Examination of Natural Attenuation of Metals in Aqueous Solution by Soils in Northern Environments.

Access Consulting Group. 2011. Minto Mine Reclamation Research Program. 2010 Activities. Prepared for Minto Explorations Ltd, Vancouver, BC.

Anderson, M.B., Dombeck, G.D., and Perry, M.W. Trace Metals Assimilation in Treatment Wetland Sediments.

CH2M Hill (Sandy, T.) 2009. Presentation: North American Metals Council 5th White Paper – Review of Available Technologies for the Removal of Selenium from Water.

Clearwater Consultants Ltd. 2010. Minto Mine – Site Water Balance Update 2010. Prepared for Minto Explorations Ltd, Vancouver, BC.

EBA Engineering Consultants Ltd. 2010a. Phase IV Waste Management Plan – Minto Mine, YT. Prepared for Minto Explorations Ltd, Vancouver, BC.

EBA Engineering Consultants Ltd. 2010b. Phase IV Tailings Management Plan – Minto Mine, YT. Prepared for Minto Explorations Ltd, Vancouver, BC.

EBA Engineering Consultants Ltd. 2008a. Geotechnical Design, Proposed Reclamation Overburden Dump, Minto Mine, Yukon. Prepared for Minto Explorations Ltd, Vancouver, BC.

EBA Engineering Consultants Ltd. 2008b. Geotechnical Design, Proposed Southwest Waste Dump, Minto Mine, Yukon. Prepared for Minto Explorations Ltd, Vancouver, BC.

EBA Engineering Consultants Ltd. 2007. Geotechnical Design Report, Dry Stack Tailings Storage Facility, Minto Mine, Yukon. Prepared for Minto Explorations Ltd, Vancouver, BC.

EBA Engineering Consultants Ltd. 2006. Geotechnical Design, Ice-Rich Overburden Dump, Minto Mine, Yukon. Prepared for Sherwood Mining Corporation, Vancouver, BC.

EBA Engineering Consultants Ltd. 1998. Geotechnical Evaluation, Proposed Main Waste Dump, Minto Project, Yukon Territory. Prepared for Sherwood Mining Corporation, Vancouver, BC.

EBA Engineering Consultants Ltd. 1997. Final Preliminary Design – Mill Water Pond, Minto Property, Yukon Territory. Prepared for Sherwood Mining Corporation, Vancouver, BC.

EBA Engineering Consultants Ltd. 1996. Waste Rock Stability Evaluation, Minto Project, Yukon Territory. Prepared for Sherwood Mining Corporation, Vancouver, BC.

Gulec, S.B., Benson, C.H., and Edil, T.B. 2005 Effect of Acidic Mine Drainage on the Mechanical and Hydraulic Properties of Three Geosynthetics. In Journal of Geotechnical and Geoenvironmental Engineering, August 2005, Pages 937 – 950.

Harrington, J., Gobla, M., Francendese, L., and Bates, E. 2009. Low Cost Treatment of a Highly Contaminated Pit Lake Using Innovative Technology, Barite Hill Mine McCormick, SC.

Indian and Northern Affairs Canada. 1992. Mine Reclamation in Northwest Territories and Yukon. Northern Water Resources Studies, Indian and Northern Affairs Canada.

International Network for Acid Prevention (INAP), 2010. Global Acid Rock Drainage Guide (GARD Guide).http://www.gardguide.com/.

Johnson, D.B., and Hallberg, K.B. 2004. Acid mine drainage remediation options: a review. In Science of the Total Environment, Volume 338, Issue 1-2, February 2005, Pages 3-14.

Kuyucak, N., Chabot, F., and Martschuk, J. 2007. Successful Implementation and Operation of a Passive Treatment System in an Extremely Cold Climate, Northern Quebec, Canada. Paper presented at the 7th International Conference on Acid Rock Drainage, March 26-30, 2006, St. Louis MO. R.I. Barnhisel (ed.) Published by the American Society of Mining and Reclamation (ASMR).

Laberge Environmental Services. 2000. Investigations Into Passive Wetlands Treatment of Mine Drainage to Remove Heavy Metals at Various Sites at UKHM. MERG Report 2000-3.

Lapakko, K. 2002. Metal Mine Rock and Waste Characterization Tools: An Overview. International Institute for Environment and Development.

Martin, A.J., Jones, R., and Buckwalter-Davis, M. 2009. Passive and Semi-Passive Treatment Alternatives for the Bioremediation of Selenium from Mine Waters.

Mattes, A., Duncan, B., and Gould, Dr. D. 2004. Biological Removal of Arsenic in a Multi-Stage Engineered Wetlands Treating a Suite of Heavy Metals.

MEND. 2010. Mine Waste Covers in Cold Regions. Mining Environment Neutral Drainage Report 1.65.1a

MEND 2009. Cold Regions Cover Research – Phase 2. Mining Environment Neutral Drainage Report 1.65.1a

Mills, C. 1997. An Assessment of the Acid Base Accounting (ABA) and Mineralogical Test Work on Eight Samples from the Proposed Minto Project, Yukon Territory. Vancouver, BC.

Minto Explorations Ltd. 2009. Minto Mine - Detailed Decommissioning and Closure Plan Revision 2.

O'Kane, M. and Wels, C. 2003. Mine Waste Cover System Design – Linking Predicted Performance to Groundwater and Surface Water Impacts.

SRK Consulting Inc. 2009a. Pre-feasibility Geotechnical Evaluation, Phase IV, Minto Mine. Prepared for Minto Explorations Ltd, Vancouver, BC.

SRK Consulting Inc. 2009b. Tailings Risk Assessment - Minto Project, Yukon Territory. Prepared for Minto Explorations Ltd, Vancouver, BC.

SRK Consulting Inc. 2010a. Minto Mine Expansion – Phase IV, ML/ARD Assessment and Post-closure Water Quality Prediction. Prepared for Minto Explorations Ltd, Vancouver, BC.

SRK Consulting Inc. 2010b. Minto Mine: Groundwater Baseline Conditions. Prepared for Minto Explorations Ltd, Vancouver, BC.

Trefry, M.G. and Patterson, B.M. 2001. An experimental determination of the effective oxygen diffusion coefficient for a high density polypropylene geomembrane. CSIRO Land and Water, Technical Report 37/01, September 2001.

U.S Environmental Protection Agency. 2002. Arsenic Treatment Technologies for Soil, Waste, and Water.

U.S. Environmental Protection Agency. 2006. Active and Semi-Passive Lime Treatment of Acid Mine Drainage at Leviathan Mine, California.

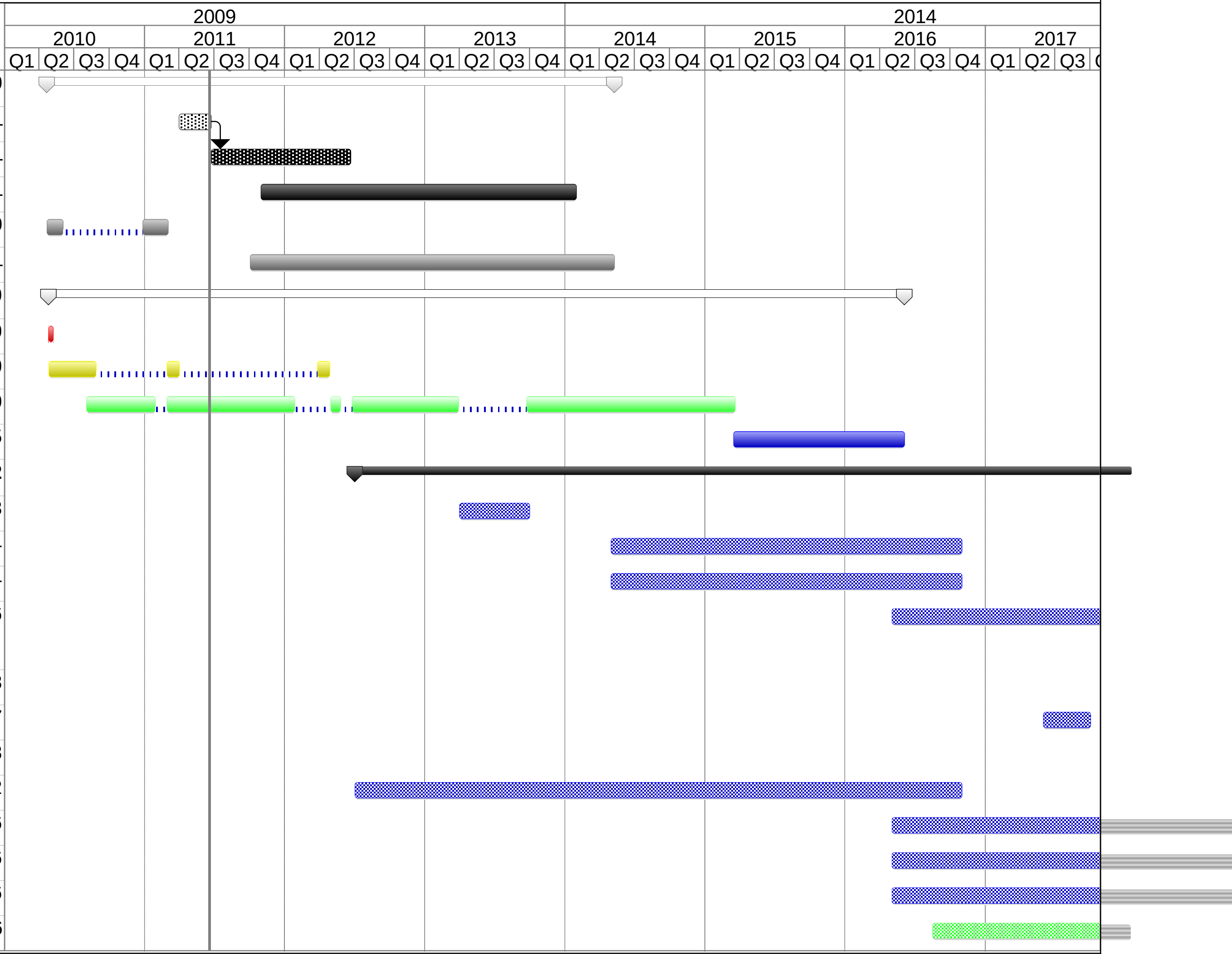
U.S. Environmental Protection Agency. 2003. Evapotranspiration Landfill Cover Systems Fact Sheet.Yukon Government. 2006. Yukon Mine Site Reclamation and Closure Policy.

Zagury G.J., Neculita C., and Bussiere, B. 2007. Passive Treatment of Acid Mine Drainage in Bioreactors: Short Review, Applications, and Research Needs. OttawaGeo2007.

Ziemkiewicz, P.F., Skousen, J.G., and Simmons, J. Long-term Performance of Passive Acid Mine Drainage Treatment Systems.

Minto Mine LOM Timeline

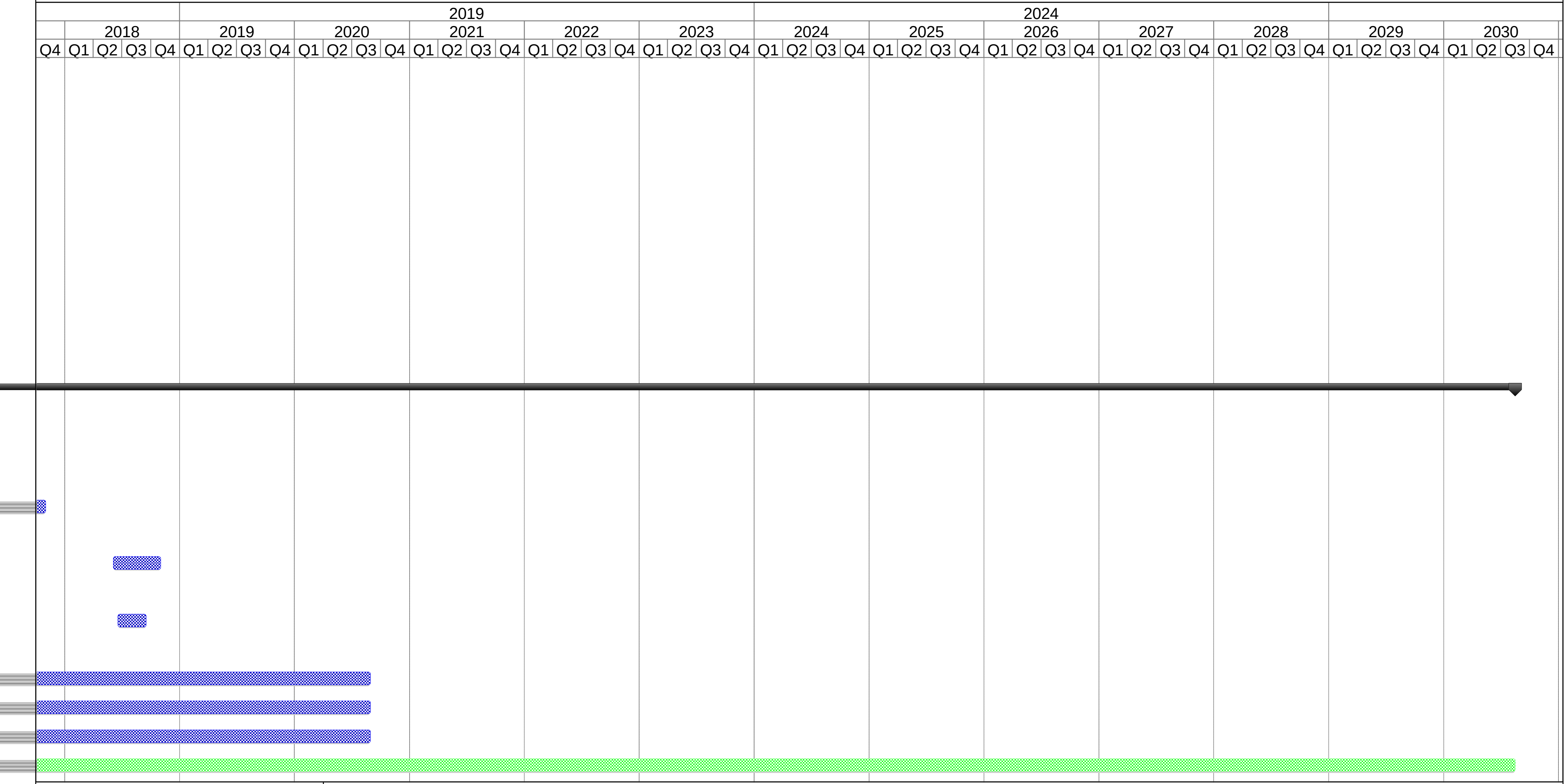
ID	Task Name	Duration	Start
1	**Phase IV Mining**	**1058 days**	**Wed 4/21/10**
2	UG Exploration Ramp Prep	3 mons	Fri 4/1/11
3	UG Ramp Development	13 mons	Fri 6/24/11
4	UG Stoping	589 days	Mon 10/31/11
5	Main Pit Ore Production	4 mons	Wed 4/21/10
6	Area 2 / 118 Ore Production	34 mons	Mon 10/3/11
7	**Mill operations**	**1595 days**	**Mon 4/26/10**
8	Draw from red stockpile	10 days	Mon 4/26/10
9	Draw from yellow stockpile	7 mons	Mon 4/26/10
10	Draw from green stockpile	49 mons	Mon 8/2/10
11	Draw from blue stockpile	16 mons	Mon 3/16/15
12	**Minto Closure Reclamation**	**4730 days?**	**Mon 7/2/12**
13	Dry Stack Tailings Storage Facility	6.55 mons	Mon 4/1/13
14	Southwest Waste Dump	32.65 mons	Thu 5/1/14
15	Main Waste Dump	32.65 mons	Thu 5/1/14
16	Bin 0.1 to 0.3 Stockpiled Material	19.6 mons	Mon 5/2/16
17	Mill Valley Fill	5.45 mons	Mon 6/4/18
18	Decommissioning Mill and Infrastruc	87 days?	Thu 6/1/17
19	Site Discharge Channel Constructio	66 days?	Mon 6/18/18
20	Area 118 Pit	1131 days	Mon 7/2/12
21	Area 2 Pit	56.55 mons	Mon 5/2/16
22	Area 1 Pit	56.55 mons	Mon 5/2/16
23	Closure Related Active Water Treat	1131 days?	Mon 5/2/16
24	Post Closure Monitoring Programs	3654 days?	Tue 8/16/16



Project: Ph IV time line 20100719
Date: Mon 6/20/11

Task	▨	External Milestone	◆	Manual Summary Rollup	▬
Split	┈	Inactive Task	▭	Manual Summary	▬
Milestone	◆	Inactive Milestone	◇	Start-only	[
Summary	▬	Inactive Summary	▭	Finish-only	]
Project Summary	▬	Manual Task	▬	Progress	▬
External Tasks	▨	Duration-only	▭	Deadline	⇩

Minto Mine LOM Timeline



Project: Ph IV time line 20100719
Date: Mon 6/20/11

Task	▨	External Milestone	◆	Manual Summary Rollup	▬
Split	┈	Inactive Task	▭	Manual Summary	▬
Milestone	◆	Inactive Milestone	◇	Start-only	[
Summary	▬	Inactive Summary	▭	Finish-only	]
Project Summary	▬	Manual Task	▬	Progress	▬
External Tasks	▨	Duration-only	▬	Deadline	⇩

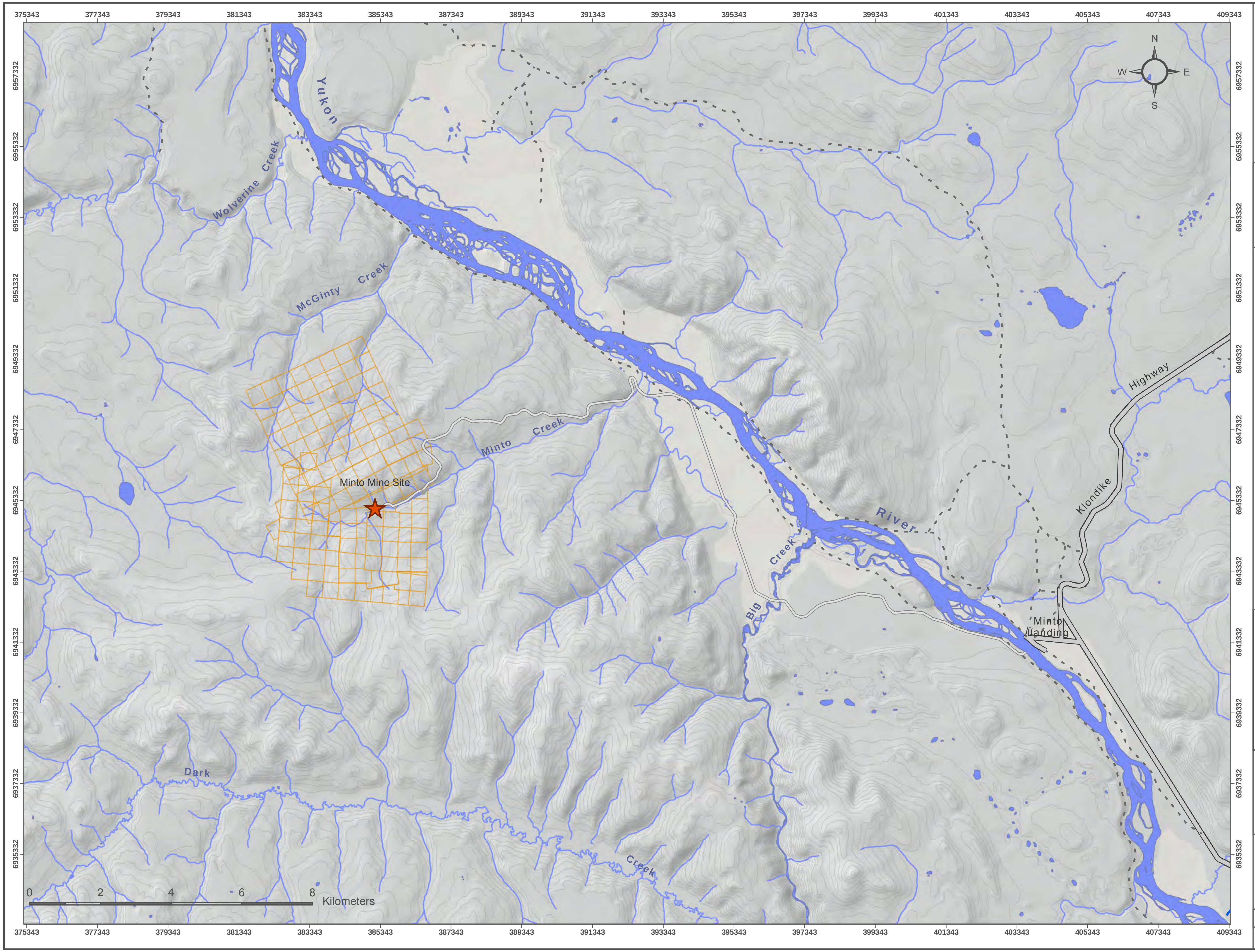
MINTO MINE

Minto Explorations Ltd.
A SUBSIDIARY OF CAPSTONE MINING LTD.

DECOMMISSIONING AND RECLAMATION PLAN Rev.3.1

FIGURE 2-1
PROJECT LOCATION

ACCESS
CONSULTING GROUP



MINTO MINE

DECOMMISSIONING AND RECLAMATION PLAN

Rev. 3-2

Minto Explorations Ltd.
A SUBSIDIARY OF CAPSTONE MINING LTD.

★ Minto Mine Site
═ Mine Access Road
━ Road
- - - Trail
— Watercourse
— Contour
▭ Minto Explorations Ltd. Claims
🟦 Waterbody

National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000.Reproduced under license from Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources Canada. All rights reserved.

Quartz claims data obtained from Energy, Mines and Ressources, YTG. Data currrent as of December 4th 2009.

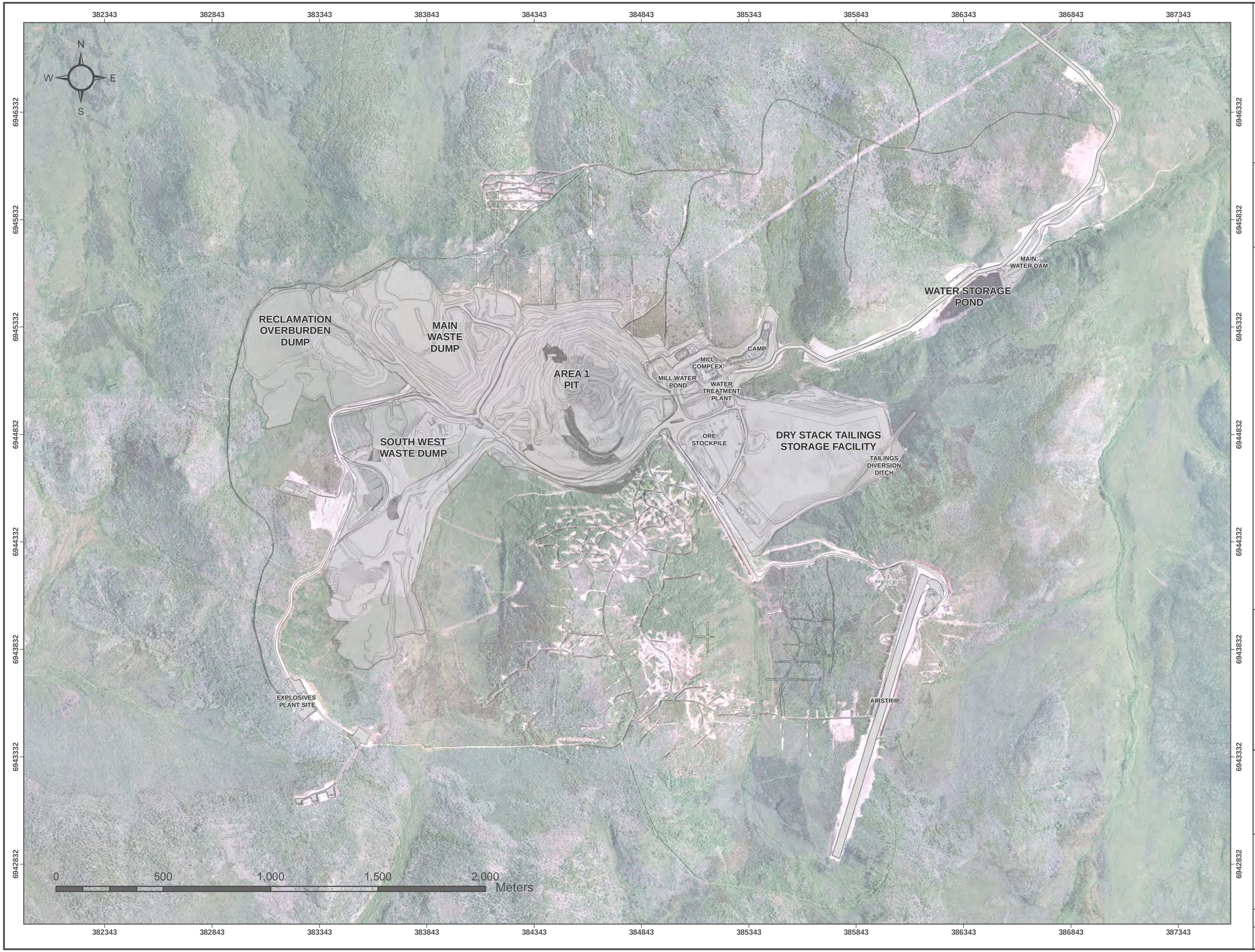
NAD 83 UTM Zone 8N

FIGURE 2-2
PROPERTY OVERVIEW

ACCESS
CONSULTING GROUP

DRAWN BY MD	JUNE 2011	VERIFIED BY SK

I:\Minto\gis\mxd\Phase_4\Closure\FEB_2011\
2-2_Area_Overview_20110210.mxd



MINTO MINE

DECOMMISSIONING AND RECLAMATION PLAN
Rev. 3-2

Minto Explorations Ltd.
A SUBSIDIARY OF CAPSTONE MINING LTD.

═	Access Road
—	Mine Site Road
—	Site Form Line

This is not a legal document. Aerial photography flight date: July 13th 2009. Ortho-rectification produced by Challenger Geomatics Ltd. Site layout provided by Minto Exploration Ltd and processed by EBA February 2011. Data current as of January 2011.

NAD 83 UTM Zone 8N

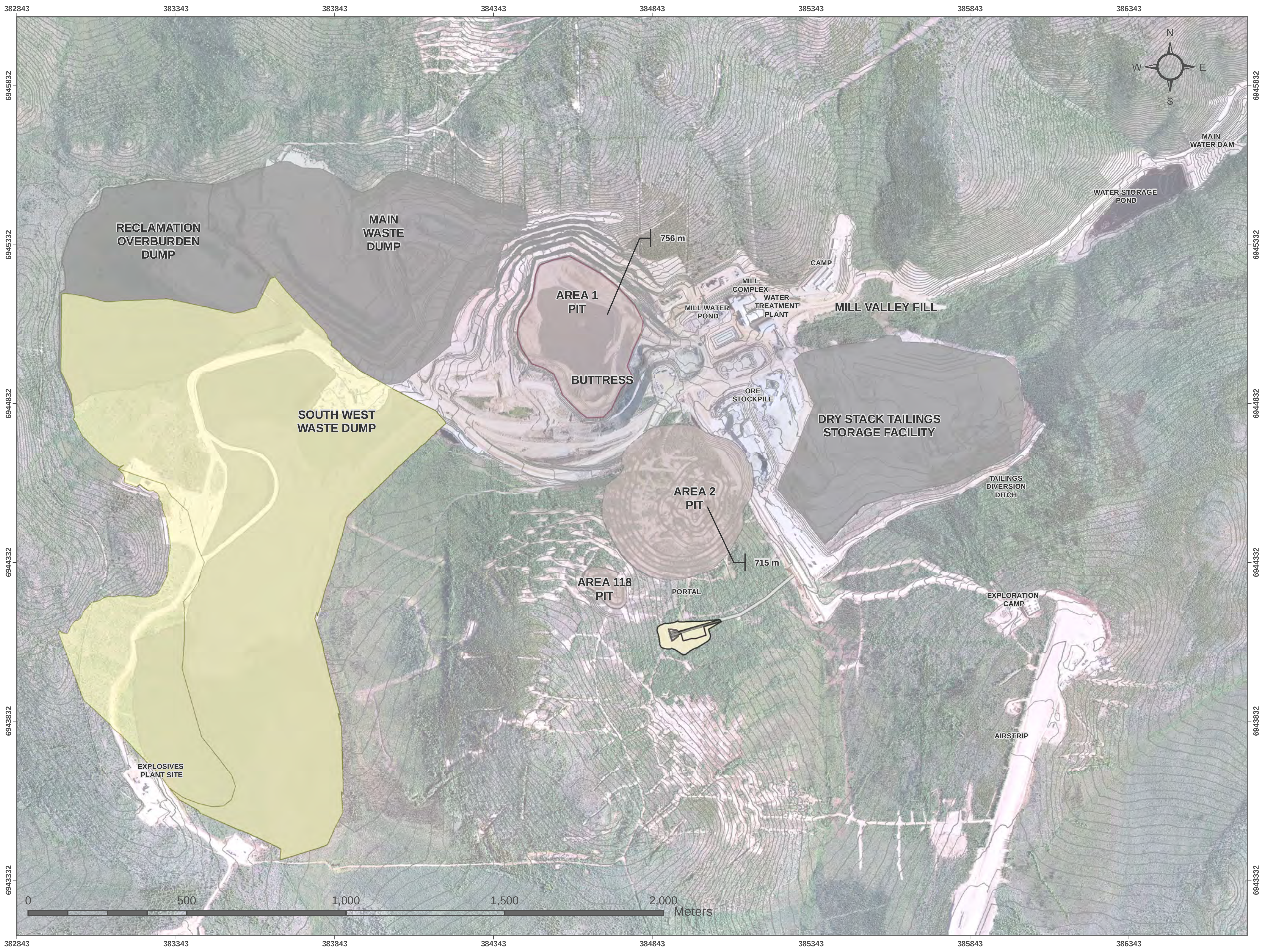
FIGURE 2-3

SITE PLAN CURRENT CONDITIONS - JANUARY 2011

ACCESS
CONSULTING GROUP

DRAWN BY MD	JUNE 2011	VERIFIED BY SK

I:\Minto\gis\mxd\Phase_4\Closure\FEB_2011\
2-3_OverallSitePlan_CurrentConditions_20110214.mxd



MINTO MINE

DECOMMISSIONING AND RECLAMATION PLAN

Rev.3-2

Minto Explorations Ltd.

A SUBSIDIARY OF CAPSTONE MINING LTD.

Mine Feature Footprints

🟨	Completed waste dump development
▨	Pit Development
🟪	Waste Rock and Tailings Placement
⬛	Previous Waste Dump Footprint

This is not a legal document. Aerial photography flight date: July 13th 2009. Ortho-rectification produced by Challenger Geomatics Ltd. Waste dump footprints provided by EBA (PRELIM PHASE IV WASTE DUMP DEVELOPMENT BY CALENDAR YEAR 2010-07-07.dxf) and W14101068.015 P4W-05 2010-07-07.dxf. Pit Development form lines provided by SRK (PHIV 2010.dxf).

NAD 83 UTM Zone 8N

FIGURE 2-4

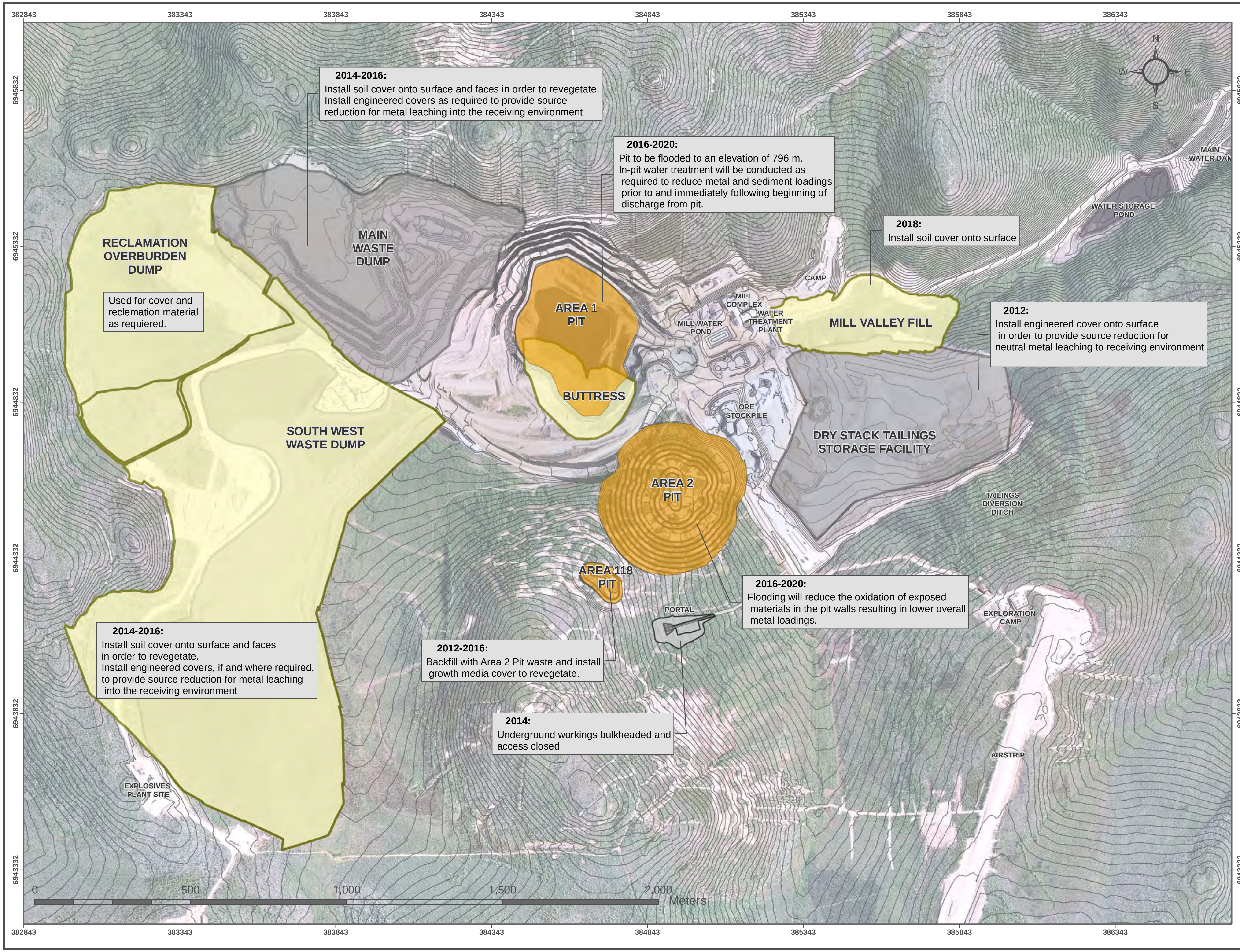
SITE PLAN JANUARY 2013

ACCESS

CONSULTING GROUP

DRAWN BY MD	JUNE 2011	VERIFIED BY SK

I:\Minto\gis\mxd\Phase_4\Closure\FEB_2011\
2-4_SumReclamMeas_20110228.mxd



2014-2016:
Install soil cover onto surface and faces in order to revegetate.
Install engineered covers as required to provide source reduction for metal leaching into the receiving environment

2016-2020:
Pit to be flooded to an elevation of 796 m.
In-pit water treatment will be conducted as required to reduce metal and sediment loadings prior to and immediately following beginning of discharge from pit.

2018:
Install soil cover onto surface

Used for cover and reclemation material as requiered.

2012:
Install engineered cover onto surface in order to provide source reduction for neutral metal leaching to receiving environment

2016-2020:
Flooding will reduce the oxidation of exposed materials in the pit walls resulting in lower overall metal loadings.

2014-2016:
Install soil cover onto surface and faces in order to revegetate.
Install engineered covers, if and where required, to provide source reduction for metal leaching into the receiving environment

2012-2016:
Backfill with Area 2 Pit waste and install growth media cover to revegetate.

2014:
Underground workings bulkheaded and access closed

MINTO MINE

DECOMMISSIONING AND RECLAMATION PLAN

Rev. 3-2

Minto Explorations Ltd.
A SUBSIDIARY OF CAPSTONE MINING LTD.

🟧 Pit Development
🟨 Waste Dump Footprint
▨ Previous Waste Dump Disturbance

This is not a legal document. Aerial photography flight date: July 13th 2009. Ortho-rectification produced by Challenger Geomatics Ltd. Waste dump footprints provided by EBA (PRELIM PHASE IV WASTE DUMP DEVELOPMENT BY CALENDAR YEAR 2010-07-07.dxf) and W14101068.015 P4W-05 2010-07-07.dxf. Pit Development form lines provided by SRK (PHIV 2010.dxf).

NAD 83 UTM Zone 8N

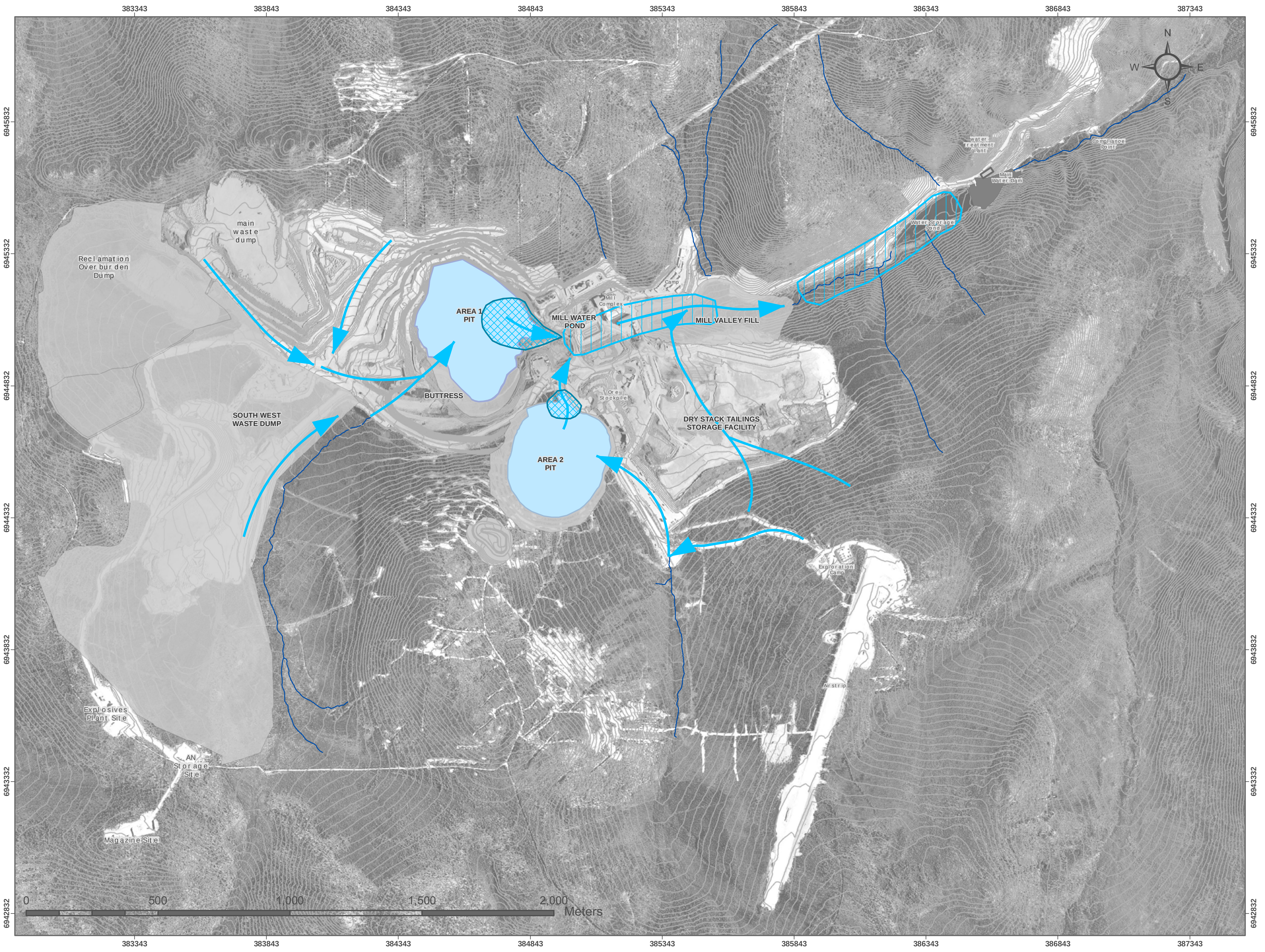
FIGURE 2-5

SITE PLAN JANUARY 2017 RECLAMATION SUMMARY

ACCESS
CONSULTING GROUP

DRAWN BY MD	JUNE 2011	VERIFIED BY SK

I:\Minto\gis\mxd\Phase_4\Closure\FEB_2011\2-5_SumReclamMeas_20110228.mxd



MINTO MINE

DECOMMISSIONING AND RECLAMATION PLAN

Rev. 3-2

Minto Explorations Ltd.

A SUBSIDIARY OF CAPSTONE MINING LTD.

➝ CONCEPTUAL FLOW PATH (APPROXIMATE LOCATION)

▥ POTENTIAL PASSIVE TREATMENT AREA (IF REQUIRED)

▩ POTENTIAL IN PIT PASSIVE TREATMENT LOCATION

This is not a legal document. Aerial photography flight date: July 13th 2009. Ortho-rectification produced by Challenger Geomatics Ltd. Site hydrology provided by provided by Minto Explorations Ltd, May 2009 and modifed to reflect Phase IV design. Waste dump footprints provided by EBA (PRELIM PHASE IV WASTE DUMP DEVELOPMENT BY CALENDAR YEAR 2010-07-07.dxf) and W14101068.015 P4W-05 2010-07-07.dxf. Pit Development form lines provided by SRK (PHIV 2010.dxf).

NAD 83 UTM Zone 8N

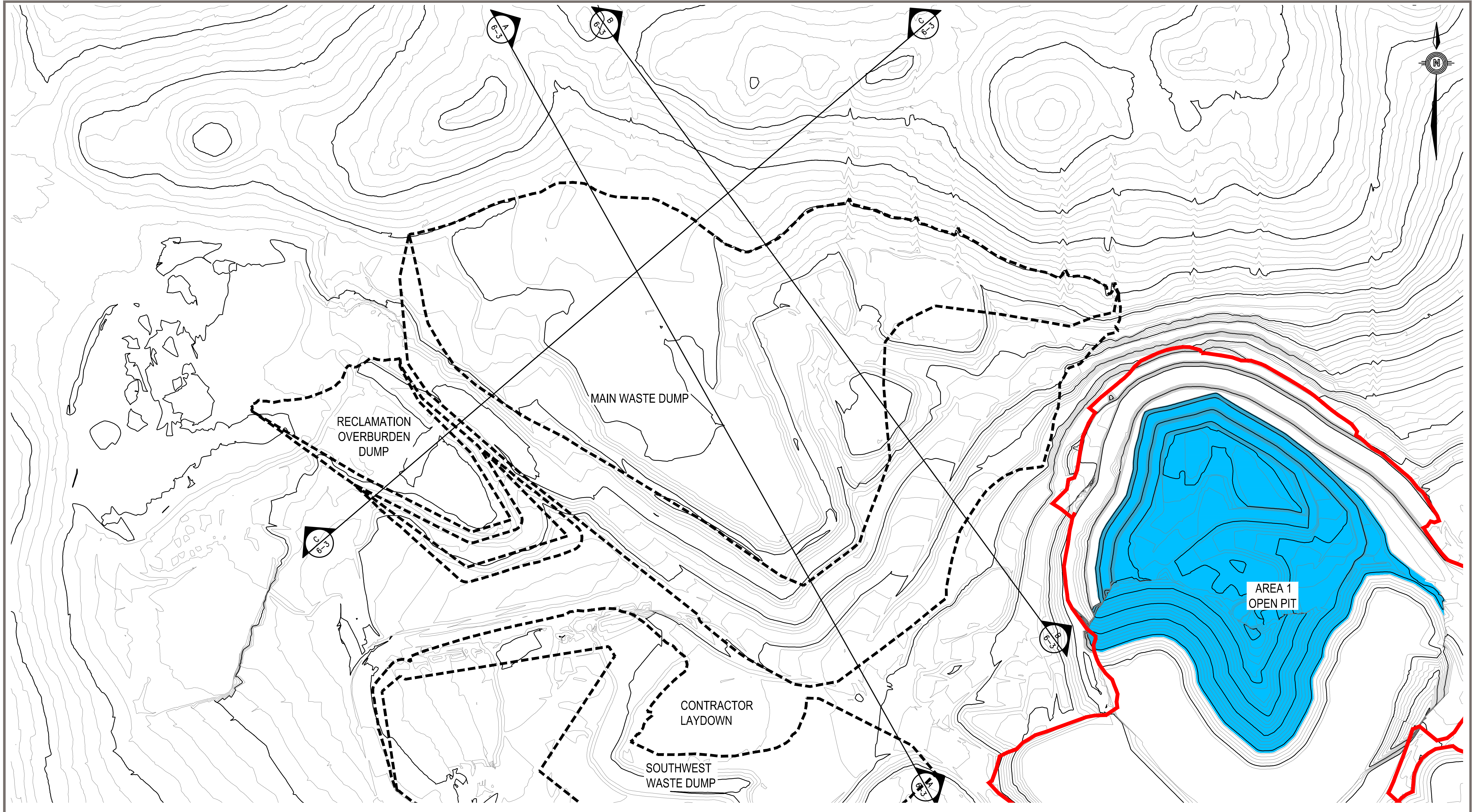
FIGURE 6-1

WATER MANAGEMENT PLAN

ACCESS
CONSULTING GROUP

DRAWN BY MD	JUNE 2011	VERIFIED BY SK

I:\Minto\gis\mxd\Phase_4\Closure\APRIL_2011\6-1_WMP_20110415.mxd (*15/04/2011/14:52 PM*)



NOTE :

3 m INTERMEDIATE AND 15 m INDEX CONTOUR DATA SHOWN
BASED ON JANUARY 2011 SURVEY DATA PROVIDED BY MINTO.

STATUS
ISSUED FOR REVIEW

0 250
Scale: 1: 5 000 (metres)

CLIENT
MINTO EXPLORATIONS LTD.

A TETRA TECH COMPANY

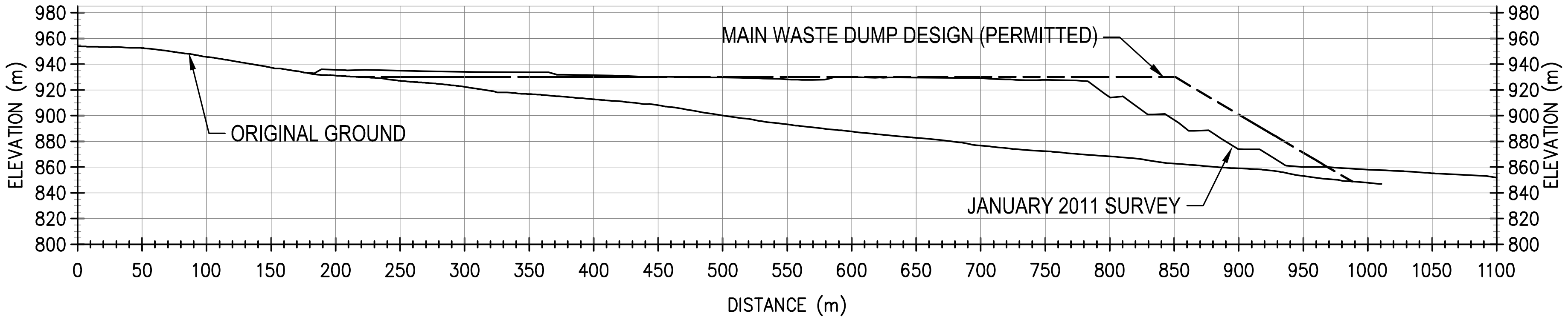
MINTO MINE DECOMMISSIONING AND RECLAMATION PLAN REVISION 3.1

MINTO MAIN WASTE DUMP PLAN

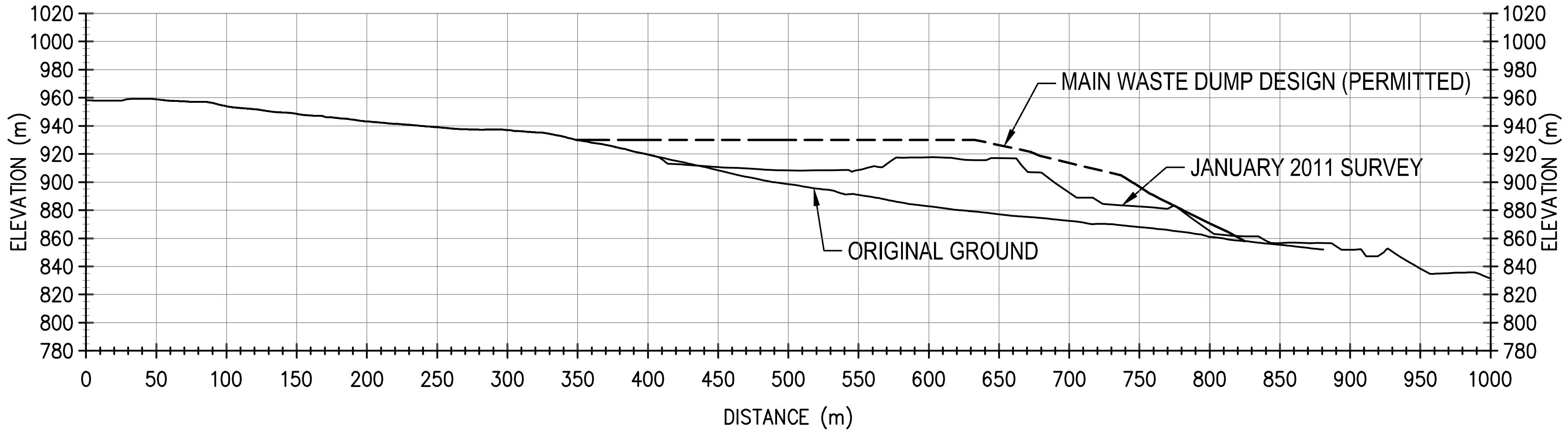
PROJECT NO.	DWN	CKD	REV
W14101068.030	CB	BJC	A
OFFICE	DATE		
EBA-WHSE	April 15, 2011		

Figure 6-2

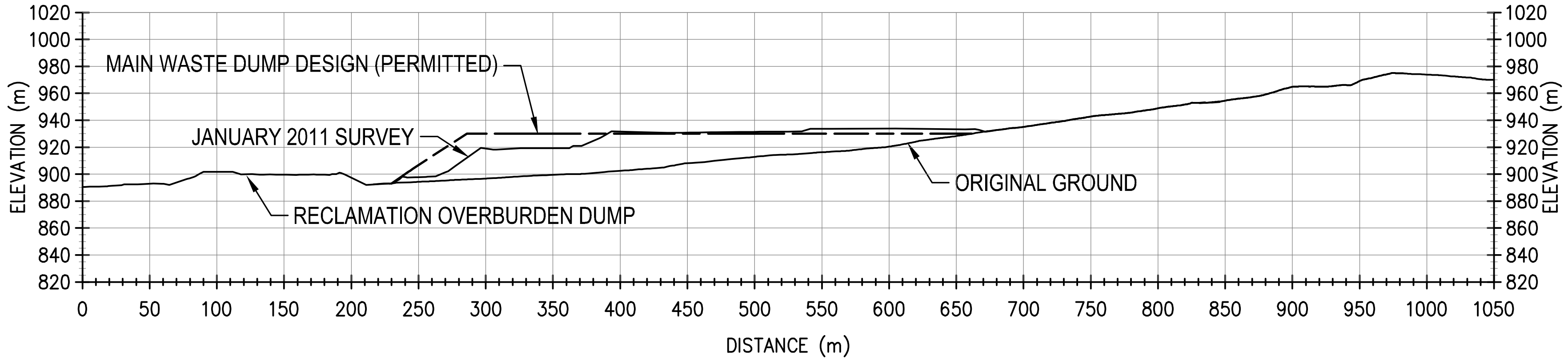
Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 030 Minto Closure Plan\April 2011 Closure\W14101068.030 Fig.6-2, 6-3.dwg [FIGURE 6-3] April 14, 2011 - 6:03:29 pm (BY: BUCHAN, CAMERON)



A
6–2
SECTION A
SCALE 1:5,000



B
6–2
SECTION B
SCALE 1:5,000



C
6–2
SECTION C
SCALE 1:5,000

STATUS
ISSUED FOR REVIEW

CLIENT
MINTO EXPLORATIONS LTD.

MINTO MINE DECOMMISSIONING AND RECLAMATION PLAN REVISION 3.1

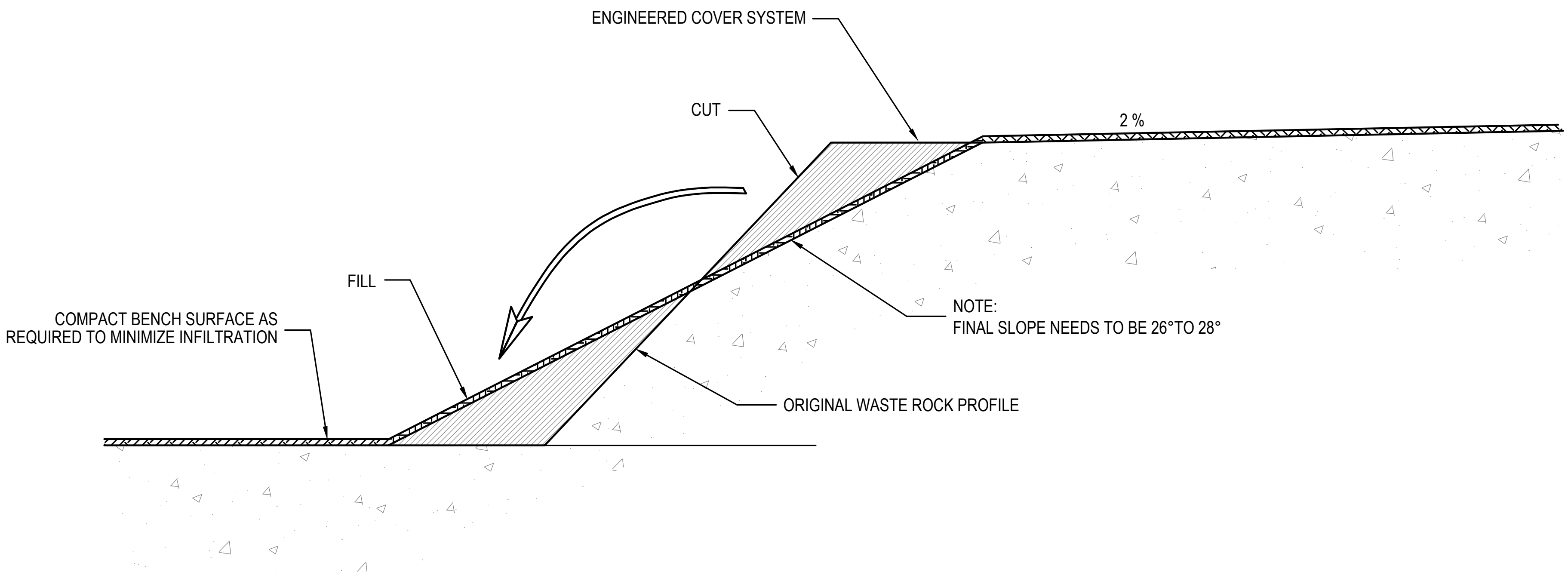
MINTO MAIN WASTE DUMP SECTIONS

A TETRA TECH COMPANY

PROJECT NO.	DWN	CKD	REV
W14101068.030	CB	BJC	A
OFFICE	DATE		
EBA-WHSE	April 15, 2011		

Figure 6-3

Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 030 Minto Closure Plan\April 2011 Closure\W14101068.030 Fig.6-4.dwg [FIGURE 6-4] April 14, 2011 - 6:04:41 pm (BY: BUCHAN, CAMERON)



STATUS
ISSUED FOR REVIEW

NOTES :

- FINAL DUMP SURFACE TO BE SLOPED TOWARD FACE AT APPROXIMATELY 2%
- FINAL LIFT OF DUMP TO BE TRAFFICKED BY MINE HAUL FLEET TO PROMOTE COMPACTION OF BENCH SURFACES
- BENCH SURFACES TO BE COMPACTED AND GRADED AS REQUIRED PRIOR TO COVER INSTALLATION

CLIENT

MINTO EXPLORATIONS LTD.

eba
A TETRA TECH COMPANY

MINTO MINE DECOMMISSIONING AND RECLAMATION PLAN REVISION 3.1

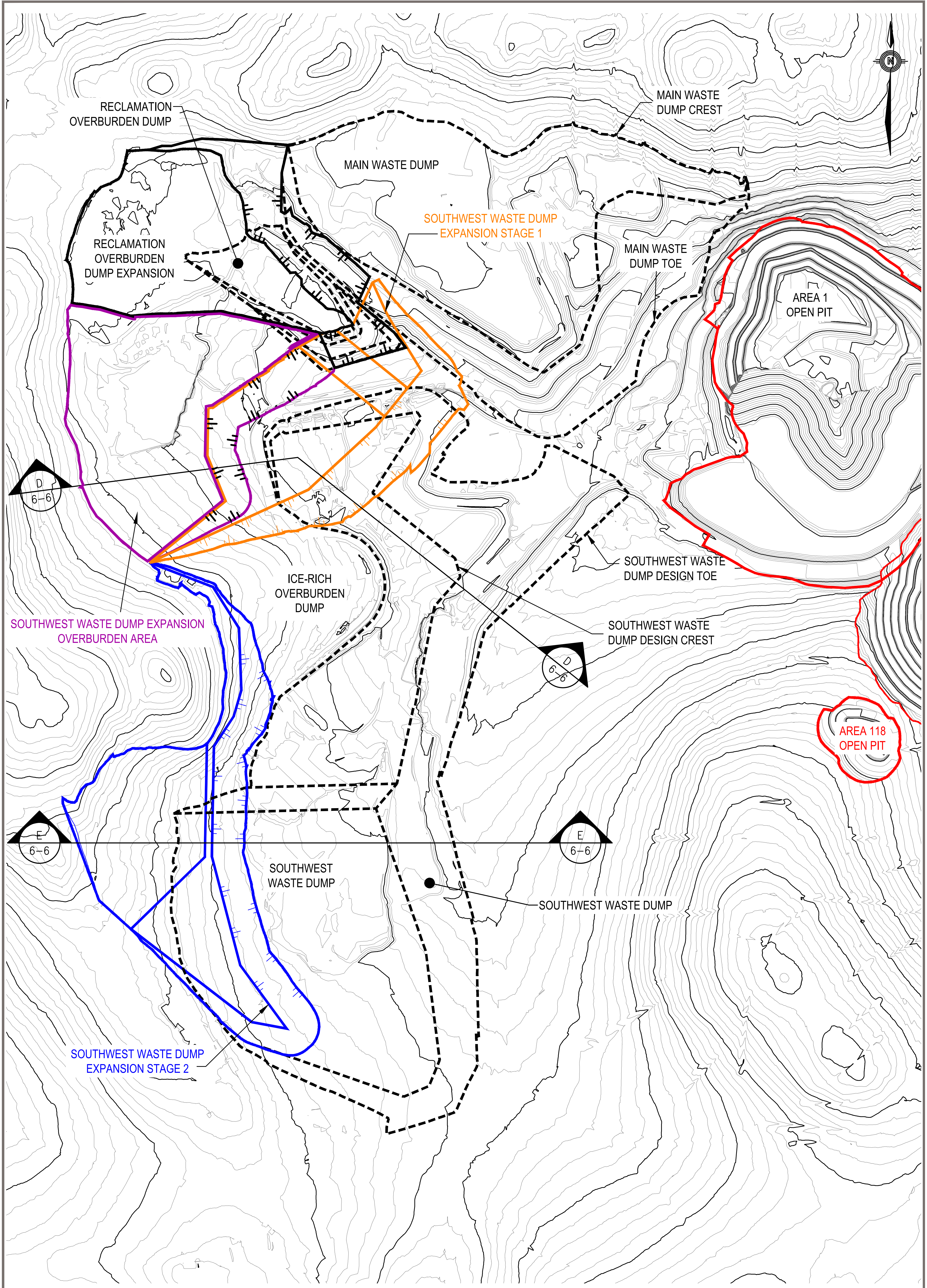
TYPICAL RECLAMATION MEASURES FOR WASTE DUMPS

PROJECT NO.	DWN	CKD	REV
W14101068.030	CB	BJC	A

OFFICE	DATE
EBA-WHSE	April 15, 2011

Figure 6-4

Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 030 Minto Closure Plan\April 2011 Closure\W14101068.030 Fig.6-5, 6-6.dwg [FIGURE 6-5] April 15, 2011 - 9:44:34 am (BY: BUCHAN, CAMERON)



NOTE :

3 m INTERMEDIATE AND 15 m INDEX CONTOUR DATA SHOWN BASED ON JANUARY 2011 SURVEY DATA PROVIDED BY MINTO.

STATUS
ISSUED FOR REVIEW

0 250
Scale: 1: 7 500 (metres)

CLIENT

MINTO EXPLORATIONS LTD.

A TETRA TECH COMPANY

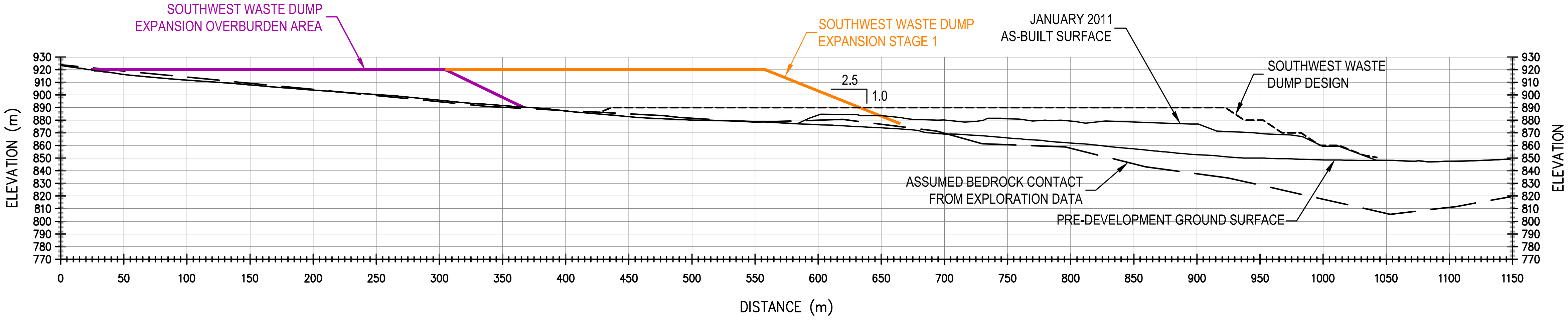
MINTO MINE DECOMMISSIONING AND RECLAMATION PLAN REVISION 3.1

SOUTHWEST WASTE DUMP EXPANSION PLAN

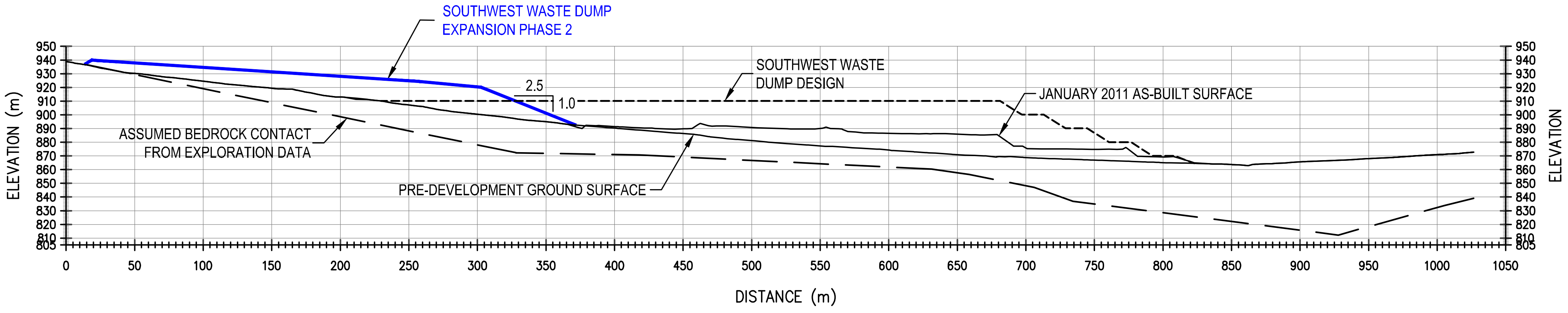
PROJECT NO.	DWN	CKD	REV
W14101068.030	CB	BJC	A
OFFICE	DATE		
EBA-WHSE	April 15, 2011		

Figure 6-5

Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 030 Minto Closure Plan\April 2011 Closure\W14101068.030 Fig.6-5, 6-6.dwg [FIGURE 6-6] April 14, 2011 - 6:34:04 pm (BY: BUCHAN, CAMERON)



D 6–5 SECTION D
SCALE 1:5,000



E 6–5 SECTION E
SCALE 1:5,000

STATUS
ISSUED FOR REVIEW

0 200
Scale: 1: 4 000 (metres)

CLIENT

MINTO EXPLORATIONS LTD.

eba
A TETRA TECH COMPANY

MINTO MINE DECOMMISSIONING AND RECLAMATION PLAN REVISION 3.1

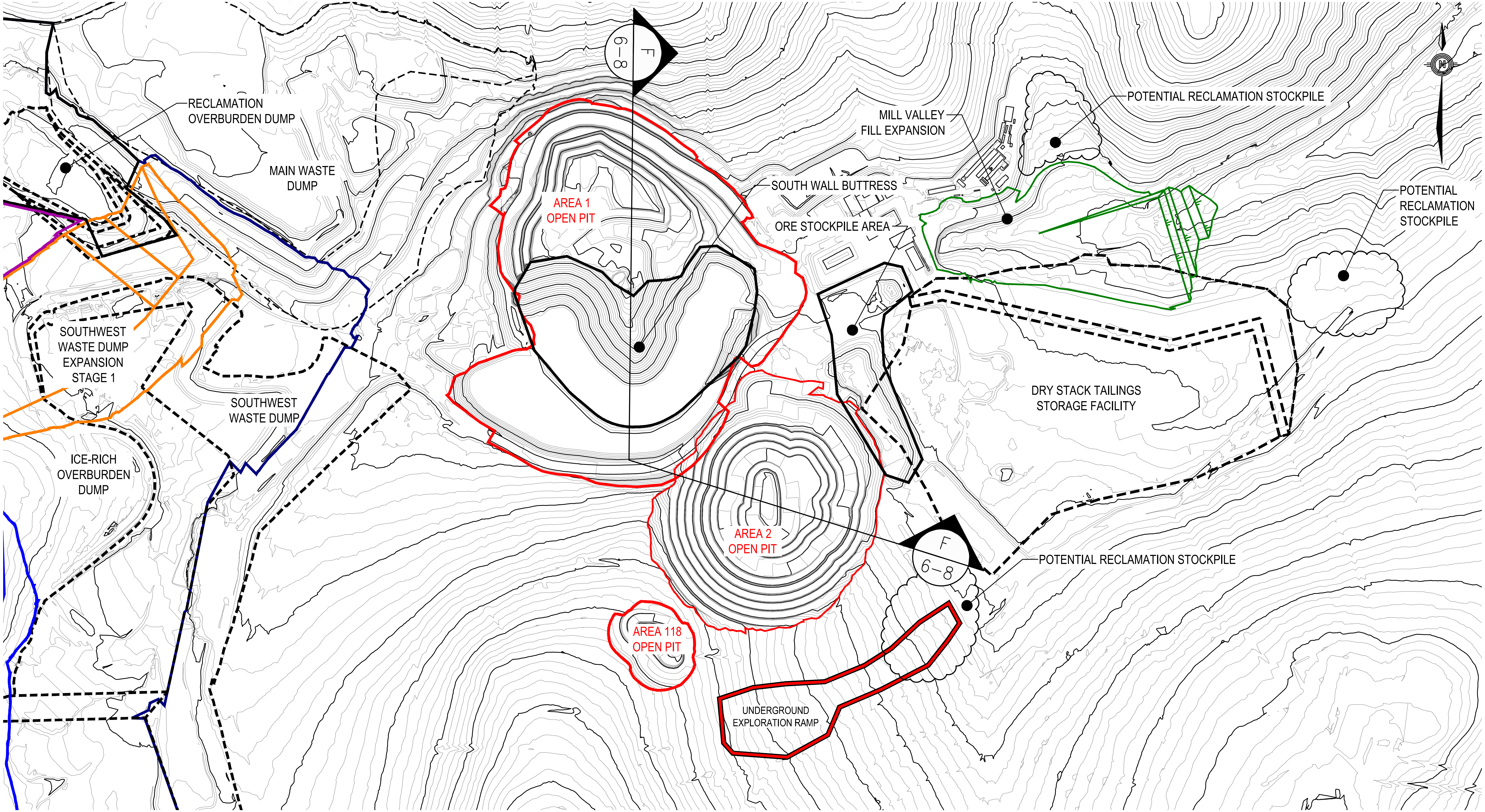
MINTO SOUTHWEST WASTE DUMP SECTIONS

PROJECT NO.	DWN	CKD	REV
W14101068.030	CB	BJC	A

OFFICE	DATE
EBA-WHSE	April 15, 2011

Figure 6-6

Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 030 Minto Closure Plan\April 2011 Closure\W14101068.030 Fig.6-7, 6-8.dwg [FIGURE 6-7] April 18, 2011 - 2:51:49 pm (BY: BUCHAN, CAMERON)



NOTE :

3 m INTERMEDIATE AND 15 m INDEX CONTOUR DATA SHOWN
BASED ON JANUARY 2011 SURVEY DATA PROVIDED BY MINTO.

STATUS
ISSUED FOR REVIEW

0 250
Scale: 1: 7 500 (metres)

CLIENT
MINTO EXPLORATIONS LTD.

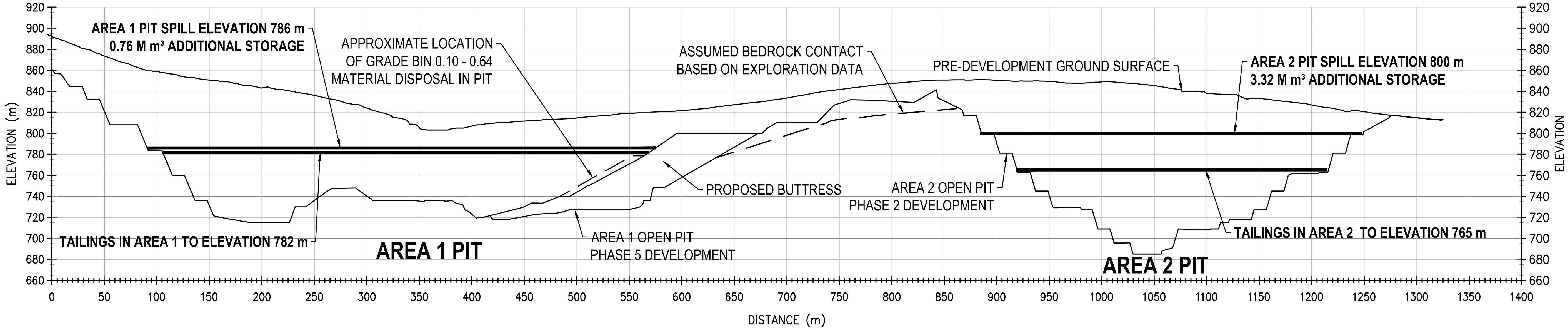
A TETRA TECH COMPANY

MINTO MINE DECOMMISSIONING AND RECLAMATION PLAN REVISION 3.1

OPEN PIT LAYOUT

PROJECT NO.	DWN	CKD	REV
W14101068.030	CB	BJC	A
OFFICE	DATE		
EBA-WHSE	April 15, 2011		

Figure 6-7



F
6-7
SECTION F
SCALE 1:4,000

STATUS
ISSUED FOR REVIEW

CLIENT
MINTO EXPLORATIONS LTD.

A TETRA TECH COMPANY

MINTO MINE DECOMMISSIONING AND RECLAMATION PLAN REVISION 3.1

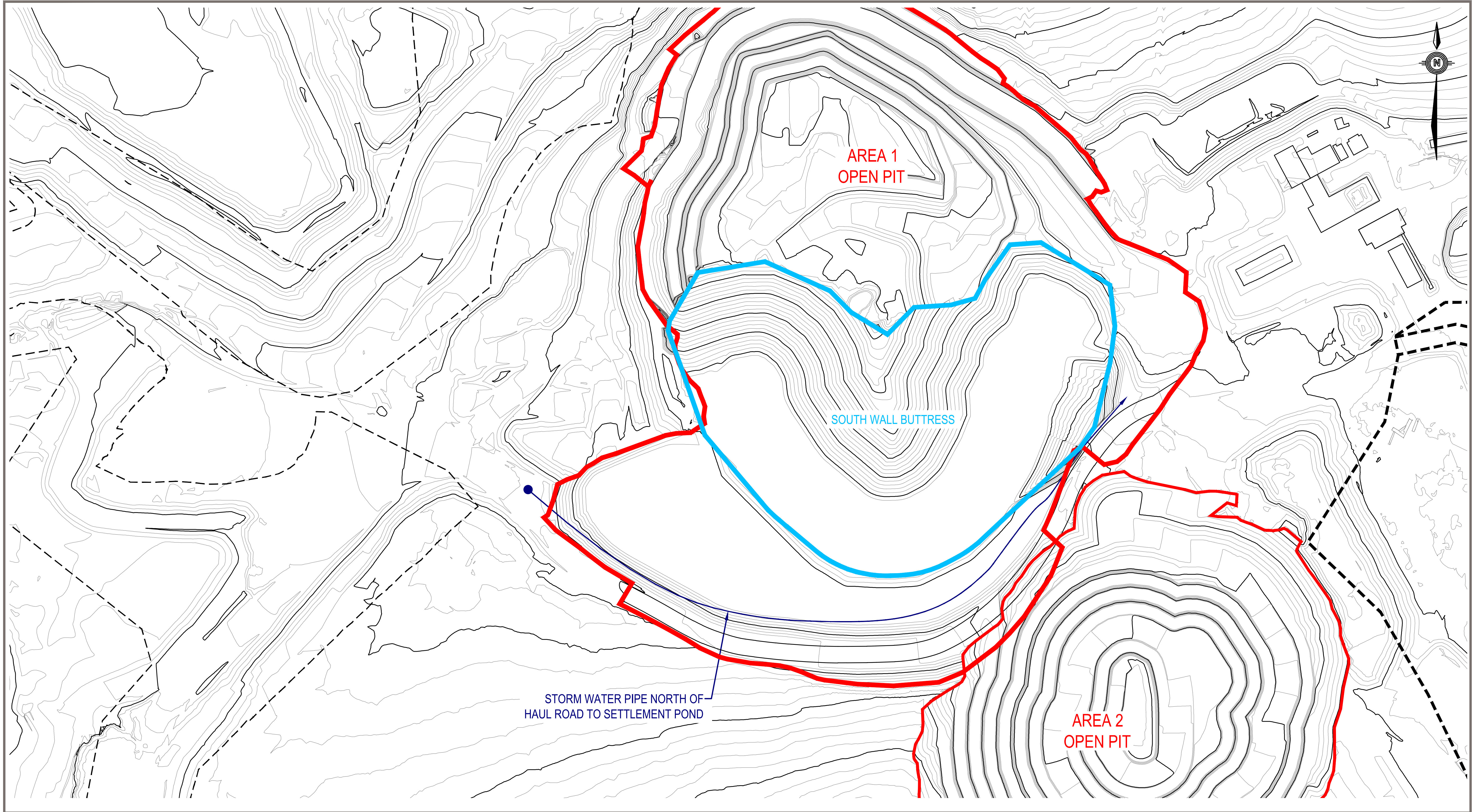
AREA 1 AND 2 OPEN PIT TYPICAL SECTION AT END OF PHASE IV

PROJECT NO.	DWN	CKD	REV
W14101068.030	CB	BJC	A

OFFICE	DATE
EBA-WHSE	April 15, 2011

Figure 6-8

Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 030 Minto Closure Plan\April 2011 Closure\W14101068.030 Fig.6-9.dwg [FIGURE 6-9] April 15, 2011 - 9:56:10 am (BY: BUCHAN, CAMERON)



LEGEND:

— SOUTH WALL BUTRESS BOUNDARY

NOTE :

3 m INTERMEDIATE AND 15 m INDEX CONTOUR DATA SHOWN
BASED ON JANUARY 2011 SURVEY DATA PROVIDED BY MINTO.

0 200
Scale: 1: 4 000 (metres)

STATUS
ISSUED FOR REVIEW

CLIENT

MINTO EXPLORATIONS LTD.

eba
A TETRA TECH COMPANY

MINTO MINE DECOMMISSIONING AND RECLAMATION PLAN REVISION 3.1

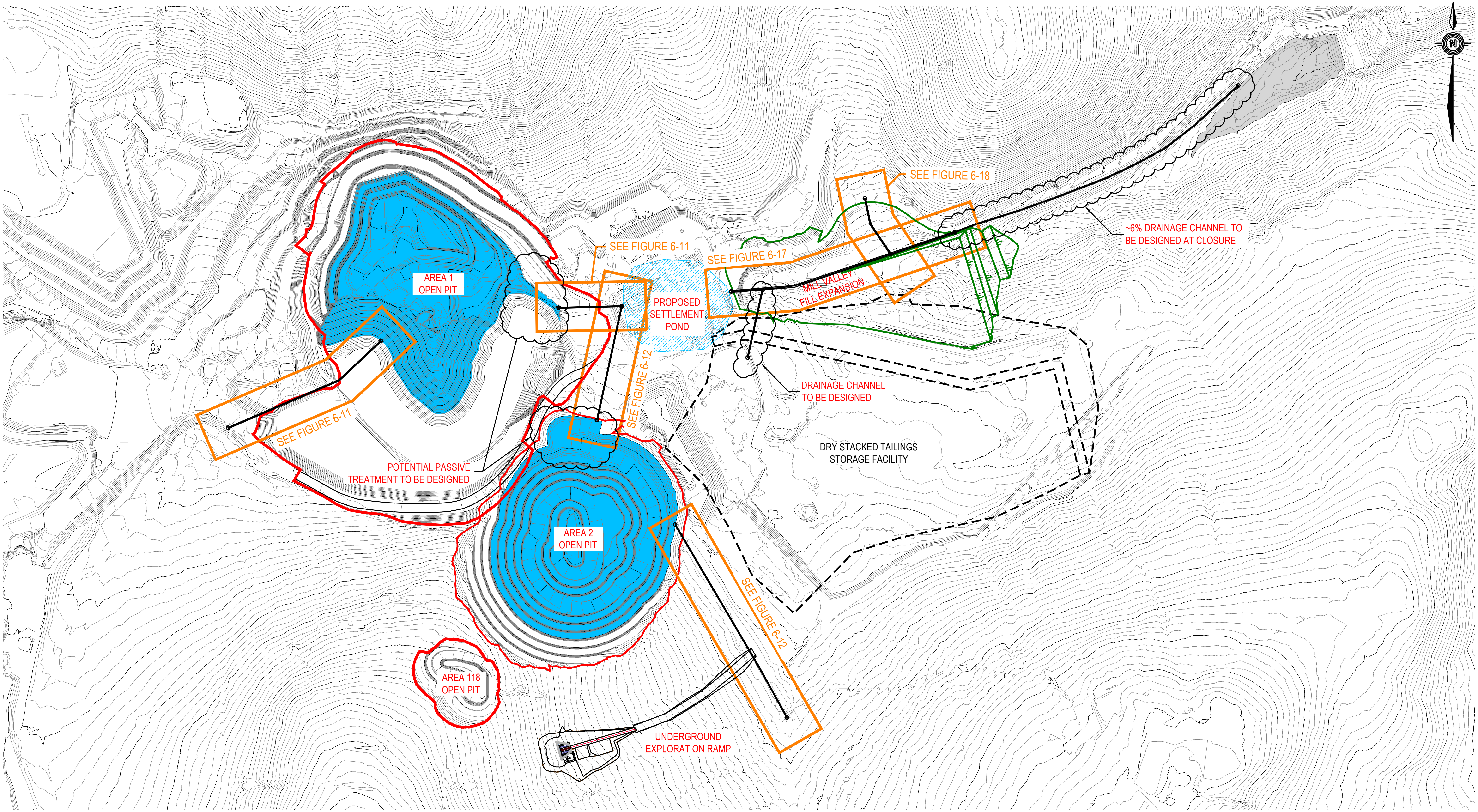
AREA 1 OPEN PIT SOUTH WALL BUTTRESS PLAN

PROJECT NO.	DWN	CKD	REV
W14101068.030	CB	BJC	A

OFFICE	DATE
EBA-WHSE	April 15, 2011

Figure 6-9

Q:\Vancouver\Drafting\Engineering\W141\W14101068\030\W14101068.030 Fig.6-10.dwg [FIGURE 6-10] June 10, 2011 - 1:40:06 pm (BY: BOKIC, JON)



LEGEND

CONTOUR - 10.0 m INTERVAL

CONTOUR - 2.0 m INTERVAL

NOTES

DRAWING BASED ON JANUARY 2011 SURVEY DATA PROVIDED BY MINTO

STATUS

ISSUED FOR REVIEW

0 250

Scale: 1: 7 500 (metres)

CLIENT

MINTO EXPLORATIONS LTD.

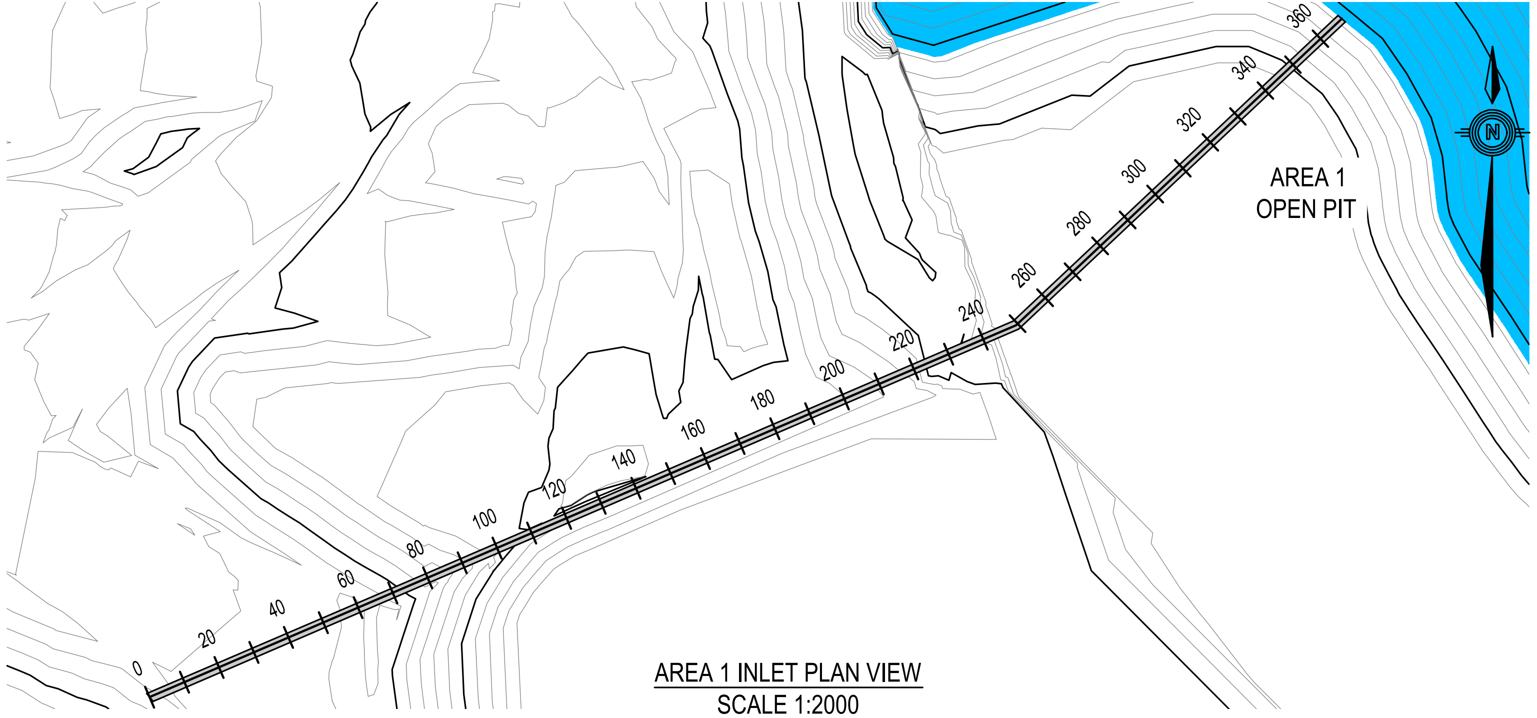
A TETRA TECH COMPANY

MINTO MINE DECOMMISSIONING AND RECLAMATION PLAN REVISION 3.1

WATER CONVEYANCE AT CLOSURE

PROJECT NO.	DWN	CKD	REV
W14101068.030	CB/JAB	BJC/CF	A
OFFICE	DATE		
EBA-WHSE	June 10, 2011		

Figure 6-10



AREA 1 INLET PLAN VIEW
SCALE 1:2000

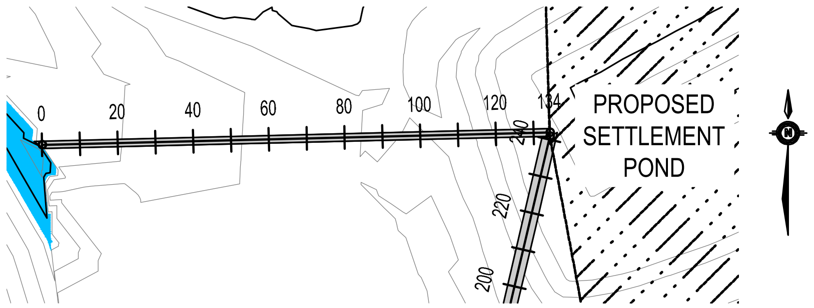
NOTES :

10kg CLASS RIPRAP

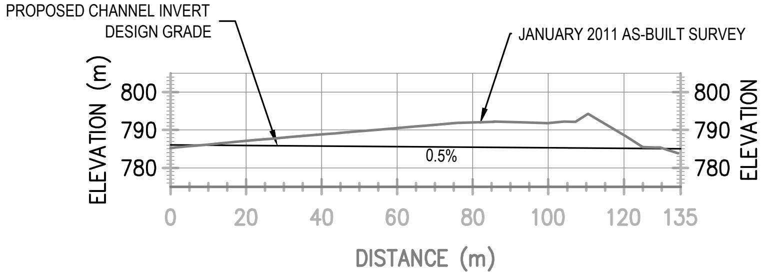
% FINER	NOMINAL SIZE (mm)
100	175-200
85	100-150
50	80-95
15	70-75

100kg CLASS RIPRAP

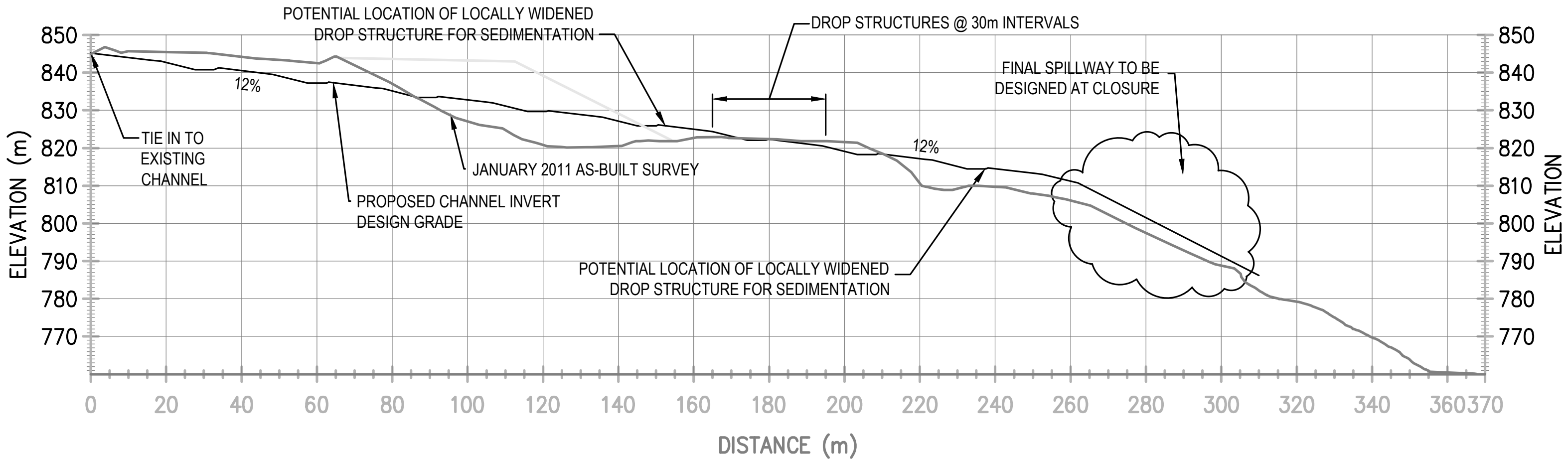
% FINER	NOMINAL SIZE (mm)
100	675-700
85	540-630
50	450-495
15	180-270



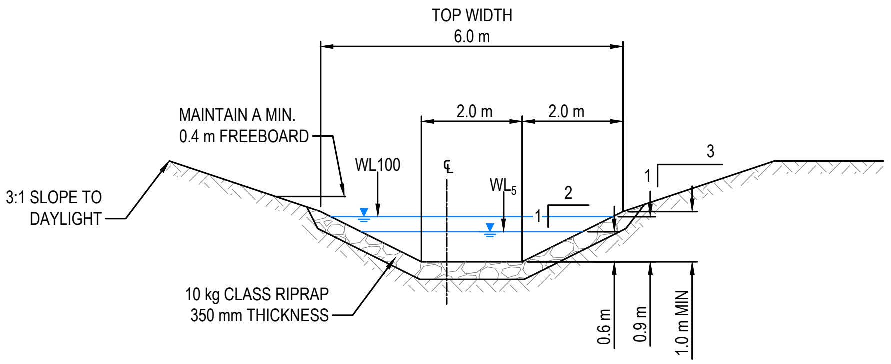
AREA 1 OUTLET PLAN VIEW
SCALE 1:2000



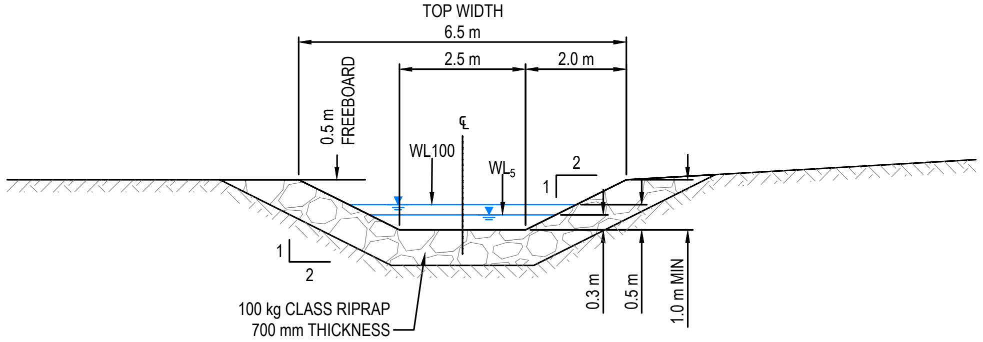
AREA 1 OUTLET PROFILE VIEW
SCALE 1:2000



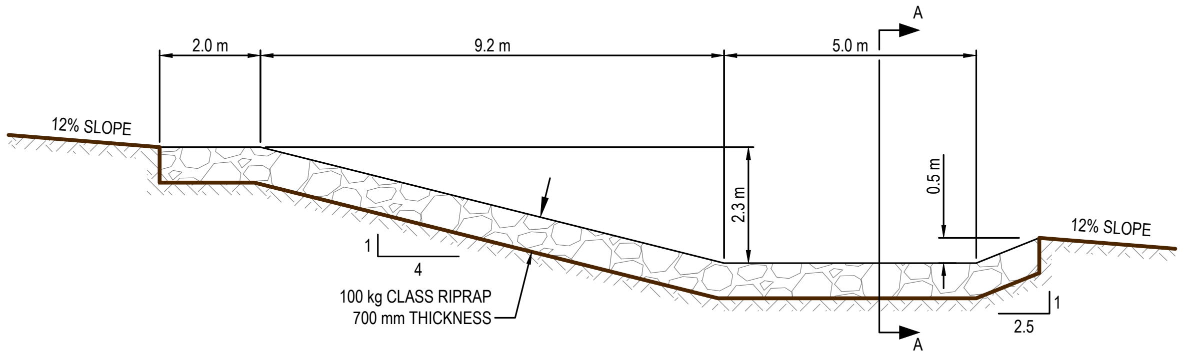
AREA 1 INLET PROFILE VIEW
SCALE 1:2000



AREA 1 OUTLET TYPICAL SECTION
SCALE 1:150



AREA 1 INLET TYPICAL SECTION
SCALE 1:150



AREA 1 INLET DROP STRUCTURE SECTION AND RIP-RAP TYPICAL DETAIL
SCALE 1:150

NOTE :

3 m INTERMEDIATE AND 15 m INDEX CONTOUR DATA SHOWN
BASED ON JANUARY 2011 SURVEY DATA PROVIDED BY MINTO.

STATUS
ISSUED FOR REVIEW

CLIENT

MINTO EXPLORATION LTD.

eba
A TETRA TECH COMPANY

MINTO MINE DECOMMISSIONING AND RECLAMATION PLAN REVISION 3.1

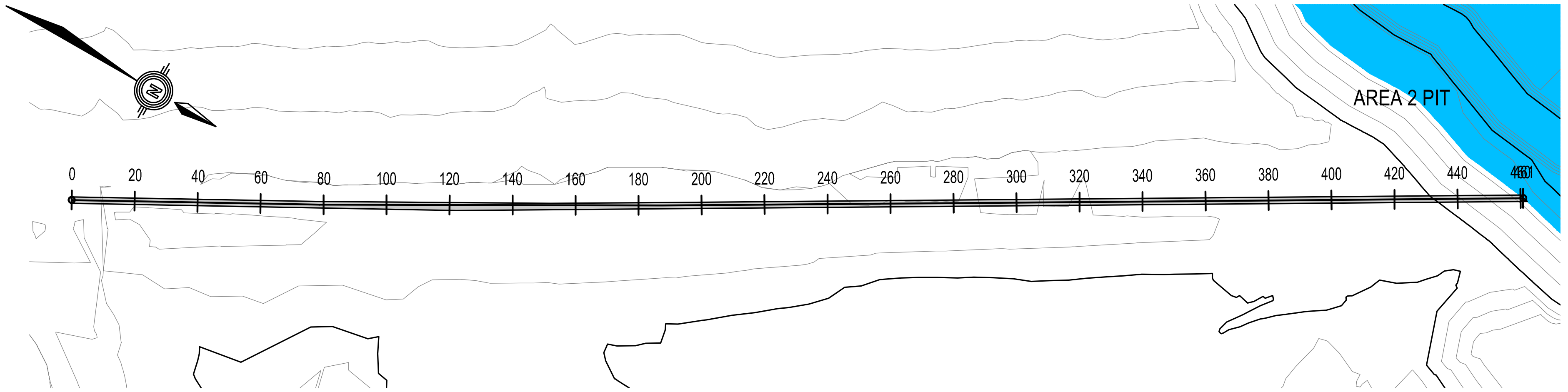
AREA 1 INLET AND OUTLET DETAILS

PROJECT NO.	DWN	CKD	REV
W14101068.030	CB	BJC	A

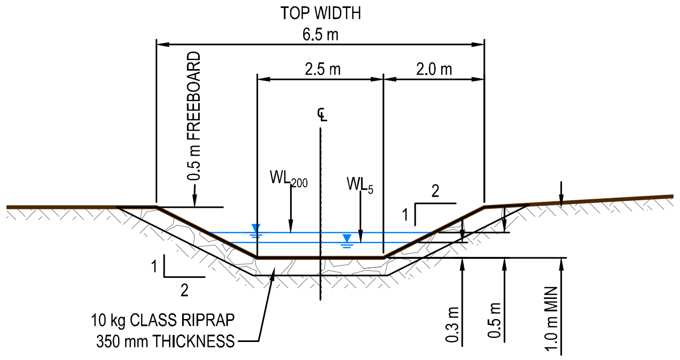
OFFICE	DATE
EBA-WHSE	April 15, 2011

Figure 6-11

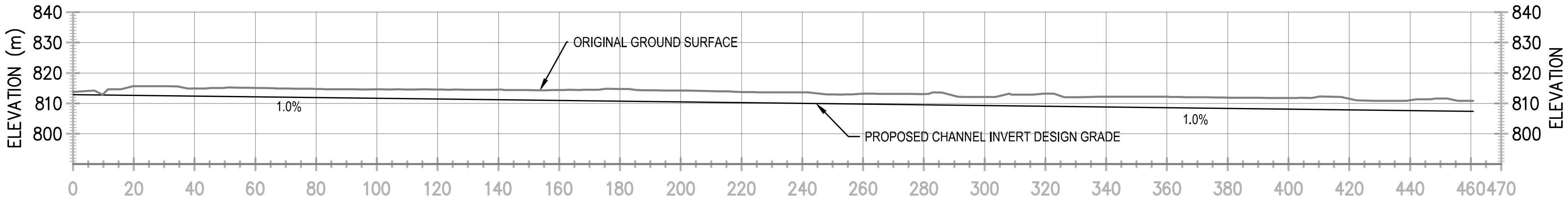
Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 030 Minto Closure Plan\April 2011 Closure\W14101068.030 Fig.6-11, 6-12.dwg [FIGURE 6-12] April 18, 2011 - 11:58:37 am (BY: BUCHAN, CAMERON)



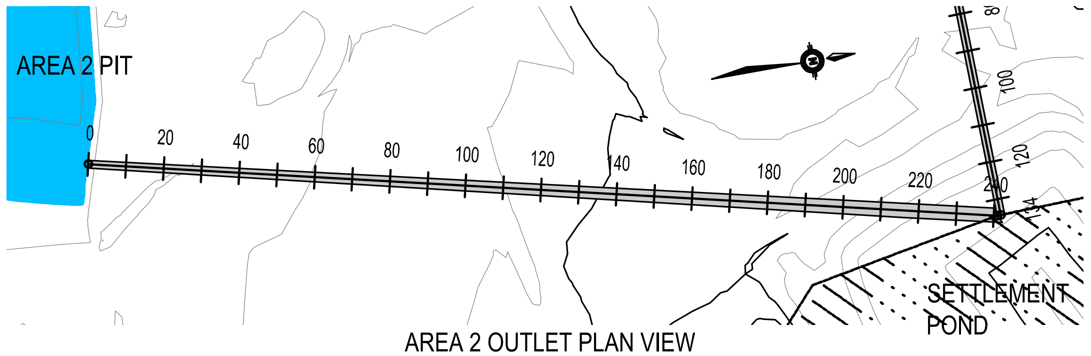
AREA 2 INLET PLAN VIEW
SCALE 1:2000



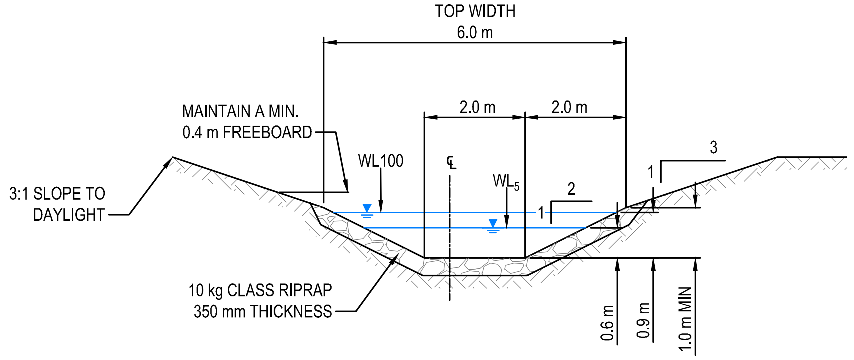
AREA 2 INLET TYPICAL SECTION
SCALE 1:150



AREA 2 INLET PROFILE VIEW
SCALE 1:2000



AREA 2 OUTLET PLAN VIEW
SCALE 1:2000



AREA 2 OUTLET TYPICAL SECTION
SCALE 1:150

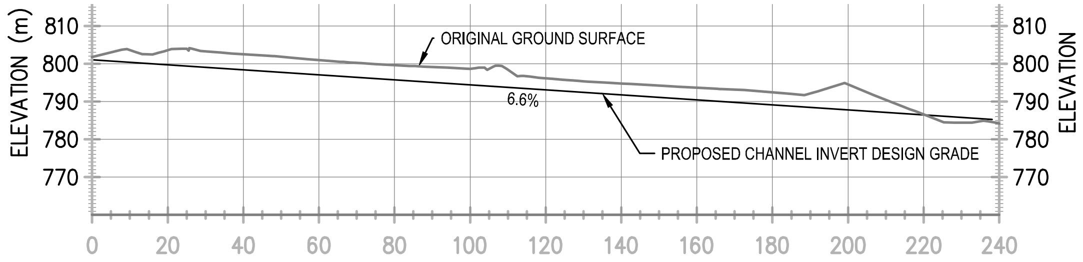
NOTES :

10kg CLASS RIPRAP

% FINER	NOMINAL SIZE (mm)
100	175-200
85	100-150
50	80-95
15	70-75

100kg CLASS RIPRAP

% FINER	NOMINAL SIZE (mm)
100	675-700
85	540-630
50	450-495
15	180-270



AREA 2 OUTLET PROFILE VIEW
SCALE 1:2000

NOTE :

3 m INTERMEDIATE AND 15 m INDEX CONTOUR DATA SHOWN
BASED ON JANUARY 2011 SURVEY DATA PROVIDED BY MINTO.

STATUS
ISSUED FOR REVIEW

CLIENT
MINTO EXPLORATION LTD.

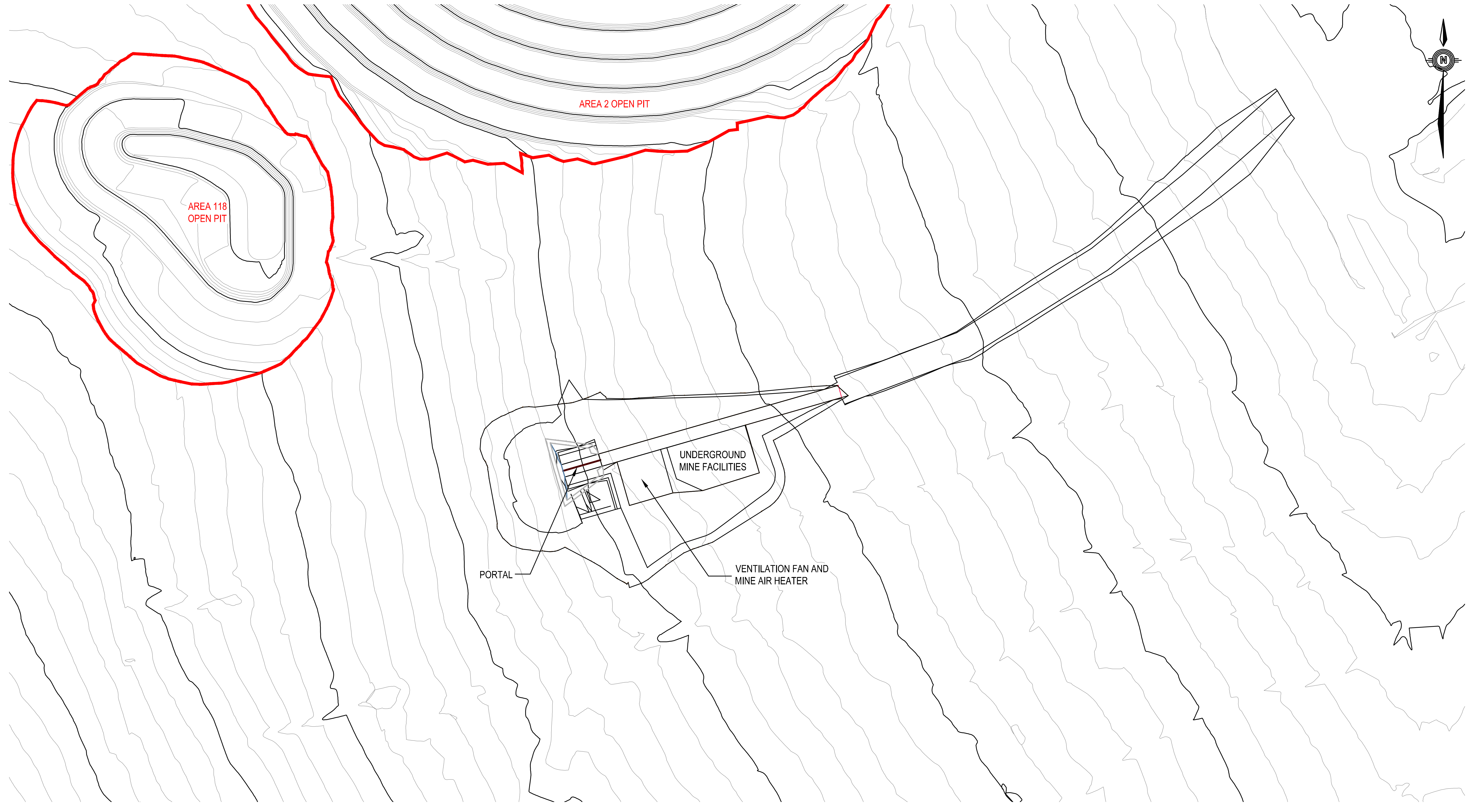
eba
A TETRA TECH COMPANY

MINTO MINE DECOMMISSIONING AND RECLAMATION PLAN REVISION 3.1

MILL VALLEY FILL DRAINAGE CHANNEL AND AREA 2 INLET AND OUTLET DETAILS

PROJECT NO.	DWN	CKD	REV
W14101068.030	CB	BJC	A
OFFICE	DATE		
EBA-WHSE	April 15, 2011		

Figure 6-12



NOTE :

3 m INTERMEDIATE AND 15 m INDEX CONTOUR DATA SHOWN
BASED ON JANUARY 2011 SURVEY DATA PROVIDED BY MINTO.

STATUS
ISSUED FOR REVIEW

0 100
Scale: 1: 2 000 (metres)

CLIENT

MINTO EXPLORATIONS LTD.

eba
A TETRA TECH COMPANY

MINTO MINE DECOMMISSIONING AND RECLAMATION PLAN REVISION 3.1

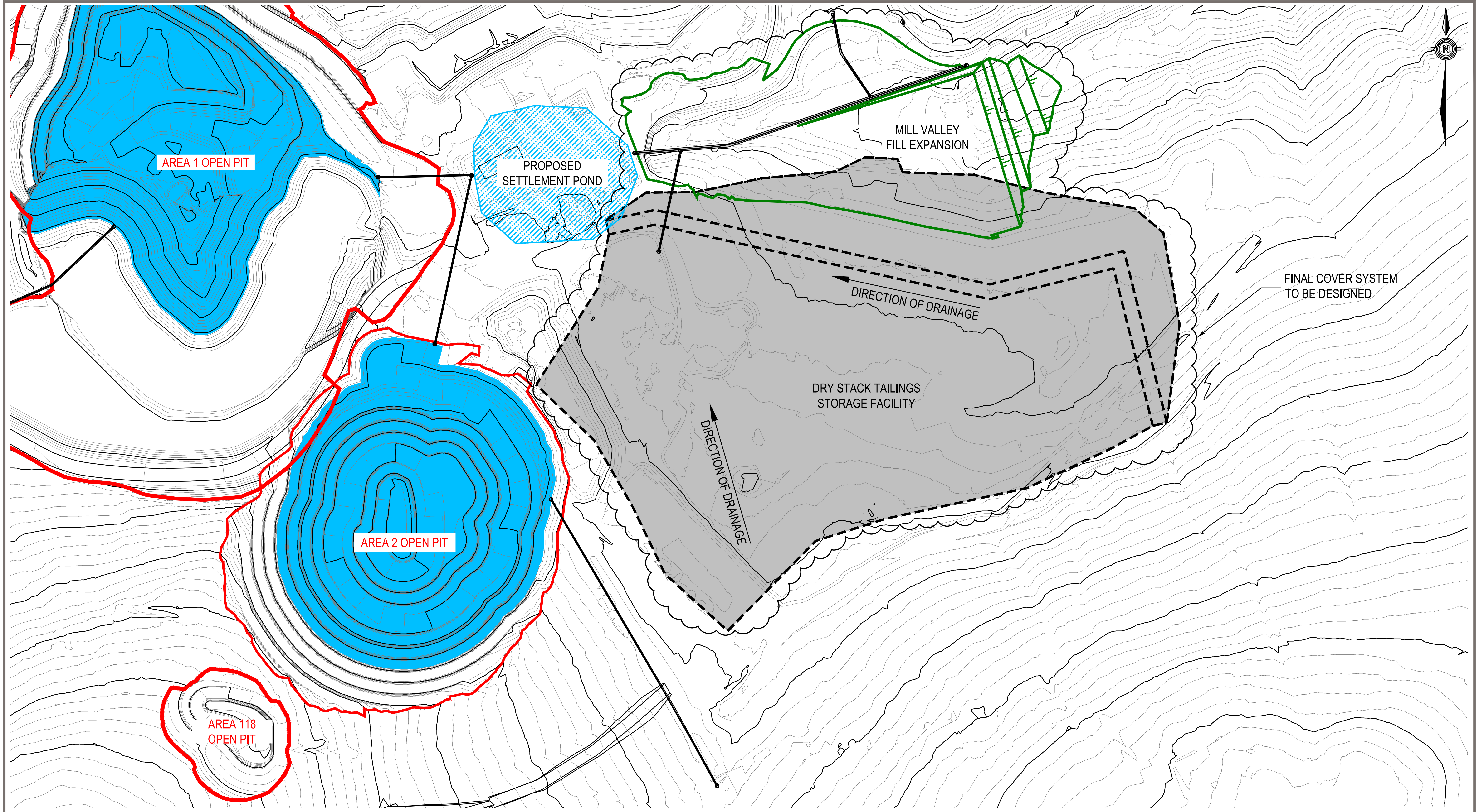
PORTAL

PROJECT NO.	DWN	CKD	REV
W14101068.030	CB	BJC	A

OFFICE	DATE
EBA-WHSE	April 15, 2011

Figure 6-13

Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 030 Minto Closure Plan\April 2011 Closure\W14101068.030 Fig.6-14.dwg [FIGURE 6-14] April 15, 2011 - 10:22:10 am (BY: BUCHAN, CAMERON)



NOTE :

3 m INTERMEDIATE AND 15 m INDEX CONTOUR DATA SHOWN
BASED ON JANUARY 2011 SURVEY DATA PROVIDED BY MINTO.

STATUS
ISSUED FOR REVIEW

0 250
Scale: 1: 5 000 (metres)

CLIENT

MINTO EXPLORATIONS LTD.

eba
A TETRA TECH COMPANY

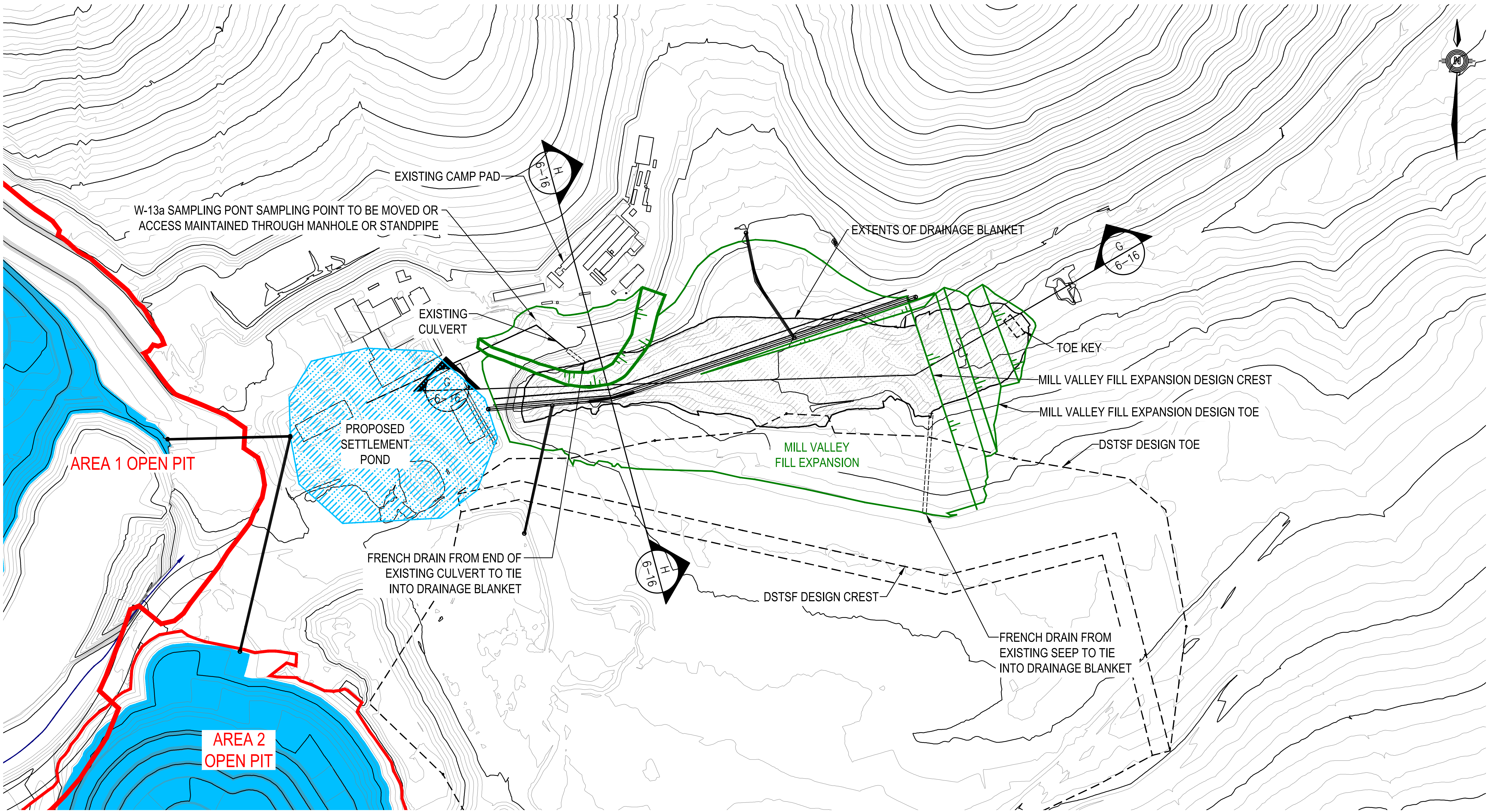
MINTO MINE DECOMMISSIONING AND RECLAMATION PLAN REVISION 3.1

RECLAMATION MEASURES FOR DRY STACK TAILINGS STORAGE FACILITY

PROJECT NO.	DWN	CKD	REV
W14101068.030	CB	BJC	A

OFFICE	DATE
EBA-WHSE	April 15, 2011

Figure 6-14



LEGEND:

🟩 MILL VALLEY FILL EXPANSION OUTLINE

NOTE :

3 m INTERMEDIATE AND 15 m INDEX CONTOUR DATA SHOWN
BASED ON JANUARY 2011 SURVEY DATA PROVIDED BY MINTO.

STATUS
ISSUED FOR REVIEW

CLIENT

MINTO EXPLORATIONS LTD.

eba
A TETRA TECH COMPANY

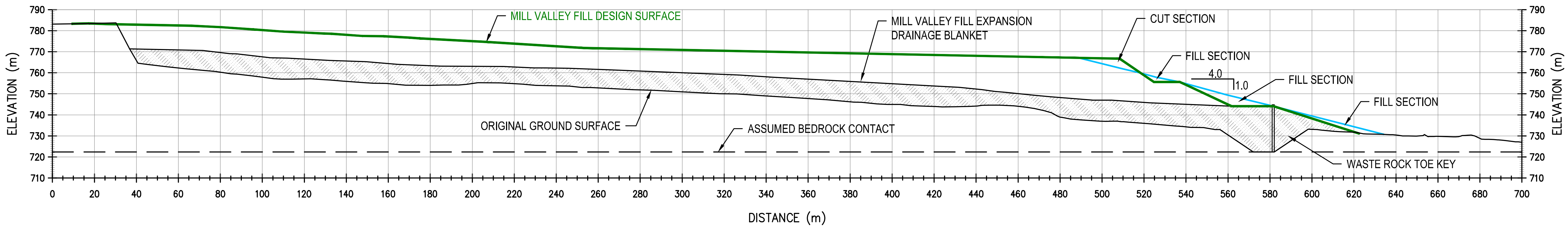
MINTO MINE DECOMMISSIONING AND RECLAMATION PLAN REVISION 3.1

MILL VALLEY FILL EXPANSION PLAN

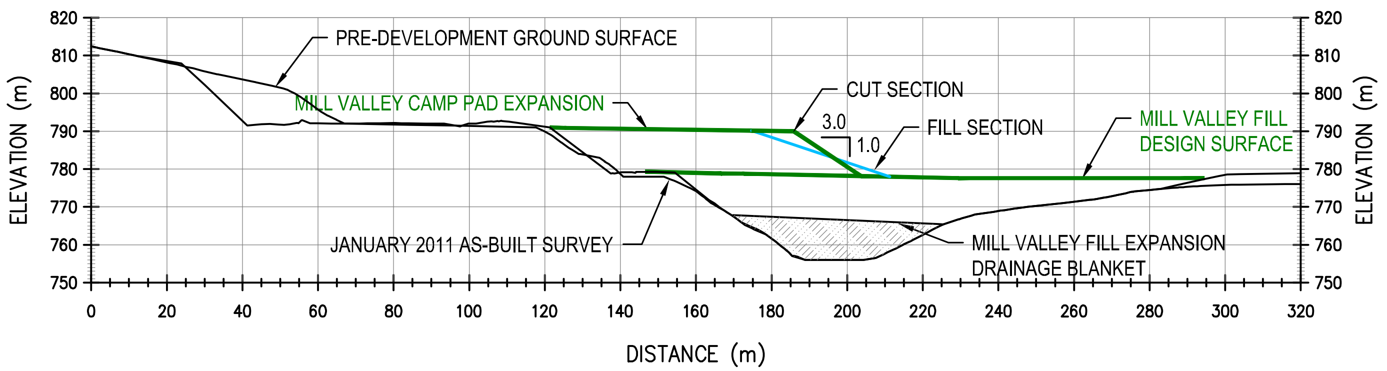
PROJECT NO.	DWN	CKD	REV
W14101068.030	CB	BJC	A
OFFICE	DATE		
EBA-WHSE	April 15, 2011		

Figure 6-15

Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 030 Minto Closure Plan\April 2011 Closure\W14101068.030 Fig.6-15, 6-16.dwg [FIGURE 6-16] April 18, 2011 - 10:34:00 am (BY: BUCHAN, CAMERON)



G
6–15
SECTION G
SCALE 1:2,000



H
6–15
SECTION H
SCALE 1:2,000

STATUS
ISSUED FOR REVIEW

CLIENT

MINTO EXPLORATIONS LTD.

A TETRA TECH COMPANY

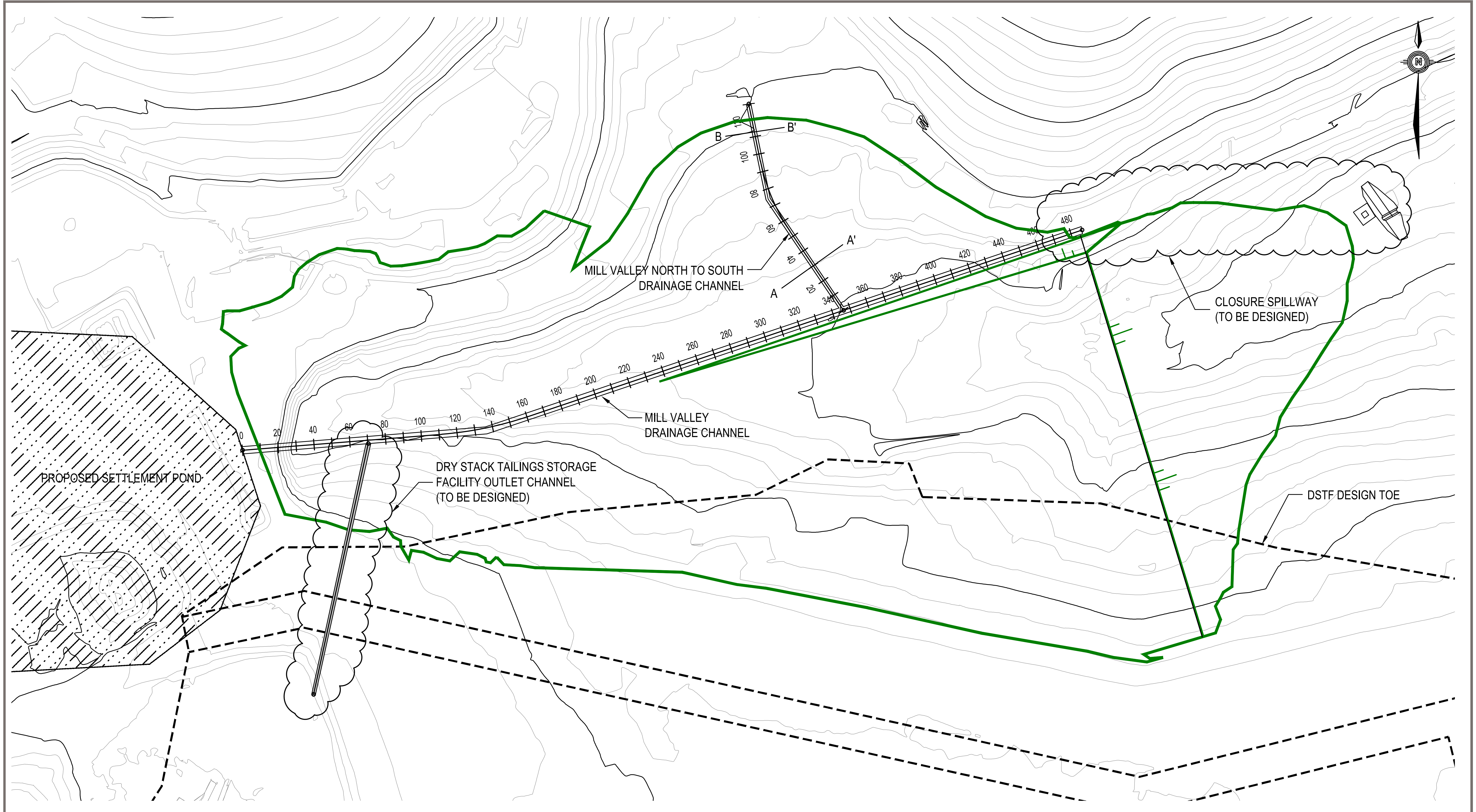
MINTO MINE DECOMMISSIONING AND RECLAMATION PLAN REVISION 3.1

MILL VALLEY FILL EXPANSION
SECTIONS G AND H AT CLOSURE

PROJECT NO.	DWN	CKD	REV
W14101068.030	CB	BJC	A

OFFICE	DATE
EBA-WHSE	April 5, 2011

Figure 6-16



NOTE :

3 m INTERMEDIATE AND 15 m INDEX CONTOUR DATA SHOWN
BASED ON JANUARY 2011 SURVEY DATA PROVIDED BY MINTO.

FOR TYPICAL SECTIONS SEE FIGURE 6-18

STATUS
ISSUED FOR REVIEW

0 100
Scale: 1: 2 000 (metres)

CLIENT
MINTO EXPLORATION LTD.

eba
A TETRA TECH COMPANY

MINTO MINE DECOMMISSIONING AND RECLAMATION PLAN REVISION 3.1

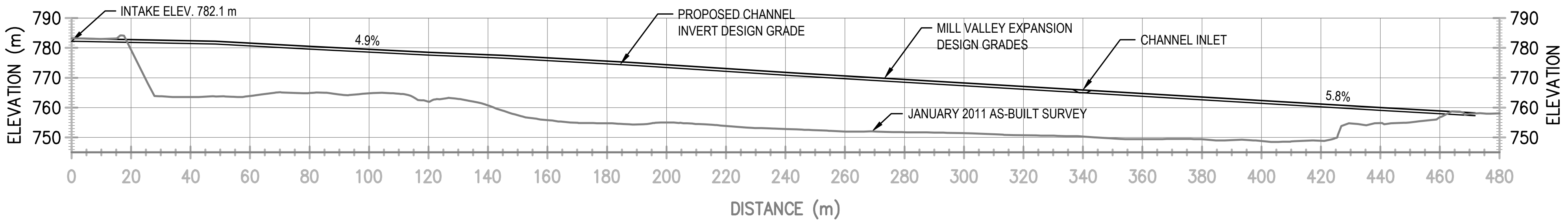
MILL VALLEY DRAINAGE CHANNEL AT CLOSURE

PROJECT NO.	DWN	CKD	REV
W14101068.030	CB	BJC	A

OFFICE	DATE
EBA-WHSE	April 15, 2011

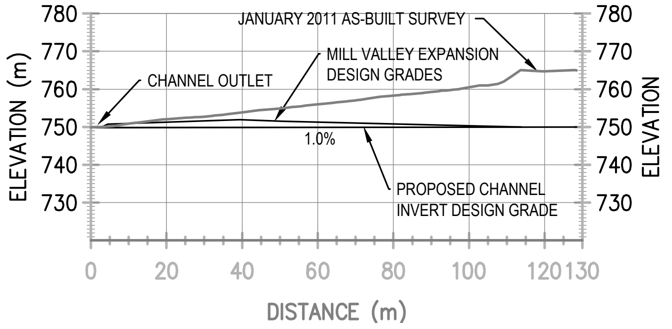
Figure 6-17

Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 030 Minto Closure Plan\April 2011 Closure\W14101068.030 Fig.6-17, 6-18.dwg [FIGURE 6-18] April 18, 2011 - 3:01:50 pm (BY: BUCHAN, CAMERON)



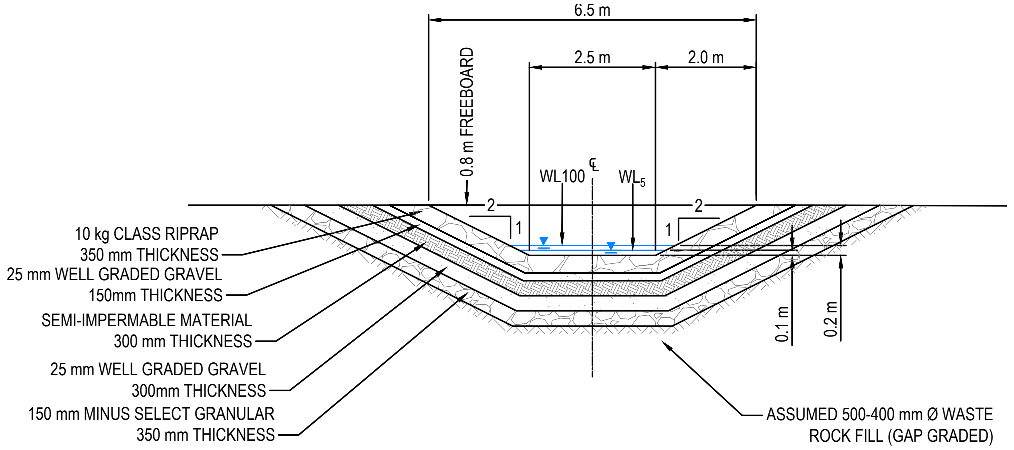
MILL VALLEY DRAINAGE CHANNEL PLAN VIEW

SCALE 1:2000



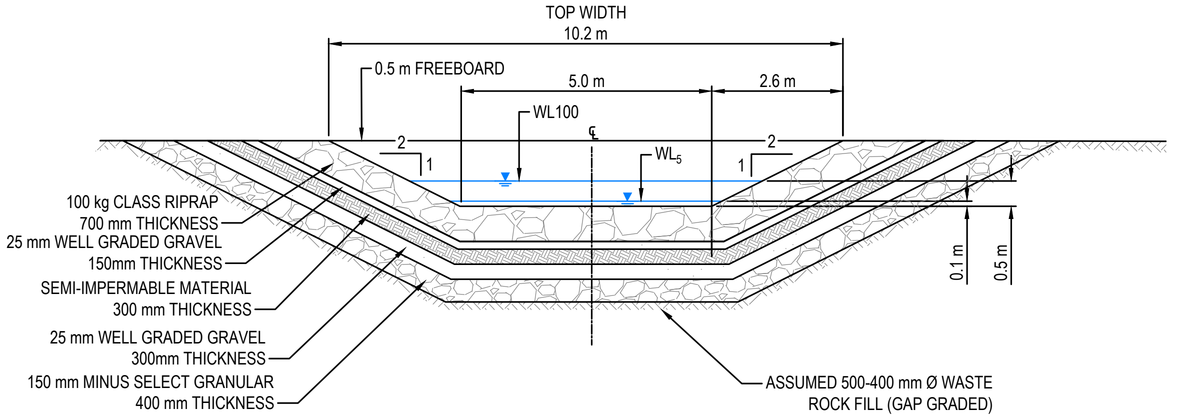
MILL VALLEY NORTH DRAINAGE CHANNEL PROFILE VIEW

SCALE 1:2000



MILL VALLEY NORTH DRAINAGE CHANNEL TYPICAL SECTION

SCALE 1:150



MILL VALLEY DRAINAGE CHANNEL TYPICAL SECTION

SCALE 1:150

NOTES :

10kg CLASS RIPRAP

% FINER	NOMINAL SIZE (mm)
100	175-200
85	100-150
50	80-95
15	70-75

100kg CLASS RIPRAP

% FINER	NOMINAL SIZE (mm)
100	675-700
85	540-630
50	450-495
15	180-270

NOTE :

3 m INTERMEDIATE AND 15 m INDEX CONTOUR DATA SHOWN BASED ON JANUARY 2011 SURVEY DATA PROVIDED BY MINTO.

STATUS
ISSUED FOR REVIEW

CLIENT

MINTO EXPLORATION LTD.

A TETRA TECH COMPANY

MINTO MINE DECOMMISSIONING AND RECLAMATION PLAN REVISION 3.1

MILL VALLEY FILL
NORTH CHANNEL DRAINAGE DETAILS

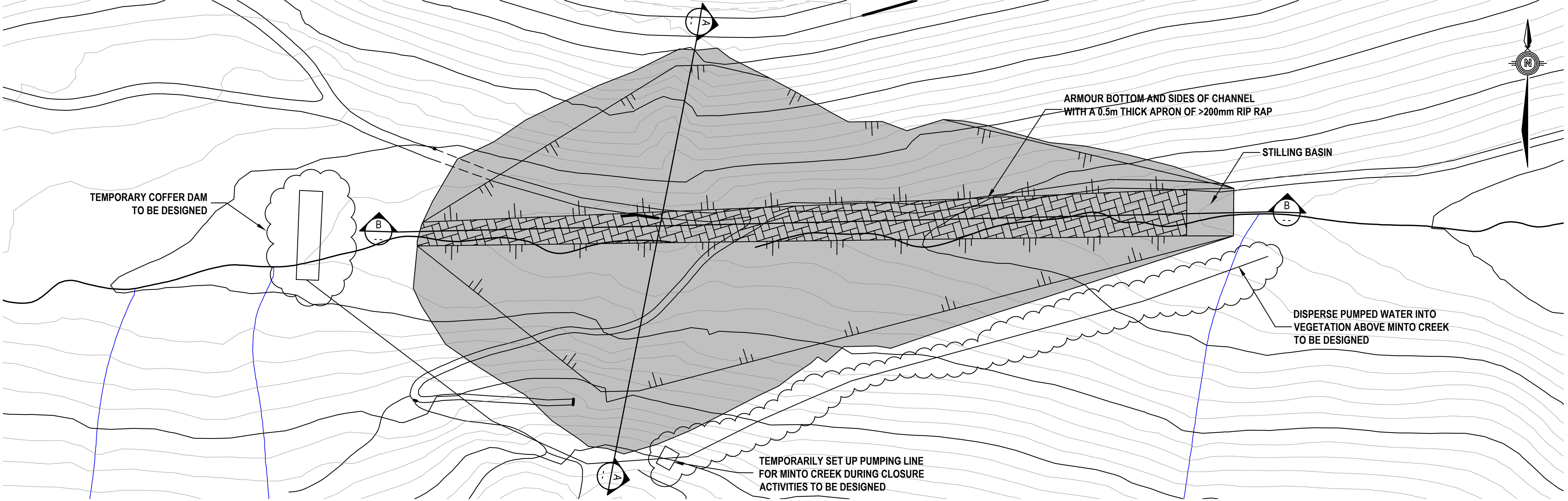
PROJECT NO.	DWN	CKD	REV
W14101068.030	CB	BJC	A

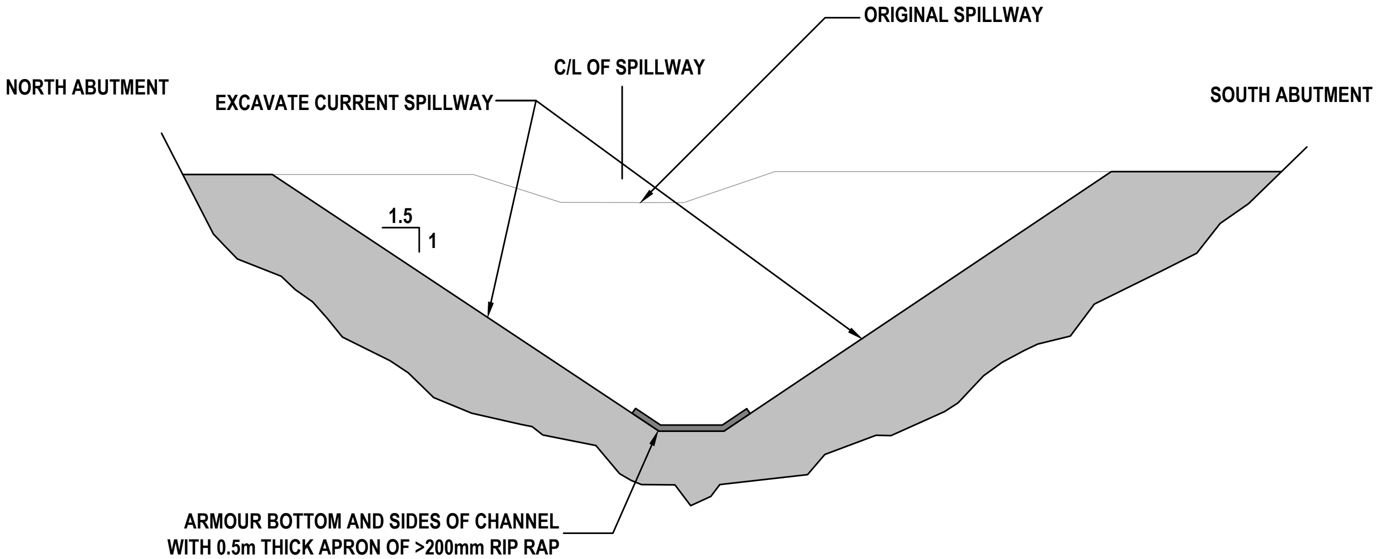
OFFICE
EBA-WHSE

DATE
April 15, 2011

Figure 6-18

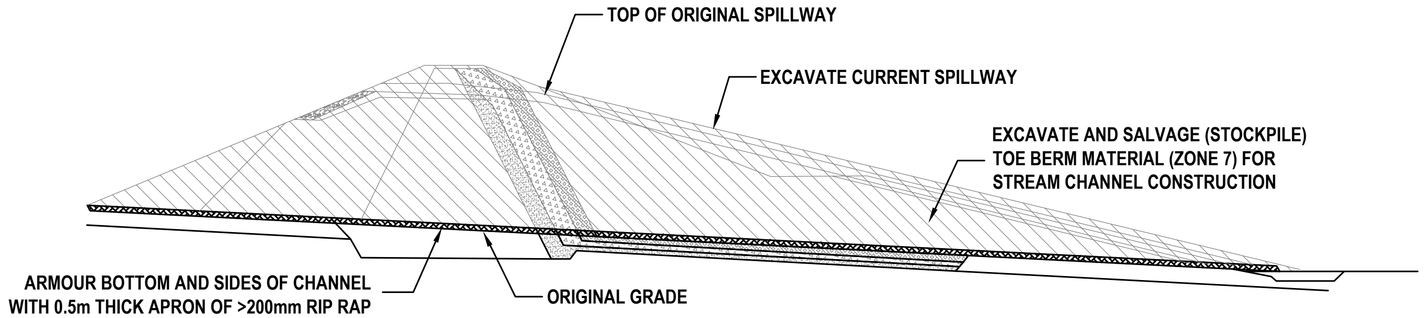
Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 030 Minto Closure Plan\April 2011 Closure\W14101068.030 Fig.6-19.dwg [FIGURE 6-19] April 18, 2011 - 11:43:27 am (BY: BUCHAN, CAMERON)





A -- SECTION - CENTRELINE OF DAM CREST

SCALE 1 : 2500



B -- WATER STORAGE POND DAM - TO BE REMOVED

SCALE 1 : 4000

NOTE :

3 m INTERMEDIATE AND 15 m INDEX CONTOUR DATA SHOWN
BASED ON JANUARY 2011 SURVEY DATA PROVIDED BY MINTO.

STATUS
ISSUED FOR REVIEW

0 50
Scale: 1: 1000 (metres)

CLIENT
MINTO EXPLORATIONS LTD.

eba
A TETRA TECH COMPANY

MINTO MINE DECOMMISSIONING AND RECLAMATION MEASURES REVISION 3.1

REMOVAL OF WATER STORAGE POND DAM AT CLOSURE

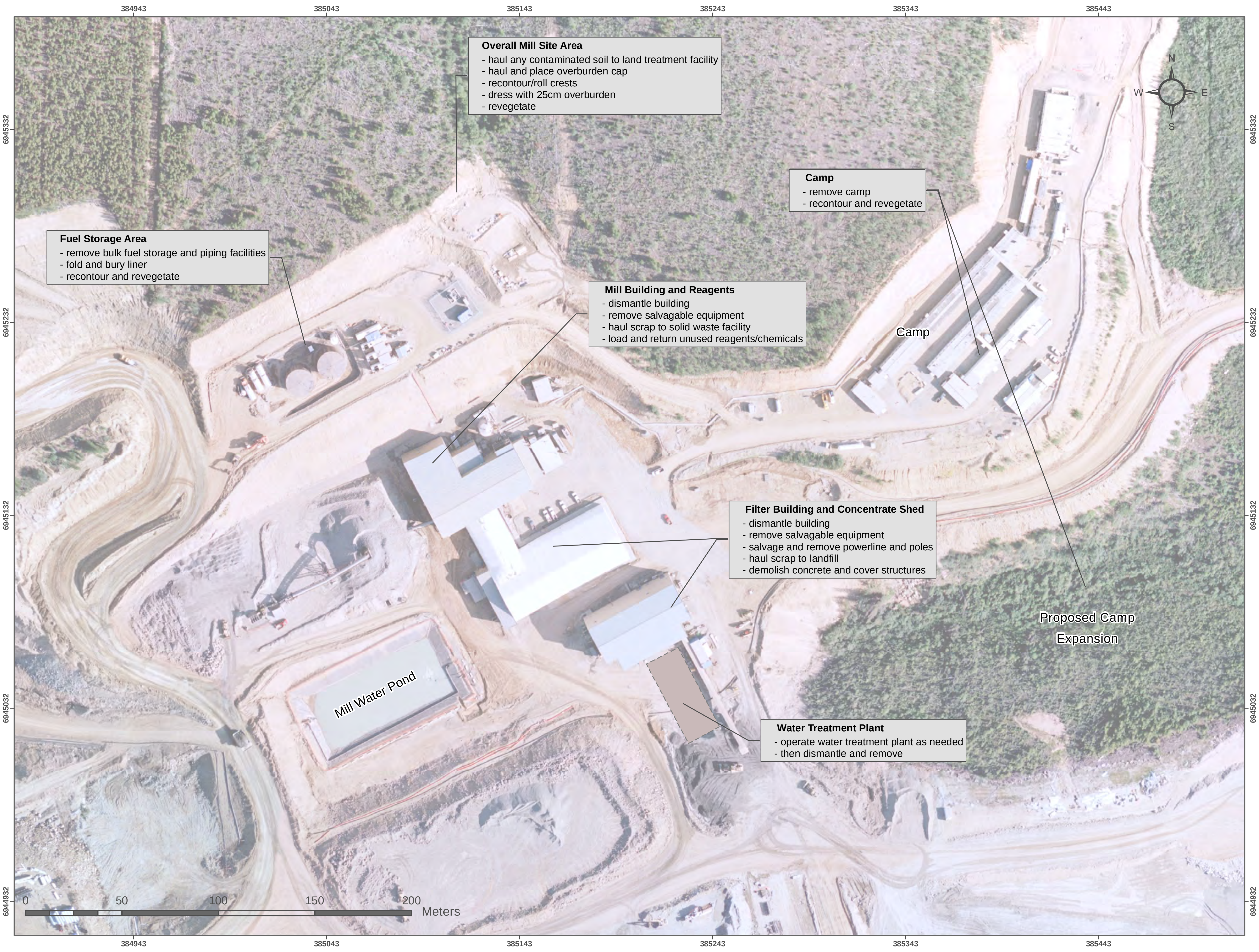
PROJECT NO.	DWN	CKD	REV
W14101068.030	CB	BJC	A
OFFICE	DATE		
EBA-WHSE	April 15, 2011		

Figure 6-19

MINTO MINE

DECOMMISSIONING AND RECLAMATION PLAN
Rev. 3-2

Minto Explorations Ltd.
A SUBSIDIARY OF CAPSTONE MINING LTD.



Overall Mill Site Area
- haul any contaminated soil to land treatment facility
- haul and place overburden cap
- recontour/roll crests
- dress with 25cm overburden
- revegetate

Camp
- remove camp
- recontour and revegetate

Fuel Storage Area
- remove bulk fuel storage and piping facilities
- fold and bury liner
- recontour and revegetate

Mill Building and Reagents
- dismantle building
- remove salvagable equipment
- haul scrap to solid waste facility
- load and return unused reagents/chemicals

Filter Building and Concentrate Shed
- dismantle building
- remove salvagable equipment
- salvage and remove powerline and poles
- haul scrap to landfill
- demolish concrete and cover structures

Water Treatment Plant
- operate water treatment plant as needed
- then dismantle and remove

This is not a legal document. Aerial photography flight date: July 13th 2009. Ortho-rectification produced by Challenger Geomatics Ltd.

NAD 83 UTM Zone 8N

FIGURE 6-20

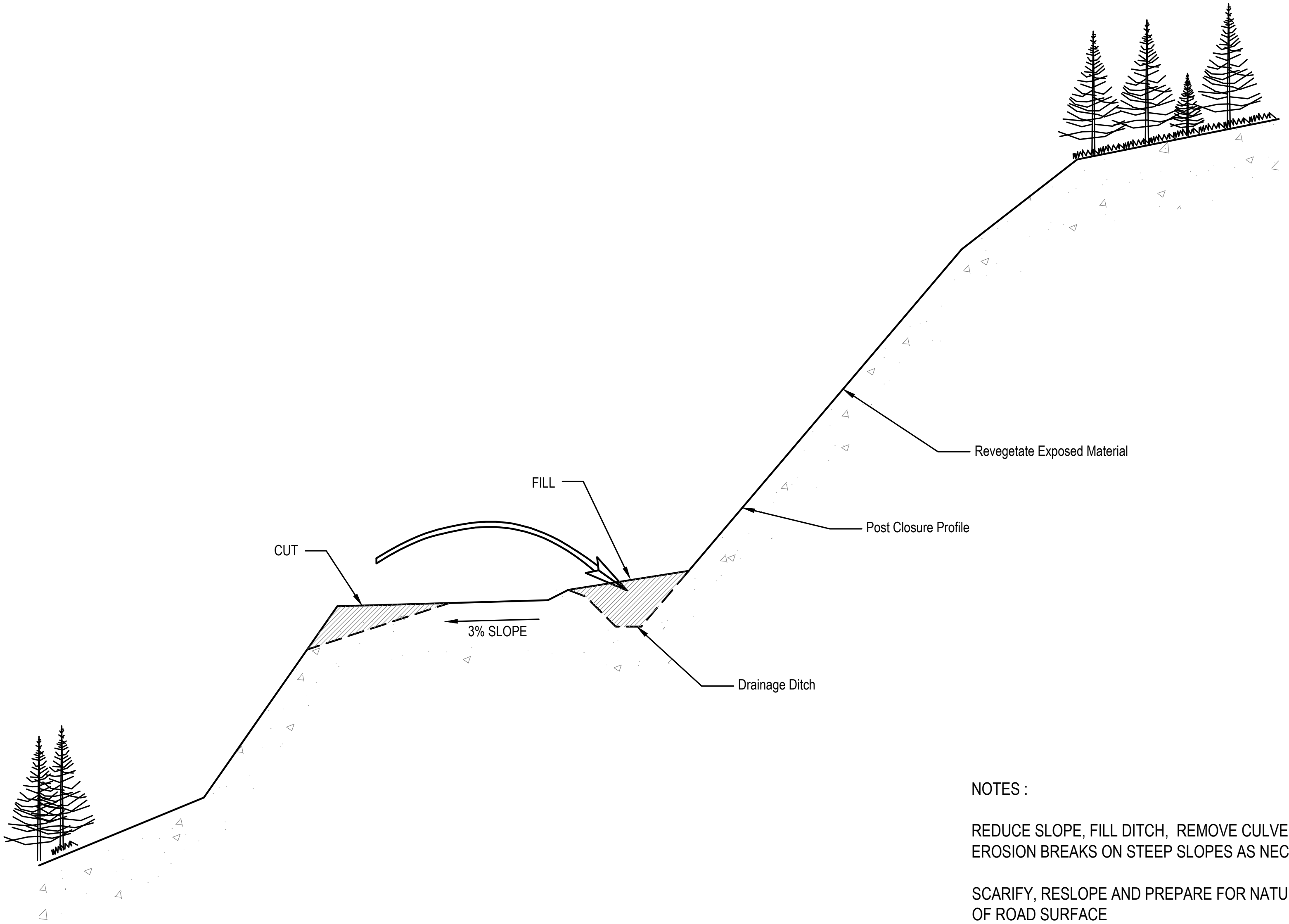
MILL AND ANCILLARY FACILITIES RECLAMATION MEASURES

ACCESS
CONSULTING GROUP

DRAWN BY MD	JUNE 2011	VERIFIED BY SK

I:\Minto\gis\mxd\Phase_4\Closure\FEB_2011\
6-20_Camps_201102123.mxd

Q:\Whitehorse\Data\0201drawings\Minto\Minto Mine Site\Phase 030 Minto Closure Plan\April 2011 Closure\W14101068.030 Fig.6-21.dwg [FIGURE 6-21] April 18, 2011 - 12:08:11 pm (BY: BUCHAN, CAMERON)



NOTES :

REDUCE SLOPE, FILL DITCH, REMOVE CULVERTS AND INSTALL EROSION BREAKS ON STEEP SLOPES AS NECESSARY

SCARIFY, RESLOPE AND PREPARE FOR NATURAL REVEGETATION OF ROAD SURFACE

LEGEND :

☐ Sand & Gravel

🌲 Existing Vegetation

STATUS
ISSUED FOR REVIEW

CLIENT

MINTO EXPLORATIONS LTD.

eba
A TETRA TECH COMPANY

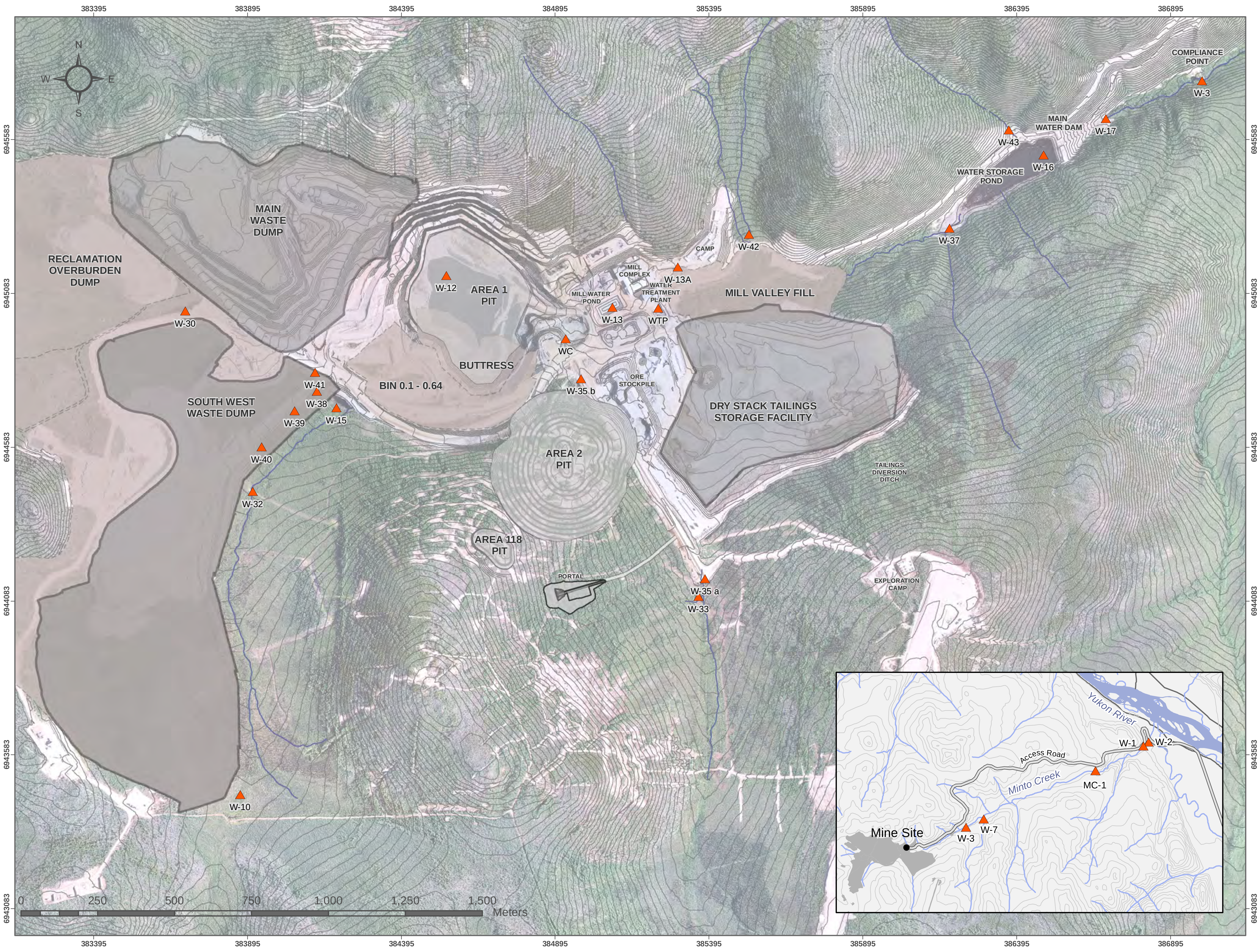
MINTO MINE DECOMMISSIONING AND RECLAMATION PLAN REVISION 3.1

HAUL ROAD AND SITE ROAD TYPICAL RECLAMATION CROSS-SECTION

PROJECT NO.	DWN	CKD	REV
W14101068.030	CB	BJC	A

OFFICE	DATE
EBA-WHSE	April 15, 2011

Figure 6-21



MINTO MINE

DECOMMISSIONING AND RECLAMATION PLAN

Rev. 3-2

Minto Explorations Ltd.

A SUBSIDIARY OF CAPSTONE MINING LTD.

▲	Surface Water Monitoring
—	Hydrology_Simplified
▭	Pit Development
▨	Waste Dump Footprint
═	
■	Previous Waste Dump Disturbance

This is not a legal document. Aerial photography flight date: July 13th 2009. Ortho-rectification produced by Challenger Geomatics Ltd. Site hydrology provided by provided by Minto Explorations Ltd, May 2009 and modifed to reflect Phase IV design. Waste dump footprints provided by EBA (PRELIM PHASE IV WASTE DUMP DEVELOPMENT BY CALENDAR YEAR 2010-07-07.dxf) and W14101068.015 P4W-05 2010-07-07.dxf. Pit Development form lines provided by SRK (PHIV 2010.dxf).

Inset Maps: National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000.Reproduced under license from Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources Canada. All rights reserved.

NAD 83 UTM Zone 8N

FIGURE 7-1

WATER QUALITY MONITORING STATION LOCATIONS

ACCESS CONSULTING GROUP

DRAWN BY MD	JUNE 2011	VERIFIED BY SK

I:\Minto\gis\mxd\Phase_4\Closure\FEB_2011\6-2_WQ_Locations_20110214.mxd

MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

Decommissioning and Reclamation Plan

Appendix A

Closure Water Quality Predictive Modeling Results

SRK Consulting
Engineers and Scientists

SRK Consulting (Canada) Inc.
Suite 2200 – 1066 West Hastings Street
Vancouver, B.C. V6E 3X2
Canada

vancouver@srk.com
www.srk.com

Tel: 604.681.4196
Fax: 604.687.5532

Memo

To:	Scott Keesey, Scott Davidson (Access Consulting Group)	**Date:**	November 10, 2010
cc:	Anne Labelle (Capstone)	**From:**	Dylan MacGregor
Subject:	Minto Phase IV Application: Response to Adequacy Review Comment 26-27C	**Project #:**	1CM022.001

1 Introduction

As part of Minto's response to agency adequacy review comments, SRK was asked to provide input to the response to Comment 26-27C. This comment is copied below for ease of reference.

> **R26-27C. Provide water quality predictions for the receiving environment. These additional predictions could be reasonably based on expected reduced loads from the various source terms after mitigation. The analysis should include scenarios that predict the effects of individual source term mitigations and scenarios that include multiple source terms mitigations. The analysis should include a clear discussion of limitations and uncertainty and a revised cost analysis.**

Following discussions and subsequent email communication between SRK and Access Consulting, it was agreed that the potential effects of soil covers and passive wetland treatment on post-closure water quality would be evaluated. The following sections describe how this evaluation was carried out and present the results.

2 Approach

2.1 Model update

In advance of carrying out additional model runs to assess load reductions that could reasonably be achieved through various closure measures, a review was carried out of the new water quality monitoring results that had been received since July 2010 (the latest results considered for the initial prediction source terms). The purpose was to ensure that the model source terms for the waste rock and tailings facilities incorporated any new peak concentrations identified during post-July 2010 monitoring. Selenium was the only trace element with post-July 2010 maxima that exceeded previously observed values, and the new maximum dissolved selenium concentrations in DSTF seepage (Station W8- dissolved Se concentration of 0.0146 mg/L) and waste rock seepage (Station W15- dissolved Se concentration of 0.0052 mg/L) have been incorporated into the updated prediction.

2.2 Assessment of potential for load reductions due to mitigation

The potential load reductions from application of two mitigation methods were evaluated. These mitigation methods consisted of 1) application of soil covers to reduce loading through reduction of infiltration, and 2) the application of soil covers combined with development of a wetland to provide additional load removal. There is a large body of literature of treatment wetlands that shows they can be effective in removing both metal and nutrient loadings in northern environments (S. Davidson, personal communication, 2010/11/09). Reviewers are referred to the Global Acid Rock Drainage (GARD) Guide for further information on passive treatment wetlands. To evaluate the range of load reductions that could be realized, six scenarios were evaluated as summarized below.

1. Soil covers on waste dumps and dry stack tailings
    a. Scenario 1: 60% reduction of infiltration on benches and 50% on faces
    b. Scenario 2: 80% reduction of infiltration on benches and 50% on faces

2. Soil covers on waste dumps and dry stack tailings, with a polishing wetland receiving the discharge from both the Main Pit and the Area 2 Pit (located roughly in the location of the current Mill Water Pond)
    a. Scenario 3: 60% reduction of infiltration on benches and 50% on faces; wetland removing 66% of received loads.
    b. Scenario 4: 80% reduction of infiltration on benches and 50% on faces; wetland removing 75% of received loads.
3. Soil covers on waste dumps and dry stack tailings, with a polishing wetland receiving the discharge from both the Main Pit and the Area 2 Pit (located roughly in the location of the current Mill Water Pond) and a second polishing wetland receiving drainage from all mine elements above Station W3 (located roughly in the current location of the Water Storage Pond)
    a. Scenario 5: 60% reduction of infiltration on benches and 50% on faces; wetland removing 66% of received loads (both wetlands).
    b. Scenario 6: 80% reduction of infiltration on benches and 50% on faces; wetland removing 75% of received loads (both wetlands).

3 Basis for Evaluation

Effects of Soil Covers: The values chosen for the evaluation of load reduction that could be achieved through the use of soil cover represent the effectiveness of a basic soil cover (60% reduction of infiltration on benches) and a high quality soil cover (80% reduction of infiltration on benches). In all scenarios, an infiltration reduction of 50% was applied to the face (sloped) areas of the waste dumps and the tailings stack.

Breakdowns of bench and face areas for the waste dumps and the dry stack tailings were provided in Table 4.2 of the Closure Plan submitted with the application (Appendix M); this table is reproduced below for ease of reference.

TABLE 4-2. MINTO MINE WASTE DUMP AND TAILINGS FACILITY SURFACE AREAS

Area	Total Surface Area (m^2)	Bench Area (m^2)	Dump Face Area (m^2)	Percentage Benches
Dry Stacked Tailings Storage Facility	380,000	310,000	70,000	81.6%
Southwest Waste Dump	740,000	653,000	87,000	88.2%
Main Waste Dump	435,000	278,100	156,900	63.9%
Mill Valley Fill Expansion	102,000	80,100	21,900	78.5%

Effects of Wetlands: The critical performance period for passive treatment wetlands in northern environments tends to be the spring freshet, when high inflow volumes lead to relatively shorter residence times (and attendant lower load removal rates) than are typical of other times of the year.

Evaluating the supplemental effect of passive treatment wetland systems, in addition to installation of soil covers on waste dumps and dry stack tailings, for removing chemical loads from feed water was carried out by running two freshet performance scenarios:

1. Basic soil cover + lower estimate of freshet load removal in wetland;
2. High quality soil cover + higher estimate of freshet load removal in wetland(s).

4 Evaluation of Effects of Mitigation Measures on Water Quality at Station W1

4.1 Unmitigated Condition

Table 1 presents the results of the post-closure water quality model for the unmitigated condition at Station W1. Predicted concentrations were compared with Site Specific Water Quality Objectives (SSWQO) where available, and with Canadian Water Quality Objectives for the Protection of Aquatic Life (CWQO) for those parameters where no SSWQO were available; for the purposes of this discussion, the term 'Water Quality Objectives' (WQO) will refer to the combined SSWQO (where available) and CWQO (where no SSWQO has been developed).

Modelled concentrations for the unmitigated condition exceeded WQO for several parameters in the month of June, and for Al, Cd, Cu, Fe, and Hg for several months.

- June results:
  - The June model results are a reflection of concentrations adopted for June background runoff water quality.
  - The lack of June flow from the upper catchment (above W3) introduces minor artifacts to the model results at W1, as model structure required end of May loads into the beginning of June for computational purposes. These artifacts manifest only in the month of June due to the lack of flow modelled for that month.
  - For this and subsequent discussion of mitigated scenarios, June concentrations that exceed WQO will not be addressed unless exceedances are also modelled to occur in other months.
- Mercury results:
  - Mercury predictions are very challenging, and always end up being very conservative when 'reasonable worst case' source terms are adopted and a mass-balance approach is followed.
  - Mercury is commonly eliminated from surface water through mechanisms such as loss to the atmosphere (volatilization) or sorption onto mineral and organic soils and sediments.
  - These and other mechanisms typically control mercury concentrations to levels below common commercial laboratory detection limits- this is why mercury is rarely detected in surface water quality analyses.
  - Notwithstanding this, the modelled mercury concentrations are less than two times the WQO (except for June- see previous point).
  - Mercury is therefore not considered to be a parameter of particular concern for the Minto Phase IV project, and mercury exceedances will not be discussed in further detail either for the unmitigated case or for the mitigated scenarios.
- Silver results:
  - The total silver concentration modelled for October exceeds the WQO by less than 10%. As silver is highly insoluble in surface waters, this modelled concentration is likely to be highly conservative. Therefore, silver is not considered to be a parameter of concern, and the October silver results will not be discussed further.

4.2 Evaluation of Effects of Soil Covers on Water Quality at Station W1

Tables 2 and 3 present the results of the post-closure water quality model for the cases where the effects of infiltration reduction covers were assessed, with Table 2 reflecting a 60% reduction of infiltration and chemical load, and with Table 3 reflecting a 80% reduction of infiltration and chemical load.

The following observations can be made:

- If the ‘reasonable worst case’ predicted concentrations are reflective of actual loadings during the post-closure period, then soil covers alone will not be sufficient to prevent WQOs from being exceeded at W1.
- The cover performance has a modest degree of influence on the modelled concentrations at Station W1.
- Outside of the points raised in the Section 4.1, the remaining parameters of concern appear to be Al, Cd, and Cu.

4.3 Evaluation of Effects of Soil Covers and a Single Polishing Wetland on Water Quality at Station W1

Tables 4 and 5 present the results of model scenarios that include basic covers on waste dumps and tailings, and a wetland located near the current Mill Water Pond. The Table 4 scenario consists of basic covers and 66% removal of intercepted load in the wetland, while the Table 5 scenario consists of higher quality covers and 75% removal of load in the intercepted wetland.

The following observations can be made:

- If the ‘reasonable worst case’ predicted concentrations are reflective of actual loadings during the post-closure period, then both ‘soil covers + 1 wetland’ options appear to be capable of reducing loads such that WQOs for copper are met at W1.
- Cadmium remains consistently above WQO for both scenarios.
- Aluminum is modelled to be above the WQO during the freshet period. Modelled concentrations are similar to aluminum concentrations observed in runoff from undisturbed portions of the catchment, and are driven by background loads that are accounted for in the modelling process.

4.4 Evaluation of Effects of Soil Covers and Two Polishing Wetlands on Water Quality at Station W1

Tables 6 and 7 present the results of model scenarios that include basic covers on waste dumps and tailings, a wetland located near the current Mill Water Pond, and a second wetland located near the current location of the Water Storage Pond (just upstream of Station W3). The Table 6 scenario consists of basic covers and 66% removal of intercepted load in the wetlands, while the Table 7 scenario consists of higher quality covers and 75% removal of intercepted load in the wetlands.

The following observations can be made:

- If the ‘reasonable worst case’ predicted concentrations are reflective of actual loadings during the post-closure period, then both ‘soil covers + 2 wetland’ options appear to be capable of reducing loads such that WQOs for all parameters except cadmium are met at Station W1.
- Cadmium remains consistently above WQO for both scenarios.
- Cadmium concentrations are near or above the WQO in the background runoff source term for the months of April, May, June, and October. The post-closure cadmium concentrations at Station W1 are unlikely to be lower than background runoff concentrations; when the undisturbed catchment runoff contains concentrations that exceed WQO, it is almost certain that the concentrations at Station W1 will also exceed WQO.
- The maximum modelled Cadmium concentration (October) exceeds the WQO by a factor of about 3.5; the modelled concentrations for all other months is less than 1.5 times the WQO concentration.

5 Conclusions

Based on the modelling results, it appears that a combination of a reduction of infiltration through waste rock and tailings (through installation of soil covers) and of load removal in polishing wetlands will be capable of adequately mitigating chemical loadings from the mine site in the post-closure period.

As site loadings are decreased, background runoff loadings become proportionally more important. In cases where background runoff concentrations are greater than WQOs, it is highly likely that WQOs will be exceeded at Station W1. The model results suggest that cadmium is the parameter that is most likely to exceed WQOs under the mitigation scenarios evaluated, and that this will largely result from load contributions from undisturbed portions of the catchment.

Table 1 W1 Post-closure Water Quality Prediction (Unmitigated Condition)

	Ag mg/L	Al mg/L	As mg/L	Cd mg/L	Cr mg/L	Cu mg/L	Fe mg/L	Hg mg/L	Mn mg/L	Mo mg/L	Ni mg/L	Pb mg/L	Se mg/L	Tl mg/L	Zn mg/L
January	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
February	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
March	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
April	0.000051	0.26	0.00046	0.000077	0.00089	0.018	0.37	0.000013	0.070	0.0013	0.0010	0.00024	0.00039	0.000006	0.0085
May	0.000068	0.83	0.00103	0.000089	0.00162	0.034	1.16	0.000019	0.154	0.0021	0.0036	0.00056	0.00081	0.000093	0.0106
June	0.000050	1.68	0.00105	0.000044	0.00363	0.006	2.48	0.001402	0.108	0.0010	0.0049	0.00077	0.00041	0.000030	0.0091
July	0.000055	0.47	0.00079	0.000046	0.00095	0.025	0.74	0.000074	0.132	0.0018	0.0020	0.00036	0.00057	0.000035	0.0080
August	0.000073	0.30	0.00080	0.000044	0.00090	0.024	0.44	0.000035	0.121	0.0025	0.0018	0.00037	0.00057	0.000041	0.0078
September	0.000106	0.81	0.00104	0.000090	0.00163	0.043	1.21	0.000036	0.198	0.0025	0.0033	0.00061	0.00084	0.000041	0.0144
October	0.000050	0.30	0.00055	0.000156	0.00090	0.014	0.48	0.000023	0.083	0.0015	0.0020	0.00076	0.00069	0.000031	0.0076
November	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CWQG (mg/L)	0.0001	0.01	0.005	0.00004	0.001	0.003	0.3	0.000026	none	0.073	0.11	0.004	0.001	0.0008	0.03
SSWQO (mg/L)		0.62			0.002	0.017	1.1		1.045						

Source: W:\01_SITES\Minto\!Databases\ML-ARD\WQ_Predictions\Load Balance\V02\[Minto.MitigationPrediction.Tables.CAJ.v02.xlsx]

Notes: Grey cells indicate values exceeding either the proposed site-specific water quality objective (SSWQO) for Station W1 (where developed) or the Canadian Water Quality Guideline values (CWQG) for the Protection of Aquatic Life (http://ceqg-rcqe.ccme.ca).

Table 2 W1 Post-closure Water Quality Prediction- Mitigation Scenario 1: Soil Cover (60% infiltration reduction) on DSTF and Waste Dumps

	Ag (mg/L)	Al (mg/L)	As (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Hg (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Se (mg/L)	Tl (mg/L)	Zn (mg/L)
January	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
February	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
March	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
April	0.000052	0.27	0.00044	0.000077	0.00089	0.016	0.38	0.000014	0.055	0.0013	0.0010	0.00025	0.00040	0.000007	0.0085
May	0.000068	0.75	0.00087	0.000073	0.00149	0.020	1.07	0.000019	0.106	0.0017	0.0032	0.00047	0.00068	0.000091	0.0088
June	0.000050	1.68	0.00104	0.000043	0.00363	0.005	2.47	0.001402	0.106	0.0010	0.0048	0.00077	0.00041	0.000030	0.0090
July	0.000054	0.41	0.00067	0.000034	0.00085	0.014	0.67	0.000072	0.086	0.0015	0.0018	0.00030	0.00047	0.000035	0.0067
August	0.000073	0.24	0.00067	0.000030	0.00081	0.013	0.37	0.000035	0.080	0.0022	0.0016	0.00031	0.00046	0.000041	0.0064
September	0.000105	0.69	0.00083	0.000066	0.00145	0.024	1.07	0.000036	0.136	0.0019	0.0028	0.00049	0.00066	0.000040	0.0117
October	0.000050	0.28	0.00049	0.000148	0.00086	0.009	0.45	0.000023	0.067	0.0014	0.0019	0.00073	0.00064	0.000031	0.0069
November	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CWQG (mg/L)	0.0001	0.01	0.005	0.00004	0.001	0.003	0.3	0.000026	none	0.073	0.11	0.004	0.001	0.0008	0.03
SSWQO (mg/L)		0.62			0.002	0.017	1.1		1.045						

Source: W:\01_SITES\Minto\!Databases\ML-ARD\WQ_Predictions\Load Balance\V02\[Minto.MitigationPrediction.Tables.CAJ.v02.xlsx]

Notes: Grey cells indicate values exceeding either the proposed site-specific water quality objective (SSWQO) for Station W1 (where developed) or the Canadian Water Quality Guideline values (CWQG) for the Protection of Aquatic Life (http://ceqg-rcqe.ccme.ca).

Table 3 W1 Post-closure Water Quality Prediction- Mitigation Scenario 2: Soil Cover (80% infiltration reduction) on DSTF and Waste Dumps

	Ag (mg/L)	Al (mg/L)	As (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Hg (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Se (mg/L)	Tl (mg/L)	Zn (mg/L)
January	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
February	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
March	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
April	0.000052	0.26	0.00042	0.000075	0.00087	0.014	0.36	0.000014	0.048	0.0013	0.0009	0.00023	0.00036	0.000007	0.0082
May	0.000067	0.72	0.00082	0.000068	0.00145	0.016	1.04	0.000019	0.092	0.0016	0.0031	0.00045	0.00061	0.000090	0.0083
June	0.000050	1.68	0.00104	0.000043	0.00363	0.005	2.47	0.001402	0.106	0.0010	0.0048	0.00077	0.00041	0.000030	0.0090
July	0.000054	0.40	0.00063	0.000031	0.00082	0.011	0.66	0.000072	0.074	0.0014	0.0017	0.00028	0.00042	0.000035	0.0064
August	0.000073	0.23	0.00064	0.000026	0.00078	0.010	0.35	0.000035	0.068	0.0021	0.0015	0.00029	0.00041	0.000041	0.0060
September	0.000105	0.66	0.00077	0.000059	0.00140	0.018	1.03	0.000036	0.118	0.0017	0.0027	0.00046	0.00057	0.000040	0.0109
October	0.000050	0.27	0.00048	0.000147	0.00084	0.008	0.44	0.000023	0.062	0.0013	0.0019	0.00072	0.00062	0.000031	0.0067
November	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CWQG (mg/L)	0.0001	0.01	0.005	0.00004	0.001	0.003	0.3	0.000026	none	0.073	0.11	0.004	0.001	0.0008	0.03
SSWQO (mg/L)		0.62			0.002	0.017	1.1		1.045						

Source: W:\01_SITES\Minto\!Databases\ML-ARD\WQ_Predictions\Load Balance\V02\[Minto.MitigationPrediction.Tables.CAJ.v02.xlsx]

Notes: Grey cells indicate values exceeding either the proposed site-specific water quality objective (SSWQO) for Station W1 (where developed) or the Canadian Water Quality Guideline values (CWQG) for the Protection of Aquatic Life (http://ceqg-rcqe.ccme.ca).

Table 4 W1 Post-closure Water Quality Prediction- Mitigation Scenario 3: Soil Cover (60% infiltration reduction) on DSTF and Waste Dumps, Wetland for Polishing Pit Discharge Waters (66% load reduction)

	Ag (mg/L)	Al (mg/L)	As (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Hg (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Se (mg/L)	Tl (mg/L)	Zn (mg/L)
January	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
February	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
March	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
April	0.000050	0.24	0.00038	0.000069	0.00082	0.013	0.34	0.000012	0.049	0.0011	0.0008	0.00021	0.00033	0.000006	0.0077
May	0.000064	0.65	0.00071	0.000060	0.00128	0.014	0.96	0.000015	0.092	0.0012	0.0028	0.00039	0.00052	0.000079	0.0075
June	0.000050	1.68	0.00104	0.000043	0.00362	0.005	2.47	0.001402	0.106	0.0010	0.0048	0.00077	0.00040	0.000030	0.0089
July	0.000053	0.36	0.00059	0.000027	0.00074	0.010	0.60	0.000055	0.079	0.0013	0.0016	0.00025	0.00040	0.000032	0.0059
August	0.000071	0.19	0.00060	0.000023	0.00072	0.008	0.31	0.000026	0.072	0.0019	0.0014	0.00026	0.00039	0.000039	0.0055
September	0.000097	0.59	0.00064	0.000052	0.00122	0.015	0.94	0.000025	0.116	0.0013	0.0024	0.00039	0.00048	0.000033	0.0096
October	0.000048	0.25	0.00045	0.000143	0.00080	0.007	0.42	0.000021	0.062	0.0012	0.0018	0.00070	0.00059	0.000029	0.0064
November	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CWQG (mg/L)	0.0001	0.01	0.005	0.00004	0.001	0.003	0.3	0.000026	none	0.073	0.11	0.004	0.001	0.0008	0.03
SSWQO (mg/L)		0.62			0.002	0.017	1.1		1.045						

Source: W:\01_SITES\Minto\!Databases\ML-ARD\WQ_Predictions\Load Balance\V02\[Minto.MitigationPrediction.Tables.CAJ.v02.xlsx]

Notes: Grey cells indicate values exceeding either the proposed site-specific water quality objective (SSWQO) for Station W1 (where developed) or the Canadian Water Quality Guideline values (CWQG) for the Protection of Aquatic Life (http://ceqg-rcqe.ccme.ca).

Table 5 W1 Post-closure Water Quality Prediction- Mitigation Scenario 4: Soil Cover (80% infiltration reduction) on DSTF and Waste Dumps, Wetland for Polishing Pit Discharge Waters (75% load reduction)

	Ag (mg/L)	Al (mg/L)	As (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Hg (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Se (mg/L)	Tl (mg/L)	Zn (mg/L)
January	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
February	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
March	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
April	0.000049	0.23	0.00036	0.000068	0.00080	0.012	0.34	0.000012	0.043	0.0010	0.0008	0.00020	0.00030	0.000006	0.0075
May	0.000064	0.63	0.00066	0.000057	0.00123	0.011	0.93	0.000014	0.080	0.0011	0.0027	0.00037	0.00046	0.000077	0.0071
June	0.000050	1.68	0.00104	0.000042	0.00362	0.005	2.47	0.001402	0.105	0.0010	0.0048	0.00077	0.00040	0.000030	0.0089
July	0.000052	0.34	0.00056	0.000025	0.00071	0.008	0.59	0.000053	0.067	0.0012	0.0015	0.00024	0.00035	0.000031	0.0057
August	0.000070	0.18	0.00057	0.000021	0.00070	0.006	0.30	0.000024	0.062	0.0018	0.0013	0.00025	0.00034	0.000039	0.0053
September	0.000096	0.56	0.00058	0.000047	0.00117	0.011	0.91	0.000024	0.101	0.0011	0.0023	0.00037	0.00040	0.000032	0.0091
October	0.000047	0.24	0.00043	0.000142	0.00079	0.006	0.41	0.000021	0.058	0.0012	0.0018	0.00069	0.00057	0.000029	0.0063
November	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CWQG (mg/L)	0.0001	0.01	0.005	0.00004	0.001	0.003	0.3	0.000026	none	0.073	0.11	0.004	0.001	0.0008	0.03
SSWQO (mg/L)		0.62			0.002	0.017	1.1		1.045						

Source: W:\01_SITES\Minto\!Databases\ML-ARD\WQ_Predictions\Load Balance\V02\[Minto.MitigationPrediction.Tables.CAJ.v02.xlsx]

Notes: Grey cells indicate values exceeding either the proposed site-specific water quality objective (SSWQO) for Station W1 (where developed) or the Canadian Water Quality Guideline values (CWQG) for the Protection of Aquatic Life (http://ceqg-rcqe.ccme.ca).

Table 6 W1 Post-closure Water Quality Prediction- Mitigation Scenario 5: Soil Cover (60% infiltration reduction) on DSTF and Waste Dumps, Wetland for Polishing Pit Discharge Waters (66% load reduction) and Additional Wetland for Polishing All Mine Site Drainage

	Ag (mg/L)	Al (mg/L)	As (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Hg (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Se (mg/L)	Tl (mg/L)	Zn (mg/L)
January	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
February	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
March	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
April	0.000048	0.22	0.00034	0.000065	0.00076	0.011	0.33	0.000011	0.039	0.0010	0.0008	0.00019	0.00028	0.000006	0.0073
May	0.000063	0.59	0.00059	0.000053	0.00113	0.009	0.88	0.000013	0.069	0.0010	0.0025	0.00034	0.00038	0.000069	0.0067
June	0.000049	1.68	0.00103	0.000042	0.00361	0.005	2.47	0.001402	0.105	0.0010	0.0048	0.00077	0.00040	0.000029	0.0089
July	0.000052	0.33	0.00053	0.000023	0.00068	0.007	0.57	0.000049	0.059	0.0011	0.0015	0.00023	0.00031	0.000030	0.0055
August	0.000070	0.17	0.00054	0.000019	0.00067	0.005	0.28	0.000022	0.054	0.0018	0.0013	0.00024	0.00031	0.000038	0.0051
September	0.000091	0.53	0.00052	0.000044	0.00107	0.009	0.86	0.000021	0.087	0.0010	0.0021	0.00033	0.00033	0.000029	0.0085
October	0.000046	0.24	0.00041	0.000139	0.00076	0.006	0.40	0.000020	0.054	0.0011	0.0017	0.00067	0.00055	0.000028	0.0061
November	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CWQG (mg/L)	0.0001	0.01	0.005	0.00004	0.001	0.003	0.3	0.000026	none	0.073	0.11	0.004	0.001	0.0008	0.03
SSWQO (mg/L)		0.62			0.002	0.017	1.1		1.045						

Source: W:\01_SITES\Minto\!Databases\ML-ARD\WQ_Predictions\Load Balance\V02\[Minto.MitigationPrediction.Tables.CAJ.v02.xlsx]

Notes: Grey cells indicate values exceeding either the proposed site-specific water quality objective (SSWQO) for Station W1 (where developed) or the Canadian Water Quality Guideline values (CWQG) for the Protection of Aquatic Life (http://ceqg-rcqe.ccme.ca).

Table 7 W1 Post-closure Water Quality Prediction- Mitigation Scenario 5: Soil Cover (80% infiltration reduction) on DSTF and Waste Dumps, Wetland for Polishing Pit Discharge Waters (75% load reduction) and Additional Wetland for Polishing All Mine Site Drainage (75% load reduction)

	Ag (mg/L)	Al (mg/L)	As (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Hg (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Se (mg/L)	Tl (mg/L)	Zn (mg/L)
January	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
February	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
March	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
April	0.000048	0.22	0.00033	0.000064	0.00075	0.010	0.32	0.000011	0.036	0.0009	0.0008	0.00018	0.00026	0.000006	0.0072
May	0.000062	0.58	0.00056	0.000051	0.00110	0.008	0.87	0.000012	0.063	0.0009	0.0024	0.00033	0.00035	0.000067	0.0065
June	0.000049	1.68	0.00103	0.000042	0.00361	0.005	2.47	0.001402	0.105	0.0010	0.0048	0.00077	0.00040	0.000029	0.0089
July	0.000052	0.32	0.00051	0.000022	0.00066	0.006	0.56	0.000048	0.053	0.0011	0.0014	0.00022	0.00029	0.000030	0.0053
August	0.000069	0.16	0.00053	0.000018	0.00066	0.004	0.27	0.000021	0.050	0.0017	0.0013	0.00023	0.00029	0.000038	0.0050
September	0.000090	0.52	0.00048	0.000042	0.00103	0.008	0.84	0.000020	0.079	0.0009	0.0020	0.00032	0.00029	0.000028	0.0082
October	0.000046	0.23	0.00041	0.000138	0.00075	0.005	0.40	0.000020	0.052	0.0011	0.0017	0.00067	0.00054	0.000028	0.0060
November	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CWQG (mg/L)	0.0001	0.01	0.005	0.00004	0.001	0.003	0.3	0.000026	none	0.073	0.11	0.004	0.001	0.0008	0.03
SSWQO (mg/L)		0.62			0.002	0.017	1.1		1.045						

Source: W:\01_SITES\Minto\!Databases\ML-ARD\WQ_Predictions\Load Balance\V02\[Minto.MitigationPrediction.Tables.CAJ.v02.xlsx]

Notes: Grey cells indicate values exceeding either the proposed site-specific water quality objective (SSWQO) for Station W1 (where developed) or the Canadian Water Quality Guideline values (CWQG) for the Protection of Aquatic Life (http://ceqg-rcqe.ccme.ca).

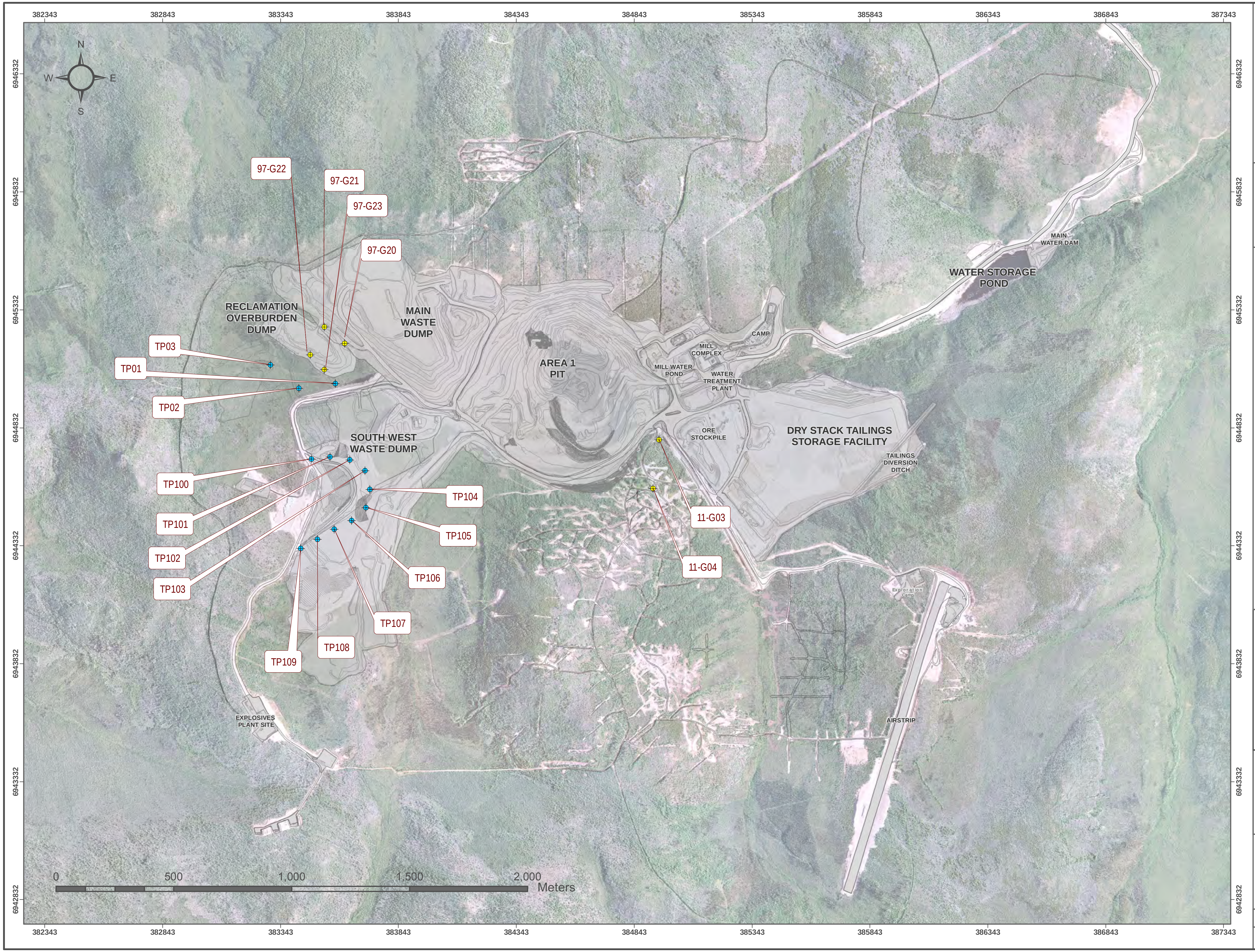
MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

Decommissioning and Reclamation Plan

Appendix B

Reclamation Material Borehole Logs and Locations

Compilation of reclamation source soils information from investigations conducted at the Minto Mine



MINTO MINE

DECOMMISSIONING AND RECLAMATION PLAN
Rev.3.1

Minto Explorations Ltd.
A SUBSIDIARY OF CAPSTONE MINING LTD.

- Bore Hole
- Test Pit
- Access Road
- Mine Site Road
- Site Form Line

This is not a legal document. Aerial photography flight date: July 13th 2009. Ortho-rectification produced by Challenger Geomatics Ltd. Site layout provided by Minto Exploration Ltd and processed by EBA February 2010. Data current as of January 2011. Instrumentation data provided by EBA, February 2011.

NAD 83 UTM Zone 8N

FIGURE 1

TEST PITS AND BORE HOLE LOCATIONS

ACCESS
CONSULTING GROUP

DRAWN BY MD	APRIL 2011	VERIFIED BY SD

I:\Minto\gis\mxd\Phase_4\Closure\FEB_2011\D-1_BoreHoles_20110223.mxd

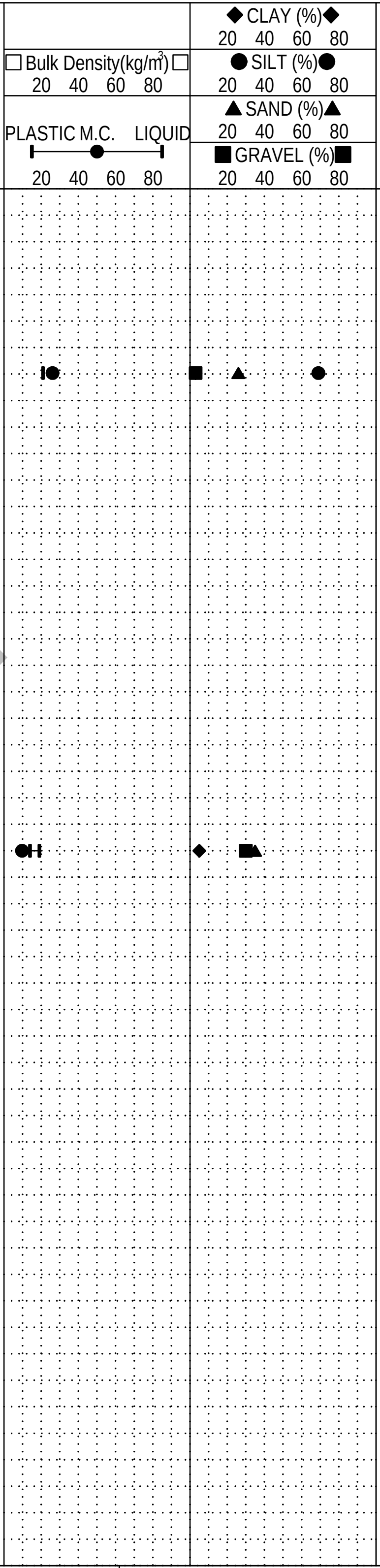
Minto Mine Overburden Investigations

Borehole/ Sample No.	Depth (m)	Clay %	Silt %	Sand %	Gravel %
1200173-042	5.00 - 5.20	0.0	59	40	1
1200173-042	15.00 - 15.20	6.0	37	47	10
1200173-042	24.50 - 24.70	16.0	47	26	11
1200173-042	35.40 - 35.55	8.0	38	41	13
1200173-042	50.00 - 50.30	28.0	19	38	15
1200173-043	7.70 - 7.90	5.0	69	26	0
1200173-043	17.70 - 17.85	6.0	36	42	16
1200173-043	27.90 - 28.10	56.0	41	3	0
1200173-043	46.00 - 46.20	28.0	56	15	1
1200173-043	56.10 - 56.30	1.0	21	41	37
1200173-044	13.10 - 13.30	5.0	22	28	45
1200173-044	23.80 - 24.00	11.0	29	21	39
1200173-044	41.10 - 41.30	11.0	30	47	12
1200173-044	50.60 - 50.80	3.0	64	33	0
1200173-045	8.80 - 9.00	1.0	32	37	30
1200173-045	19.80 - 20.00	0.0	12	63	25
1200173-045	30.10 - 30.30	3.0	57	40	0
1200173-045	41.10 - 41.30	36.0	62	2	0
1200173-045	50.60 - 50.80	17.0	18	22	43
1200173-045B	3.00 - 3.20	2.0	18	49	31
1200173-045B	6.20 - 6.40	6.0	32	27	35
1200173-045B	11.70 - 11.90	20.0	19	36	25
1200173-045B	23.20 - 23.50	14.0	46	40	0
1200173-045B	29.20 - 29.40	35.0	48	15	2
08-ROD-OB01	796	18	30	14	38
08-ROD-OB02	808	8	18	15	59
08-ROD-TP03	1.6 - 1.8	4	37	45	14
08-ROD-TP02	1.4 - 1.5	2	34	40	24
08-ROD-TP01	0.6 - 0.8	8	40	43	9
08-ROD-TP01	3.3 - 3.5	4	18	54	24
TP2(2B)	3.00 - 4.00	21.7	32.9	27.7	17.7
TP2(2A)	3.00 - 4.00	18.6	28.0	25.5	27.9
TP1(1B)	1.00 - 2.00	7.2	31.7	40.4	20.7
TP1(1A)	1.00 - 2.00	8.9	41.4	43.0	6.7
97-TP02	3.30 - 3.50	24.9		50.9	24.2
97-TP01	1.50 - 1.70	6.0		27.4	66.6
97-G21	4.40 - 4.60	24.5		44.8	30.7
97-G20	2.1 - 2.30	19.1		80.9	0.0
97-G19	4.10 - 4.30	13		67.5	19.5
97-G18	2.50 - 2.70	10.3		72.4	17.3
97-G18	7.10 - 7.30	17.3	31.8	42.2	8.7
11-G03	3.38 - 3.58	3	69	25	3
11-G03	12.4 - 12.6	5	30	35	30
11-G03	27.64 - 27.84	21	57	18	4
11-G03	30.6 - 30.8	26	69	5	0
11-G03	37.9 - 38.1	21	63	13	3
11-G04	1.0 - 1.5	7	82	10	0

Winter 2011 Geotechnical Drilling	CLIENT: Minto Explorations Ltd.	BOREHOLE NO: 11-G03
Area 2	DRILL: HQ Diamond	PROJECT NO: W14101068.033
Minto Mine, YT	6944782.093N; 384948.312E; Zone 8	ELEVATION: 803.697m

SAMPLE TYPE	■ GRAB SAMPLE	◺ NO RECOVERY	☒ BULK	☰ CRREL CORE	▥ SHELBY TUBE	▮ GRAB CORE
BACKFILL TYPE	■ BENTONITE	⁘ PEA GRAVEL	▥ SLOUGH	⁘ GROUT	▧ DRILL CUTTINGS	⁘ SAND

Depth (m)	LITHOLOGICAL DESCRIPTION	SAMPLE NUMBER	GROUND ICE DESCRIPTION AND COMMENTS	Elevation (m)
0	PEAT and ORGANIC SILT - brown	G1	- Vr <2%	
1	SILT (TILL) - sandy, trace gravel, trace clay, non-plastic, gravel <25 mm, poorly graded, angular to sub-angular, occasional organics	G2		803.0
2			- Vs <4%	802.0
3	- gravel seam - increased gravel <20 mm			801.0
4		G3		800.0
5		G4		799.0
6				798.0
7		G5		797.0
8		G6		796.0
9	- increased gravel < 30 mm for 0.4 m	G7		795.0
10	- cobble 200 mm - only cobbles and gravel recovered, fines washed out for 100 mm			794.0
11		G8		793.0
12	- only cobbles and gravel recovered, fines washed out for 150 mm - decreased gravel content for 1.4 m		- Vr	792.0
13	SAND: silty, gravelly, trace clay, well to poorly graded, angular to subangular, brownish grey	G9		791.0
14				790.0
15	- only gravel recovered, fines washed out for 100 mm	G10		789.0
16	- becomes gravelly, some sand, gravel <50 mm, sand and gravel poorly graded	G11	- Vs <5%	788.0
17				787.0
18		G12	- 35 mm thick ice lens - Vr <10% for 1.8 m	786.0
19				785.0
20		G13		784.0
21				783.0
22	- increased gravel and cobbles for 2.3 m	G14		782.0
23		G15		781.0
24				780.0
25		G16		779.0
26				778.0



EBA Engineering Consultants Ltd.

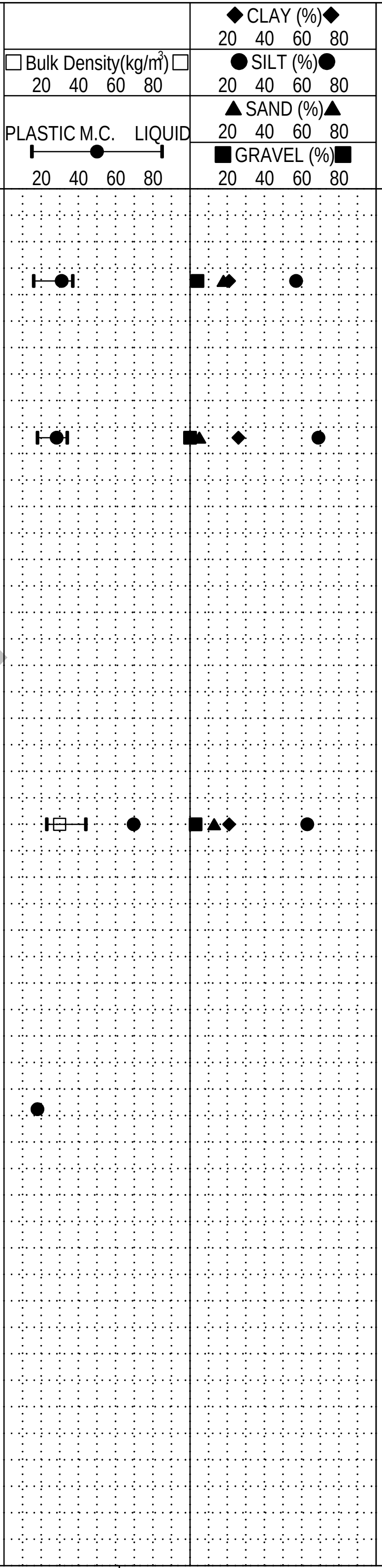
LOGGED BY: AT & SMC	COMPLETION DEPTH: 50.9m
REVIEWED BY: JGD	COMPLETE: 1/18/2011
DRAWING NO:	Page 1 of 2

Winter 2011 Geotechnical Drilling	CLIENT: Minto Explorations Ltd.	BOREHOLE NO: 11-G03
Area 2	DRILL: HQ Diamond	PROJECT NO: W14101068.033
Minto Mine, YT	6944782.093N; 384948.312E; Zone 8	ELEVATION: 803.697m

SAMPLE TYPE ▨ GRAB SAMPLE ▨ NO RECOVERY ☒ BULK ▤ CRREL CORE ▥ SHELBY TUBE ▮ GRAB CORE

BACKFILL TYPE ▨ BENTONITE ▨ PEA GRAVEL ▥ SLOUGH ▨ GROUT ▨ DRILL CUTTINGS ▨ SAND

Depth (m)	LITHOLOGICAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION AND COMMENTS	Elevation (m)
26					777.0
27	CLAY - silty, some sand, trace gravel, medium plastic, gravel <15 mm, poorly graded	▮	G17	- Vr <3%	776.0
28	- clay content increases, gravel content decreases, plasticity increases	▮	G18		775.0
29					774.0
30		▮	G19		773.0
31	- cobble 60 mm, no more gravel	▮	G20		772.0
32	SAND - trace silt, trace gravel, sub-rounded, gravel <10 mm, medium brown	▮	G21		771.0
33	- less gravel, less silt	▮	G22	- Nbn	770.0
34	- becomes some gravel				769.0
35	- becomes trace gravel	▮	G23	- Vx <5%	768.0
36	- bedded coarse grained sand 45° to horizontal				767.0
37	- gravel seam 65 mm CLAY - silty, some sand, trace gravel, medium plastic, grey	▮	G24	- ice lens 40 mm, clear	766.0
38		▮	G25	- horizontal ice lenses for 1.2 m	765.0
39	- becomes laminated, 5 mm thick bands of black clay oriented at 45° to horizontal	▮	G26		764.0
40		▮	G27	- ice lens 20 mm, clear	763.0
41	- clay becomes dry, very stiff to hard				762.0
42					761.0
43		▮	G28		760.0
44	- increased sand and gravel, sub-angular, set in clay matrix	▮	G29	- unfrozen	759.0
45	- boulder 300 mm	▮	G30	- Nbn	758.0
46	SILT - sandy, some gravel, non-plastic, angular to sub-angular, dark brown to grey				757.0
47					756.0
48	BEDROCK - grandiorite				755.0
49					754.0
50					753.0
51	END OF BOREHOLE @ 50.9 m				752.0
52					



EBA Engineering Consultants Ltd.

LOGGED BY: AT & SMC	COMPLETION DEPTH: 50.9m
REVIEWED BY: JGD	COMPLETE: 1/18/2011
DRAWING NO:	Page 2 of 2

PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422, C136 & C117

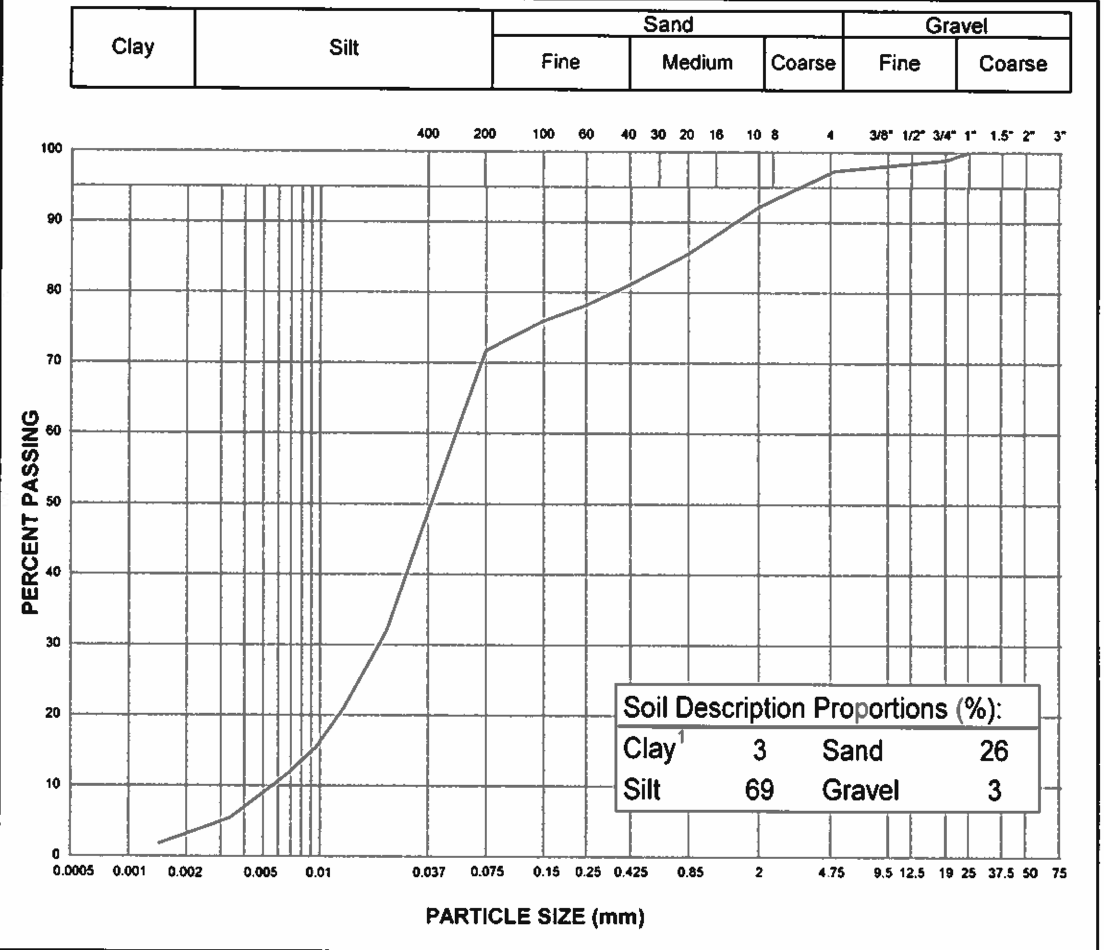
Project:	Winter 2011 Geotechnical Drilling	Sample No.:	G3
Project No.:	W14101068.033	Material Type:	
Site:	Minto Mine, YT	Sample Loc.:	11-G03
Client:	Minto Explorations Ltd.	Sample Depth:	3.38 - 3.58 m
Client Rep.:		Sampling Method:	Core Grab
Date Tested:	January 27, 2011 By: SMS/PE	Date sampled:	January 18, 2011
Soil Description[2]:	SILT - sandy, trace clay, trace gravel	Sampled By:	AT/SC
		USC Classification:	

Cu: 9.6

Moisture Content: 26.1%

Cc: 1.3

Particle Size (mm)	Percent Passing
75	
50	
38	
25	100
19	99
12.5	99
10	99
5	97
2	92
0.85	86
0.425	81
0.25	78
0.15	76
0.075	72
0.0336	45.7
0.0223	32.0
0.0133	21.0
0.0096	15.5
0.0069	11.9
0.0034	5.5
0.0014	1.8



Soil Description Proportions (%):

Clay[1]	3	Sand	26
Silt	69	Gravel	3

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is based on the results of grain size testing

Specification:

Remarks:

Reviewed By: ____________________

PARTICLE SIZE ANALYSIS TEST REPORT

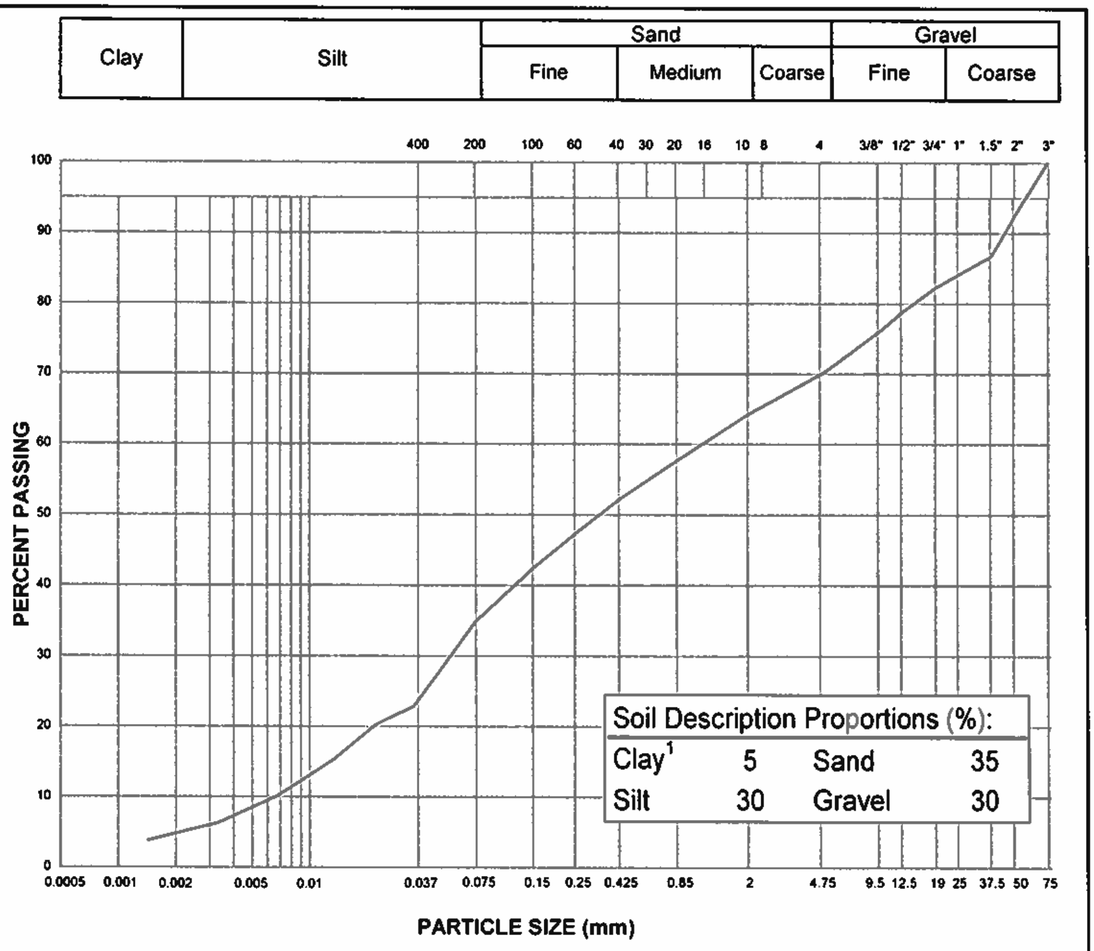
ASTM D422, C136 & C117

Project:	Winter 2011 Geotechnical Drilling	Sample No.:	G9
Project No.:	W14101068.033	Material Type:	
Site:	Minto Mine, YT	Sample Loc.:	11-G03
Client:	Minto Explorations Ltd.	Sample Depth:	12.4 - 12.6 m
Client Rep.:		Sampling Method:	Core Grab
Date Tested:	January 27, 2011 By: SMS/PE	Date sampled:	January 18, 2011
Soil Description[2]:	SAND - gravelly, silty, trace clay	Sampled By:	AT/SC

USC Classification: Cu: 189.2

Moisture Content: 9.7% Cc: 0.4

Particle Size (mm)	Percent Passing
75	100
50	
38	87
25	87
19	82
12.5	79
10	76
5	70
2	64
0.85	58
0.425	52
0.25	47
0.15	42
0.075	35
0.0351	22.9
0.0225	20.3
0.0133	15.3
0.0095	12.7
0.0068	10.2
0.0033	6.4
0.0014	3.8



Soil Description Proportions (%):

Clay[1]	5	Sand	35
Silt	30	Gravel	30

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is based on the results of grain size testing

Specification: ____________________

Remarks: ____________________

Reviewed By: ____________________

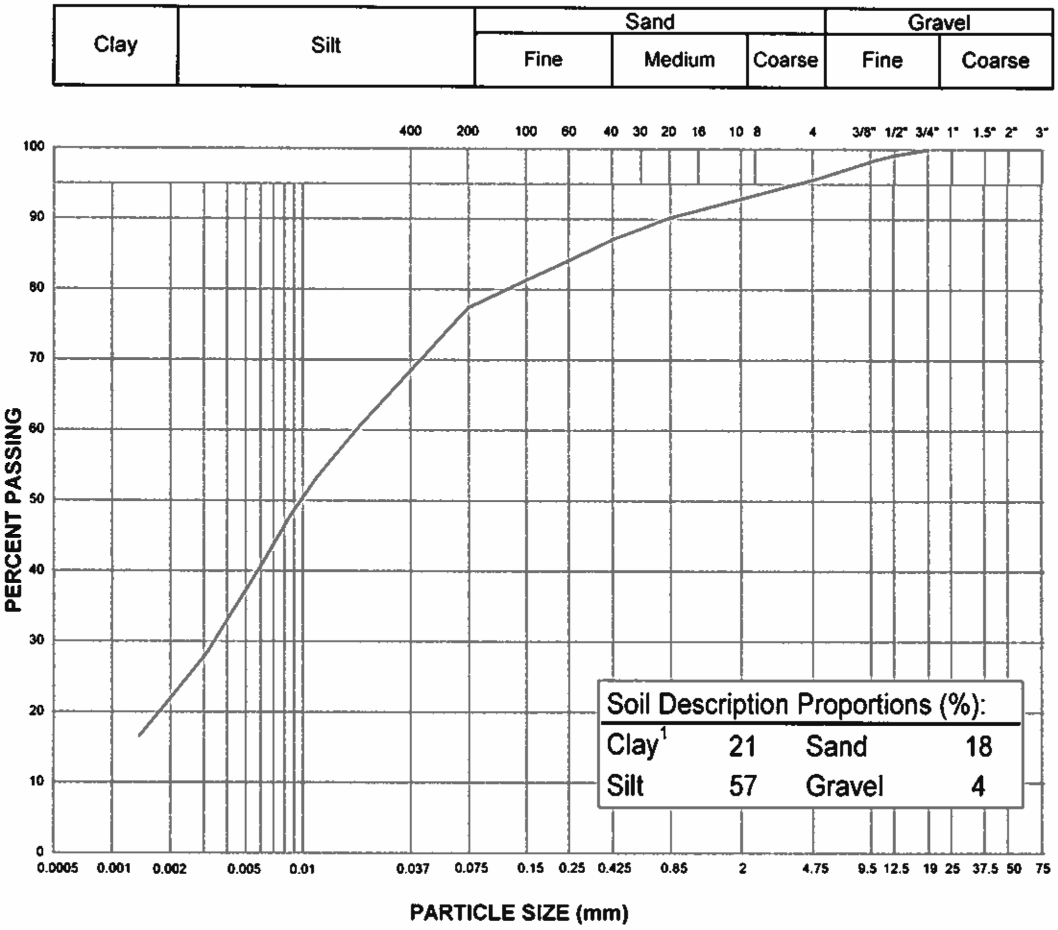
eba A TETRA TECH COMPANY

PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422, C136 & C117

Project:	Winter 2011 Geotechnical Drilling	Sample No.:	G18
Project No.:	W14101068.033	Material Type:	
Site:	Minto Mine, YT	Sample Loc.:	11-G03
Client:	Minto Explorations Ltd.	Sample Depth:	27.64 - 27.84 m
Client Rep.:		Sampling Method:	Core Grab
Date Tested:	January 27, 2011 By: SMS/PE	Date sampled:	January 18, 2011
Soil Description^2:	SILT - clayey, some sand, trace gravel	Sampled By:	AT/SC
		USC Classification:	Cu:
Moisture Content:	31.0%		Cc:

Particle Size (mm)	Percent Passing
75	
50	
38	
25	
19	100
12.5	99
10	98
5	96
2	93
0.85	90
0.425	87
0.25	84
0.15	81
0.075	77
0.0310	66.2
0.0201	60.7
0.0119	53.3
0.0086	47.8
0.0062	41.4
0.0032	28.5
0.0014	16.6



Soil Description Proportions (%):

Clay^1	21	Sand	18
Silt	57	Gravel	4

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is based on the results of grain size testing

Specification: ______________________

Remarks: ______________________

Reviewed By: ______________________

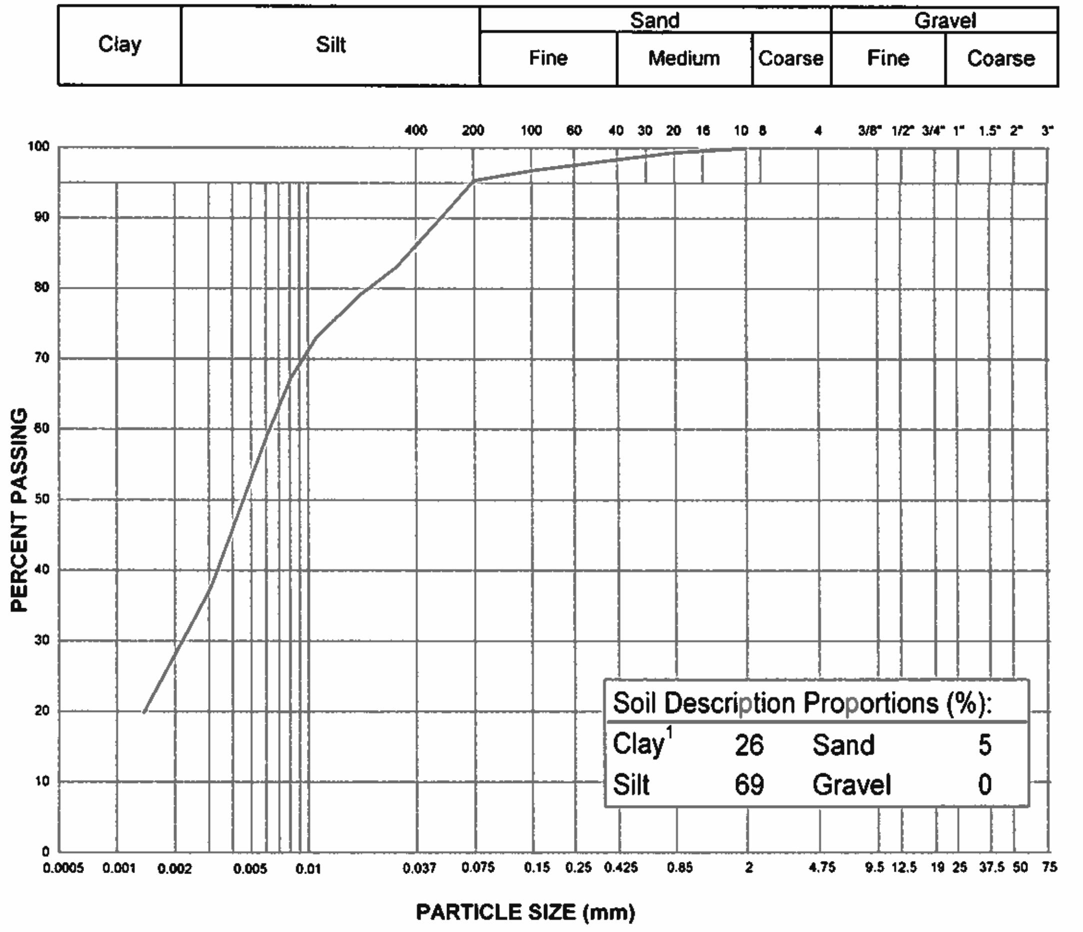
eba
A TETRA TECH COMPANY

PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422, C136 & C117

Project:	Winter 2011 Geotechnical Drilling	Sample No.:	G20
Project No.:	W14101068.033	Material Type:	
Site:	Minto Mine, YT	Sample Loc.:	11-G03
Client:	Minto Explorations Ltd.	Sample Depth:	30.6 - 30.8 m
Client Rep.:		Sampling Method:	Core Grab
Date Tested:	January 27, 2011 By: SMS/PE	Date sampled:	January 18, 2011
Soil Description[2]:	SILT - clayey, trace sand	Sampled By:	AT/SC
		USC Classification:	Cu:
Moisture Content:	28.3%		Cc:

Particle Size (mm)	Percent Passing
75	
50	
38	
25	
19	
12.5	
10	
5	
2	100
0.85	99
0.425	98
0.25	98
0.15	97
0.075	95
0.0295	83.2
0.0190	79.2
0.0112	73.3
0.0081	67.3
0.0059	58.4
0.0031	37.6
0.0014	19.8



Soil Description Proportions (%):

Clay[1]	26	Sand	5
Silt	69	Gravel	0

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is based on the results of grain size testing

Specification:

Remarks:

Reviewed By:

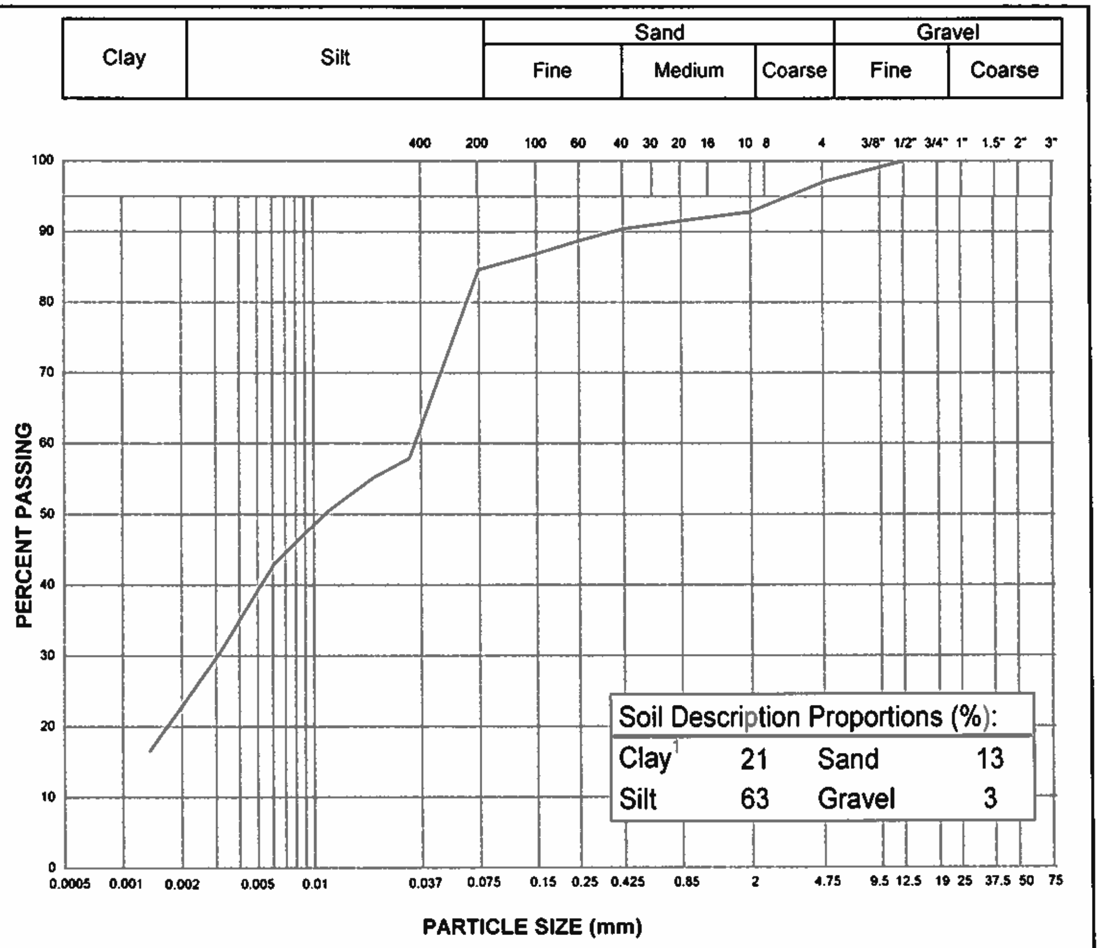
A TETRA TECH COMPANY

PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422, C136 & C117

Project:	Winter 2011 Geotechnical Drilling	Sample No.:	G25
Project No.:	W14101068.033	Material Type:	
Site:	Minto Mine, YT	Sample Loc.:	11-G03
Client:	Minto Explorations Ltd.	Sample Depth:	37.9 - 38.1 m
Client Rep.:		Sampling Method:	Core Grab
Date Tested:	January 27, 2011 By: SMS/PE	Date sampled:	January 18, 2011
Soil Description[2]:	SILT - clayey, some sand, trace gravel	Sampled By:	AT/SC
		USC Classification:	Cu:
Moisture Content:	69.7%		Cc:

Particle Size (mm)	Percent Passing
75	
50	
38	
25	
19	
12.5	100
10	99
5	97
2	93
0.85	92
0.425	90
0.25	89
0.15	87
0.075	85
0.0321	57.9
0.0206	55.2
0.0121	50.6
0.0086	46.9
0.0062	43.2
0.0031	30.3
0.0014	16.6



Soil Description Proportions (%):

Clay[1]	21	Sand	13
Silt	63	Gravel	3

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is based on the results of grain size testing

Specification: ______

Remarks: ______

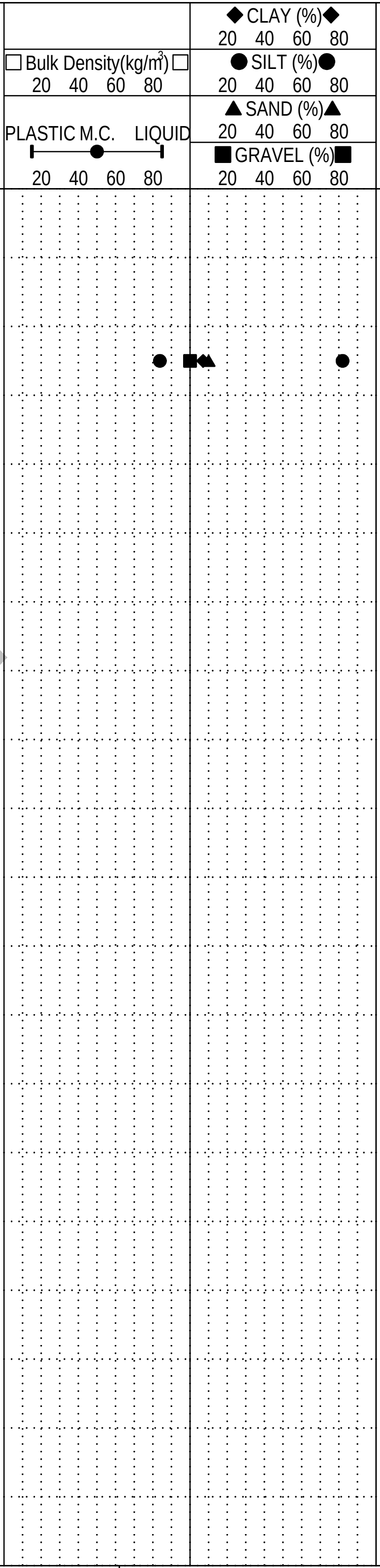
Reviewed By: ______

Winter 2011 Geotechnical Drilling	CLIENT: Minto Explorations Ltd.	BOREHOLE NO: 11-G04
Area 2	DRILL: HQ Diamond	PROJECT NO: W14101068.033
Minto Mine, YT	6944576.52N; 384922.911E; Zone 8	ELEVATION: 836.303m

SAMPLE TYPE ▆ GRAB SAMPLE ◪ NO RECOVERY ☒ BULK ▤ CRREL CORE ▥ SHELBY TUBE ▮ GRAB CORE

BACKFILL TYPE ▆ BENTONITE ▨ PEA GRAVEL ▥ SLOUGH ▨ GROUT ▧ DRILL CUTTINGS ▨ SAND

Depth (m)	LITHOLOGICAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION AND COMMENTS	Elevation (m)
0	SAND - silty, some gravel, light brown, organics - organic layer 150 mm			- Vx <15%	836.0
	SILT - some sand, trace clay, faint organic smell				
1		▮	G1	- Nbn	835.0
2				- ice lens 100 mm, cloudy, porous	834.0
	SAND (RESIDUUM) - some silt, some gravel, gravel <20 mm	▮	G2	- Vx <50%	
3					833.0
4		▮	G3		832.0
5	BEDROCK				831.0
6					830.0
7					829.0
8	END OF BOREHOLE @ 8.23 m				828.0
9					827.0
10					



EBA Engineering Consultants Ltd.

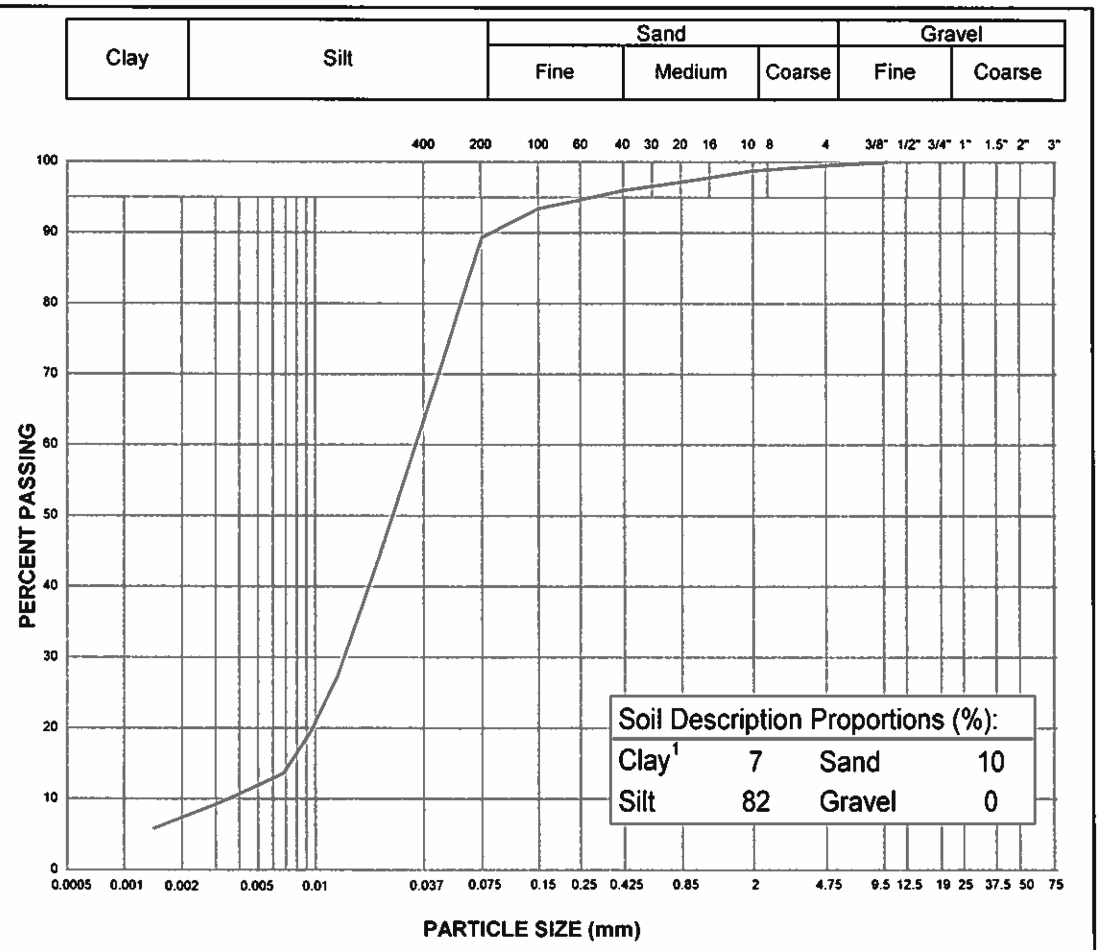
LOGGED BY: AT & SMC	COMPLETION DEPTH: 8.23m
REVIEWED BY: JGD	COMPLETE: 1/18/2011
DRAWING NO:	Page 1 of 1

PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422, C136 & C117

Project:	Winter 2011 Geotechnical Drilling	Sample No.:	G1
Project No.:	W14101068.033	Material Type:	
Site:	Minto Mine, YT	Sample Loc.:	11-G04
Client:	Minto Explorations Ltd.	Sample Depth:	1.0 - 1.5 m
Client Rep.:		Sampling Method:	Core Grab
Date Tested:	January 27, 2011 By: SMS/PE	Date sampled:	January 18, 2011
Soil Description[2]:	SILT - trace sand, trace clay	Sampled By:	AT/SC
		USC Classification:	Cu:
Moisture Content:	83.8%		Cc:

Particle Size (mm)	Percent Passing
75	
50	
38	
25	
19	
12.5	
10	100
5	100
2	99
0.85	97
0.425	96
0.25	95
0.15	93
0.075	89
0.0325	58.7
0.0216	44.0
0.0131	27.4
0.0095	19.6
0.0069	13.7
0.0033	9.8
0.0014	5.9



Soil Description Proportions (%):

Clay[1]	7	Sand	10
Silt	82	Gravel	0

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is based on the results of grain size testing

Specification: ________________

Remarks: ________________

Reviewed By: ________________

eba
A TETRA TECH COMPANY

MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

Decommissioning and Reclamation Plan

Appendix C

Closure Cost Estimates, Year 0, Year 2 and End of Mine Life

MINTO MINE CLOSURE COSTING

Table 8.1-1

Minto Mine Closure Unit Rates

Equipment Rates		
Equipment	**Rates/hr**	**Rate/mo**
D9H Dozer	$268	
Haul Truck D250E	$227	
Tandem Haul Truck	$155	
Cat 235 Excavator	$247	
Cat 235 Excavator w hammer	$283	
Cat 16H grader	$227	
988B Loader	$258	
Tractor Trailer (lowbed)	$134	
30 ton Crane	$165	
Hiab Flatdeck truck	$129	
Cat 950 loader	$129	
Vibratory Roller	$120	
Pickup Truck		$2,500
Personnel Rates		
Personnel	**Rates/hr**	**Rate/mo**
Blaster	$62	
General Labourer	$47	
Trades Labourer	$83	
Site Supervisor	$99	
Design Engineer	$135	
Environmental Scientist	$99	
Project Manager		$9,700
Camp Labourer		$4,000
Site Caretaker		$6,100
Environmental Monitor		$5,000
Revegetation Rates		
Revegetation Seed Mix	$13.00	per kg
Revegetation Seed Mix - 50kg/ha	$510.00	per ha
Fertilizer	$1.00	per kg
Fertilizer - 250kg/ha	$250.00	per ha
Tree Seedlings (1,000 seedlings per ha)	$1,750.00	per ha
Seed/Fertilizer Application	$1,500.00	per ha
Erosion Barrier	$3.00	per square m
Revegetation cost per ha. Including application cost	**$2,400.00**	**per ha**
Contractor Unit Rates & Camp Costs		
Load, Haul and place soil cover MWD	$5.08	cu.m
Load, Haul and place soil cover SWD	$3.85	cu.m
Load, Haul & Place rock cover	$6.42	cu.m
Custom Rate A (Load, haul and place from IROD - MWD / LGO)	$5.08	cu.m
Custom Rate B (Load, haul and place IROD - HGO/MainWater Dam)	$5.99	cu.m
Custom Rate C (Load, haul and place IROD - CSA)	$5.05	cu.m
Custom Rate D (Push from TFOD - TF)	$2.15	cu.m
Custom Rate E (Push from MWD - U/S MWD)	$2.15	cu.m
Unit Basis (footing burial)	$5.00	each
Load and Haul Rip Rap	$12.50	cu.m
Place Riprap	$12.50	cu.m
Freight run to Whitehorse	$1,000.00	per load
Camp Cost	$70.00	per day per person
Power and Heat	$5,500.00	per month
Employee Transport Costs	$3,000.00	per month
Barge Operating Cost	$10,000.00	per month

Note:
Custom Unit Rates have been developed specifically for Minto Mine, taking into account such factors as haul distance, grade, machinery required, time required, etc.

MINTO MINE CLOSURE COSTING

Table 8.1-2

Minto Mine Closure Unit Rates for Current Year

Equipment Rates		
Equipment	**Rates/hr**	**Rate/mo**
D9H Dozer	$260	
Haul Truck D250E	$220	
Tandem Haul Truck	$150	
Cat 235 Excavator	$240	
Cat 235 Excavator w hammer	$275	
Cat 16H grader	$220	
988B Loader	$250	
Tractor Trailer (lowbed)	$130	
30 ton Crane	$160	
Hiab Flatdeck truck	$125	
Cat 950 loader	$125	
Pickup Truck		$2,500
Personnel Rates		
Personnel	**Rates/hr**	**Rate/mo**
Blaster	$62	
General Labourer	$47	
Trades Labourer	$83	
Site Supervisor	$99	
Design Engineer	$135	
Environmental Scientist	$99	
Project Manager		$9,700
Camp Labourer		$4,000
Site Caretaker		$6,100
Environmental Monitor		$5,000
Revegetation Rates		
Revegetation Seed Mix	$13.00	per kg
Revegetation Seed Mix - 50kg/ha	$510.00	per ha
Fertilizer	$1.00	per kg
Fertilizer - 250kg/ha	$250.00	per ha
Tree Seedlings (1,000 seedlings per ha)	$1,750.00	per ha
Seed/Fertilizer Application	$1,500.00	per ha
Erosion Barrier	$3.00	per square m
Revegetation cost per ha. Including application cost	**$2,400.00**	**per ha**
Contractor Unit Rates & Camp Costs		
Load, Haul and place soil cover MWD	$5.08	cu.m
Load, Haul and place soil cover SWD	$3.85	cu.m
Load, Haul & Place rock cover	$6.42	cu.m
Custom Rate A (Load, haul and place from IROD - MWD / LGO)	$5.08	cu.m
Custom Rate B (Load, haul and place IROD - HGO/MainWater Dam)	$5.99	cu.m
Custom Rate C (Load, haul and place IROD - CSA)	$5.05	cu.m
Custom Rate D (Push from TFOD - TF)	$2.15	cu.m
Custom Rate E (Push from MWD - U/S MWD)	$2.15	cu.m
Unit Basis (footing burial)	$5.00	each
Load and Haul Rip Rap	$12.50	cu.m
Place Riprap	$12.50	cu.m
Freight run to Whitehorse	$1,000.00	per load
Camp Cost	$70.00	per day per person
Power and Heat	$5,500.00	per month
Employee Transport Costs	$3,000.00	per month
Barge Operating Cost	$10,000.00	per month

Note:
Custom Unit Rates have been developed specifically for Minto Mine, taking into account such factors as haul distance, grade, machinery required, time required, etc.

MINTO MINE CLOSURE COSTING

Table 8.1-2a

Summary Table of Estimated Closure Costs - 2011 (Year 0)

Table #	Description	Total Cost
3	**Overburden & Waste Rock Dumps**	$2,671,163
4	**Open Pit and Haul Roads**	$326,279
5	**Tailings Area and Diversion Structures**	$1,511,945
6	**Main Water Dam**	$542,172
7	**Mill and Ancillary Facilities**	$643,531
8	**Mill Pond**	$174,414
9	**Main Access Road**	
	Scenario 1 - No Access Road Deactivation	$2,140
	Scenario 2 - Deactivate Access Road from Minto Creek to Mine Site	$127,812
	Scenario 3 - Deactivate Entire Access Road	$222,772
10	**Miscellaneous Sites and Facilities**	$173,096
11	**Reclamation Research and Revegetation**	
	Scenario 1 - No Access Road Deactivation	$1,048,440
	Scenario 2 - Deactivate Access Road from Minto Creek to Mine Site	$1,053,240
	Scenario 3 - Deactivate Entire Access Road	$1,062,840
12	**Post Closure Site Management**	$3,716,800
13	**Supporting Studies**	$500,000

Closure		
	Scenario 1 - No Access Road Deactivation	**$11,309,981**
	Scenario 2 - Deactivate Access Road from Minto Creek to Mine Site	**$11,440,452**
	Scenario 3 - Deactivate Entire Access Road	**$11,545,013**

Total Closure Costs (Including Percentage Contingency Allowance on Above Elements)		**12%**
	Scenario 1 - No Access Road Deactivation	**$12,667,179**
	Scenario 2 - Deactivate Access Road from Minto Creek to Mine Site	**$12,813,307**
	Scenario 3 - Deactivate Entire Access Road	**$12,930,414**

Table 8.1-3a

Waste Rock and Overburden Dumps, Estimated Closure Costs - 2011 (Year 0)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	WASTE ROCK AND OVERBURDEN DUMPS						
3.1	**Main Waste Dump (s 5.1.1.2)**						
	Roll crest and recontour	D9H Dozer	hrs	300	$260	$78,000	$78,000
	Haul and place overburden for revegetation	Load, Haul and place soil cover MWD	cu.m.	176000	$5.08	$894,080	$894,080
	Project Management & Engineering	7% of Total Cost	%		7.00%	$68,046	$68,046
	Sub-Total						**$1,040,126**
3.2	**Southwest Dump (s 5.1.1.2)**						
	Roll crest and recontour	D9H Dozer	hrs	168	$260	$43,680	$43,680
	Haul and place overburden for revegetation	Load, Haul and place soil cover SWD	cu.m.	295500	$3.85	$1,137,675	$1,137,675
	Project Management & Engineering	7% of Total Cost	%		7.00%	$82,695	$82,695
	Sub-Total						**$1,264,050**
3.3	**Ice-Rich Overburden Dump (s 5.1.2.2)**						
	Roll crest of berm and recontour	D9H Dozer	hrs	16	$260.00	$4,160	$4,160
	Push overburden onto toe of berm (~1ha) for revegetation	Custom Rate D (Push from TFOD - TF)	cu.m.	2500	$2.20	$5,500	$5,500
	Project Management & Engineering	7% of Total Cost	%		7.00%	$291	$291
	TOE BERM FROM WASTE ROCK SEE TEXT						
	Sub-Total						**$9,951**
3.4	**Reclamation Overburden Dump**						
	Blade pad after removal of material during reclamation	Cat 16H grader	hrs	6	$220	$1,320	**$1,320**
3.5	**Low Grade Ore Stockpile and Pad (s 5.1.3.2)**						
	Recontour Stockpile and Pad	D9H Dozer	hrs	39.5	$260	$10,270	$10,270
	Haul and place overburden for revegetation	Custom Rate A (Load, haul and place from IROD - MWD / LGO)	cu.m.	16250	$5.08	$82,550	$82,550
	Removal of bottom layer of material, move to pit.	Unit basis)				$5,000	$5,000
	Project Management & Engineering	7% of Total Cost	%		7.00%	$6,497	$6,497
	Sub-Total						**$104,317**
3.6	**High Grade Ore Stockpile Pad (s 5.1.3.2)**						
	Recontour stockpile and pad	D9H Dozer	hrs	54	$260.00	$14,040	$14,040
	Haul and place overburden for revegetation	Custom Rate B (Load, haul and place IROD - HGO/MainWater Dam)	cu.m.	23000	$5.99	$137,770	$137,770
	Removal of bottom layer of material, move to pit.	Unit basis				$7,500	$7,500
	Project Management & Engineering	7% of Total Cost			7.00%	$10,627	$10,627
	Sub-Total						**$169,937**
3.7	**Contractor's Shop and Work Area (s 5.1.4.2)**						
	Remove salvageable equipment	General Labourer	hrs	60	$47	$2,808	
		Haul Truck D250E	hrs	20	$220	$4,400	
		Trades Labourer	hrs	48	$83	$3,994	$11,202
	Dismantle buildings	General Labourer	hrs	60	$47	$2,808	
		30 ton Crane	hrs	10	$160	$1,600	
		Cat 235 Excavator	hrs	30	$240	$7,200	$11,608
	Haul building pieces off site - equipment	Tractor Trailer (lowbed)	hrs	20	$130	$2,600	$2,600
	Scrap haul to site landfill	Haul Truck D250E	hrs	20	$220	$4,400	$4,400
	Bury footings - haul and place fill, locally sourced	Unit basis (footing burial)	each	2500	$5	$12,500	$12,500
	Recontour	D9H Dozer	hrs	15	$260	$3,900	$3,900
	Haul and place overburden for revegetation	Custom Rate C (Load, haul and place IROD - CSA)	cu.m.	5000	$5	$25,250	$25,250
	Project Management & Engineering	7% of Total Cost	%		7.00%	$5,002	$5,002
	Sub-Total						**$76,462**
3.8	**Contaminated Soils - Transport to LTF**	Unit basis		5000		$5,000	**$5,000**
Total Estimated Cost in Reclaiming Overburden and Waste Rock Dumps							**$2,671,163**

Note:

MINTO MINE CLOSURE COSTING

Table 8.1-4a
Open Pit and Haul Roads, Estimated Closure Costs - 2011 (Year 0)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	OPEN PIT AND HAUL ROADS						
4.1	**Ultimate Pit (s 5.2.1.2)**						
	Remove pit pumps and pipe column/general cleanup	General Labourer	hrs	80	$47	$3,744	
		Trades Labourer	hrs	20	$83	$1,664	
		Support equipment	l.s.		$1,000	$1,000	$6,408
	Secure pit access - boulder placement	Cat 235 Excavator	hrs	20	$240	$4,800	
		Haul Truck D250E	hrs	20	$220	$4,400	$9,200
	Highwall perimeter safety berm/trench (~1km)	Cat 235 Excavator	hrs	40	$240	$9,600	$9,600
	Construct exit channel into Mill Pond system	Cat 235 Excavator	hrs	20	$240	$4,800	
	Riprap shoulder exiting pit	Place Riprap	cu.m	50	$13	$625	
	Exit Spillway construction	General Labourer	hrs	10	$47	$468	
		Load and Haul Rip Rap	cu.m	50	$13	$625	$6,518
	Construct Passive Treatment System						
	Organic carbon source (to site or chipped at site)	Haulage and handling	l.s.		$75,000	$75,000	
	Clean (< 0.1% Cu) Waste Rock for Construction	Haulage and handling	l.s.		$25,000	$25,000	
	Construction of treatment area	Cat 235 Excavator	hrs	160	$240	$38,400	
		Haul Truck D250E	hrs	160	$220	$35,200	
		General Labourer	hrs	200	$48	$9,600	$183,200
	Project Management & Engineering	7% of Total Cost	%		7.00%	$15,045	$15,045
	Sub-Total						**$229,971**
4.2	**Haul Roads (s 5.2.2.2) (13 ha)**						
	Remove culverts and haul away	General Labourer	hrs	40	$47	$1,872	
		Cat 235 Excavator	hrs	20	$240	$4,800	
		Haul Truck D250E	hrs	20	$220	$4,400	$11,072
	Recontour slopes	D9H Dozer	hrs	150	$260	$39,000	$39,000
	Scarify surfaces	Cat 16H grader	hrs	150	$220	$33,000	
		General Labourer	hrs	20	$47	$936	$33,936
	Stabilize slopes - erosion barriers - material	Unit Cost Basis	sq.m	2,000	$3	$6,000	$6,000
	Project Management & Engineering	7% of Total Cost	%		7.00%	$6,301	$6,301
	Sub-Total						**$96,309**
Total Estimated Cost in Reclaiming Open Pit and Haul Roads							**$326,279**

Note:
Linear disturbances to be scarified / decompacted and allowed to naturally revegetate

MINTO MINE CLOSURE COSTING

Table 8.1-5a

Tailings Area and Diversion Structures, Estimated Closure Costs - 2011 (Year 0)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	TAILINGS AREA						
5.1	**Tailings Deposit - Final Lift**						
	Roll crest of starter bench and recontour	D9H Dozer	hrs	50	$260.00	$13,000	$13,000
	Haul overburden ROD - DSTF	Custom Haul Rate	cu.m	191200	$5.80	$1,108,960	$1,108,960
	Project Management & Engineering	7% of Total Cost	%		7.00%	$78,537	$78,537
	Sub-Total						**$1,200,497**
5.2	**South Diversion Ditch**						
	Widen south diversion ditch	D9H Dozer	hrs	50	$260	$13,000	$13,000
		Cat 235 Excavator	hrs	20	$240	$4,800	
	Haul and place riprap	Load and Haul Rip Rap	cu.m	2400	$13	$30,000	
		Place Riprap	cu.m	2400	$13	$30,000	$60,000
	HDPE liner	Unit rate	sq.m	4800	$10	$48,000	$48,000
		General Labourer	hrs	80	$47	$3,744	$3,744
	Project Management & Engineering	7% of Total Cost	%		7.00%	$8,806	$8,806
	Sub-Total						**$133,550**
5.3	**Surface Drainage Channel (~750m length)**						
	Construct channel atop covered facility	Misc.	l.s.		$37,500	$37,500	$37,500
	Engineering design for channel	Misc.	l.s.		$5,000	$5,000	$5,000
	Line channel with liner and armoring	Produce Rip Rap	cu.m	2400	$13	$31,200	
		Load, haul & place riprap	cu.m	2400	$13	$31,200	
		HDPE liner	sq.m	3600	$10	$36,000	
		Bedding-Filter zones	cu.m	3600	$6	$21,600	
		General Labourer	hrs	80	$47	$3,760	$123,760
	Project Management & Engineering	7% of Total Cost	%		7.00%	$11,638	$11,638
	Sub-Total						**$177,898**
Total Estimated Cost in Reclaiming Tailings Area							**$1,511,945**

Note:

MINTO MINE CLOSURE COSTING

Table 8.1-6a
Main Water Dam, Estimated Closure Costs - 2011 (Year 0)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	WATER DAM						
6.1	**Reclaim System**						
	Remove salvageable equipment - pipeline/pumps	General Labourer	hrs	48	$47	$2,246	
		Trades Labourer	hrs	98	$83	$8,154	$10,400
	Remove pipeline	Haul Truck D250E	hrs	100	$220	$22,000	
		Cat 235 Excavator	hrs	100	$240	$24,000	
		General Labourer	hrs	200	$47	$9,360	$55,360
	Dismantle Building	Cat 235 Excavator	hrs	16	$240	$3,840	
		Trades Labourer	hrs	10	$83	$832	
		General Labourer	hrs	20	$47	$940	$5,612
	Misc. Supplies & Tools	Misc.	l.s.		$1,000	$1,000	$1,000
	Recontour alignment	D9H Dozer	hrs	16	$260	$4,160	$4,160
	Project Management & Engineering	7% of Total Cost	%		7.00%	$5,357	$5,357
	Sub-Total						**$81,889**
6.2	**Main Dam**						
	Pump down impounded water, over spillway (using reclaim pumps)	General Labourer	hrs	96	$47	$4,493	$4,493
	Misc. Supplies & Tools	Misc.	l.s.	1	$5,000	$5,000	$5,000
	Build coffer dam and install pump-around system Operate system until new structure is ready	Misc.	l.s.	1	$10,000	$10,000	$10,000
	Engineering design for final structure include appropriate flow determination, channel designs, etc.	Misc.	l.s.	1	$20,000	$20,000	$20,000
	Stockpile rip rap from downstream shell	Unit Cost Basis	cu.m	10,000	$10	$100,000	$100,000
	Breach Dam: push material using dozer into new areas	Custom Rate E (Push from MWD - U/S MWD)	cu.m	25,000	$2	$53,750	
	and load, haul & dump and contour material in new area	Unit Cost Basis	cu.m	31,000	$4.50	$139,500	
		Environmental Scientist	hrs	60	$98.80	$5,928	$199,178
	Construct stream channel at original grade - haul and place rip rap	Unit Cost Basis	cu.m	1,125	$3	$3,375	
		Unit Cost Basis	cu.m	1,125	$9	$10,125	$13,500
	Haul and place overburden on slopes of new area u/s of MWD	Unit Cost Basis	cu.m	15,000	$2	$30,000	$30,000
	Stabilize slopes with erosion barriers	Unit Rates	per sq. m	15,000	$3	$45,000	$45,000
	Misc. Supplies & Tools	Misc.	l.s.		$3,000	$3,000	$3,000
	Project Management & Engineering	7% of Total Cost	%		7.00%	$30,112	$30,112
	Sub-Total						**$460,283**
Total Estimated Cost in Reclaiming Water Dam							**$542,172**

MINTO MINE CLOSURE COSTING

Table 8.1-7a

Mill & Ancillary Facilities, Estimated Closure Costs - 2011 (Year 0)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	MILL AND ANCILLARY FACILITIES						
7.1	**Mill Building**						
	Remove salvageable equipment	General Labourer	hrs	550	$47	$25,740	
		Trades Labourer	hrs	600	$83	$49,920	
		Crane Support	hrs	40	$145	$5,800	$81,460
	Decontaminate Building-hosing and clean-up	Trades Labourer	hrs	160	$83	$13,312	$13,312
	Dismantle Building	General Labourer	hrs	1000	$47	$46,800	
		Trades Labourer	hrs	600	$83	$49,920	
		Cat 235 Excavator w hammer	hrs	120	$275	$33,000	
		Crane Support	hrs	60	$145	$8,700	$138,420
	Concrete Demolition	Blaster	hrs	40	$62	$2,496	
		Cat 235 Excavator	hrs	20	$240	$4,800	
		D9H Dozer	hrs	20	$260	$5,200	$12,496
	Misc. Supplies & Tools	Misc.	l.s.		$11,000	$11,000	$11,000
	Scrap haul to solid waste facility	Cat 235 Excavator	hrs	50	$240	$12,000	
		Haul Truck D250E	hrs	100	$220	$22,000	$34,000
	Project Management & Engineering	7% of Total Cost	%		7.00%	$20,348	$20,348
	Subtotal:						**$311,036**
		Subtract 50% for Salvage Value					**$155,518**
7.2	**Generator & Filter Buildings & Concentrate Shed**						
	Remove salvageable equipment	General Labourer	hrs	240	$47	$11,232	
		Trades Labourer	hrs	240	$83	$19,968	$31,200
		Crane Support	hrs	24	$145	$3,480	
	Salvage and remove powerline and poles		l.s.		$27,500	$27,500	$30,980
	Dismantle Buildings	General Labourer	hrs	160	$47	$7,488	
		Trades Labourer	hrs	80	$83	$6,656	
		Cat 235 Excavator w hammer	hrs	40	$275	$11,000	
		Crane Support	hrs	30	$145	$4,350	$29,494
	Concrete Demolition	Blaster	hrs	40	$62	$2,496	
		Cat 235 Excavator	hrs	20	$240	$4,800	
		D9H Dozer	hrs	20	$260	$5,200	$12,496
	Misc. Supplies & Tools	Misc.	l.s.		$10,000	$10,000	$10,000
	Scrap haul to solid waste facility	Cat 235 Excavator	hrs	10	$240	$2,400	
		Haul Truck D250E	hrs	20	$220	$4,400	$6,800
	Project Management & Engineering	7% of Total Cost	%		7.00%	$8,468	$8,468
	Subtotal:						**$129,438**
		Subtract 50% for Salvage Value					**$64,719**
7.3	**Fuel Storage Area**						
	Cleanout tanks-remove sludge, pressure wash	General Labourer	hrs	60	$47	$2,808	
		Removal to Licensed facility	l.s.		$10,000	$10,000	$12,808
	Remove bulk fuel storage and piping facilities	General Labourer	hrs	100	$47	$4,680	
		Trades Labourer	hrs	120	$83	$9,984	
		Crane Support	hrs	30	$145	$4,350	
		Support Equipment	l.s.		$2,500	$2,500	
		Cat 235 Excavator	hrs	40	$240	$9,600	
		General Labourer	hrs	40	$47	$1,872	
		Tractor Trailer (lowbed)	hrs	30	$130	$3,900	$36,886
	Fold and Bury Liner	Cat 235 Excavator	hrs	20	$240	$4,800	
		D9H Dozer	hrs	100	$260	$26,000	$30,800
	Project Management & Engineering	7% of Total Cost	%		7.00%	$5,635	$5,635
	Subtotal:						**$86,129**
7.4	**Mill Reagents**						
	Load and return extra reagents/chemicals	General Labourer	hrs	100	$47	$4,680	
		Support Equipment	l.s.		$2,500	$2,500	
		Disposal Cost-bulk materials	l.s.		$5,000	$5,000	
		Disposal Cost-lab-pacs	pallets	2	$2,000	$4,000	$16,180
	Removal of drums, steel, oils, glycol & batteries, as per 09July quote from General Waste Management to MEL	Contractor quote	l.s.		$50,900	$50,900	$50,900
	Project Management & Engineering	7% of Total Cost	%		7.00%	$1,133	$1,133
	Subtotal:						**$68,213**
7.5	**Reclaim Entire Mill Site Area**						
	Test soils for contamination	Environmental Scientist	hrs	35	$99	$3,458	
		Analytical Costs	l.s.		$6,000	$6,000	$9,458
	Haul any contaminated soils to Land Treatment Facility	Cat 235 Excavator	hrs	15	$240	$3,600	
		Haul Truck D250E	hrs	15	$220	$3,300	$6,900
	Re-contour area and slopes to bury footings and establish drainage	D9H Dozer	hrs	100	$260	$26,000	$26,000
	Haul and place overburden cap	Unit Rate	cu.m	38000	$5.50	$209,000	$209,000
	Project Management & Engineering	7% of Total Cost	%		7.00%	$17,595	$17,595
	Subtotal:						**$268,953**
Total Estimated Cost in Reclaiming Mill and Ancillary Facilities							**$643,531**

MINTO MINE CLOSURE COSTING

Table 8.1-8a

Mill Water Pond, Estimated Closure Costs - 2011 (Year 0)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	MILL POND						
8.1	**Reclaim Mill Pond**						
	Remove upstream culvert	General Labourer	hrs	10	$47	$468	
		Cat 235 Excavator	hrs	10	$240	$2,400	$2,868
	Construct channel	Cat 235 Excavator	hrs	100	$240	$24,000	
		D9H Dozer	hrs	20	$260	$5,200	$29,200
		Produce rip rap	cu.m	5,000	$13	$65,000	$65,000
		Load,haul & place riprap	cu.m	5,000	$13	$65,000	$65,000
		General Labourer	hrs	20	$47	$936	$936
	Project Management & Engineering	7% of Total Cost	%		7.00%	$11,410	$11,410
	Subtotal:						**$174,414**
Total Estimated Cost in Reclaiming Mill Pond							**$174,414**

MINTO MINE CLOSURE COSTING

Table 8.1-9a

Main Access Road, Estimated Closure Costs - 2011 (Year 0)

Scenario 1 - No Road Deactivation

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
9.1	**NO ROAD DECOMMISSIONING REQUIRED**						
9.1.1	**Road Surface**						
	Install road barrier at west side of Minto Creek	Misc	l.s.		$2,000	$2,000	$2,000
	Project Management & Engineering	7% of Total Cost	%		7.00%	$140	$140
	Subtotal:						
Total Estimated Cost for Access Road Closure (Scenario 1)							**$2,140**

Scenario 2 - Decommission Access Road From Minto Creek to Mine Site (11 KM)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
9.2	**ACCESS ROAD - 11 KM SECTION**						
9.2.1	**Road Surface**						
	Scarify - 11 km	Cat 16H grader	hrs	70	$220	$15,400	$15,400
	Recontour slopes and drainages	Cat 235 Excavator	hrs	25	$240	$6,000	$6,000
	Project Management & Engineering	7% of Total Cost	%		7.00%	$1,498	$1,498
	Subtotal:						**$22,898**
9.2.2	**Culverts**						
	Culvert excavation (40 small culverts)	Cat 235 Excavator	hrs	100	$240	$24,000	$24,000
	Culvert removal	General Labourer	hrs	140	$47	$6,552	
		Haul Truck D250E	hrs	100	$220	$22,000	$28,552
	Minto Creek Culvert Removal & Streambank Restoration	Trades Labourer	hrs	40	$83	$3,328	
		General Labourer	hrs	75	$47	$3,510	
		Cat 235 Excavator	hrs	40	$240	$9,600	$16,438
	Recontour slopes and drainage	D9H Dozer	hrs	70	$260	$18,200	$18,200
	Stabilize slopes	General Labourer	hrs	200	$47	$9,360	
	Erosion barriers	Unit Cost Basis	per sq. m	500	$3	$1,500	$10,860
	Project Management & Engineering	7% of Total Cost	%		7.00%	$6,864	$6,864
	Subtotal:						**$104,914**
Total Estimated Cost for Access Road Closure (Scenario 2)							**$127,812**

Scenario 3 - Decommission Entire Access Road (27 KM)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
9.3	**ACCESS ROAD - 27 KM SECTION**						
9.3.1	**Road Surface**						
	Scarify - 27 km	Cat 16H grader	hrs	150	$220	$33,000	$33,000
	Recontour slopes and drainage	D9H Dozer	hrs	50	$260	$13,000	$13,000
	Project Management & Engineering	7% of Total Cost	%		7.00%	$3,220	$3,220
	Subtotal:						**$49,220**
9.3.2	**Big Creek Bridge**						
	Remove bridge decking and span	General Labourer	hrs	50	$47	$2,340	
		Crane	hrs	40	$145	$5,800	
		Cat 235 Excavator	hrs	40	$240	$9,600	
		Tractor Trailer (lowbed)	hrs	20	$130	$2,600	$20,340
	Cut off piles	General Labourer	hrs	50	$47	$2,340	$2,340
	Re-contour	Cat 235 Excavator	hrs	30	$240	$7,200	
		D9H Dozer	hrs	30	$260	$7,800	$15,000
	Project Management & Engineering	7% of Total Cost	%		7.00%	$2,638	$2,638
	Subtotal:						**$40,318**
9.3.3	**Barge Ramps**						
	Remove all gravel	Cat 235 Excavator	hrs	20	$240	$4,800	$4,800
	Re-countour areas and scarify	D9H Dozer	hrs	30	$260	$7,800	$7,800
	Shoreline restoration	Misc.	l.s.		$5,000	$5,000	$5,000
	Project Management & Engineering	7% of Total Cost	%		7.00%	$1,232	$1,232
	Subtotal:						**$18,832**
9.3.4	**Culverts**						
	Culvert excavation (45 small culverts)	Cat 235 Excavator	hrs	115	$240	$27,600	$27,600
	Culvert removal	General Labourer	hrs	150	$47	$7,020	
		Haul Truck D250E	hrs	115	$220	$25,300	$32,320
	Minto Creek Culvert Removal & Streambank Restoration	Trades Labourer	hrs	40	$83	$3,328	
		General Labourer	hrs	75	$47	$3,510	
		Cat 235 Excavator	hrs	40	$240	$9,600	$16,438
	Recontour slopes and drainage	D9H Dozer	hrs	70	$260	$18,200	$18,200
	Stabilize slopes	General Labourer	hrs	200	$47	$9,360	
	Erosion barriers	Unit Cost Basis	per sq. m.	1,000	$3	$3,000	$12,360
	Project Management & Engineering	7% of Total Cost	%		7.00%	$7,484	$7,484
	Subtotal:						**$114,402**
Total Estimated Cost for Access Road Closure (Scenario 3)							**$222,772**

MINTO MINE CLOSURE COSTING

Table 8.1-10a

Miscellaneous Sites and Facilities, Estimated Closure Costs - 2011 (Year 0)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	MISCELLANEOUS SITES AND FACILITIES						
10.1	**Airstrip**						
	Scarify airstrip and adjacent laydown areas	Cat 16H Grader	hrs	40	$220	$8,800	$8,800
	Project Management & Engineering	7% of Total Cost	%		7.00%	$616	$616
	Natural revegetation	n/a	n/a				
	Subtotal:						**$9,416**
10.2	**Mine Camp and Related Infrastructure**						
	Disconnect Services	Trades Labourer	hrs	80	$83	$6,656	$6,656
	Remove salvageable equipment	General Labourer	hrs	704	$47	$32,947	$32,947
	Dismantle buildings	General Labourer	hrs	1200	$47	$56,160	
		Cat 235 Excavator	hrs	120	$240	$28,800	$84,960
	Haul scrap to Solid Waste Facility	Haul Truck D250E	hrs	20	$220	$4,400	
		Cat 235 Excavator	hrs	10	$240	$2,400	$6,800
	Reclaim Septic System	General Labourer	hrs	10	$47	$468	
		Cat 235 Excavator	hrs	2	$240	$480	$948
	Site Clean-Up	General Labourer	hrs	500	$47	$23,400	$23,400
	Project Management & Engineering	7% of Total Cost	%		7.00%	$10,434	$10,434
	Subtotal:						**$83,073**
10.3	**Explosives Plant Site**						
	Remove salvageable equipment	General Labourer	hrs	100	$47	$4,680	
		Trades Labourer	hrs	50	$83	$4,160	$8,840
	Dismantle buildings	General Labourer	hrs	200	$47	$9,360	
		Cat 235 Excavator	hrs	30	$240	$7,200	$16,560
	Disconnect Services	Trades Labourer	hrs	20	$83	$1,664	$8,864
	Crane services	30 ton Crane	hrs	5	$160	$800	$2,464
	Haul scrap to Solid Waste Facility	Haul Truck D250E	hrs	30	$220	$6,600	
		Cat 235 Excavator	hrs	10	$240	$2,400	$9,000
	Project Management & Engineering	7% of Total Cost	%		7.00%	$2,580	$2,580
	Subtotal:						**$24,154**
10.4	**Exploration Sites and Trails**						
	Natural revegetation	n/a	n/a				
	Subtotal:						**$0**
10.5	**Land Treatment Facility**						
	Prepare and submit closure plan	Misc	l.s.		$2,000	$2,000	$2,000
	Characterize final soil hydrocarbon concentrations	Misc	l.s.		$3,000	$3,000	$3,000
	Recontour	D9H Dozer	hrs	2	$260	$520	$520
	Haul and place overburden cap from nearby	Cat 235 Excavator	hrs	20	$240	$4,800	
		Haul Truck D250E	hrs	20	$220	$4,400	
		D9H Dozer	hrs	6	$260	$1,560	$10,760
	Project Management & Engineering	7% of Total Cost	%		7.00%	$1,140	$1,140
	Subtotal:						**$17,420**
10.6	**Solid Waste Facility**						
	Prepare detailed closure plan	Misc	l.s.		$2,000	$2,000	$2,000
	Characterize final waste area	Misc	l.s.		$2,000	$2,000	$2,000
	Remove recyclables and special waste materials	Tractor Trailer (lowbed)	hrs	40	$130	$5,200	$5,200
	Recontour	D9H Dozer	hrs	2	$260	$520	$520
	Haul and cover with adjacent fill and place overburden cap	Cat 235 Excavator	hrs	20	$240	$4,800	
		Haul Truck D250E	hrs	20	$220	$4,400	
	Compaction of cover	D9H Dozer	hrs	6	$260	$1,560	$10,760
	Project Management & Engineering	7% of Total Cost	%		7.00%	$1,434	$1,434
	Subtotal:						**$21,914**
10.7	**Site Roads**						
	Recontour	Cat 235 Excavator	hrs	30	$240	$7,200	$7,200
	Scarify	Cat 16H Grader	hrs	40	$220	$8,800	$8,800
	Project Management & Engineering	7% of Total Cost	%		7.00%	$1,120	$1,120
	Subtotal:						**$17,120**
Total Estimated Cost in Reclaiming Miscellaneous Sites and Facilities							**$173,096**

Note:
Land treatment facility is a licensed facility and will be reclaimed as per license terms and conditions

Table 8.1-11a

Reclamation Research and Revegetation, Estimated Closure Costs - 2011 (Year 0)

Item No.	Work Item Description	Units	Quantity	Unit Rates	Cost	Total Adjusted
11.1	**REVEGETATION ACTIVITIES**					
11.1.0	**Determination of Revegetation Plan for Current Site**					
	Issuance of a plan for all site areas for regulatory review and approval	Misc	1		$20,000	$20,000
	Sub-Total					**$20,000**
11.1.1	**Main and Southwest Dumps (total surface area of 94.3 ha)**					
	Seed and fertilize w/ labour	ha	94.3	$2,400	$226,320	
	Re-seed and fertilize (1/2 of total area)	ha	47.2	$2,400	$113,160	
	Re-forest	ha	94.3	$1,750	$165,025	$504,505
	Sub-Total					**$504,505**
11.1.2	**Ice-Rich Overburden Dump (toe berm surface area of 6.9ha)**					
	Seed and fertilize w/ labour	ha	6.9	$2,400	$16,560	
	Re-seed and fertilize (1/2 of total area)	ha	3.5	$2,400	$8,280	
	Re-forest	ha	6.9	$1,750	$12,075	$36,915
	Sub-Total					**$36,915**
11.1.3	**Reclamation Overburden Dump (total surface area of 5.5 ha)**					
	Seed and fertilize w/ labour	ha	5.5	$2,400	$13,200	
	Re-seed and fertilize (1/2 of total area)	ha	2.8	$2,400	$6,600	
	Re-forest	ha	5.5	$1,750	$9,625	$29,425
	Sub-Total					**$29,425**
11.1.4	**Ore Stockpiles and Pads (final total surface area of 15.7 ha)**					
	Seed and fertilize w/ labour	ha	15.7	$2,400	$37,680	
	Re-seed and fertilize (1/2 of total area)	ha	7.9	$2,400	$18,840	
	Re-forest	ha	15.7	$1,750	$27,475	$83,995
	Sub-Total					**$83,995**
11.1.5	**Contractor's Shop and Office Area (disturbed area of 2.5 ha)**					
	Seed and fertilize w/ labour	ha	2.5	$2,400	$6,000	
	Re-seed and fertilize (1/2 of total area)	ha	1.3	$2,400	$3,000	
	Re-fertilize only (1/2 total area - re-seed area)	ha	0.0	$1,900	$0	
	Re-forest	ha	2.5	$1,750	$4,375	$13,375
	Sub-Total					**$13,375**
11.1.6	**Tailings Area current disturbed area of 40.3 ha)**					
	Seed and fertilize w/ labour	ha	40.3	$2,400	$96,720	
	Re-seed and fertilize (1/2 of total area)	ha	20.2	$2,400	$48,360	
	Re-forest	ha	40.3	$1,750	$70,525	$215,605
	Sub-Total					**$215,605**
11.1.7	**Main Water Dam (total dam surface area 3.3 ha)**					
	Seed and fertilize w/ labour	ha	3.3	$2,400	$7,920	
	Re-seed and fertilize (1/2 of total area)	ha	1.7	$2,400	$3,960	
	Re-forest	ha	3.3	$1,750	$5,775	$17,655
	Sub-Total					**$17,655**
11.1.8	**Mill Area (total surface area of 7.6 ha)**					
	Seed and Fertilize w/ labour	ha	7.6	$2,400	$18,240	
	Re-seed and fertilize (1/2 of total area)	ha	3.8	$2,400	$9,120	
	Re-forest	ha	7.6	$1,750	$13,300	$40,660
	Subtotal:					**$40,660**
11.1.9	**Haul Road (total surface area of 13 ha)**					
		ha	13.0	$2,400	$31,200	**$31,200**
11.1.10	**Miscellaneous Sites - Camp, Airstrip, Waste Facilities, Explosives Site (area for reclamation of 10.3 ha)**					
	Seed and fertilize w/ labour	ha	10.3	$2,400	$24,720	
	Re-seed and fertilize (1/2 of total area)	ha	5.2	$2,400	$12,360	
	Re-forest	ha	10.3	$1,750	$18,025	$55,105
	Subtotal:					**$55,105**
11.1.11	**Access Road**					
	Scenario 1 - No Deactivation					
	No revegetation					
	Subtotal:					**$0**
	Scenario 2 - Deactivate from Minto Creek to Mine Site					
	Revegetate and fertilize banks at culvert excavations, including labour	ha	2.0	$2,400	$4,800	$4,800
	Subtotal:					**$4,800**
	Scenario 3 - Deactivate Entire Road					
	Revegetate and fertilize banks at culvert excavations, including labour	ha	6.0	$2,400	$14,400	$14,400
	Subtotal:					**$14,400**
Total Estimated Cost for Reclamation Research and Revegetation						
	Scenario 1 - No Access Road Deactivation					**$1,048,440**
	Scenario 2 - Deactivate Access Road from Minto Creek to Mine Site					**$1,053,240**
	Scenario 3 - Deactivate Entire Access Road					**$1,062,840**

MINTO MINE CLOSURE COSTING

Table 8.1-12a

Site Management and Monitoring, Estimated Closure Costs - 2011 (Year 0)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	SITE MANAGEMENT						
12.1	**Onsite Management**						
	Project Management and Engineering - Included in PME Costs in each Closure Component						
	Pickup truck	Light truck	monthly	50	$2,500	$125,000	$125,000
	Sundry equipment maintenance	Unit Cost Basis	yearly	10	$5,000	$50,000	$50,000
	Power and heat	Unit Cost Basis	monthly	30	$5,500	$165,000	$165,000
	General Administrative expenses	Unit Cost Basis	monthly	50	$2,000	$100,000	$100,000
	Camp Costs (5 year period)	Unit Cost Basis	man-day	5580	$60	$334,800	$334,800
	Subtotal:						**$774,800**
12.2	**Transport Costs**						
	Employee transport costs	Unit Cost Basis	monthly	50	$3,000	$150,000	$150,000
	Barge operating costs	Unit Cost Basis	monthly	20	$10,000	$200,000	$200,000
	Subtotal:						**$350,000**
12.3	**Water Treatment and Compliance Monitoring incl. Reporting**						
	Active - Treatment, operating costs (4 years) incl. staff, reagents		monthly	12	$87,000	$1,044,000	$1,044,000
	Cost per cubic metre of compliant water (0.01 ppm Cu) (4 years)		cu.m	1440000	$0	$576,000	$576,000
	Subtotal:						**$1,620,000**
12. 4	**Water Quality Monitoring (Post Mine Closure) (50:50 sampling labour/analyses costs split)**						
	Years 1-5 (monthly during open season)	Misc.	monthly	30	$4,000	$120,000	
	Years 6-10 (quarterly - spring/summer/fall)	Misc.	quarterly	15	$4,000	$60,000	
	Years 11-15 (once annually - post spring freshet)	Misc.	yearly	5	$4,000	$20,000	$200,000
	Disbursements (non-labour/non-analytical)	Misc.	l.s.	15	$4,000	$60,000	$60,000
	LTF Monitoring and Maintenance (years 1-5)	Misc.	yearly	5	$4,000	$20,000	$20,000
	Enhanced Groundwater/Foundation monitoring below TF and Waste Rock Dumps	Misc.	yearly	15	$6,000	$90,000	$90,000
	Geo-technical Inspections (annually yrs 1-5, bi-annual yrs 6-15)	Misc.	l.s.	10	$6,000	$60,000	$60,000
	Reclamation Inspections (annually yrs 1-5, bi-annual yrs 6-15)	Misc.	l.s.	10	$7,500	$75,000	$75,000
	Biological Monitoring - Closure implementation	Misc.	l.s.		$10,000	$10,000	
	Years 1-5 (Annually)	Misc.	yearly	5	$4,000	$20,000	
	Years 6-10 (Annually)	Misc.	yearly	5	$4,000	$20,000	
	Years 11-15 (Every two years)	Misc.	bi-annual	3	$3,500	$10,500	$60,500
	Subtotal:						**$565,500**
12.5	**Post Closure Maintenance - Main Dam**						
	Monitoring of piezometers, thermistors						
	Years 1-5 (quarterly)	Misc.	quarterly	20	$3,000	$60,000	
	Years 6-10 (bi-annually)	Misc.	bi-annually	8	$3,000	$24,000	
	Years 11-15 (annually)	Misc.	annual	5	$2,500	$12,500	
	Annual Inspection + report	Misc.	annual	15	$3,000	$45,000	
	Carry out inspection recommendations/maintenance	Misc.	annual	15	$10,000	$150,000	$291,500
	Misc. maintenance work related to the site after closure (Yr1-5)	Misc.	yearly	5	$10,000	$50,000	$50,000
	Misc. maintenance work related to the site after closure (Yr6-15)	Misc.	per year	10	$5,000	$50,000	$50,000
	Subtotal:						**$391,500**
12.6	**Ulitmate Removal of wells and instrumentation**	Misc.	unit basis		$15,000		**$15,000**
Total Estimated Cost for Post Closure Site Management							**$3,716,800**

Note:

Camp Costs calculation based on "Table 7-1 Site Decommissioning and Reclamation Seasonal Personnel Requirements" using a 90 day work year

MINTO MINE CLOSURE COSTING

Table 8.1-13a

Supporting Studies - 2011 (Year 0)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
13.1	**Permafrost Foundation Monitoring**						
13.1.1	Enhanced subsurface monitoring program in and below waste rock dumps (WRD)						
	preparing detailed monitoring program	Misc.	l.s.		$8,000	$8,000	
	undertake additional monitoring as per program(covered in T. 12)	Misc.	yearly		$7,000	$7,000	$15,000
	Enhanced Adaptive Management Plan for WRD	Misc.	l.s.	1	$8,000	$8,000	$8,000
13.1.2	Enhanced subsurface monitoring program in and below Tailings Facility (TF)						
	preparing detailed monitoring program	Misc.	l.s.		$4,000	$4,000	
	undertake additional monitoring as per program (covered in T. 12)	Misc.	yearly	1	$3,500	$3,500	$7,500
	Enhanced Adaptive Management Plan for TF	Misc.	l.s.	1	$4,000	$4,000	$4,000
	Sub-Total						**$34,500**
13.2	**Kinetic Tailings Testing**						
13.2.1	Monitoring program and field test to enhance long term water quality prediction related to drystack tailings facility						
	preparing composite sample over several months of production	Misc.	l.s.		$5,000	$2,500	$2,500
	undertaking field test	Misc.	l.s.		$12,000	$6,000	
	initiate parallel laboratory analysis	Misc.	l.s.		$10,000	$5,000	
	monitoring field apparatus (columns)	Misc.	l.s.		$4,000	$2,000	$13,000
	reporting				$5,000	$2,500	$2,500
	Sub-Total						**$18,000**
13.3	**Other Adaptive Management Plans scheduled for Operating Life or Required Only in Early Shutdown**						
	Changes in WTP input water quality or quantity	Misc.	l.s.			$22,500	$22,500
	Sludge Management Plan - for material from WTP	Misc.	l.s.			$15,000	$15,000
	Site Testing ML ARD	Misc.	l.s.			$45,000	$45,000
	Dry Stack Tailings Facility - Confirmation of closure methodology	Misc.	l.s.			$15,000	$15,000
	Long Term Reclamation of Contaminated Soils	Misc.	l.s.			$22,500	$22,500
	Physical Monitoring program prior to closure	Misc.	l.s.			$60,000	$60,000
	Modeling of Pit Lake water quality prior to flooding	Misc.	l.s.			$22,500	$22,500
	Sub-Total						**$202,500**
13.4	**Closure Specific Studies and Field Trials**						
	Main Site Discharge Channel Geotechnical Design and Stability Evaluation	Engineering/Design	l.s.	1	$30,000	$30,000	$30,000
	Stability Assessment of Main Pit South Wall with Flooding of Pit for closure of current site	Engineering/Design	l.s.	1	$50,000	$50,000	$50,000
	Passive Treatment Evaluations	Engineering/Design	l.s.	1	$60,000	$60,000	$60,000
	Engineered Cover Evaluations	Engineering/Design	l.s.	1	$50,000	$50,000	$50,000
	Site contamination surveys (pre $35K, post $20K)		l.s.	1	$55,000	$55,000	$55,000
	Sub-Total						**$245,000**
Total Estimated Cost for Supporting Studies							**$500,000**
Note:							

MINTO MINE CL0SURE COSTING

Table 8-1

Summary Table of Estimated Closure Costs - 2013 (Year 2)

Table #	Description	Total Cost
3	**Overburden & Waste Rock Dumps**	$4,190,059
4	**Open Pit, Underground and Haul Roads**	$780,304
5	**Tailings Area and Diversion Structures**	$1,463,525
6	**Main Water Dam**	$545,252
7	**Mill and Ancillary Facilities**	$657,424
8	**Mill Pond**	$175,482
9	**Main Access Road**	
	Scenario 1 - No Access Road Deactivation	$2,140
	Scenario 2 - Deactivate Access Road from Minto Creek to Mine Site	$131,626
	Scenario 3 - Deactivate Entire Access Road	$227,956
10	**Miscellaneous Sites and Facilities**	$217,332
11	**Reclamation Research and Revegetation**	
	Scenario 1 - No Access Road Deactivation	$1,389,065
	Scenario 2 - Deactivate Access Road from Minto Creek to Mine Site	$1,393,865
	Scenario 3 - Deactivate Entire Access Road	$1,403,465
12	**Post Closure Site Management**	$3,750,280
13	**Supporting Studies**	$468,000
Total Closure Costs		
	Scenario 1 - No Access Road Deactivation	**$13,638,864**
	Scenario 2 - Deactivate Access Road from Minto Creek to Mine Site	**$13,773,150**
	Scenario 3 - Deactivate Entire Access Road	**$13,879,080**
Total Closure Costs (Including Percentage Contingency Allowance on Above Elements)		**12%**
	Scenario 1 - No Access Road Deactivation	**$15,275,527**
	Scenario 2 - Deactivate Access Road from Minto Creek to Mine Site	**$15,425,928**
	Scenario 3 - Deactivate Entire Access Road	**$15,544,570**

MINTO MINE CLOSURE COSTING

Table 8-2

Minto Mine Closure Unit Rates for Current Year

Equipment Rates		
Equipment	**Rates/hr**	**Rate/mo**
D9H Dozer	$267.86	
Haul Truck D250E	$226.65	
Tandem Haul Truck	$154.53	
Cat 235 Excavator	$247.25	
Cat 235 Excavator w hammer	$283.31	
Cat 16H grader	$226.65	
988B Loader	$257.56	
Tractor Trailer (lowbed)	$133.93	
30 ton Crane	$164.84	
Hiab Flatdeck truck	$128.78	
Cat 950 loader	$128.78	
Pickup Truck		$2,500
Personnel Rates		
Personnel	**Rates/hr**	**Rate/mo**
Blaster	$64.29	
General Labourer	$48.21	
Trades Labourer	$85.71	
Site Supervisor	$101.79	
Design Engineer	$139.29	
Environmental Scientist	$101.79	
Project Manager		$9,700
Camp Labourer		$4,000
Site Caretaker		$6,100
Environmental Monitor		$5,000
Revegetation Rates		
Revegetation Seed Mix	$13.00	per kg
Revegetation Seed Mix - 50kg/ha	$510.00	per ha
Fertilizer	$1.00	per kg
Fertilizer - 250kg/ha	$250.00	per ha
Tree Seedlings (1,000 seedlings per ha)	$1,750.00	per ha
Seed/Fertilizer Application	$1,500.00	per ha
Erosion Barrier	$3.00	per square m
Revegetation cost per ha. Including application cost	**$2,400.00**	**per ha**
Contractor Unit Rates & Camp Costs		
Load, Haul and place soil cover MWD	$5.16	cu.m
Load, Haul and place soil cover SWD	$3.91	cu.m
Load, Haul & Place rock cover	$6.52	cu.m
Custom Rate A (Load, haul and place from IROD - MWD / LGO)	$5.16	cu.m
Custom Rate B (Load, haul and place IROD - HGO/MainWater Dam)	$6.08	cu.m
Custom Rate C (Load, haul and place IROD - CSA)	$5.13	cu.m
Custom Rate D (Push from TFOD - TF)	$2.18	cu.m
Custom Rate E (Push from MWD - U/S MWD)	$2.18	cu.m
Unit Basis (footing burial)	$5.08	each
Load and Haul Rip Rap	$12.69	cu.m
Place Riprap	$12.69	cu.m
Freight run to Whitehorse	$1,000.00	per load
Camp Cost	$70.00	per day per person
Power and Heat	$5,500.00	per month
Employee Transport Costs	$3,000.00	per month
Barge Operating Cost	$10,000.00	per month

Note:

Custom Unit Rates have been developed specifically for Minto Mine, taking into account such factors as haul distance, grade, machinery required, time required, etc.

MINTO MINE CLOSURE COSTING

Table 8-3

Waste Rock and Overburden Dumps, Estimated Closure Costs - 2013 (Year 2)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	WASTE ROCK AND OVERBURDEN DUMPS						
3.1	**Main Waste Dump**						
	Roll crest and recontour	D9H Dozer	hrs	500	$268	$133,929	$133,929
	Haul and place overburden for revegetation	Load, Haul and place soil cover MWD	cu.m.	176000	$5.16	$907,491	$907,491
	Project Management & Engineering	7% of Total Cost	%		7.00%	$72,899	$72,899
	Sub-Total						**$1,114,320**
3.2	**Southwest Dump**						
	Roll crest and recontour	D9H Dozer	hrs	220	$268	$58,929	$58,929
	Haul and place overburden for revegetation	Load, Haul and place soil cover SWD	cu.m.	348250	$5.70	$1,985,025	$1,985,025
	Project Management & Engineering	7% of Total Cost	%		7.00%	$143,077	$143,077
	Sub-Total						**$2,187,031**
3.3	**Ice-Rich Overburden Dump**						
	Roll crest of berm and recontour	D9H Dozer	hrs	16	$268	$4,286	$4,286
	Excavate material for placement on berm	Cat 235 Excavator	hrs	40	$247	$9,890	$9,890
	Project Management & Engineering	7% of Total Cost	%		7.00%	$992	$992
	Sub-Total						**$15,168**
3.4	**Reclamation Overburden Dump**						
	Final Dump Surface Recontouring	Dozer D6LGP	hrs	60	$169	$10,164	**$10,164**
3.5	**Low Grade Ore Stockpile and Pad**						
	Recontour Stockpile and Pad	D9H Dozer	hrs	39.5	$268	$10,580	$10,580
	Haul and place overburden for revegetation	Custom Rate A (Load, haul and place from IROD - MWD / LGO)	cu.m.	16250	$6.60	$107,250	$107,250
	Removal of bottom layer of material, move to pit.	Misc.	l.s.	1	$5,000	$5,000	$5,000
	Project Management & Engineering	7% of Total Cost	%				$8,598.13
	Sub-Total						**$131,429**
3.6	**High Grade Ore Stockpile Pad (s 6.2)**						
	Recontour stockpile and pad	D9H Dozer	hrs	54	$268	$14,464	$14,464
	Haul and place overburden for revegetation	Custom Rate A (Load, haul and place from IROD - MWD / LGO)	cu.m.	23000	$6.60	$151,800	$151,800
	Removal of bottom layer of material, move to pit.	Misc.	l.s.	1	$7,500	$7,500	$7,500
	Project Management & Engineering	7% of Total Cost	%				$12,163.51
	Sub-Total						**$185,928**
3.7	**Contractor's Shop and Work Area**						
	Remove salvageable equipment	General Labourer	hrs	75	$48	$3,616	
		Haul Truck D250E	hrs	25	$227	$5,666	
		Trades Labourer	hrs	60	$86	$5,143	$14,425
	Dismantle buildings	General Labourer	hrs	60	$48	$2,893	
		30 ton Crane	hrs	12.5	$165	$2,060	
		Cat 235 Excavator	hrs	37.5	$247	$9,272	$14,225
	Haul building pieces off site - equipment	Tractor Trailer (lowbed)	hrs	25	$134	$3,348	$3,348
	Scrap haul to site landfill	Haul Truck D250E	hrs	25	$227	$5,666	$5,666
	Bury footings - haul and place fill, locally sourced	Unit basis (footing burial)	each	3125	$5.08	$15,859	$15,859
	Recontour	D9H Dozer	hrs	18.75	$268	$5,022	$5,022
	Haul and place overburden for revegetation	Custom Rate C (Load, haul and place IROD - CSA)	cu.m.	6250	$5.13	$32,036	$32,036
	Project Management & Engineering	7% of Total Cost	%		7.00%	$6,341	$6,341
	Sub-Total						**$96,923**
3.8	**Contaminated Soils - Transport to LTF**						
		Unit basis	l.s.	1	$5,000	$5,000	**$5,000**
3.9	**Mill Valley Fill**						
	Roll crest and recontour	D9H Dozer	hrs	30	$268	$8,036	$8,036
	Haul and place overburden for revegetation	Load, Haul and place soil cover MWD	cu.m.	25500	$10.63	$271,065	$271,065
	Excavation of spillway channel	Cat 235 Excavator	hrs	120	$240	$28,800	$28,800
		D9H Dozer	hrs	120	$268	$32,143	$32,143
	Provision for placement of rip rap	Rip rap from local area to MVF	cu.m.	5000	$15	$75,000	$75,000
	Project Management & Engineering	7% of Total Cost	%		7%	$29,053	$29,053
	Sub-Total						**$444,097**
Total Estimated Cost in Reclaiming Overburden and Waste Rock Dumps							**$4,190,059**

Note:

The Dozer D6LGP (item 3.4) unit rate was obtained from the Canadian Blue Book value and then inflated by 10% for the Yukon, prior to 8 yrs inflation of 1.5% compounded annually.

Item 3.5 quantities were estimated to move 930,000 t using two haul trucks and 1 loader. The material bordering the pit can be moved solely using the loader.

MINTO MINE CLOSURE COSTING

Table 8-4

Open Pit, Underground and Haul Roads, Estimated Closure Costs - 2013 (Year 2)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	OPEN PIT, UNDERGROUND AND HAUL ROADS						
4.1	**Area 1 Pit**						
	Remove pit pumps and pipe column/general cleanup	General Labourer	hrs	80	$48	$3,857	
		Trades Labourer	hrs	20	$86	$1,714	
		Support equipment	l.s.		$1,000	$1,000	$6,571
	Secure pit access - boulder placement	Cat 235 Excavator	hrs	20	$247	$4,945	
		Haul Truck D250E	hrs	20	$227	$4,533	$9,478
	Highwall perimeter safety berm/trench (~1km)	Cat 235 Excavator	hrs	40	$247	$9,880	$9,880
	Construct exit channel into Mill Pond system	Cat 235 Excavator	hrs	20	$247	$4,945	
	Riprap shoulder exiting pit	Place Riprap	cu.m	50	$15	$750	
	Exit Spillway construction	General Labourer	hrs	10	$48	$482	
		Load and Haul Rip Rap	cu.m	50	$13	$634	$6,812
	Construct Passive Treatment System						
	Organic carbon source (to site or chipped at site)	Haulage and handling	l.s.		$75,000	$75,000	
	Clean (< 0.1% Cu) Waste Rock for Construction	Haulage and handling	l.s.		$25,000	$25,000	
	Construction of treatment area	Cat 235 Excavator	hrs	160	$247	$39,561	
		Haul Truck D250E	hrs	160	$227	$36,264	
		General Labourer	hrs	200	$48	$9,600	$185,425
	Project Management & Engineering	7% of Total Cost	%		7.00%	$2,292	$2,292
	Sub-Total						**$220,458**
4.2	**Area 2 Pit**						
	Remove pit pumps and pipe column/general cleanup	General Labourer	hrs	80	$48	$3,857	
		Trades Labourer	hrs	20	$86	$1,714	
		Support equipment	l.s.		$1,000	$1,000	$6,571
	Secure pit access - boulder placement	Cat 235 Excavator	hrs	20	$247	$4,945	
		Haul Truck D250E	hrs	20	$227	$4,533	$9,478
	Construct exit channel into Mill Pond system	Cat 235 Excavator	hrs	40	$247	$9,890	
	Riprap shoulder exiting pit	Place Riprap	cu.m	50	$15	$750	
	Exit Spillway construction	General Labourer	hrs	40	$48	$1,929	
		Load and Haul Rip Rap	cu.m	250	$13	$3,172	$15,741
	Project Management & Engineering	7% of Total Cost	%		7.00%	$2,225	$2,225
	Sub-Total						**$34,015**
4.3	**Area 118 Pit**						
	Remove pit pumps and pipe column/general cleanup	General Labourer	hrs	60	$48	$2,893	
		Trades Labourer	hrs	15	$86	$1,286	
		Support equipment	l.s.		$750	$750	$4,929
	Secure pit access - boulder placement	Cat 235 Excavator	hrs	15	$247	$3,709	
		Haul Truck D250E	hrs	15	$227	$3,400	$7,109
	Construct exit channel into Mill Pond system	Cat 235 Excavator	hrs	30	$247	$7,418	
	Riprap shoulder exiting pit	Place Riprap	cu.m	37.5	$15	$563	
	Exit Spillway construction	General Labourer	hrs	30	$48	$1,446	
		Load and Haul Rip Rap	cu.m	187.5	$13	$2,379	$11,805
	Haul and place overburden for revegetation	Load, Haul and place soil cover	cu.m.	7500	$4.30	$32,250	$32,250
	Project Management & Engineering	7% of Total Cost	%		7.00%	$1,669	$1,669
	Sub-Total						**$57,762**
4.4	**Haul Roads (15 ha)**						
	Remove culverts and haul away	General Labourer	hrs	55	$48	$2,670	
		Cat 235 Excavator	hrs	28	$247	$6,847	
		Haul Truck D250E	hrs	28	$227	$6,276	$15,794
	Recontour slopes	D9H Dozer	hrs	208	$268	$55,632	$55,632
	Scarify surfaces	Cat 16H grader	hrs	208	$227	$47,073	
		General Labourer	hrs	28	$48	$1,335	$48,409
	Stabilize slopes - erosion barriers - material	Unit Cost Basis	sq.m	2,769	$3	$8,308	$8,308
	Project Management & Engineering	7% of Total Cost	%		7.00%	$8,970	$8,970
	Sub-Total						**$137,112**
4.5	**Underground**						
	Backfill underground waste	Load and haul material	cu.m	70,000	$4.16	**$291,200**	**$291,200**
	Recontour slopes	D9H Dozer	hrs	12	$268	**$3,214**	**$3,214**
	Seal off underground portal		l.s.	1	$10,000	**$10,000**	**$10,000**
	Seal off ventilation raise	Cat 235 Excavator	hrs	12	$247	**$2,967**	**$2,967**
		Haul Truck D250E	hrs	2	$227	**$453**	**$453**
	Rip and scarify road	Cat 16H grader	hrs	8	$227	**$1,813**	**$1,813**
	Project Management & Engineering	7% of Total Cost	%		7.00%	**$21,309**	**$21,309**
	Sub-Total						**$330,957**
Total Estimated Cost in Reclaiming Open Pit and Haul Roads							**$780,304**

Note:

Linear disturbances to be scarified / decompacted and allowed to naturally revegetate

Ventilation raise to be sealed by dumping rocks down raise until a bridge is formed and it fills to surface. Portal allowance assumes installation of bulkhead with locked door should access

MINTO MINE CLOSURE COSTING

Table 8-5

Tailings Area & Diversion Structures, Estimated Closure Costs - 2013 (Year 2)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	TAILINGS AREA						
5.1	**Tailings Deposit - Final Lift**						
	Roll crest of starter bench and recontour	D9H Dozer	hrs	50	$268	$13,393	$13,393
	Haul overburden ROD - DSTF	Custom Haul Rate	cu.m	191200	$5.80	$1,108,960	$1,108,960
	Project Management & Engineering	7% of Total Cost	%		7.00%	$78,565	$78,565
	Sub-Total						**$1,200,918**
5.2	**South Diversion Ditch**						
	Widen south diversion ditch	D9H Dozer	hrs	50	$268	$13,393	$13,393
		Cat 235 Excavator	hrs	20	$247	$4,945	$4,945
	Haul and place riprap	Load and Haul Rip Rap	cu.m	1200	$13	$15,225	
		Place Riprap	cu.m	1200	$15	$18,000	$33,225
	HDPE liner	Unit rate	sq.m	2400	$10	$24,000	$24,000
		General Labourer	hrs	80	$48	$3,857	$3,857
	Project Management & Engineering	7% of Total Cost	%		7.00%	$5,289	$5,289
	Sub-Total						**$84,710**
5.3	**Surface Drainage Channel (~750m length)**						
	Construct channel atop covered facility	Misc.	l.s.		$37,500	$37,500	$37,500
	Engineering design for channel	Misc.	l.s.		$5,000	$5,000	$5,000
	Line channel with liner and armoring	Produce Rip Rap	cu.m	2400	$13	$31,200	
		Load, haul & place riprap	cu.m	2400	$13	$31,200	
		HDPE liner	sq.m	3600	$10	$36,000	
		Bedding-Filter zones	cu.m	3600	$6	$21,600	
		General Labourer	hrs	80	$47	$3,760.00	$123,760
	Project Management & Engineering	7% of Total Cost	%		7.00%	$11,638	$11,638
	Sub-Total						**$177,898**
Total Estimated Cost in Reclaiming Tailings Area							**$1,463,525**

Note:
Material to provide soil cover for the dry stack tailings will be sourced from the Area 2 Pit.

MINTO MINE CLOSURE COSTING

Table 8-6

Main Water Dam, Estimated Closure Costs - 2013 (Year 2)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	WATER DAM						
6.1	**Reclaim System**						
	Remove salvageable equipment - pipeline/pumps	General Labourer	hrs	48	$48	$2,314	
		Trades Labourer	hrs	98	$86	$8,400	$10,714
	Remove pipeline	Haul Truck D250E	hrs	100	$227	$22,665	
		Cat 235 Excavator	hrs	100	$247	$24,725	
		General Labourer	hrs	200	$48	$9,643	$57,033
	Dismantle Building	Cat 235 Excavator	hrs	16	$247	$3,956	
		General Labourer	hrs	10	$47	$470	
		Trades Labourer	hrs	10	$83	$830	$5,256
	Misc. Supplies & Tools	Misc.	l.s.		$1,000	$1,000	$1,000
	Recontour alignment	D9H Dozer	hrs	16	$268	$4,286	$4,286
	Project Management & Engineering	7% of Total Cost	%		7.00%	$5,480	$5,480
	Sub-Total						**$83,770**
6.2	**Main Dam**						
	Pump down impounded water, over spillway (using reclaim pumps)	General Labourer	hrs	96	$48	$4,629	$4,629
	Misc. Supplies & Tools	Misc.	l.s.		$5,000	$5,000	$5,000
	Engineering design for final structure include appropriate flow determination, channel designs, etc.	Misc.	l.s.	1	$20,000	$20,000	$20,000
	Build coffer dam and install pump-around system Operate system until new structure is ready	Misc.	l.s.		$10,000	$10,000	$10,000
	Stockpile rip rap from downstream shell	Unit Cost Basis	cu.m	10,000	$10	$100,000	$100,000
	Breach Dam: push material using dozer into new areas	Custom Rate E (Push from MWD - U/S MWD)	cu.m	25,000	$2	$54,556	
	and load, haul & dump and contour material in new area	Unit Cost Basis	cu.m	31,000	$4.50	$139,500	
		Environmental Scientist	hrs	60	$101.79	$6,107	$200,163
	Construct stream channel at original grade - haul and place rip rap	Unit Cost Basis	cu.m	1,125	$3	$3,375	
		Unit Cost Basis	cu.m	1,125	$9	$10,125	$13,500
	Haul and place overburden on slopes of new area u/s of MWD	Unit Cost Basis	cu.m	15,000	$2	$30,000	$30,000
	Stabilize slopes with erosion barriers	Unit Rates	per sq. m	15,000	$3	$45,000	$45,000
	Misc. Supplies & Tools	Misc.	l.s.		$3,000	$3,000	$3,000
	Project Management & Engineering	7% of Total Cost	%		7.00%	$30,190	$30,190
	Sub-Total						**$461,482**
Total Estimated Cost in Reclaiming Water Dam							**$545,252**

Note:
A monitoring/maintenance program for the dam is included in Table 8.1-12

MINTO MINE CLOSURE COSTING

Table 8-7

Mill &Ancillary Facilities, Estimated Closure Costs - 2013 (Year 2)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	MILL AND ANCILLARY FACILITIES						
7.1	**Mill Building**						
	Remove salvageable equipment	General Labourer	hrs	550	$48	$26,518	
		Trades Labourer	hrs	600	$86	$51,429	
		Crane Support	hrs	40	$145	$5,800	$83,747
	Decontaminate Building-hosing and clean-up	Trades Labourer	hrs	160	$86	$13,714	$13,714
	Dismantle Building	General Labourer	hrs	1000	$48	$48,215	
		Trades Labourer	hrs	600	$86	$51,429	
		Cat 235 Excavator w hammer	hrs	120	$283	$33,997	
		Crane Support	hrs	60	$145	$8,700	$142,341
	Concrete Demolition	Blaster	hrs	40	$64	$2,571	
		Cat 235 Excavator	hrs	20	$247	$4,945	
		D9H Dozer	hrs	30	$268	$8,036	$15,552
	Misc. Supplies & Tools	Misc.	l.s.		$11,000	$11,000	$11,000
	Scrap haul to solid waste facility	Cat 235 Excavator	hrs	50	$247	$12,363	
		Haul Truck D250E	hrs	100	$227	$22,665	$35,028
	Project Management & Engineering	7% of Total Cost	%		7.00%	$21,097	$21,097
	Subtotal:						**$322,479**
		Subtract 50% for Salvage Value					**$161,239**
7.2	**Generator & Filter Buildings & Concentrate Shed**						
	Remove salvageable equipment	General Labourer	hrs	240	$48	$11,571	
		Trades Labourer	hrs	240	$86	$20,572	$32,143
		Crane Support	hrs	24	$145	$3,480	
	Salvage and remove powerline and poles		l.s.		$27,500	$27,500	$30,980
	Dismantle Buildings	General Labourer	hrs	160	$48	$7,714	
		Trades Labourer	hrs	80	$86	$6,857	
		Cat 235 Excavator w hammer	hrs	40	$283	$11,332	
		Crane Support	hrs	30	$145	$4,350	$30,254
	Concrete Demolition	Blaster	hrs	40	$64	$2,571	
		Cat 235 Excavator	hrs	20	$247	$4,945	
		D9H Dozer	hrs	20	$268	$5,357	$12,874
	Misc. Supplies & Tools	Misc.	l.s.		$10,000	$10,000	$10,000
	Scrap haul to solid waste facility	Cat 235 Excavator	hrs	10	$247	$2,473	
		Haul Truck D250E	hrs	20	$227	$4,533	$7,006
	Project Management & Engineering	7% of Total Cost	%		7.00%	$8,628	$8,628
	Subtotal:						**$131,884**
		Subtract 50% for Salvage Value					**$65,942**
7.3	**Fuel Storage Area**						
	Cleanout tanks-remove sludge, pressure wash	General Labourer	hrs	60	$48	$2,893	
		Removal to Licensed facility	l.s.		$10,000	$10,000	$12,893
	Remove bulk fuel storage and piping facilities	General Labourer	hrs	100	$48	$4,821	
		Trades Labourer	hrs	120	$86	$10,286	
		Crane Support	hrs	30	$145	$4,350	
		Support Equipment	l.s.		$2,500	$2,500	
		Cat 235 Excavator	hrs	40	$247	$9,890	
		General Labourer	hrs	40	$48	$1,929	
		Tractor Trailer (lowbed)	hrs	30	$134	$4,018	$37,794
	Fold and Bury Liner	Cat 235 Excavator	hrs	20	$247	$4,945	
		D9H Dozer	hrs	100	$268	$26,786	$31,731
	Project Management & Engineering	7% of Total Cost	%		7.00%	$5,769	$5,769
	Subtotal:						**$88,187**
7.4	**Mill Reagents**						
	Load and return extra reagents/chemicals	General Labourer	hrs	100	$48	$4,821	
		Support Equipment	l.s.		$2,500	$2,500	
		Disposal Cost-bulk materials	l.s.		$5,000	$5,000	
		Disposal Cost-lab-pacs	pallets	2	$2,000	$4,000	$16,321
	Removal of drums, steel, oils, glycol & batteries, as per 09July quote from General Waste Management to MEL	Contractor quote	l.s.		$50,900	$50,900	$50,900
	Project Management & Engineering	7% of Total Cost	%		7.00%	$4,706	$4,706
	Subtotal:						**$71,927**
7.5	**Reclaim Entire Mill Site Area**						
	Test soils for contamination	Environmental Scientist	hrs	35	$102	$3,563	
		Analytical Costs	l.s.		$6,000	$6,000	$9,563
	Haul any contaminated soils to Land Treatment Facility	Cat 235 Excavator	hrs	15	$247	$3,709	
		Haul Truck D250E	hrs	15	$227	$3,400	$7,109
	Re-contour area and slopes to bury footings and establish drainage	D9H Dozer	hrs	100	$268	$26,786	$26,786
	Haul and place overburden cap	Unit Rate	cu.m	38000	$5.50	$209,000	$209,000
	Project Management & Engineering	7% of Total Cost	%		7.00%	$17,672	$17,672
	Subtotal:						**$270,129**
Total Estimated Cost in Reclaiming Mill and Ancillary Facilities							**$657,424**

MINTO MINE CLOSURE COSTING

Table 8-8

Mill Water Pond, Estimated Closure Costs - 2013 (Year 2)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	MILL POND						
8.1	**Reclaim Mill Pond**						
	Remove upstream culvert	General Labourer	hrs	10	$48	$482	
		Cat 235 Excavator	hrs	10	$247	$2,473	$2,955
	Construct channel	Cat 235 Excavator	hrs	100	$247	$24,725	
		D9H Dozer	hrs	20	$268	$5,357	
		Produce rip rap	cu.m	5,000	$13	$65,000	
		Load,haul & place ripra	cu.m	5,000	$13	$65,000	
		General Labourer	hrs	20	$48	$964	$161,047
	Project Management & Engineering	7% of Total Cost	%		7.00%	$11,480	$11,480
	Subtotal:						**$175,482**
Total Estimated Cost in Reclaiming Mill Pond							**$175,482**

Note:

MINTO MINE CLOSURE COSTING

Table 8-9

Main Access Road, Estimated Closure Costs - 2013 (Year 2)

Scenario 1 - No Road Deactivation

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
9.1	**NO ROAD DECOMMISSIONING REQUIRED**						
9.1.1	**Road Surface**						
	Install road barrier at west side of Minto Creek	Misc	l.s.		$2,000	$2,000	$2,000
	Project Management & Engineering	7% of Total Cost	%		7.00%	$140	$140
	Subtotal:						**$2,140**
Total Estimated Cost for Access Road Closure (Scenario 1)							**$2,140**

Scenario 2 - Decommission Access Road From Minto Creek to Mine Site (11 KM)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
9.2	**ACCESS ROAD - 11 KM SECTION**						
9.2.1	**Road Surface**						
	Scarify - 11 km	Cat 16H grader	hrs	70	$227	$15,865	$15,865
	Recontour slopes and drainages	Cat 235 Excavator	hrs	25	$247	$6,181.35	$6,181
	Project Management & Engineering	7% of Total Cost	%		7.00%	$1,543	$1,543
	Subtotal:					**$23,590**	**$23,590**
9.2.2	**Culverts**						
	Culvert excavation (40 small culverts)	Cat 235 Excavator	hrs	100	$247	$24,725	$24,725
	Culvert removal	General Labourer	hrs	140	$48	$6,750	
		Haul Truck D250E	hrs	100	$227	$22,665	$29,415
	Minto Creek Culvert Removal & Streambank Restoration	Trades Labourer	hrs	40	$86	$3,429	
		General Labourer	hrs	75	$48	$3,616	
		Cat 235 Excavator	hrs	40	$247	$9,890	$16,935
	Recontour slopes and drainage	D9H Dozer	hrs	70	$268	$18,750	$18,750
	Stabilize slopes	General Labourer	hrs	200	$48	$9,643	
	Erosion barriers	Unit Cost Basis	per sq. m	500	$3.00	$1,500	$11,143
	Project Management & Engineering	7% of Total Cost	%		7.00%	$7,068	$7,068
	Subtotal:						**$108,036**
Total Estimated Cost for Access Road Closure (Scenario 2)							**$131,626**

Scenario 3 - Decommission Entire Access Road (27 KM)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
9.3	**ACCESS ROAD - 27 KM SECTION**						
9.3.1	**Road Surface**						
	Scarify - 27 km	Cat 16H grader	hrs	150	$227	$33,997	$33,997
	Recontour slopes and drainage	Cat 235 Excavator	hrs	50	$247	$12,363	$12,363
	Project Management & Engineering	7% of Total Cost	%		7.00%	$3,245	$3,245
	Subtotal:						**$49,605**
9.3.2	**Big Creek Bridge**						
	Remove bridge decking and span	General Labourer	hrs	50	$48	$2,411	
		Crane	hrs	40	$145	$5,800	
		Cat 235 Excavator	hrs	40	$247	$9,890	
		Tractor Trailer (lowbed)	hrs	20	$134	$2,679	$20,779
	Cut off piles	General Labourer	hrs	50	$48	$2,411	$2,411
	Re-contour	Cat 235 Excavator	hrs	30	$247	$7,418	
		D9H Dozer	hrs	30	$268	$8,036	$15,453
	Project Management & Engineering	7% of Total Cost	%		7.00%	$2,705	$2,705
	Subtotal:						**$41,349**
9.3.3	**Barge Ramps**						
	Remove all gravel	Cat 235 Excavator	hrs	20	$247	$4,945	$4,945
	Re-countour areas and scarify	D9H Dozer	hrs	30	$268	$8,036	$8,036
	Shoreline restoration	Misc.	l.s.		$5,000	$5,000	$5,000
	Project Management & Engineering	7% of Total Cost	%		7.00%	$1,259	$1,259
	Subtotal:						**$19,239**
9.3.4	**Culverts**						
	Culvert excavation (45 small culverts)	Cat 235 Excavator	hrs	115	$247	$28,434	$28,434
	Culvert removal	General Labourer	hrs	150	$48	$7,232	
		Haul Truck D250E	hrs	115	$227	$26,065	$33,297
	Minto Creek Culvert Removal & Streambank Restoration	Trades Labourer	hrs	40	$86	$3,429	
		General Labourer	hrs	75	$48	$3,616	
		Cat 235 Excavator	hrs	40	$247	$9,890	$16,935
	Recontour slopes and drainage	D9H Dozer	hrs	70	$268	$18,750	$18,750
	Stabilize slopes	General Labourer	hrs	200	$48	$9,643	
	Erosion barriers	Unit Cost Basis	per sq. m.	1,000	$3	$3,000	$12,643
	Project Management & Engineering	7% of Total Cost	%		7.00%	$7,704	$7,704
	Subtotal:						**$117,763**
Total Estimated Cost for Access Road Closure (Scenario 3)							**$227,956**

Note:

MINTO MINE CLOSURE COSTING

Table 8-10

Miscellaneous Sites and Facilities, Estimated Closure Costs - 2013 (Year 2)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	MISCELLANEOUS SITES AND FACILITIES						
10.1	**Airstrip**						
	Scarify airstrip and adjacent laydown areas	Cat 16H Grader	hrs	40	$227	$9,066	$9,066
	Project Management & Engineering	7% of Total Cost	%		7.00%	$635	$635
	Natural revegetation	n/a	n/a				
	Subtotal:						**$9,701**
10.2	**Mine Camp and Related Infrastructure**						
	Disconnect Services	Trades Labourer	hrs	120	$86	$10,286	$10,286
	Remove salvageable equipment	General Labourer	hrs	1056	$48	$50,915	$50,915
	Dismantle buildings	General Labourer	hrs	1800	$48	$86,786	
		Cat 235 Excavator	hrs	180	$247	$44,506	$131,292
	Haul scrap to Solid Waste Facility	Haul Truck D250E	hrs	30	$227	$6,799	
		Cat 235 Excavator	hrs	15	$247	$3,709	$10,508
	Reclaim Septic System	General Labourer	hrs	15	$48	$723	
		Cat 235 Excavator	hrs	3	$247	$742	$1,465
	Site Clean-Up	General Labourer	hrs	750	$48	$36,161	$36,161
	Project Management & Engineering	7% of Total Cost	%		7.00%	$16,124	$16,124
	Subtotal:						**$256,750**
		Subtract 50% for Salvage Value					**$128,375**
10.3	**Explosives Plant Site**						
	Remove salvageable equipment	General Labourer	hrs	100	$48	$4,821	
		Trades Labourer	hrs	50	$86	$4,286	$9,107
	Dismantle buildings	General Labourer	hrs	200	$48	$9,643	
		Cat 235 Excavator	hrs	30	$247	$7,418	$17,061
	Disconnect Services	Trades Labourer	hrs	20	$86	$1,714	$1,714
	Crane services	30 ton Crane	hrs	5	$165	$824	$824
	Haul scrap to Solid Waste Facility	Haul Truck D250E	hrs	30	$227	$6,799	
		Cat 235 Excavator	hrs	10	$247	$2,473	$9,272
	Project Management & Engineering	7% of Total Cost	%		7.00%	$2,658	$2,658
	Subtotal:						**$40,637**
		Subtract 50% for Salvage Value					**$20,318**
10.4	**Exploration Sites and Trails**						
	Natural revegetation	n/a	n/a				
	Subtotal:						**$0**
10.5	**Land Treatment Facility**						
	Prepare and submit closure plan	Misc	l.s.		$2,000	$2,000	$2,000
	Characterize final soil hydrocarbon concentrations	Misc	l.s.		$4,000	$4,000	$4,000
	Recontour	D9H Dozer	hrs	2	$268	$536	$536
	Haul and place overburden cap from nearby	Cat 235 Excavator	hrs	20	$247	$4,945	
		Haul Truck D250E	hrs	20	$227	$4,533	
		D9H Dozer	hrs	6	$268	$1,607	$11,085
	Project Management & Engineering	7% of Total Cost	%		7.00%	$1,233	$1,233
	Subtotal:						**$18,854**
10.6	**Solid Waste Facility**						
	Prepare detailed closure plan	Misc	l.s.		$2,000	$2,000	$2,000
	Characterize final waste area	Misc	l.s.		$2,000	$2,000	$2,000
	Remove recyclables and special waste materials	Tractor Trailer (lowbed)	hrs	40	$134	$5,357	$5,357
	Recontour	D9H Dozer	hrs	2	$268	$536	$536
	Haul and cover with adjacent fill and place overburden cap	Cat 235 Excavator	hrs	20	$247	$4,945	
		Haul Truck D250E	hrs	20	$227	$4,533	
	Compaction of cover	D9H Dozer	hrs	6	$268	$1,607	$11,085
	Project Management & Engineering	7% of Total Cost	%		7.00%	$1,468	$1,468
	Subtotal:						**$22,447**
10.7	**Site Roads**						
	Recontour	Cat 235 Excavator	hrs	30	$247	$7,418	$7,418
	Scarify	Cat 16H Grader	hrs	40	$227	$9,066	$9,066
	Project Management & Engineering	7% of Total Cost	%		7.00%	$1,154	$1,154
	Subtotal:						**$17,637**
Total Estimated Cost in Reclaiming Miscellaneous Sites and Facilities							**$217,332**

Note:

Land treatment facility is a licensed facility and will be reclaimed as per license terms and conditions

MINTO MINE CLOSURE COSTING

Table 8-11

Reclamation Research and Revegetation, Estimated Closure Costs - 2013 (Year 2)

Item No.	Work Item Description	Units	Quantity	Unit Rates	Cost	Total Adjusted
11.1	**REVEGETATION ACTIVITIES**					
11.1.0	**Determination of Revegetation Plan for Current Site**					
	Issuance of a plan for all site areas for regulatory review and approval	Misc	1	$20,000	$20,000	$20,000
	Sub-Total					**$20,000**
11.1.1	**Main and Southwest Dumps (total surface area of 117.5 ha)**					
	Seed and fertilize w/ labour	ha	117.5	$2,400	$282,000	
	Re-seed and fertilize (1/2 of total area)	ha	58.8	$2,400	$141,000	
	Re-forest	ha	117.5	$1,750	$205,625	$628,625
	Sub-Total					**$628,625**
11.1.2	**Ice-Rich Overburden Dump (toe berm surface area of 6.9ha)**					
	Seed and fertilize w/ labour	ha	6.9	$2,400	$16,560	
	Re-seed and fertilize (1/2 of total area)	ha	3.5	$2,400	$8,280	
	Re-forest	ha	6.9	$1,750	$12,075	$36,915
	Sub-Total					**$36,915**
11.1.3	**Reclamation Overburden Dump (total surface area of 30 ha)**					
	Seed and fertilize w/ labour	ha	30.0	$2,400	$72,000	
	Re-seed and fertilize (1/2 of total area)	ha	15.0	$2,400	$36,000	
	Re-forest	ha	30.0	$1,750	$52,500	$160,500
	Sub-Total					**$160,500**
11.1.4	**Ore Stockpiles and Pads (final total surface area of 15.7 ha)**					
	Seed and fertilize w/ labour	ha	15.7	$2,400	$37,680	
	Re-seed and fertilize (1/2 of total area)	ha	7.9	$2,400	$18,840	
	Re-forest	ha	15.7	$1,750	$27,475	$83,995
	Sub-Total					**$83,995**
11.1.5	**Mill Valley Fill (8 ha)**					
	Seed and fertilize w/ labour	ha	8.0	$2,400	$19,200	
	Re-seed and fertilize (1/2 of total area)	ha	4.0	$2,400	$9,600	
	Re-forest	ha	8.0	$1,750	$14,000	$42,800
	Sub-Total					**$42,800**
11.1.6	**Contractor's Shop and Office Area (disturbed area of 2.5 ha)**					
	Seed and fertilize w/ labour	ha	2.5	$2,400	$6,000	
	Re-seed and fertilize (1/2 of total area)	ha	1.3	$2,400	$3,000	
	Re-fertilize only (1/2 total area - re-seed area)	ha	0.0	$1,900	$0	
	Re-forest	ha	2.5	$1,750	$4,375	$13,375
	Sub-Total					**$13,375**
11.1.7	**Tailings Area current disturbed area of 30.2 ha)**					
	Seed and fertilize w/ labour	ha	30.2	$2,400	$72,480	
	Re-seed and fertilize (1/2 of total area)	ha	15.1	$2,400	$36,240	
	Re-forest	ha	30.2	$1,750	$52,850	$161,570
	Sub-Total					**$161,570**
11.1.8	**Main Water Dam (total dam surface area 3.3 ha)**					
	Seed and fertilize w/ labour	ha	3.3	$2,400	$7,920	
	Re-seed and fertilize (1/2 of total area)	ha	1.7	$2,400	$3,960	
	Re-forest	ha	3.3	$1,750	$5,775	$17,655
	Sub-Total					**$17,655**
11.1.9	**Mill Area (total surface area of 7.6 ha)**					
	Seed and Fertilize w/ labour	ha	7.6	$2,400	$18,240	
	Re-seed and fertilize (1/2 of total area)	ha	3.8	$2,400	$9,120	
	Re-forest	ha	7.6	$1,750	$13,300	$40,660
	Subtotal:					**$40,660**
11.1.10	**Haul Road (total surface area of 15 ha)**					
		ha	15.0	$2,400		**$0**
11.1.11	**Underground (total surface area of 20.2 ha)**					
	Seed and fertilize w/ labour	ha	20.2	$2,400	$48,480	
	Re-seed and fertilize (1/2 of total area)	ha	10.1	$2,400	$24,240	
	Re-forest	ha	20.2	$1,750	$35,350	$108,070
	Subtotal:					**$108,070**
11.1.12	**Miscellaneous Sites - Camp, Airstrip, Waste Facilities, Explosives Site (area for reclamation of 10.3 ha)**					
	Seed and fertilize w/ labour	ha	14.0	$2,400	$33,600	
	Re-seed and fertilize (1/2 of total area)	ha	7.0	$2,400	$16,800	
	Re-forest	ha	14.0	$1,750	$24,500	$74,900
	Subtotal:					**$74,900**
11.1.13	**Access Road**					
	Scenario 1 - No Deactivation					
	No revegetation					
	Subtotal:					**$0**
	Scenario 2 - Deactivate from Minto Creek to Mine Site					
	Revegetate and fertilize banks at culvert excavations, including labour	ha	2.0	$2,400	$4,800	$4,800
	Subtotal:					**$4,800**
	Scenario 3 - Deactivate Entire Road					
	Revegetate and fertilize banks at culvert excavations, including labour	ha	6.0	$2,400	$14,400	$14,400
	Subtotal:					**$14,400**
Total Estimated Cost for Reclamation Research and Revegetation						
	Scenario 1 - No Access Road Deactivation					**$1,389,065**
	Scenario 2 - Deactivate Access Road from Minto Creek to Mine Site					**$1,393,865**
	Scenario 3 - Deactivate Entire Access Road					**$1,403,465**

MINTO MINE CLOSURE COSTING

Table 8-12

Site Management and Monitoring, Estimated Closure Costs - 2013 (Year 2)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	SITE MANAGEMENT						
12.1	**Onsite Management**						
	Project Management and Engineering - Included in PME Costs in each Closure Component						
	Pickup truck	Light truck	monthly	50	$2,500	$125,000	$125,000
	Sundry equipment maintenance	Unit Cost Basis	yearly	10	$5,000	$50,000	$50,000
	Power and heat	Unit Cost Basis	monthly	30	$5,500	$165,000	$165,000
	General Administrative expenses	Unit Cost Basis	monthly	50	$2,000	$100,000	$100,000
	Camp Costs (5 year period)	Unit Cost Basis	man-day	6138	$60	$368,280	$368,280
	Subtotal:						**$808,280**
12.2	**Transport Costs**						
	Employee transport costs	Unit Cost Basis	monthly	50	$3,000	$150,000	$150,000
	Barge operating costs	Unit Cost Basis	monthly	20	$10,000	$200,000	$200,000
	Subtotal:						**$350,000**
12.3	**Water Treatment and Compliance Monitoring incl. Reporting**						
	Active - Treatment, operating costs (4 years) incl. staff, reagents		monthly	12	$87,000	$1,044,000	$1,044,000
	Cost per cubic metre of compliant water (0.01 ppm Cu) (4 years)		cu.m	1440000	$0.40	$576,000	$576,000
	Subtotal:						**$1,620,000**
12. 4	**Water Quality Monitoring (Post Mine Closure) (50:50 sampling labour/analyses costs split)**						
	Years 1-5 (monthly during open season)	Misc.	monthly	30	$4,000	$120,000	
	Years 6-10 (quarterly - spring/summer/fall)	Misc.	quarterly	15	$4,000	$60,000	
	Years 11-15 (once annually - post spring freshet)	Misc.	yearly	5	$4,000	$20,000	$200,000
	Disbursements (non-labour/non-analytical)	Misc.	l.s.	15	$4,000	$60,000	$60,000
	LTF Monitoring and Maintenance (years 1-5)	Misc.	yearly	5	$4,000	$20,000	$20,000
	Enhanced Groundwater/Foundation monitoring below TF and Waste Rock Dumps	Misc.	yearly	15	$6,000	$90,000	$90,000
	Geo-technical Inspections (annually yrs 1-5, bi-annual yrs 6-15)	Misc.	l.s.	10	$6,000	$60,000	$60,000
	Reclamation Inspections (annually yrs 1-5, bi-annual yrs 6-15)	Misc.	l.s.	10	$7,500	$75,000	$75,000
	Biological Monitoring - Closure implementation	Misc.	l.s.	1	$10,000	$10,000	
	Years 1-5 (Annually)	Misc.	yearly	5	$4,000	$20,000	
	Years 6-10 (Annually)	Misc.	yearly	5	$4,000	$20,000	
	Years 11-15 (Every two years)	Misc.	bi-annual	3	$3,500	$10,500	$60,500
	Subtotal:						**$565,500**
12.5	**Post Closure Maintenance - Main Dam**						
	Monitoring of piezometers, thermistors						
	Years 1-5 (quarterly)	Misc.	quarterly	20	$3,000	$60,000	
	Years 6-10 (bi-annually)	Misc.	bi-annually	8	$3,000	$24,000	
	Years 11-15 (annually)	Misc.	annual	5	$2,500	$12,500	
	Annual Inspection + report	Misc.	annual	15	$3,000	$45,000	
	Carry out inspection recommendations/maintenance	Misc.	annual	15	$10,000	$150,000	$291,500
	Misc. maintenance work related to the site after closure (Yr1-5)	Misc.	yearly	5	$10,000	$50,000	$50,000
	Misc. maintenance work related to the site after closure (Yr6-15)	Misc.	per year	10	$5,000	$50,000	$50,000
	Subtotal:						**$391,500**
12.6	**Ulitmate Removal of wells and instrumentation**	Misc.	unit basis		$15,000		**$15,000**
Total Estimated Cost for Post Closure Site Management							**$3,750,280**

Note:
Camp Costs calculation based on "Table 7-1 Site Decommissioning and Reclamation Seasonal Personnel Requirements" using a 90 day work year
Inflation rates vary per subtask depending upon the year expenses are incurred or the average year over which expenses are incurred

MINTO MINE CLOSURE COSTING

Table 8-13b

Supporting Studies, Estimated Closure Costs - 2013 (Year 2)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
13.1	**Permafrost Foundation Monitoring**						
13.1.1	Enhanced subsurface monitoring program in and below waste rock dumps (WRD)						
	preparing detailed monitoring program	Misc.	l.s.		$8,000	$8,000	
	undertake additional monitoring as per program(covered in T. 12)	Misc.	yearly		$7,000	$7,000	$15,000
	Enhanced Adaptive Management Plan for WRD	Misc.	l.s.	1	$8,000	$8,000	$8,000
13.1.2	Enhanced subsurface monitoring program in and below Tailings Facility (TF)						
	preparing detailed monitoring program	Misc.	l.s.		$4,000	$4,000	
	undertake additional monitoring as per program (covered in T. 12)	Misc.	yearly	1	$3,500	$3,500	$7,500
	Enhanced Adaptive Management Plan for TF	Misc.	l.s.	1	$4,000	$4,000	$4,000
	Subtotal:						**$34,500**
13.2	**Kinetic Tailings Testing**						
13.2.1	Monitoring program and field test to enhance long term water quality prediction related to drystack tailings facility						
	preparing composite sample over several months of production	Misc.	l.s.		$5,000	$5,000	$5,000
	undertaking field test	Misc.	l.s.		$12,000	$12,000	
	initiate parallel laboratory analysis	Misc.	l.s.		$10,000	$10,000	
	monitoring field apparatus (columns	Misc.	l.s.		$4,000	$4,000	$26,000
	reporting				$5,000	$5,000	$5,000
	Subtotal:						**$36,000**
13.3	**Other Adaptive Management Plans scheduled for Operating Life or Required Only in Early Shutdown**						
	Changes in WTP input water quality or quantity	Misc.	l.s.		$22,500	$22,500	$22,500
	Sludge Management Plan - for material from WTP	Misc.	l.s.		$15,000	$15,000	$15,000
	Site Testing ML ARD	Misc.	l.s.		$45,000	$45,000	$45,000
	Groundwater Management Plan	Misc.	l.s.		$15,000	$15,000	$15,000
	Long Term Reclamation of Contaminated Soils	Misc.	l.s.		$22,500	$22,500	$22,500
	Physical Monitoring program prior to closure	Misc.	l.s.		$60,000	$60,000	$60,000
	Modeling of Pit Lake water quality prior to flooding	Misc.	l.s.		$22,500	$22,500	$22,500
	Subtotal:						**$202,500**
13.4	**Closure Specific Studies and Field Trials**						
	Main Site Discharge Channel Geotechnical Design and Stability Evaluation	Engineering/Design	l.s.	1	$30,000	$30,000	$30,000
	Passive Treatment Evaluations	Engineering/Design	l.s.	1	$60,000	$60,000	$60,000
	Engineered Cover Evaluations (construction/monitoring)	Engineering/Design	l.s.	1	$50,000	$50,000	$50,000
	Site contamination surveys		l.s.	1	$55,000	$55,000	$55,000
	Subtotal:						**$195,000**
Total Estimated Cost for Supporting Studies							**$468,000**

Note:

Table 8-1
Summary Table of Estimated Closure Costs - End of Mine Life

Table #	Description	Total Cost
3	**Overburden & Waste Rock Dumps**	$6,083,050
4	**Open Pit, Underground and Haul Roads**	$793,904
5	**Tailings Area and Diversion Structures**	$1,285,897
6	**Main Water Dam**	$640,271
7	**Mill and Ancillary Facilities**	$652,428
8	**Mill Pond**	$184,510
9	**Main Access Road**	
	Scenario 1 - No Access Road Deactivation	$2,140
	Scenario 2 - Deactivate Access Road from Minto Creek to Mine Site	$131,193
	Scenario 3 - Deactivate Entire Access Road	$227,956
10	**Miscellaneous Sites and Facilities**	$173,471
11	**Reclamation Research and Revegetation**	
	Scenario 1 - No Access Road Deactivation	$1,405,270
	Scenario 2 - Deactivate Access Road from Minto Creek to Mine Site	$1,410,070
	Scenario 3 - Deactivate Entire Access Road	$1,419,670
12	**Post Closure Site Management**	$3,585,300
13	**Supporting Studies**	$413,000
Total Closure Costs		
	Scenario 1 - No Access Road Deactivation	**$15,219,240**
	Scenario 2 - Deactivate Access Road from Minto Creek to Mine Site	**$15,353,094**
	Scenario 3 - Deactivate Entire Access Road	**$15,459,457**
Total Closure Costs (Including Percentage Contingency Allowance on Above Elements)		**12%**
	Scenario 1 - No Access Road Deactivation	**$17,045,549**
	Scenario 2 - Deactivate Access Road from Minto Creek to Mine Site	**$17,195,465**
	Scenario 3 - Deactivate Entire Access Road	**$17,314,592**

MINTO MINE CLOSURE COSTING

Table 8-2

Minto Mine Closure Unit Rates for Current Year

Equipment Rates		
Equipment	**Rates/hr**	**Rate/mo**
D9H Dozer	$267.86	
Haul Truck D250E	$226.65	
Tandem Haul Truck	$154.53	
Cat 235 Excavator	$247.25	
Cat 235 Excavator w hammer	$283.31	
Cat 16H grader	$226.65	
988B Loader	$257.56	
Tractor Trailer (lowbed)	$133.93	
30 ton Crane	$164.84	
Hiab Flatdeck truck	$128.78	
Cat 950 loader	$128.78	
Pickup Truck		$2,500
Personnel Rates		
Personnel	**Rates/hr**	**Rate/mo**
Blaster	$64.29	
General Labourer	$48.21	
Trades Labourer	$85.71	
Site Supervisor	$101.79	
Design Engineer	$139.29	
Environmental Scientist	$101.79	
Project Manager		$9,700
Camp Labourer		$4,000
Site Caretaker		$6,100
Environmental Monitor		$5,000
Revegetation Rates		
Revegetation Seed Mix	$13.00	per kg
Revegetation Seed Mix - 50kg/ha	$510.00	per ha
Fertilizer	$1.00	per kg
Fertilizer - 250kg/ha	$250.00	per ha
Tree Seedlings (1,000 seedlings per ha)	$1,750.00	per ha
Seed/Fertilizer Application	$1,500.00	per ha
Erosion Barrier	$3.00	per square m
Revegetation cost per ha. Including application cost	**$2,400.00**	**per ha**
Contractor Unit Rates & Camp Costs		
Load, Haul and place soil cover MWD	$5.16	cu.m
Load, Haul and place soil cover SWD	$3.91	cu.m
Load, Haul & Place rock cover	$6.52	cu.m
Custom Rate A (Load, haul and place from IROD - MWD / LGO)	$5.16	cu.m
Custom Rate B (Load, haul and place IROD - HGO/MainWater Dam)	$6.08	cu.m
Custom Rate C (Load, haul and place IROD - CSA)	$5.13	cu.m
Custom Rate D (Push from TFOD - TF)	$2.18	cu.m
Custom Rate E (Push from MWD - U/S MWD)	$2.18	cu.m
Unit Basis (footing burial)	$5.08	each
Load and Haul Rip Rap	$12.69	cu.m
Place Riprap	$12.69	cu.m
Freight run to Whitehorse	$1,000.00	per load
Camp Cost	$70.00	per day per person
Power and Heat	$5,500.00	per month
Employee Transport Costs	$3,000.00	per month
Barge Operating Cost	$10,000.00	per month

Note:

Custom Unit Rates have been developed specifically for Minto Mine, taking into account such factors as haul distance, grade, machinery required, time required, etc.

MINTO MINE CLOSURE COSTING

Table 8-3

Waste Rock and Overburden Dumps, Estimated Closure Costs - End of Mine Life

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	WASTE ROCK AND OVERBURDEN DUMPS						
3.1	**Main Waste Dump**						
	Roll crest and recontour	D9H Dozer	hrs	300	$268	$80,358	$80,358
	Haul and place overburden for revegetation	Load, Haul and place soil cover MWD	cu.m.	178275	$5.16	$919,222	$919,222
	Project Management & Engineering	7% of Total Cost	%	5065	7.00%	$69,971	$69,971
	Sub-Total						**$1,069,550**
3.2	**Southwest Dump**						
	Roll crest and recontour	D9H Dozer	hrs	240	$268	$64,286	$64,286
	Haul and place overburden for revegetation	Load, Haul and place soil cover SWD	cu.m.	348250	$5.70	$1,985,025	$1,985,025
	Project Management & Engineering	7% of Total Cost	%		7.00%	$143,452	$143,452
	Sub-Total						**$2,192,763**
3.3	**Ice-Rich Overburden Dump**						
	Roll crest of berm and recontour	D9H Dozer	hrs	16	$268	$4,286	$4,286
	Excavate material for placement on berm	Cat 235 Excavator	cu.m.	2500	$2.20	$5,500	$5,500
	Project Management & Engineering	7% of Total Cost	%		7.00%	$685	$685
	Sub-Total						**$10,471**
3.4	**Reclamation Overburden Dump**						
	Final Dump Surface Recontouring	Dozer D6LGP	hrs	60	$169	$10,164	**$10,164**
3.5	**Grade Bin Disposal Area**						
	Move material to Area 1 Pit	988B Loader	hrs	1900	$258	$489,357	$489,357
		D9H Dozer	hrs	400	$268	$107,200	$107,200
		773 Haul Truck	hrs	5700	$268	$1,527,600	$1,527,600
	Project Management & Engineering	7% of Total Cost	%		7.00%	$148,691	$148,691
	Sub-Total						**$2,272,848**
3.7	**Contractor's Shop and Work Area**						
	Remove salvageable equipment	General Labourer	hrs	60	$48	$2,893	
		Haul Truck D250E	hrs	20	$227	$4,533	
		Trades Labourer	hrs	48	$86	$4,114	$11,540
	Dismantle buildings	General Labourer	hrs	60	$48	$2,893	
		30 ton Crane	hrs	10	$165	$1,648	
		Cat 235 Excavator	hrs	30	$247	$7,418	$11,959
	Haul building pieces off site - equipment	Tractor Trailer (lowbed)	hrs	20	$134	$2,679	$2,679
	Scrap haul to site landfill	Haul Truck D250E	hrs	20	$227	$4,533	$4,533
	Bury footings - haul and place fill, locally sourced	Unit basis (footing burial)	each	2500	$5.08	$12,688	$12,688
	Recontour	D9H Dozer	hrs	15	$268	$4,018	$4,018
	Haul and place overburden for revegetation	Custom Rate C (Load, haul and place IROD - CSA)	cu.m.	5000	$5.13	$25,629	$25,629
	Project Management & Engineering	7% of Total Cost	%		7.00%	$5,113	$5,113
	Sub-Total						**$78,158**
3.8	**Contaminated Soils - Transport to LTF**						
		Unit basis	l.s.	1	$5,000	$5,000	**$5,000**
3.9	**Mill Valley Fill**						
	Roll crest and recontour	D9H Dozer	hrs	30	$268	$8,036	$8,036
	Haul and place overburden for revegetation	Load, Haul and place soil cover MWD	cu.m.	25500	$10.63	$271,065	$271,065
	Excavation of spillway channel	Cat 235 Excavator	hrs	120	$240	$28,800	$28,800
		D9H Dozer	hrs	120	$268	$32,143	$32,143
	Provision for placement of rip rap	Rip rap from local area to MVF	cu.m.	5000	$15	$75,000	$75,000
	Project Management & Engineering	7% of Total Cost	%		7%	$29,053	$29,053
	Sub-Total						**$444,097**
Total Estimated Cost in Reclaiming Overburden and Waste Rock Dumps							**$6,083,050**

Note:

The Dozer D6LGP (item 3.4) unit rate was obtained from the Canadian Blue Book value and then inflated by 10% for the Yukon, prior to 8 yrs inflation of 1.5% compounded annually.

Item 3.5 quantities were estimated to move 930,000 t using two haul trucks and 1 loader. The material bordering the pit can be moved solely using the loader.

MINTO MINE CLOSURE COSTING

Table 8-4

Open Pit, Underground and Haul Roads, Estimated Closure Costs - End of Mine Life

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	OPEN PIT, UNDERGROUND AND HAUL ROADS						
4.1	**Area 1 Pit**						
	Remove pit pumps and pipe column/general cleanup	General Labourer	hrs	80	$48	$3,857	
		Trades Labourer	hrs	20	$86	$1,714	
		Support equipment	l.s.		$1,000	$1,000	$6,571
	Secure pit access - boulder placement	Cat 235 Excavator	hrs	20	$247	$4,945	
		Haul Truck D250E	hrs	20	$227	$4,533	$9,478
	Construct exit channel into Mill Pond system	Cat 235 Excavator	hrs	20	$247	$4,945	
	Highwall perimeter safety berm/trench (~1km)	Cat 235 Excavator	hrs	40	$247	$9,880	$9,880
	Riprap shoulder exiting pit	Place Riprap	cu.m	50	$15	$750	
	Exit Spillway construction	General Labourer	hrs	10	$48	$482	
		Load and Haul Rip Rap	cu.m	50	$13	$634	$16,692
	Construct Passive Treatment System						
	Organic carbon source (to site or chipped at site)	Haulage and handling	l.s.		$75,000	$75,000	
	Clean (< 0.1% Cu) Waste Rock for Construction	Haulage and handling	l.s.		$25,000	$25,000	
	Construction of treatment area	Cat 235 Excavator	hrs	160	$247	$39,561	
		Haul Truck D250E	hrs	160	$227	$36,264	
		General Labourer	hrs	200	$48	$9,600	$185,425
	Project Management & Engineering	7% of Total Cost	%		7.00%	$15,272	$15,272
	Sub-Total						**$243,317**
4.2	**Area 2 Pit**						
	Remove pit pumps and pipe column/general cleanup	General Labourer	hrs	80	$48	$3,857	
		Trades Labourer	hrs	20	$86	$1,714	
		Support equipment	l.s.		$1,000	$1,000	$6,571
	Secure pit access - boulder placement	Cat 235 Excavator	hrs	20	$247	$4,945	
		Haul Truck D250E	hrs	20	$227	$4,533	$9,478
	Construct exit channel into Mill Pond system	Cat 235 Excavator	hrs	20	$247	$4,945	
	Riprap shoulder exiting pit	Place Riprap	cu.m	50	$15	$750	
	Exit Spillway construction	General Labourer	hrs	40	$48	$1,929	
		Load and Haul Rip Rap	cu.m	250	$13	$3,172	$10,796
	Project Management & Engineering	7% of Total Cost	%		7.00%	$1,879	$1,879
	Sub-Total						**$28,724**
4.3	**Area 118 Pit**						
	Remove pit pumps and pipe column/general cleanup	General Labourer	hrs	60	$48	$2,893	
		Trades Labourer	hrs	15	$86	$1,286	
		Support equipment	l.s.		$750	$750	$4,929
	Secure pit access - boulder placement	Cat 235 Excavator	hrs	15	$247	$3,709	
		Haul Truck D250E	hrs	15	$227	$3,400	$7,109
	Construct exit channel into Mill Pond system	Cat 235 Excavator	hrs	15	$247	$3,709	
	Riprap shoulder exiting pit	Place Riprap	cu.m	37.5	$15	$563	
	Exit Spillway construction	General Labourer	hrs	30	$48	$1,446	
		Load and Haul Rip Rap	cu.m	187.5	$13	$2,379	$8,097
	Haul and place overburden for revegetation	Load, Haul and place soil cove	cu.m.	7500	$4.30	$32,250	$32,250
	Project Management & Engineering	7% of Total Cost	%		7.00%	$1,409	$1,409
	Sub-Total						**$53,793**
4.4	**Haul Roads (15 ha)**						
	Remove culverts and haul away	General Labourer	hrs	55	$48	$2,670	
		Cat 235 Excavator	hrs	28	$247	$6,847	
		Haul Truck D250E	hrs	28	$227	$6,276	$15,794
	Recontour slopes	D9H Dozer	hrs	208	$268	$55,632	$55,632
	Scarify surfaces	Cat 16H grader	hrs	208	$227	$47,073	
		General Labourer	hrs	28	$48	$1,335	$48,409
	Stabilize slopes - erosion barriers - material	Unit Cost Basis	sq.m	2,769	$3	$8,308	$8,308
	Project Management & Engineering	7% of Total Cost	%		7.00%	$8,970	$8,970
	Sub-Total						**$137,112**
4.5	**Underground**						
	Backfill underground waste	Load and haul material	cu.m	70,000	$4.16	$291,200	**$291,200**
	Recontour slopes	D9H Dozer	hrs	12	$268	$3,214	**$3,214**
	Seal off underground portal		l.s.	1	$10,000	$10,000	**$10,000**
	Seal off ventilation raise	Cat 235 Excavator	hrs	12	$247	$2,967	**$2,967**
		Haul Truck D250E	hrs	2	$227	$453	**$453**
	Rip and scarify road	Cat 16H grader	hrs	8	$227	$1,813	**$1,813**
	Project Management & Engineering	7% of Total Cost	%		7.00%	$21,309	**$21,309**
	Sub-Total						**$330,957**
Total Estimated Cost in Reclaiming Open Pit and Haul Roads							**$793,904**

Note:

Linear disturbances to be scarified / decompacted and allowed to naturally revegetate

Ventilation raise to be sealed by dumping rocks down raise until a bridge is formed and it fills to surface. Portal allowance assumes installation of bulkhead with locked door should access be

MINTO MINE CLOSURE COSTING

Table 8-5

Tailings Area & Diversion Structures, Estimated Closure Costs - End of Mine Life

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	TAILINGS AREA						
5.1	**Tailings Deposit - Final Lift**						
	Roll crest of starter bench and recontour	D9H Dozer	hrs	50	$268	$13,393	$13,393
	Haul overburden ROD - DSTF	Custom Haul Rate	cu.m	191200	$5.80	$1,108,960	$1,108,960
	Project Management & Engineering	7% of Total Cost	%		7.00%	$78,565	$78,565
	Sub-Total						**$1,200,918**
5.2	**South Diversion Ditch**						
	Widen south diversion ditch	D9H Dozer	hrs	50	$268	$13,393	$13,393
		Cat 235 Excavator	hrs	20	$247	$4,945	$4,945
	Haul and place riprap	Load and Haul Rip Rap	cu.m	1200	$13	$15,225	
		Place Riprap	cu.m	1200	$15	$18,000	$33,225
	HDPE liner	Unit rate	sq.m	2400	$10	$24,000	$24,000
		General Labourer	hrs	80	$48	$3,857	$3,857
	Project Management & Engineering	7% of Total Cost	%		7.00%	$5,559	$5,559
	Sub-Total						**$84,980**
Total Estimated Cost in Reclaiming Tailings Area							**$1,285,897**

Note:

Material to provide soil cover for the dry stack tailings will be sourced from the Area 2 Pit.

MINTO MINE CLOSURE COSTING

Table 8-6

Main Water Dam, Estimated Closure Costs - End of Mine Life

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	WATER DAM						
6.1	**Reclaim System**						
	Remove salvageable equipment - pipeline/pumps	General Labourer	hrs	48	$48	$2,314	
		Trades Labourer	hrs	98	$86	$8,400	$10,714
	Remove pipeline	Haul Truck D250E	hrs	100	$227	$22,665	
		Cat 235 Excavator	hrs	100	$247	$24,725	
		General Labourer	hrs	200	$48	$9,643	$57,033
	Dismantle Building	Cat 235 Excavator	hrs	16	$247	$3,956	
		Trades Labourer	hrs	10	$86	$860	
		General Labourer	hrs	20	$48	$964	$5,780
	Misc. Supplies & Tools	Misc.	l.s.		$1,000	$1,000	$1,000
	Recontour alignment	D9H Dozer	hrs	16	$268	$4,286	$4,286
	Project Management & Engineering	7% of Total Cost	%		7.00%	$5,517	$5,517
	Sub-Total						**$84,331**
6.2	**Main Dam**						
	Pump down impounded water, over spillway (using reclaim pumps)	General Labourer	hrs	96	$48	$4,629	$4,629
	Misc. Supplies & Tools	Misc.	l.s.		$5,000	$5,000	$5,000
	Build coffer dam and install pump-around system Operate system until new structure is ready	Misc.	l.s.		$10,000	$10,000	$10,000
	Engineering design for final structure include appropriate flow determination, channel designs, etc.	Misc.	l.s.	1	$20,000	$20,000	$20,000
	Stockpile rip rap from downstream shell	Unit Cost Basis	cu.m	10,000	$10	$100,000	$100,000
	Breach Dam: push material using dozer into new areas	Custom Rate E (Push from MWD - U/S MWD)	cu.m	25,000	$2	$54,556	
	and load, haul & dump and contour material in new area	Unit Cost Basis	cu.m	31,000	$4.50	$139,500	
		Environmental Scientist	hrs	60	$101.79	$6,107	$200,163
	Construct stream channel at original grade - haul and place rip rap	Unit Cost Basis	cu.m	1,125	$3	$3,375	
		Unit Cost Basis	cu.m	1,125	$9	$10,125	$13,500
	Haul and place overburden on slopes of new area u/s of MWD	Unit Cost Basis	cu.m	15,000	$2	$30,000	$30,000
	Stabilize slopes with erosion barriers	Unit Rates	per sq. m	15,000	$3	$45,000	$45,000
	Misc. Supplies & Tools	Misc.	l.s.		$3,000	$3,000	$3,000
	Excavate passive wetland polishing system	Cat 235 Excavator	hrs	80	$247	$19,760	
		Haul Truck D250E	hrs	120	$227	$27,198	
	Place rip-rap for wetland outflow erosion protection	Unit Cost Basis	cu.m	250	$10	$2,500	
	Organic carbon source (to site or chipped at site)	Misc.	l.s.		$30,000	$30,000	
	Wetland vegetation purchase and planting + minor amount of grass seeding	Misc.	l.s.		$15,000	$15,000	$94,458
	Project Management & Engineering	7% of Total Cost	%		7.00%	$30,190	$30,190
	Sub-Total						**$555,940**
Total Estimated Cost in Reclaiming Water Dam							**$640,271**

MINTO MINE CLOSURE COSTING

Table 8-7

Mill &Ancillary Facilities, Estimated Closure Costs - End of Mine Life

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	MILL AND ANCILLARY FACILITIES						
7.1	**Mill Building**						
	Remove salvageable equipment	General Labourer	hrs	550	$48	$26,518	
		Trades Labourer	hrs	600	$86	$51,429	
		Crane Support	hrs	40	$145	$5,800	$83,747
	Decontaminate Building-hosing and clean-up	Trades Labourer	hrs	160	$86	$13,714	$13,714
	Dismantle Building	General Labourer	hrs	1000	$48	$48,215	
		Trades Labourer	hrs	600	$86	$51,429	
		Cat 235 Excavator w hammer	hrs	120	$283	$33,997	
		Crane Support	hrs	60	$145	$8,700	$142,341
	Concrete Demolition	Blaster	hrs	40	$64	$2,571	
		Cat 235 Excavator	hrs	20	$247	$4,945	
		D9H Dozer	hrs	20	$268	$5,357	$12,874
	Misc. Supplies & Tools	Misc.	l.s.		$11,000	$11,000	$11,000
	Scrap haul to solid waste facility	Cat 235 Excavator	hrs	50	$247	$12,363	
		Haul Truck D250E	hrs	100	$227	$22,665	$35,028
	Project Management & Engineering	7% of Total Cost	%		7.00%	$20,909	$20,909
	Subtotal:						**$319,613**
		Subtract 50% for Salvage Value					**$159,806**
7.2	**Generator & Filter Buildings & Concentrate Shed**						
	Remove salvageable equipment	General Labourer	hrs	240	$48	$11,571	
		Trades Labourer	hrs	240	$86	$20,572	$32,143
		Crane Support	hrs	24	$145	$3,480	
	Salvage and remove powerline and poles		l.s.		$27,500	$27,500	$30,980
	Dismantle Buildings	General Labourer	hrs	160	$48	$7,714	
		Trades Labourer	hrs	80	$86	$6,857	
		Cat 235 Excavator w hammer	hrs	40	$283	$11,332	
		Crane Support	hrs	30	$145	$4,350	$30,254
	Concrete Demolition	Blaster	hrs	40	$64	$2,571	
		Cat 235 Excavator	hrs	20	$247	$4,945	
		D9H Dozer	hrs	20	$268	$5,357	$12,874
	Misc. Supplies & Tools	Misc.	l.s.		$10,000	$10,000	$10,000
	Scrap haul to solid waste facility	Cat 235 Excavator	hrs	10	$247	$2,473	
		Haul Truck D250E	hrs	20	$227	$4,533	$7,006
	Project Management & Engineering	7% of Total Cost	%		7.00%	$8,628	$8,628
	Subtotal:						**$131,884**
		Subtract 50% for Salvage Value					**$65,942**
7.3	**Fuel Storage Area**						
	Cleanout tanks-remove sludge, pressure wash	General Labourer	hrs	60	$48	$2,893	
		Removal to Licensed facility	l.s.		$10,000	$10,000	$12,893
	Remove bulk fuel storage and piping facilities	General Labourer	hrs	100	$48	$4,821	
		Trades Labourer	hrs	120	$86	$10,286	
		Crane Support	hrs	30	$145	$4,350	
		Support Equipment	l.s.		$2,500	$2,500	
		Cat 235 Excavator	hrs	40	$247	$9,890	
		General Labourer	hrs	40	$48	$1,929	
		Tractor Trailer (lowbed)	hrs	30	$134	$4,018	$37,794
	Fold and Bury Liner	Cat 235 Excavator	hrs	20	$247	$4,945	
		D9H Dozer	hrs	100	$268	$26,786	$31,731
	Project Management & Engineering	7% of Total Cost	%		7.00%	$5,769	$5,769
	Subtotal:						**$88,187**
7.4	**Mill Reagents**						
	Load and return extra reagents/chemicals	General Labourer	hrs	100	$48	$4,821	
		Support Equipment	l.s.		$2,500	$2,500	
		Disposal Cost-bulk materials	l.s.		$5,000	$5,000	
		Disposal Cost-lab-pacs	pallets	2	$2,000	$4,000	$16,321
	Removal of drums, steel, oils, glycol & batteries, as per 09July quote from General Waste Management to MEL	Contractor quote	l.s.		$50,900	$50,900	$50,900
	Project Management & Engineering	7% of Total Cost	%		7.00%	$1,143	$1,143
	Subtotal:						**$68,364**
7.5	**Reclaim Entire Mill Site Area**						
	Test soils for contamination	Environmental Scientist	hrs	35	$102	$3,563	
		Analytical Costs	l.s.		$6,000	$6,000	$9,563
	Haul any contaminated soils to Land Treatment Facility	Cat 235 Excavator	hrs	15	$247	$3,709	
		Haul Truck D250E	hrs	15	$227	$3,400	$7,109
	Re-contour area and slopes to bury footings and establish drainage	D9H Dozer	hrs	100	$268	$26,786	$26,786
	Haul and place overburden cap	Unit Rate	cu.m	38000	$5.50	$209,000	$209,000
	Project Management & Engineering	7% of Total Cost	%		7.00%	$17,672	$17,672
	Subtotal:						**$270,129**
Total Estimated Cost in Reclaiming Mill and Ancillary Facilities							**$652,428**

MINTO MINE CLOSURE COSTING

Table 8-8

Mill Water Pond, Estimated Closure Costs - End of Mine Life

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	MILL POND						
8.1	**Reclaim Mill Pond**						
	Remove upstream culvert	General Labourer	hrs	10	$48	$482	
		Cat 235 Excavator	hrs	10	$247	$2,473	$2,955
	Construct channel	Cat 235 Excavator	hrs	100	$247	$24,725	
		D9H Dozer	hrs	20	$268	$5,357	$30,083
		Load and Haul Rip Rap	cu.m	5,000	$13	$63,438	$63,438
		General Labourer	hrs	20	$48	$964	$964
		Place Riprap	cu.m	5,000	$15	$75,000	$75,000
	Project Management & Engineering	7% of Total Cost	%		7.00%	$12,071	$12,071
	Subtotal:						**$184,510**
Total Estimated Cost in Reclaiming Mill Pond							**$184,510**

Note:

MINTO MINE CLOSURE COSTING

Table 8-9

Main Access Road, Estimated Closure Costs - End of Mine Life

Scenario 1 - No Road Deactivation

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
9.1	**NO ROAD DECOMMISSIONING REQUIRED**						
9.1.1	**Road Surface**						
	Install road barrier at west side of Minto Creek	Misc	l.s.		$2,000	$2,000	$2,000
	Project Management & Engineering	7% of Total Cost	%		7.00%	$140	$140
	Subtotal:						**$2,140**
Total Estimated Cost for Access Road Closure (Scenario 1)							**$2,140**

Scenario 2 - Decommission Access Road From Minto Creek to Mine Site (11 KM)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
9.2	**ACCESS ROAD - 11 KM SECTION**						
9.2.1	**Road Surface**						
	Scarify - 11 km	Cat 16H grader	hrs	70	$227	$15,865	$15,865
	Recontour slopes and drainage	Cat 235 Excavator	hrs	25	$247	$6,181	$6,181
	Project Management & Engineering	7% of Total Cost	%		7.00%	$1,111	$1,111
	Subtotal:						**$23,157**
9.2.2	**Culverts**						
	Culvert excavation (40 small culverts)	Cat 235 Excavator	hrs	100	$247	$24,725	$24,725
	Culvert removal	General Labourer	hrs	140	$48	$6,750	
		Haul Truck D250E	hrs	100	$227	$22,665	$29,415
	Minto Creek Culvert Removal & Streambank Restoration	Trades Labourer	hrs	40	$86	$3,429	
		General Labourer	hrs	75	$48	$3,616	
		Cat 235 Excavator	hrs	40	$247	$9,890	$16,935
	Recontour slopes and drainage	D9H Dozer	hrs	70	$268	$18,750	$18,750
	Stabilize slopes	General Labourer	hrs	200	$48	$9,643	
	Erosion barriers	Unit Cost Basis	per sq. m	500	$3.00	$1,500	$11,143
	Project Management & Engineering	7% of Total Cost	%		7.00%	$7,068	$7,068
	Subtotal:						**$108,036**
Total Estimated Cost for Access Road Closure (Scenario 2)							**$131,193**

Scenario 3 - Decommission Entire Access Road (27 KM)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
9.3	**ACCESS ROAD - 27 KM SECTION**						
9.3.1	**Road Surface**						
	Scarify - 27 km	Cat 16H grader	hrs	150	$227	$33,997	$33,997
	Recontour slopes and drainage	Cat 235 Excavator	hrs	50	$247	$12,363	$12,363
	Project Management & Engineering	7% of Total Cost	%		7.00%	$3,245	$3,245
	Subtotal:						**$49,605**
9.3.2	**Big Creek Bridge**						
	Remove bridge decking and span	General Labourer	hrs	50	$48	$2,411	
		Crane	hrs	40	$145	$5,800	
		Cat 235 Excavator	hrs	40	$247	$9,890	
		Tractor Trailer (lowbed)	hrs	20	$134	$2,679	$20,779
	Cut off piles	General Labourer	hrs	50	$48	$2,411	$2,411
	Re-contour	Cat 235 Excavator	hrs	30	$247	$7,418	
		D9H Dozer	hrs	30	$268	$8,036	$15,453
	Project Management & Engineering	7% of Total Cost	%		7.00%	$2,705	$2,705
	Subtotal:						**$41,349**
9.3.3	**Barge Ramps**						
	Remove all gravel	Cat 235 Excavator	hrs	20	$247	$4,945	$4,945
	Re-countour areas and scarify	D9H Dozer	hrs	30	$268	$8,036	$8,036
	Shoreline restoration	Misc.	l.s.		$5,000	$5,000	$5,000
	Project Management & Engineering	7% of Total Cost	%		7.00%	$1,259	$1,259
	Subtotal:						**$19,239**
9.3.4	**Culverts**						
	Culvert excavation (45 small culverts)	Cat 235 Excavator	hrs	115	$247	$28,434	$28,434
	Culvert removal	General Labourer	hrs	150	$48	$7,232	
		Haul Truck D250E	hrs	115	$227	$26,065	$33,297
	Minto Creek Culvert Removal & Streambank Restoration	Trades Labourer	hrs	40	$86	$3,429	
		General Labourer	hrs	75	$48	$3,616	
		Cat 235 Excavator	hrs	40	$247	$9,890	$16,935
	Recontour slopes and drainage	D9H Dozer	hrs	70	$268	$18,750	$18,750
	Stabilize slopes	General Labourer	hrs	200	$48	$9,643	
	Erosion barriers	Unit Cost Basis	per sq. m.	1,000	$3	$3,000	$12,643
	Project Management & Engineering	7% of Total Cost	%		7.00%	$7,704	$7,704
	Subtotal:						**$117,763**
Total Estimated Cost for Access Road Closure (Scenario 3)							**$227,956**

Note:

Table 8-10
Miscellaneous Sites and Facilities, Estimated Closure Costs - End of Mine Life

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	MISCELLANEOUS SITES AND FACILITIES						
10.1	**Airstrip**						
	Scarify airstrip	Cat 16H Grader	hrs	40	$227	$9,066	$9,066
	Project Management & Engineering	7% of Total Cost	%		7.00%	$635	$635
	Natural revegetation	n/a	n/a				
	Subtotal:						**$9,701**
10.2	**Mine Camp and Related Infrastructure**						
	Disconnect Services	Trades Labourer	hrs	80	$86	$6,857	$6,857
	Remove salvageable equipment	General Labourer	hrs	704	$48	$33,943	$33,943
	Dismantle buildings	General Labourer	hrs	1200	$48	$57,857	
		Cat 235 Excavator	hrs	120	$247	$29,670	$87,528
	Haul scrap to Solid Waste Facility	Haul Truck D250E	hrs	20	$227	$4,533	
		Cat 235 Excavator	hrs	10	$247	$2,473	$7,006
	Reclaim Septic System	General Labourer	hrs	10	$48	$482	
		Cat 235 Excavator	hrs	2	$247	$495	$977
	Site Clean-Up	General Labourer	hrs	500	$48	$24,107	$24,107
	Project Management & Engineering	7% of Total Cost	%		7.00%	$10,749	$10,749
	Subtotal:						**$171,167**
							$85,583
10.3	**Explosives Plant Site**						
	Remove salvageable equipment	General Labourer	hrs	100	$48	$4,821	
		Trades Labourer	hrs	50	$86	$4,286	$9,107
	Dismantle buildings	General Labourer	hrs	200	$48	$9,643	
		Cat 235 Excavator	hrs	30	$247	$7,418	$17,061
	Disconnect Services	Trades Labourer	hrs	20	$86	$1,714	$1,714
	Crane services	30 ton Crane	hrs	5	$165	$824	$824
	Haul scrap to Solid Waste Facility	Haul Truck D250E	hrs	30	$227	$6,799	
		Cat 235 Excavator	hrs	10	$247	$2,473	$9,272
	Project Management & Engineering	7% of Total Cost	%		7.00%	$2,658	$2,658
	Subtotal:						**$40,637**
							$20,318
10.4	**Exploration Sites and Trails**						
	Natural revegetation	n/a	n/a				
	Subtotal:						**$0**
10.5	**Land Treatment Facility**						
	Prepare and submit closure plan	Misc	l.s.		$2,000	$2,000	$2,000
	Characterize final soil hydrocarbon concentrations	Misc	l.s.		$3,000	$3,000	$3,000
	Recontour	D9H Dozer	hrs	2	$268	$536	$536
	Haul and place overburden cap from nearby	Cat 235 Excavator	hrs	20	$247	$4,945	
		Haul Truck D250E	hrs	20	$227	$4,533	
		D9H Dozer	hrs	6	$268	$1,607	$11,085
	Project Management & Engineering	7% of Total Cost	%		7.00%	$1,163	$1,163
	Subtotal:						**$17,784**
10.6	**Solid Waste Facility**						
	Prepare detailed closure plan	Misc	l.s.		$2,000	$2,000	$2,000
	Characterize final waste area	Misc	l.s.		$2,000	$2,000	$2,000
	Remove recyclables and special waste materials	Tractor Trailer (lowbed)	hrs	40	$134	$5,357	$5,357
	Recontour	D9H Dozer	hrs	2	$268	$536	$536
	Haul and cover with adjacent fill and place overburden cap	Cat 235 Excavator	hrs	20	$247	$4,945	
		Haul Truck D250E	hrs	20	$227	$4,533	
	Compaction of cover	D9H Dozer	hrs	6	$268	$1,607	$11,085
	Project Management & Engineering	7% of Total Cost	%		7.00%	$1,468	$1,468
	Subtotal:						**$22,447**
10.7	**Site Roads**						
	Recontour	Cat 235 Excavator	hrs	30	$247	$7,418	$7,418
	Scarify	Cat 16H Grader	hrs	40	$227	$9,066	$9,066
	Project Management & Engineering	7% of Total Cost	%		7.00%	$1,154	$1,154
	Subtotal:						**$17,637**
Total Estimated Cost in Reclaiming Miscellaneous Sites and Facilities							**$173,471**

Note:
Land treatment facility is a licensed facility and will be reclaimed as per license terms and conditions

MINTO MINE CLOSURE COSTING

Table 8-11

Reclamation Research and Revegetation, Estimated Closure Costs - End of Mine Life

Item No.	Work Item Description	Units	Quantity	Unit Rates	Cost	Total Adjusted
11.1	**REVEGETATION ACTIVITIES**					
11.1.0	**Determination of Revegetation Plan for Current Site**					
	Issuance of a plan for all site areas for regulatory review and approval	Misc	1	$20,000	$20,000	$20,000
	Sub-Total					**$20,000**
11.1.1	**Main and Southwest Dumps (total surface area of 117.5 ha)**					
	Seed and fertilize w/ labour	ha	117.5	$2,400	$282,000	
	Re-seed and fertilize (1/2 of total area)	ha	58.8	$2,400	$141,000	
	Re-forest	ha	117.5	$1,750	$205,625	$628,625
	Sub-Total					**$628,625**
11.1.2	**Ice-Rich Overburden Dump (toe berm surface area of 6.9ha)**					
	Seed and fertilize w/ labour	ha	6.9	$2,400	$16,560	
	Re-seed and fertilize (1/2 of total area)	ha	3.5	$2,400	$8,280	
	Re-forest	ha	6.9	$1,750	$12,075	$36,915
	Sub-Total					**$36,915**
11.1.3	**Reclamation Overburden Dump (total surface area of 30 ha)**					
	Seed and fertilize w/ labour	ha	30.0	$2,400	$72,000	
	Re-seed and fertilize (1/2 of total area)	ha	15.0	$2,400	$36,000	
	Re-forest	ha	30.0	$1,750	$52,500	$160,500
	Sub-Total					**$160,500**
11.1.4	**Ore Stockpiles and Pads (final total surface area of 15.7 ha)**					
	Seed and fertilize w/ labour	ha	15.7	$2,400	$37,680	
	Re-seed and fertilize (1/2 of total area)	ha	7.9	$2,400	$18,840	
	Re-forest	ha	15.7	$1,750	$27,475	$83,995
	Sub-Total					**$83,995**
11.1.5	**Mill Valley Fill (8 ha)**					
	Seed and fertilize w/ labour	ha	8.0	$2,400	$19,200	
	Re-seed and fertilize (1/2 of total area)	ha	4.0	$2,400	$9,600	
	Re-forest	ha	8.0	$1,750	$14,000	$42,800
	Sub-Total					**$42,800**
11.1.6	**Contractor's Shop and Office Area (disturbed area of 2.5 ha)**					
	Seed and fertilize w/ labour	ha	2.5	$2,400	$6,000	
	Re-seed and fertilize (1/2 of total area)	ha	1.3	$2,400	$3,000	
	Re-fertilize only (1/2 total area - re-seed area)	ha	0.0	$1,900	$0	
	Re-forest	ha	2.5	$1,750	$4,375	$13,375
	Sub-Total					**$13,375**
11.1.7	**Tailings Area current disturbed area of 30.2 ha)**					
	Seed and fertilize w/ labour	ha	30.2	$2,400	$72,480	
	Re-seed and fertilize (1/2 of total area)	ha	15.1	$2,400	$36,240	
	Re-forest	ha	30.2	$1,750	$52,850	$161,570
	Sub-Total					**$161,570**
11.1.8	**Main Water Dam (total dam surface area 3.3 ha)**					
	Seed and fertilize w/ labour	ha	3.3	$2,400	$7,920	
	Re-seed and fertilize (1/2 of total area)	ha	1.7	$2,400	$3,960	
	Re-forest	ha	3.3	$1,750	$5,775	$17,655
	Sub-Total					**$17,655**
11.1.9	**Mill Area (total surface area of 7.6 ha)**					
	Seed and Fertilize w/ labour	ha	7.6	$2,400	$18,240	
	Re-seed and fertilize (1/2 of total area)	ha	3.8	$2,400	$9,120	
	Re-forest	ha	7.6	$1,750	$13,300	$40,660
	Subtotal:					**$40,660**
11.1.10	**Haul Road (total surface area of 15 ha)**					
		ha	15.0	$2,400	$36,000	**$36,000**
11.1.11	**Underground (total surface area of 20.2 ha)**					
	Seed and fertilize w/ labour	ha	20.2	$2,400	$48,480	
	Re-seed and fertilize (1/2 of total area)	ha	10.1	$2,400	$24,240	
	Re-forest	ha	20.2	$1,750	$35,350	$108,070
	Subtotal:					**$108,070**
11.1.12	**Miscellaneous Sites - Camp, Airstrip, Waste Facilities, Explosives Site (area for reclamation of 10.3 ha)**					
	Seed and fertilize w/ labour	ha	10.3	$2,400	$24,720	
	Re-seed and fertilize (1/2 of total area)	ha	5.2	$2,400	$12,360	
	Re-forest	ha	10.3	$1,750	$18,025	$55,105
	Subtotal:					**$55,105**
11.1.13	**Access Road**					
	Scenario 1 - No Deactivation					
	No revegetation					
	Subtotal:					**$0**
	Scenario 2 - Deactivate from Minto Creek to Mine Site					
	Revegetate and fertilize banks at culvert excavations, including labour	ha	2.0	$2,400	$4,800	$4,800
	Subtotal:					**$4,800**
	Scenario 3 - Deactivate Entire Road					
	Revegetate and fertilize banks at culvert excavations, including labour	ha	6.0	$2,400	$14,400	$14,400
	Subtotal:					**$14,400**
Total Estimated Cost for Reclamation Research and Revegetation						
	Scenario 1 - No Access Road Deactivation					**$1,405,270**
	Scenario 2 - Deactivate Access Road from Minto Creek to Mine Site					**$1,410,070**
	Scenario 3 - Deactivate Entire Access Road					**$1,419,670**

MINTO MINE CLOSURE COSTING

Table 8-12

Site Management and Monitoring, Estimated Closure Costs - End of Mine Life

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Cost	Total Adjusted
	SITE MANAGEMENT						
12.1	**Onsite Management**						
	Project Management and Engineering - Included in PME Costs in each Closure Component						
	Pickup truck	Light truck	monthly	50	$2,500	$125,000	$125,000
	Sundry equipment maintenance	Unit Cost Basis	yearly	10	$5,000	$50,000	$50,000
	Power and heat	Unit Cost Basis	monthly	30	$5,500	$165,000	$165,000
	General Administrative expenses	Unit Cost Basis	monthly	50	$2,000	$100,000	$100,000
	Camp Costs (5 year period)	Unit Cost Basis	man-day	5580	$60	$334,800	$334,800
	Subtotal:						**$774,800**
12.2	**Transport Costs**						
	Employee transport costs	Unit Cost Basis	monthly	50	$3,000	$150,000	$150,000
	Barge operating costs	Unit Cost Basis	monthly	20	$10,000	$200,000	$200,000
	Subtotal:						**$350,000**
12.3	**Water Treatment and Compliance Monitoring incl. Reporting**						
	Active - Treatment, operating costs (4 years) incl. staff, reagents		monthly	12	$87,000	$1,044,000	$1,044,000
	Cost per cubic metre of compliant water (0.01 ppm Cu) (4 years)		cu.m	1440000	$0.40	$576,000	$576,000
	Subtotal:						**$1,620,000**
12. 4	**Water Quality Monitoring (Post Mine Closure) (50:50 sampling labour/analyses costs split)**						
	Years 1-5 (monthly during open season)	Misc.	monthly	30	$3,000	$90,000	
	Years 6-10 (quarterly - spring/summer/fall)	Misc.	quarterly	15	$3,000	$45,000	
	Years 11-15 (once annually - post spring freshet)	Misc.	yearly	5	$3,000	$15,000	$150,000
	Disbursements (non-labour/non-analytical)	Misc.	l.s.	15	$3,000	$45,000	$45,000
	LTF Monitoring and Maintenance (years 1-5)	Misc.	yearly	5	$3,500	$17,500	$17,500
	Enhanced Groundwater/Foundation monitoring below TF and Waste Rock Dumps	Misc.	yearly	15	$5,000	$75,000	$75,000
	Geo-technical Inspections (annually yrs 1-5, bi-annual yrs 6-15)	Misc.	l.s.	10	$5,000	$50,000	$50,000
	Reclamation Inspections (annually yrs 1-5, bi-annual yrs 6-15)	Misc.	l.s.	10	$5,000	$50,000	$50,000
	Biological Monitoring - Closure implementation	Misc.	l.s.	1	$9,000	$9,000	
	Years 1-5 (Annually)	Misc.	yearly	5	$3,000	$15,000	
	Years 6-10 (Annually)	Misc.	yearly	5	$3,000	$15,000	
	Years 11-15 (Every two years)	Misc.	bi-annual	3	$2,500	$7,500	$46,500
	Subtotal:						**$434,000**
12.5	**Post Closure Maintenance - Main Dam**						
	Monitoring of piezometers, thermistors						
	Years 1-5 (quarterly)	Misc.	quarterly	20	$3,000	$60,000	
	Years 6-10 (bi-annually)	Misc.	bi-annually	8	$3,000	$24,000	
	Years 11-15 (annually)	Misc.	annual	5	$2,500	$12,500	
	Annual Inspection + report	Misc.	annual	15	$3,000	$45,000	
	Carry out inspection recommendations/maintenance	Misc.	annual	15	$10,000	$150,000	$291,500
	Misc. maintenance work related to the site after closure (Yr1-5)	Misc.	yearly	5	$10,000	$50,000	$50,000
	Misc. maintenance work related to the site after closure (Yr6-15)	Misc.	per year	10	$5,000	$50,000	$50,000
	Subtotal:						**$391,500**
12.6	**Ulitmate Removal of wells and instrumentation**	Misc.	unit basis		$15,000	$15,000	**$15,000**
Total Estimated Cost for Post Closure Site Management							**$3,585,300**

Note:

Camp Costs calculation based on "Table 7-1 Site Decommissioning and Reclamation Seasonal Personnel Requirements" using a 90 day work year

Inflation rates vary per subtask depending upon the year expenses are incurred or the average year over which expenses are incurred

MINTO MINE CLOSURE COSTING

Table 8-13

Supporting Studies, Estimated Closure Costs - End of Mine Life

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Inflated Unit Rates	Cost	Total Adjusted
13.1	**Permafrost Foundation Monitoring**							
13.1.1	Enhanced subsurface monitoring program in and below waste rock dumps (WRD)							
	preparing detailed monitoring program	Misc.	l.s.		$8,000	$8,000	$8,000	
	undertake additional monitoring as per program(covered in T. 12)	Misc.	yearly		$7,000	$7,000	$7,000	$15,000
	Enhanced Adaptive Management Plan for WRD	Misc.	l.s.	1	$8,000	$8,000	$8,000	$8,000
13.1.2	Enhanced subsurface monitoring program in and below Tailings Facility (TF)							
	preparing detailed monitoring program	Misc.	l.s.		$4,000	$4,000	$4,000	
	undertake additional monitoring as per program (covered in T. 12)	Misc.	yearly	1	$3,500	$3,500	$3,500	$7,500
	Enhanced Adaptive Management Plan for TF	Misc.	l.s.	1	$4,000	$4,000	$4,000	$4,000
	Subtotal:							**$34,500**
13.2	**Kinetic Tailings Testing**							
13.2.1	Monitoring program and field test to enhance long term water quality prediction related to drystack tailings facility							
	preparing composite sample over several months of production	Misc.	l.s.		$5,000	$5,000	$5,000	$5,000
	undertaking field test	Misc.	l.s.		$12,000	$12,000	$12,000	
	initiate parallel laboratory analysis	Misc.	l.s.		$10,000	$10,000	$10,000	
	monitoring field apparatus (columns	Misc.	l.s.		$4,000	$4,000	$4,000	$26,000
	reporting				$5,000	$5,000	$5,000	$5,000
	Subtotal:							**$36,000**
13.3	**Other Adaptive Management Plans scheduled for Operating Life or Required Only in Early Shutdown**							
	Changes in WTP input water quality or quantity	Misc.	l.s.		$22,500	$22,500	$22,500	$22,500
	Sludge Management Plan - for material from WTP	Misc.	l.s.		$15,000	$15,000	$15,000	$15,000
	Site Testing ML ARD	Misc.	l.s.		$45,000	$45,000	$45,000	$45,000
	Groundwater Management Plan	Misc.	l.s.		$15,000	$15,000	$15,000	$15,000
	Long Term Reclamation of Contaminated Soils	Misc.	l.s.		$22,500	$22,500	$22,500	$22,500
	Physical Monitoring program prior to closure	Misc.	l.s.		$60,000	$60,000	$60,000	$60,000
	Modeling of Pit Lake water quality prior to flooding	Misc.	l.s.		$22,500	$22,500	$22,500	$22,500
	Subtotal:							**$202,500**
13.4	**Closure Specific Studies and Field Trials**							
	Main Site Discharge Channel Geotechnical Design and Stability Evaluation	Engineering/Design	l.s.	1	$30,000	$30,000	$30,000	$30,000
	Passive Treatment Evaluations	Engineering/Design	l.s.	1	$60,000	$60,000	$60,000	$60,000
	Engineered Cover Evaluations	Engineering/Design	l.s.	1	$50,000	$50,000	$50,000	$50,000
	Subtotal:							**$140,000**
Total Estimated Cost for Supporting Studies								**$413,000**

Note: