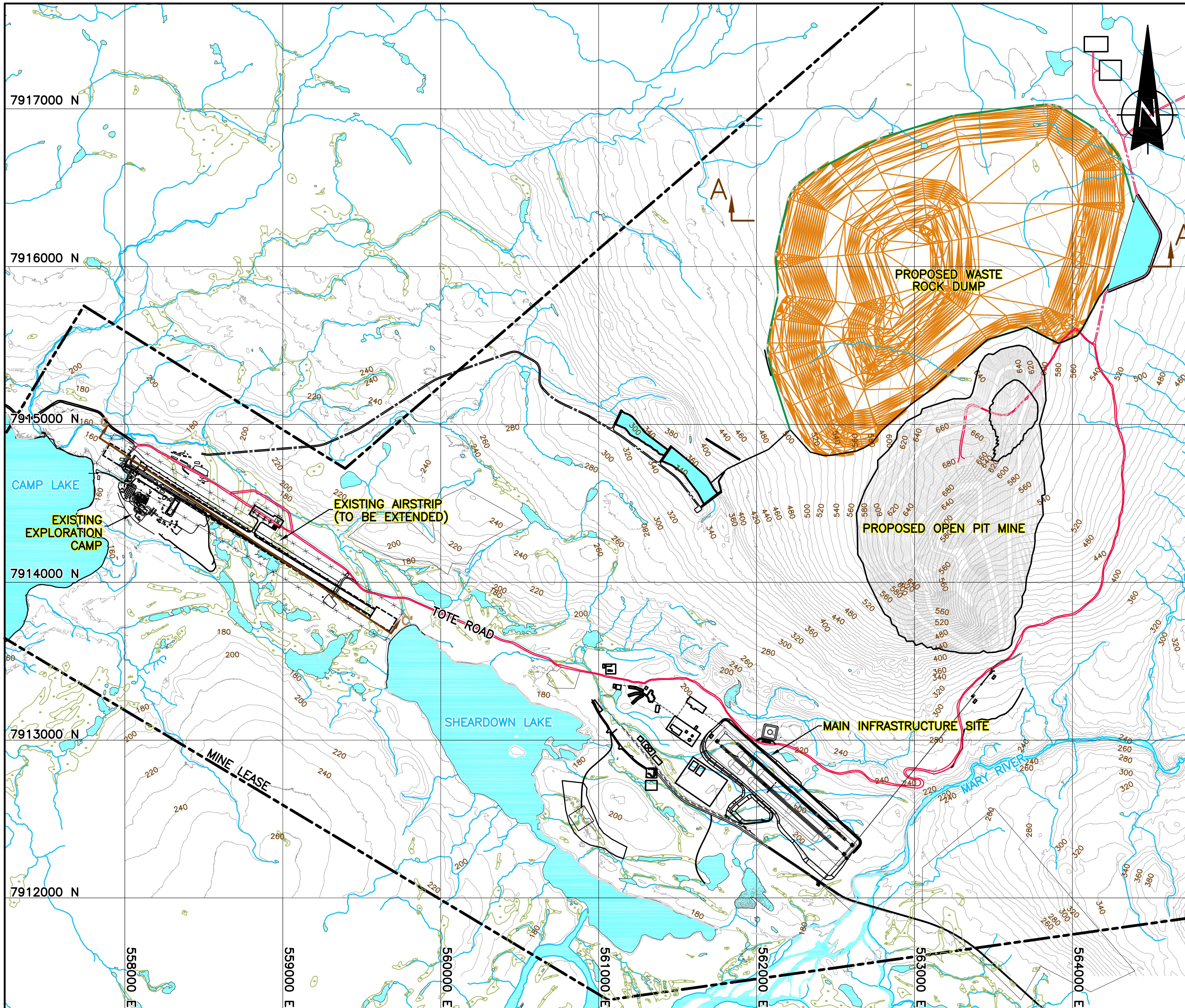

NOTES:

1 BASE PLAN SUPPLIED BY HATCH ENGINEERING GROUP FILE "H337697-4060-10-014-0002.dwg" DATED 11/08/08.

0 0.5 1.0 1.5 2.0 km

REV	DESCRIPTION	DRAWN BY	APPROVED BY	DATE (MM/DD/YY)
0	FINAL REPORT	ICB	LBS	11/7/11

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ICB	LBS	LBS

SCALE	DATE	FILE No.
1:25000	SEPTEMBER 29, 2011	19-1605-126-C1A

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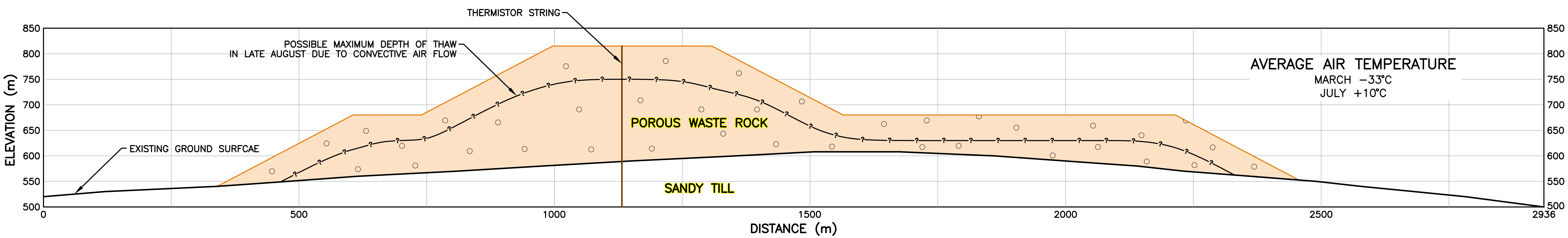
MARY RIVER PROJECT

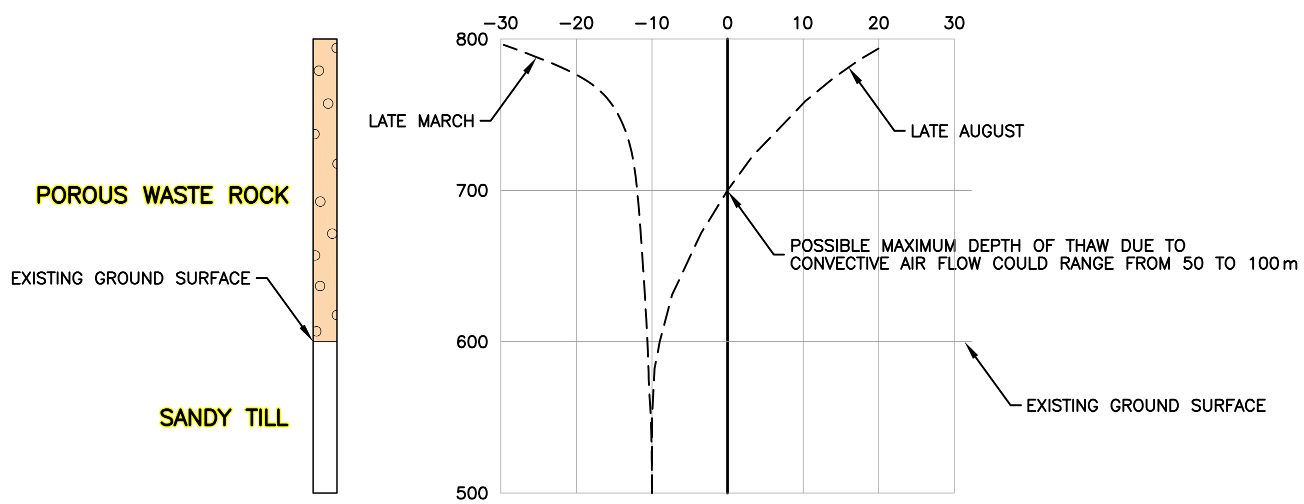
OVERVIEW MAP OF THE MARY RIVER MINE SITE

FIGURE A.1

THURBER ENGINEERING LTD.



CROSS SECTION A–A'



CONCEPTUAL TEMPERATURE DISTRIBUTION
IN WASTE ROCK DUMP IF CONVECTIVE AIR FLOW DOMINATES

REV	DESCRIPTION	DRAWN BY	APPROVED BY	DATE (MM/DD/YY)
0	FINAL REPORT	ICB	LBS	11/7/11

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SCALE 1:8000	DATE SEPTEMBER 30, 2011	FILE No. 19–1605–126–C2A	

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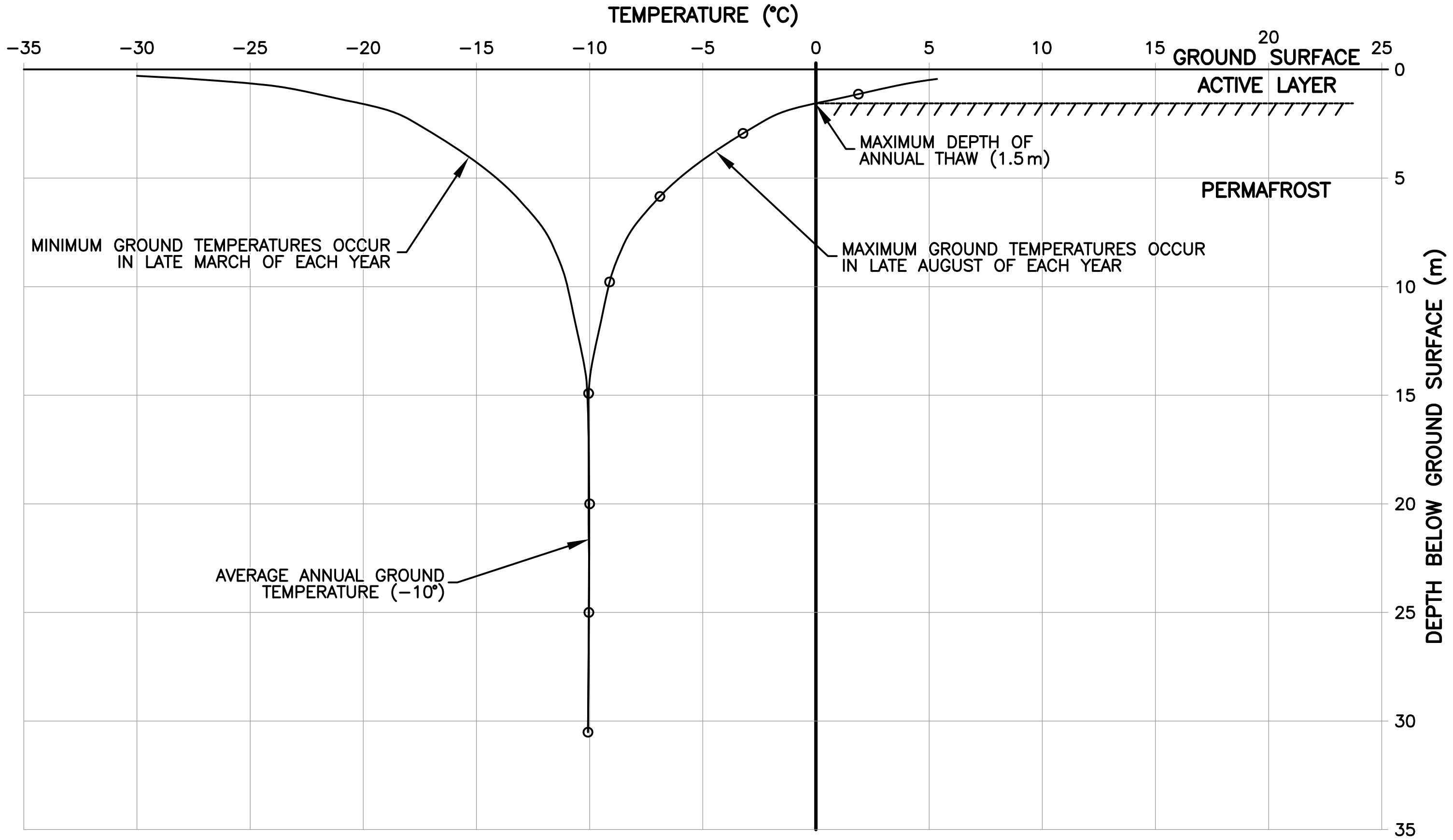
MARY RIVER PROJECT

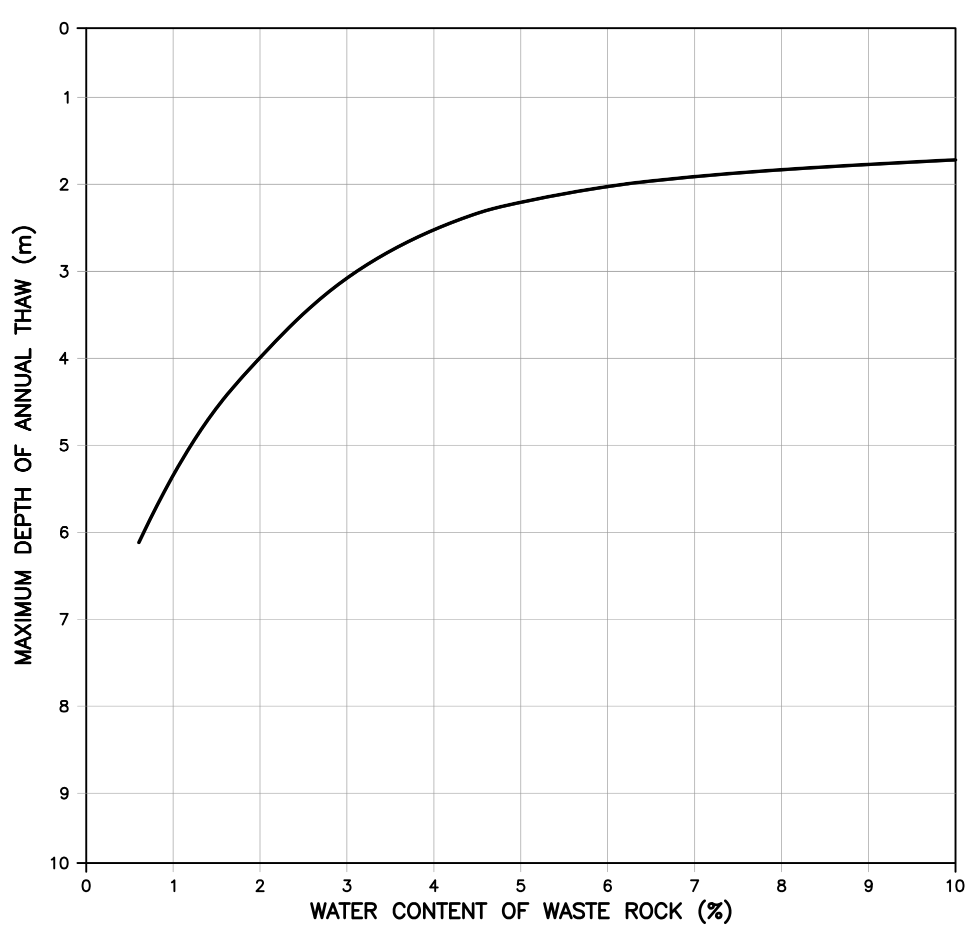
CONCEPTUAL GROUND TEMPERATURES IN A POROUS WASTE ROCK DUMP DUE TO CONVECTIVE AIR FLOW

FIGURE A.2

THURBER ENGINEERING LTD.



ANNUAL GROUND TEMPERATURES
IN THE VICINITY OF THE
MARY RIVER MINE SITE



APPROXIMATE DEPTH OF MAXIMUM ANNUAL THAW AS
A FUNCTION OF SOIL WATER CONTENT

REV	DESCRIPTION	DRAWN BY	APPROVED BY	DATE (MM/DD/YY)
0	FINAL REPORT	ICB	LBS	11/7/11

DRAWN BY ICB	DESIGNED BY LBS	APPROVED BY LBS
SCALE AS SHOWN	DATE NOVEMBER 7, 2011	FILE No. 19−1605−126−D0A

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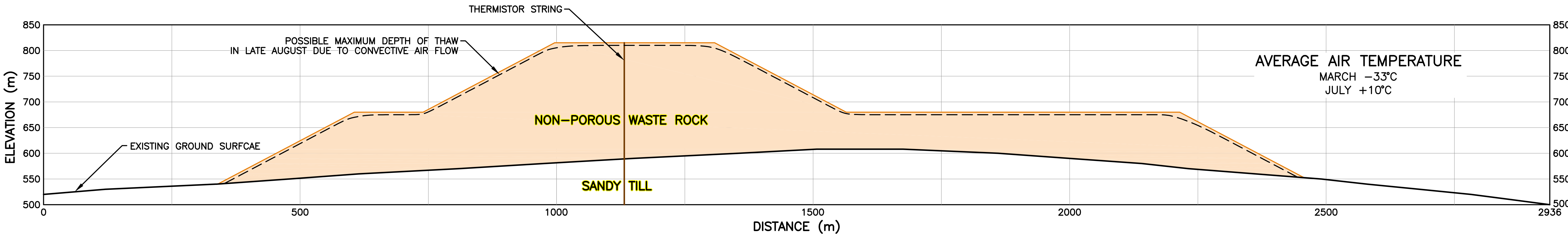
MARY RIVER PROJECT

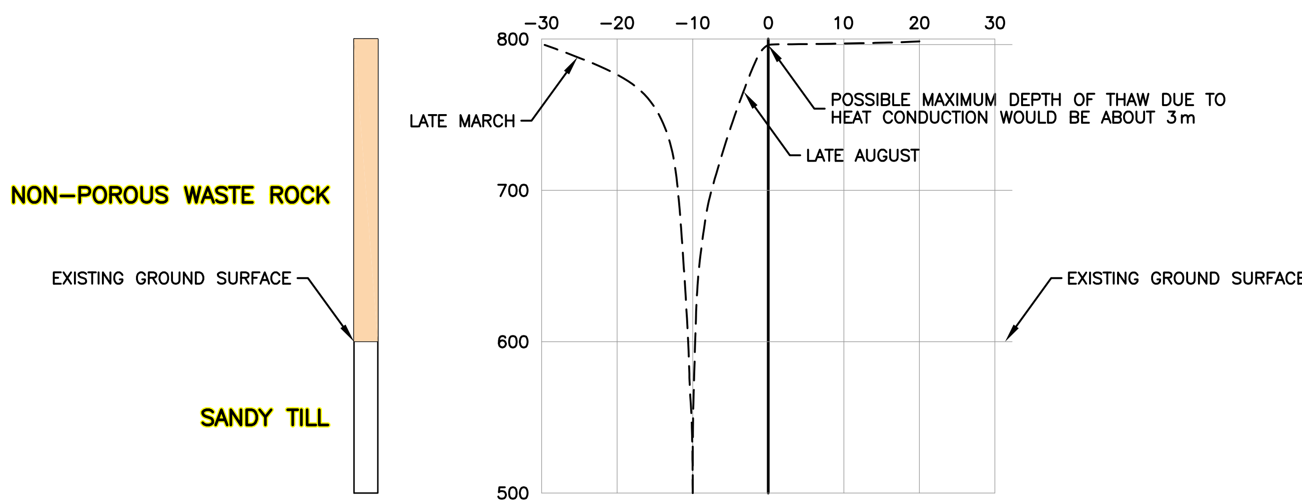
DEPTH OF THAW DUE TO
HEAT CONDUCTION IN PERMAFROST

FIGURE A.3

THURBER ENGINEERING LTD.



CROSS SECTION A–A'



CONCEPTUAL TEMPERATURE DISTRIBUTION
IN WASTE ROCK DUMP IF HEAT CONDUCTION DOMINATES

REV	DESCRIPTION	DRAWN BY	APPROVED BY	DATE (MM/DD/YY)
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SCALE 1:8000 | DATE SEPTEMBER 30, 2011 | FILE No. 19–1605–126–C2A

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MARY RIVER PROJECT

CONCEPTUAL GROUND TEMPERATURES IN A NON-POROUS WASTE ROCK DUMP DUE TO HEAT CONDUCTION

FIGURE A.4

THURBER ENGINEERING LTD.

Appendix 3:
Waste Rock Geological and Geochemical Characterization Program

Baffinland
Iron Mines Corporation

WASTE ROCK GEOLOGICAL AND GEOCHEMICAL CHARACTERIZATION PROGRAM (2012-2014)

MARY RIVER PROJECT - DEPOSIT NO. 1

January 2012

ACKNOWLEDGEMENTS

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BAFFINLAND IRON MINES CORPORATION

WASTE ROCK GEOLOGICAL AND GEOCHEMICAL CHARACTERIZATION PROGRAM (2012-2014)

MARY RIVER PROJECT - DEPOSIT NO. 1

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SECTION 1.0 - INTRODUCTION

1.1 BACKGROUND

A waste rock disposal area designed for permanent storage of waste rock will be located northwest of the Deposit No. 1 open pit (refer to attached Figure 3-2.3 (Appendix A), taken from the FEIS). Based on the current mine plan for Deposit No. 1, an estimated 570 Mt of waste rock will be generated over a period of 21 years. The shell of the open pit will eventually fill with meteoric water to an approximate volume of 45 million m^3 (Knight Piésold. 2008a).

As detailed in the associated Waste Rock Management Plan, open pit mining will generate large quantities of waste rock that will be stored at a dedicated location adjacent to the open pit. These waste rock materials have been characterized and grouped on the basis of geological characteristics and the results of geochemical static and kinetic test work. Environmental management plans are developed for each material group based on projected ltihology and mineralogy and chemical reactivity and physical properties to ensure long-term environmentally acceptable storage.

The results of the geochemical characterization of waste rock to date have been used to develop predictive water quality models. These models integrate the geochemical static and kinetic test results for the currently available sampling program with the overall geological, physical, and hydrological setting of the site, the proposed mine plan, and the operational waste rock management practices outlined in the Waste Rock Management Plan. These management practices are intended to minimize risk to the receiving environment from potential acidic, metal rich runoff and seepage. Similarly, a water quality model has been developed to generate predictions of pit water quality both during mine operations and post closure. The water quality models that have been developed are adaptable and will be updated over the next several years as new geochemical and physical data and interpretation become available, the mine plan is finalized, and environmental management practices are further refined.

Baffinland has recognized that there is a need to for an ongoing geological and geochemical characterization gap-filling program that will assist in confirming water quality model assumptions and predictions. During and subsequent to the NIRB pre-hearing technical meetings held in Iqaluit during late October, 2011 Baffinland acknowledged this requirement and committed to the following:

> "A sampling and testing program for the characterization of the waste rock for the period of 2012-2014 will be developed and will involve devising a representative sampling program for the waste rock based on the configuration of the ore body and the mining plan; analysis of the lithology, morphology and mineralogy of the waste rock; additional testing (both static and humidity cell). An independent expert will review and provide

guidance for this program. The characterisation program will be ongoing for the Life of the Project and will guide the development adaptive management strategies for waste rock management (should this be required over the life of the Project). This program will be presented in the FEIS.[1]"

1.2 PROGRAM COMPONENTS AND APPROACH

A waste rock geological and geochemical characterization program (the "Program") for the period 2012 to 2014 has been developed to address gaps in the existing database and to evaluate and adjust as warranted current assumptions used in predictive models. The Program is focussed on information gaps in the following component areas:

- Waste rock geology on the deposit scale utilizing surface mapping and drilling techniques;
- Predictive geochemical sampling and testing programs using mineralogical, static testing, and kinetic testing methodologies; and
- Sensitive input parameters (i.e., climate, hydrology, permafrost, and geochemical source terms) used to make water quality predictions for waste rock and open pit.

In the following sections of this document, the current data base is reviewed in relation to the above component areas, information gaps are identified, and programs to address gaps are proposed.

In addition, a preliminary operational and verification monitoring program is proposed for the post-2014 period when the commencement of pre-strip and mining of the open pit is scheduled to commence. This program will be subject to further adjustment based on the results of the 2012-2014 work.

[1] Commitment No. 233 as outlined in November 4, 2011, letter from Baffinland to NIRB, Re: Revised List of Commitments from Technical meeting.

SECTION 2.0 - MINE PLAN AND BASELINE SITE CONDITIONS

The mine plan, waste rock management plan, and baseline site conditions for the Project are described in detail within the FEIS. The reader is referred to the following sections of the FEIS for further information:

- Mine Plan – FEIS Volume 3, Project Description:
  - Section 3.4, Mine Site – Operation Phase
  - Table 3-3.1 Preliminary Schedule of Waste Rock Production
  - Figure 3-2.3 Mine Site Layout (Appendix A to this report)
- Waste Rock Management Plan – FEIS Volume 3, Appendix 3B, Attachment 5
  - Annex 2. Technical Memorandum from Thurber Engineering Ltd. to Hatch, dated November 23, 2011, Re: Development of Permafrost in Waste Rock Dumps – Preliminary Geotechnical Evaluation
  - Annex 4. Interim Waste Rock Stockpile Seepage Quality Model Report, Mary River Project. Dated January 2012. Prepared by AMEC
  - Annex 5. Interim Open Pit Water Quality Model Technical Memorandum, Mary River Project. Dated January 2012. Prepared by AMEC.
- Climate – FEIS Volume 5, Atmospheric Environment:
  - Section 1.0 – Climate
  - Tables 5-1.1 to 5-1.7, incl. – Climate normal, forecasts, and return periods for extreme temperature events
- Terrestrial Environment – FEIS Volume 6:
  - Section 2.1 – Landforms, Soils and Permafrost Baseline Summary, includes geochemical, geotechnical, geomechanical, and hydrological conditions
  - Appendix 6B-1 – Geochemical Evaluation of Ore and Waste Rock
  - Figure 6-2.3 – Surficial Geology in the Mine Site Area
- Freshwater Environment – FEIS Volume 7:
  - Section 1.0 – Regional Freshwater Setting
  - Section 2.1 – Freshwater Quantity Baseline Summary
  - Section 3.1 and 3.2 – Water and Sediment Quality Baseline Summary

A description of the regional and local geology for Deposit No. 1 is provided in Section 3.1.

SECTION 3.0 - GEOLOGY

3.1 OVERVIEW OF REGIONAL AND LOCAL GEOLOGY

The detailed description of the regional and local ore deposit geology is provided in Volume 6 of the FEIS, particularly Section 2.1 and Appendix 6B-1. Figure 6-2.3 (Appendix A to this report), is taken from the FEIS and shows the surficial geology of the mine site area. Figure A-1 (Appendix A to this report) shows the bedrock geology of Deposit No. 1 and exploration / environmental drill holes that have intersected and sampled the deposit and adjacent wall rock within the proposed pit perimeter. A description of the regional and local geology of Deposit No. 1, taken from Appendix 6B-1 of the FEIS, is provided below.

3.1.1 REGIONAL GEOLOGY

The northern part of Baffin Island consists of the ca. 3.0-2.5 Ga Committee Fold belt which lies within the Rae domain of the western Churchill Province (Jackson and Berman, 2000). The Committee belt extends north-east for around 2000 km from south-west of Baker Lake, Nunavut Territory to northwestern Greenland. Four major assemblages of Precambrian rocks have been identified within the Committee Belt. The iron ore deposits occur as part of the supra-crustal rocks of the Neoarchean aged (2.76-2.71 Ga) Mary River Group in the region. The Central Borden Fault Zone passes within 1 km to the south-west of the site. This fault separates the highly deformed Precambrian rocks to the north-west from the early Paleozoic relatively flat lying sedimentary rocks to the southwest. The generalized stratigraphic sequence of the Mary River group from top to base according to Young et al. (2004) and Johns and Young (2006) is:

- interbedded ultramafic and intermediate volcanic rocks;
- quartzite;
- Algoma–type oxide– and silicate–facies iron formation;
- amphibolite; and
- psammite and sedimentary migmatite.

The thickness of individual units varies considerably across the area. Ultramafic and gabbroic intrusions in the form of small sills and dykes (<10 m in thickness) may occur within the sedimentary rocks, iron formation and amphibolite units (Johns and Young, 2006). Locally these intrusions have been observed to contain thin sulphide veinlets and disseminated sulphides. At the deposit scale, the overall sequence can be complicated by inferred early isoclinal folds and ramp and flat thrust faults (Young et al., 2004) which create complex and variable stratigraphic relationships. The contact between the Mary River group and gneiss basement rock are generally not directly exposed, being obscured by younger granitic intrusions.

Iron formation within the Mary River Group occurs as an oxide- and silicate- facies unit. Oxide facies iron formations vary from lean magnetite-chert to iron-ore quality deposits of magnetite and hematite (Johns and Young, 2006). Genesis of high grade iron ores is the result of the Hudsonian age deformation and metamorphism of enriched Archean Banded Iron Formation. The silicate–facies iron formation is generally thin and found in association with the oxide–facies, although it also occurs on its own. It commonly contains coarse garnet, anthophyllite, cummingtonite, and actinolite porphyroblasts.

3.1.2 DEPOSIT GEOLOGY

Deposit No.1 occurs at the nose of a syncline plunging steeply to the north-east (Aker Kvaerner, 2008). The iron formation occupies the nose and two limbs of this feature with an ~1300 m long northern portion and an ~700 m long southern portion. The footwall to the iron formation mainly consists of gneiss with minor schist, psammitic gneiss (psammite) and amphibolite. The hanging wall is primarily composed of schist and volcanic tuff with lesser amphibolite and metasediment.

The hanging wall primarily encompasses chlorite–actinolite schist and garnetiferous amphibolites. Meta-volcanic tuff is also a significant lithology identified in the hanging wall. The footwall mainly consists of quartz-feldspar-mica gneiss with lesser meta-sediment (greywacke) and quartz-mica schist. Microcline and albite are the predominant feldspars within the gneiss and biotite is generally more abundant than muscovite.

The iron ore deposits at the Mary River project represent high-grade examples of Algoma-type iron formation and are composed of hematite, magnetite and mixed hematite-magnetite-specular hematite varieties of ore (Aker Kvaerner, 2008). The iron deposits consist of a number of lensoidal bodies that vary in their proportions of the main iron oxide minerals and impurity content of sulphur and silica in the ore. The massive hematite ore is the highest grade ore and also has the fewest impurities, which may indicate it was derived from relatively pure magnetite or that chert, quartzite and sulphides were leached and oxidized during alteration of the iron formation.

Intense deformation and lack of outcrop limit the ability to subdivide by lithology on the basis of future mined tonnages. Rather, the waste material has been subdivided on the basis of zonal relationships around the iron ore as described in Table 1.

3.2 EXISTING GEOLOGICAL DATABASE

The existing geological database for Deposit No. 1 was obtained primarily from drilling with surfacing mapping and geophysics providing only a minor source of data.

3.2.1 SURFACE MAPPING AND GEOPHYSICS

The exposed portions of Deposit No. 1 have been mapped systematically using standard geological mapping techniques since 2006. Some detailed mapping of individual outcrops has been performed on the southwest facing slope of the deposit to gain an understanding of the complexity of the structure that has affected the ore zone and wall rocks. Within the area of the proposed open pit, there is very little bedrock exposure of waste rock across the footwall and hanging wall. The exposure is estimated to be less than 10%. Based on discussions with senior Baffinland geological staff, there is no more information to be gained from ground work across this area. The overburden thickness maps for the deposit in the vicinity of the waste rock hanging wall and footwall areas are still in development.

Table 3-1 Summary of Waste Types and Tonnages

Waste Type	In-Pit Tonnage (t)	% of Waste	Lithologies (in approximate order of abundance)
Hanging wall (HW)	114,506,831	20.0	meta-volcanic (tuff); greywacke; amphibolite; chlorite, mica or amphibole schist; ultramafite; and gneiss
Hanging wall schist (HWS)	103,479,188	18.1	chlorite, mica, or amphibole schist; amphibolite; greywacke; and meta-volcanic (tuff)
Internal waste (IW)	2,982,893	0.5	schist; amphibolite; and meta-volcanic (tuff)
Deleterious ore (DO)	13,672,193	2.4	high grade iron formation (elevated Mn, S or P); and banded iron formation
Footwall schist (FWS)	45,917,213	8.0	chlorite, mica, or amphibole schist; gneiss; greywacke; amphibolite; and meta-volcanic (tuff)
Footwall (FW)	291,226,388	50.9	gneiss; metasediments (e.g. greywacke); chlorite, mica or amphibole schist; and amphibolites
Total	571,784,706	100.0	

The entire area of Deposit No. 1 was covered by airborne magnetic survey flown in 2008. Limited ground magnetic work was performed in 2010 and 2011 covering selected areas along the east and northernmost parts of the deposit. Ground gravity surveys were performed along the eastern edge and northeast portion of the deposit in 2011. The geophysics completed to date has been utilized primarily for ore zone delineation. It is the opinion of Baffinland geological staff that geophysical techniques would not be helpful in differentiating different waste rock lithologies on the scale required.

3.2.2 DRILLING

The existing geological database and interpretation of the Deposit No. 1 ore zone and waste rock is derived mainly from rotary core drilling, core logging, and core sampling. Since 2004, a total of 26,852 metres of drilling in 136 holes has been completed on Deposit No. 1. There has been drilling on Deposit No. 1 annually from 2004 to 2010. The locations of the drill holes that have been used as part of the geochemical characterization program and database are presented in Figure A-1.

The drilling season on Deposit No. 1 is of short duration (mid-June to end of August); therefore, most of the drilling completed in the early years was focused on ore delineation rather than waste rock delineation. It is of note, however, that most of the drill holes that intersected the ore zone were also continued for approximately 20 m into the wall rock (waste rock) providing some opportunity to characterize waste rock materials near the ore zone.

Since 2010, there has been a concerted effort to characterize the wall rock and three drill holes were advanced in 2010 through the footwall lithologies, specifically to provide representative information on the waste rock to be produced during mining. There was no drilling completed in 2011 since that program was focussed exclusively on geotechnical assessments. However, much of the wall rock core was relogged and resampled in an attempt to increase the existing waste rock geological and geochemical database.

3.3 IDENTIFIED DATA GAPS AND PROPOSED DRILLING PROGRAM

Based on a review of the deposit geology and drill hole locations shown on Figure A-1, there are large volumes of wall rock within the proposed pit perimeter that have not been systematically characterized by drilling. These areas occur mainly in the footwall of the deposit, but also within the hanging wall area. Figure A-1 shows these areas delineated by red cloud-like polygons. These delineated areas will be the focus for a 2000 to 3000 m drilling program using rotary core drill rigs to be completed during the summer of 2012. The drilling will be focussed on a series of eight to ten vertical cross-sections across the hanging wall and the footwall of the deposit at a section spacing yet to be finalized, but likely to be around 400 or 500 m. The recovered drill core will be logged and sampled in accordance to methods based on MEND (2009) and Price (1997). The drill core loggers and samplers will be trained and work under the direction and training of the project geochemists to ensure that core logging and sampling methodologies are consistently applied and will address the identified data gaps.

In an attempt to share available resources, the drilling locations for the 2012 geochemical characterization drilling program will be optimized so as to fill gaps related to the geotechnical and geomechanical aspects of the pit design. The recovered drill core will be used to assess both geochemical and geotechnical/geomechanical aspects of the pit design.

SECTION 4.0 - PREDICTIVE GEOCHEMICAL SAMPLING AND TESTING PROGRAMS EXISTING DATABASE

4.1 SAMPLING

Assessment of the potential for ML/ARD from mine rock has been undertaken primarily by sampling of the Project's archived exploration drill core. Sampling and analysis has been conducted in stages since 2006 (Knight Piésold 2008, Knight Piésold 2009, AMEC 2010a and AMEC 2012a). The highly deformed nature of the deposit and the relatively high metamorphic grade has largely restricted interpretation of waste material tonnages to a spatial (hanging wall and footwall) rather than a lithological basis. In addition to the archived drill core, three drillholes (318 m in total) were advanced in 2010 to specifically address a lack of representative waste material in the footwall of the deposit. Limited sampling of overburden material in the area has been completed.

Work in 2011 included collection of an additional 377 samples of waste rock material on the basis of a revised waste type model that subdivided the hangingwall (HW) and footwall (FW) zones to incorporate more schist dominated regions (HWS and FWS) occurring generally in close proximity to the iron ore. It has been observed that sulphide content in these regions while variable is typically higher than that in the more distal hanging wall and footwall material. The revised waste model also incorporated an internal waste (IW) subdivision (waste fingering within the ore zone) and a deleterious ore (DO) zone that has been identified as probable waste in the footwall.

4.2 STATIC TESTING

Static testing has included modified Sobek acid base accounting (ABA) with sulphur speciation and carbon analysis, net acid generation (NAG) testing, total element analyses, and short term leach analyses. Materials tested have primarily included waste rock (613 samples) with some testing of ore (21 samples) and overburden (seven near-surface outside of pit area).

Waste rock is characterized by generally low modified Sobek neutralization potentials (NP) and low sulphide contents with resulting low acid potentials (AP) (Figure 4-1). Carbonate NP typically represents < 30% of the modified Sobek NP. Sulphide content in excess of 0.5% is generally predictive of an NPR (the ratio of NP/AP) less than 2 (Figure 4-2). A summary of static ABA waste rock results by waste type are provided in Table 4-1. Overall, assuming that a NPR ≤ 2 is representative of PAG material and based on the current understanding of waste distributions in the pit, an estimated 15% of waste rock is expected to be PAG.

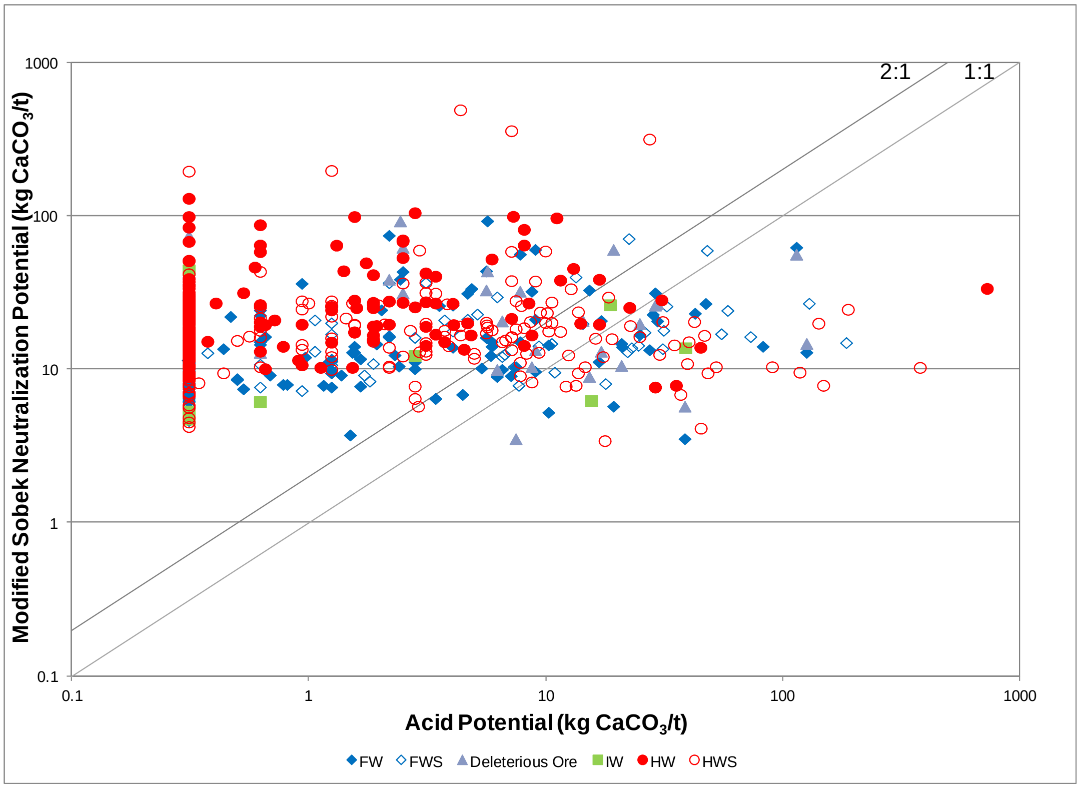

Figure 4-1 Neutralization Potential (NP) vs. Acid Potential (AP)

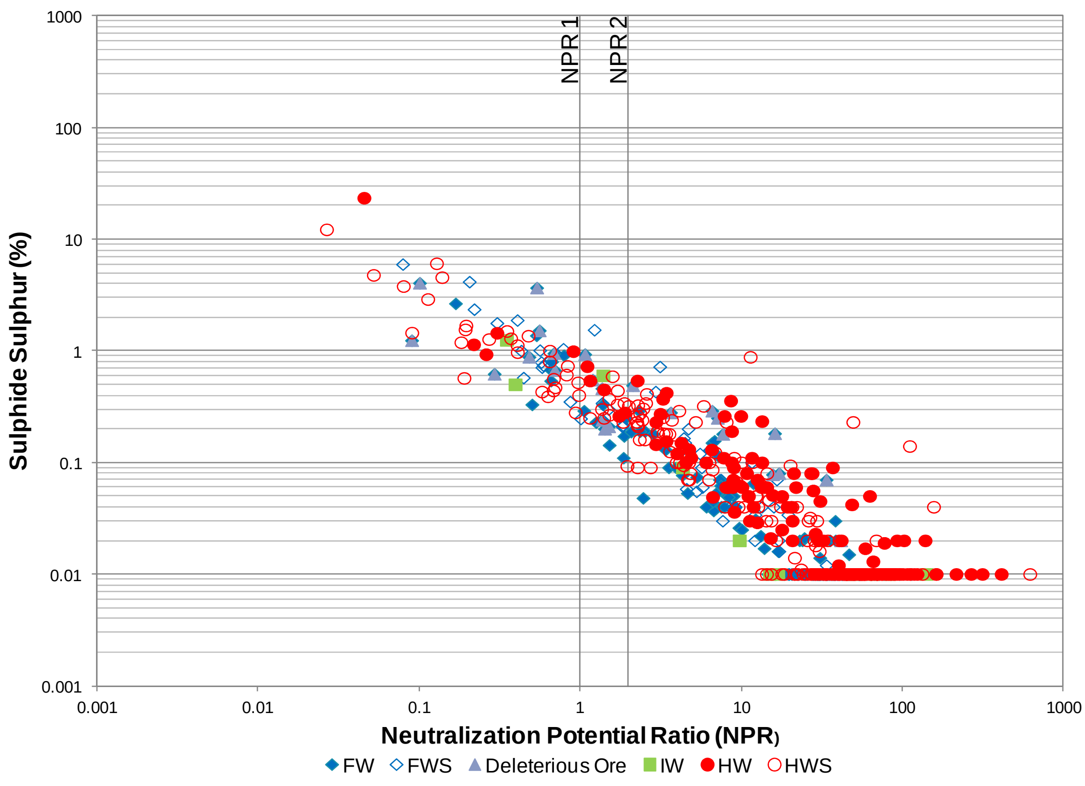

Figure 4-2 Neutralization Potential Ratio vs. Sulphide Sulphur

Table 4-1 Summary of Waste Rock Static ABA Test Results

Waste Type	Number of samples	NPR* < 2		Modeled In-Pit Tonnage	Estimated PAG Tonnage
	N	n	%	t	t
HW	142	10	7.0	114,506,831	8,063,861
HWS	207	48	23.2	103,479,188	23,995,174
IW	11	3	27.3	2,982,893	813,516
DO	27	15	55.6	13,672,193	7,595,662
FWS	99	23	23.2	45,917,213	10,667,635
FW	127	14	11.0	291,226,388	32,103,696
Total	613	113	18.4	571,784,706	83,239,546
* NPR = mod. Sobek NP/AP	% PAG normalized to tonnage =				15

The static ABA sampling program completed in 2011 included a component of mineralogical work (see below) to improve the overall understanding of ML/ARD of the waste rock and particularly the source of non-carbonate acid neutralizing potential in the waste rock. This, along with kinetic testing, has been identified as a critically important consideration to support and better understand the adequacy of non-carbonate neutralization capacity in waste rock to limit acidic drainage.

Overburden from the pit volume has not been specifically tested. However, selected sampling of overburden from potential borrow areas around the site and along the proposed tote road to the north have been completed (Knight Piésold 2008, AMEC 2010b). Testing of these largely glacially derived surficial materials indicated they were generally low in sulphide content and in many cases contained abundant carbonate presumably derived from the local Palaeozoic carbonate rocks that outcrop in the region.

4.3 MINERALOGY

Selected samples have been characterized by qualitative and Rietveld XRD (R-XRD), optical microscopy and SEM to better understand the waste rock mineralogy in terms of ML/ARD. The work initiated in late 2011 is continuing and will be reported in 2012; however, initial results indicate the following:

Sulphides

- The most common sulphide mineral present is pyrite.
- Chalcopyrite is the next most abundant sulphide though usually at trace concentrations.
- Sphalerite (sometimes Cd bearing), pyrrhotite, pentlandite, cobalt-pentlandite and marcasite have also been identified as trace sulphide constituents;

Carbonates

- The most common carbonate minerals observed are dolomite-ankerite and siderite, with the latter more common in proximity to the ore. The siderite and the Fe-component of the dolomite-ankerite carbonates are not expected to provide significant neutralization potential.

Silicates

- Quartz, plagioclase, k-feldspar, amphiboles (e.g. cummingtonite and hornblende), biotite, muscovite, and chlorite (Fe-rich and Mg-rich) are the major silicate rock forming minerals present.
- Plagioclase ranged from albite (Na rich) to anorthite (Ca rich) in composition.
- Silicate minerals occurring in more typically in minor to trace amounts include garnet, epidote, staurolite, cordierite, and andalusite.

Oxides

- Oxide minerals identified include magnetite, hematite, goethite, ilmenite and chromite with granular magnetite in waste iron formation.

The mineralogical work underway is being directed to better understand the potential non-carbonate NP sources among the different waste rock types

4.4 KINETIC TESTING

Ten waste rock samples were run in humidity cells for 53 weeks in 2008 and 2009. A further 17 waste rock samples were initiated in humidity cell tests in May 2011. Nine of these samples were standard humidity cells and eight were NP depleted humidity cells designed to assess drainage quality in the absence of carbonate NP. Available humidity cell results have produced pH in the circum-neutral to weakly acidic (pH 5) range, but no strongly acidic drainage ($pH<5$) has occurred. All 2011 humidity cell tests are continuing.

Humidity cell metal leaching results are generally consistent with the sulphide mineralogy identified, with measureable loadings of copper, nickel, zinc and cobalt present in some humidity cells. Based on limited kinetic data, total sulphide content of samples is weakly correlated with sulphate release rates; however, through the current periods of testing metal release rates and trends vary among the cells. Overall, metal release rates for the weak acid (pH 5 to 6.5) humidity cells are higher than those of neutral pH cells. The metals copper, nickel, zinc and cobalt discussed above were also consistently identified at elevated levels in NAG leachate analyses of the net-acidic samples tested.

Two field lysimeters are in operation at the Mary River site. The two lysimeters were constructed by placing lump and fine ore left over from the 2008 bulk sampling program on an impermeable membrane to allow collection of run-off water. Though minor gypsum has been locally identified with some ore, the presence of sulphate and some elevated dissolved metals (e.g. nickel) has been inferred to be related to sulphide oxidation in these materials. Long-term storage of ore during operations is not expected; however, continued monitoring of these ore lysimeters may provide field scale and climate driven data pertinent to low NP sulphide oxidizing material.

Shallow hydrogeological investigations of the active zone in overburden adjacent to existing ore stockpiles were intiated during 2011 with the installation of four shallow monitoring wells. These wells will be monitored and sampled during the 2012 field season.

4.5 IDENTIFIED GEOCHEMICAL DATA GAPS AND ADDITIONAL WORK

The following data gaps and planned work to address them is outlined below.

Sampling

- The large extent of presently unsampled footwall material and smaller gaps in hanging wall material within the pit volume and adjacent to the ultimate pit on the HW side is to be drilled and sampled in 2012 (see Section 3).
- Overburden material within the pit volume is presently unsampled. Sampling of this material will be included to the extent possible in the additional planned drilling program or coordinated with other site work.

Static Testing

- In addition to the geological characterization of the above currently unsampled waste rock materials, static testing of these footwall, and hanging wall materials will be conducted as part of the planned drilling and sampling program in 2012. Sampling and analytical methods will be consistent with previous Project work.
- Static testing of representative overburden material samples within the pit volume is also planned.

Mineralogy

- Mineralogical characterization of drill core to better understand the effective neutralization potential of waste rock for the range of lithologies and waste types will continue in 2012.
- Detailed mineralogical characterization by R-XRD, optical microscopy and SEM is also planned for selected humidity cell samples that will include an attempt to identify and assess accumulated alteration products to support the understanding of metal attenuation during oxidative weathering of waste rock.

PAG Segregation

- The following work will continue or be initiated to identify the importance and ability to segregate PAG materials.
    - The overall percentage and distribution of PAG will be updated on the basis of the expanded footwall and hanging wall sampling program planned for 2012.
    - Continuous sampling over several targeted long sections of core will be completed in 2012 to better assess continuity of PAG materials at the bench scale.

- Mineralogical and kinetic testing work will continue to be integrated with static testing results to improve the understanding of potential simplified surrogate relationships that can be used to assist in PAG segregation during operations should this be required.

Kinetic Testing

- A continued expansion of the laboratory kinetic testing program consistant with previous Project work is planned to include:
  - Humidity cell testing of deteterious footwall ore not presently represented in kinetic testing data base;
  - Humidity cell testing (as required) of presently unsampled lithostratigraphic units to be drilled in 2012;
  - Column or humidity cell testing of a range of non-PAG materials of various sulphide contents to better understand metal leaching from this material, and
  - Comparative kinetic testing of cold and room temperature leaching of selected PAG materials.
- On-going sampling of drainage from the existing lysimeters, other ore and waste stockpiles and rock-face seepage in the vicinity of the pit will continue for at least 2012 through 2014.
- Where possible, upgrades to existing lysimeters and adjacent active zone monitoring will be made to better quantify and constrain metal loadings released from these facilities.
- If suitable material is identified, field test piles will be setup and instrumented for both thermal monitoring and drainage quality.
- Where field test piles are established, laboratory testing representative of the test pile material will also be completed to provide direct comparison and insight into the scaling factors from lab to field.

SECTION 5.0 - WATER QUALITY PREDICTIONS – WASTE ROCK AND PIT

5.1 BASIS OF WASTE ROCK SEEPAGE AND PIT DRAINAGE WATER QUALITY MODELS

Mass loading models with limited geochemical attenuation modeling have been developed to predict water quality from the waste rock stockpiles and future pit water drainage. Detailed descriptions of the models are described in AMEC (2012b) and AMEC (2012c). Water inputs to the waste rock stockpile and pit models were based on monthly precipitation values provided by Knight Piésold (2011). Drainage only occurs during the summer months (June to September). Expected release rates for the mine rock were derived from available humidity cell data. There is presently no humidity cell data available for acidic drainage conditions. Therefore, where acidic drainage was required to be modeled preliminary source terms were established using NAG leachate metal data proportioned to a sulphate release rate set at five times the non-acidic sulphate rate. Key assumptions used in application of the source terms include:

- Sulphide oxidation rates were assumed to be 100% of laboratory rates during the summer months (June to September) and 50% during the remainder of the year (winter months) due to reduced temperatures (MEND 1996);
- The effective reactive surface area of waste rock in the pile was assumed to be 50 m^2/ton;
- The effective reactive surface area of the pit walls was assumed to be 50 times the calculated pit wall surface (calculated from pit dimensions) to allow for surface roughness and fracture influences (Morin and Hutt, 2004); and
- An ARD onset time of 5 years was assumed for the PAG mine rock in the stockpiles and pit walls based on the estimated average carbonate neutralization potential (carbonate NP) depletion time derived from humidity cell testing of PAG materials.

5.2 EXISTING STATUS OF WASTE ROCK WATER QUALITY MODEL

The material balance used for the waste rock model was based on the current mine plan and a number of assumptions regarding the mine operation and mine waste management that are consistent with BIM plans and commitments.

Key assumptions in the current waste rock seepage model include the following:

- Construction of the waste rock stockpile is complete and the mine site is in Closure;
- A thermal steady-state condition has been achieved in the waste pile, with established permafrost conditions occurring in all but an outer 10 m active layer of the pile;
- Hydrology of the stockpile is in a steady-state condition;
- Seepage only occurs from the active layer of the stockpile and there are no groundwater inflows to the pit;
- Annual seepage flows equal annual infiltration rates, no infiltration is lost to the permafrost zone;
- Sulphide oxidation occurs within the active layer, but not within the permafrost zone;

- The rate of sulphide oxidation in the active layer is temperature dependent;
- PAG and non-PAG rock will be effectively segregated during mining such that:
  - PAG rock will be placed within the core of the stockpile; and
  - Only non-PAG waste rock will be present within the active layer.
- Waste management practices will be utilized in the waste rock stockpile construction to:
  - Promote permafrost development within the piles, and
  - Minimize the active layer thickness of the waste stockpiles.

5.2.1 MODELING RESULTS

The estimated seepage concentrations (in process) for the waste rock model base case are provided in Table 5-1. Full details including discussion and sensitivity analysis of these results are provided in AMEC (2012b). These mass balance derived values may exceed geochemical solubility limits and therefore, the results were checked through geochemical equilibration in PHREEQC. The resulting equilibrated values are also provided in Table 5-1.

Table 5-1 Estimated Water Quality of Waste Rock Stockpile Seepage

Parameters	MMER values	Maximum			
		West Catchment		East Catchment	
		Unequilibrated	Equilibrated*	Unequilibrated	Equilibrated*
pH		6.9	6.9	6.9	6.9
Sulphate (mg/L)		124	124	99	99
Arsenic (mg/L)	0.5	0.012	0.012	0.010	0.010
Copper (mg/L)	0.3	0.022	0.022	0.018	0.018
Lead (mg/L)	0.2	0.001	0.001	0.001	0.001
Nickel (mg/L)	0.5	0.006	0.006	0.005	0.005
Zinc (mg/L)	0.5	0.075	0.075	0.060	0.060
Aluminum (mg/L)		0.554	0.321	0.443	0.295
Antimony (mg/L)		0.012	0.012	0.009	0.009
Boron (mg/L)		0.096	0.096	0.077	0.077
Cadmium (mg/L)		0.0002	0.0002	0.0001	0.0001
Chromium (mg/L)		0.022	0.022	0.018	0.018
Cobalt (mg/L)		0.0030	0.0030	0.0024	0.0024
Iron (mg/L)		0.137	<0.002	0.109	<0.002
Manganese (mg/L)		0.0358	0.00002	0.0286	0.00003
Mercury (mg/L)		0.004	0.004	0.003	0.003
Molybdenum (mg/L)		0.039	0.039	0.031	0.031
Selenium (mg/L)		0.047	0.047	0.038	0.038
Silver (mg/L)		0.0005	0.0005	0.0004	0.0004
Thallium (mg/L)		0.004	0.004	0.003	0.003
Vanadium (mg/L)		0.006	0.006	0.005	0.005
Barium (mg/L)		0.241	0.241	0.193	0.193
Sodium (mg/L)		1.535	1.535	1.227	1.227

Table 5-1 Estimated Water Quality of Waste Rock Stockpile Seepage (Cont')

Parameters	MMER values	Maximum			
		West Catchment		East Catchment	
		Unequilibrated	Equilibrated*	Unequilibrated	Equilibrated*
Potassium (mg/L)		46.8	46.8	37.4	37.4
Calcium (mg/L)		57.8	57.8	46.2	46.2
Magnesium (mg/L)		32.4	32.4	25.9	25.9

* Results oversaturated with respect to $Al(OH)_3$, ferrihydrite (poorly crystalline Fe oxide) and manganite (MnO(OH)) were equilibrated in PHREEQC (AMEC 2012b).

5.3 EXISTING STATUS OF PIT DRAINAGE WATER QUALITY MODEL

The material balance used for the pit drainage water quality model was based on the current mine plan, modeled waste distribution within the pit and a number of assumptions regarding the mine operation and pit management that are consistent with BIM plans and commitments. In order to model pit water quality during operations, additional information on mine progress over time has been provided by Hatch (2012).

Key assumptions in the current pit drainage model include the following:

- Water flow into the pit is by direct precipitation (rain and snow) within the pit/mined perimeter and no additional natural drainage or catchments drain to the pit;
- Draining water within the pit/mined perimeter collects at either perimeter drains (early time) or to pit sump(s) for management during operations;
- No groundwater inflow occurs to the pit and no evaporation loss from the pit surface;
- After closure, the pit will be filled to overflow at elevation 320 masl within five years; and,
- Overall pit water quality at a given point in time is derived by:
    - complete mixing of drainage proportioned on the basis of exposed (unflooded) incremental surface areas and the pit lake surface area (post flooding);
    - incremental surfaces are assigned on the basis of exposed (unflooded) surfaces from the block model within the pit (e.g. HW, FW, HWS, FWS, IW, DO, Ore and overburden);
    - source terms are assigned to each of the incremental surfaces on the basis of the percentage PAG for that material type;
    - metal release rates based on acidic conditions are allowed for PAG expected to have been exposed for more than 5 years; and,
    - total flushing of accumulated metals on surfaces is assumed during drainage period (June to September).

The pit drainage water quality model is presently under development and results are currently unavailable.

5.4 IDENTIFIED GAPS IN INPUT PARAMETERS AND SENSITIVITIES IN INPUT PARAMETERS AND PLANNED WORK

The mass balance waste rock and pit models were prepared using a number of assumptions in lieu of supporting data. Several items have been identified where additional work could either verify such assumptions or improve values estimated or assumed for the purposes of the modeling. These items are described below.

Hydrology

Modeling of the waste rock stockpile and pit identified that the models were sensitive to the volume of water flushing through the system. Therefore, any update to the understanding of pit and waste rock stockpile hydrology should be incorporated into the model.

Source Terms

The source terms for the waste rock and pit models for non-acidic conditions are presently based on available humidity cell data. Source terms for acidic drainage for pit water models are based on scaling of NAG leachate data with acidic drainage. This approach is considered highly conservative and could lead to significant overestimations regarding concentrations in acidic drainage. In general, source terms are sensitive parameters in predicting mass inputs into the system. Therefore, these source terms will be reevaluated with additional humidity cell data as they become available. Acidic leachate data in particular should it become available (e.g. with continued operation of the NP depleted humidity cells) may substantially increase the reliability of modeling acidic drainage at the site. Estimation of drainage inputs from non-PAG rock is presently based on largely PAG humidity cells operating under non-acidic drainage conditions. The planned addition of a range of humidity cells or column tests for non-PAG materials with a range in sulphide concentrations (Section 4) including samples without detectable sulphide could substantially improve reliability in the estimation of non-PAG drainage quality for the waste rock stockpile and pit.

Proportion of PAG Rock

The percentage PAG in the waste rock stock pile and at pit limits is an important and sensitive factor in predicting future water quality due to potential acidic drainage. Additional sampling and ML/ARD characterization work to be completed in 2012 will provide an update on the percentage and distribution of PAG material in the pit and resulting waste rock stockpile. This can then be incorporated in the existing models.

ARD On-set Time

The ARD on-set time for PAG rock is also a critical factor in predicting the timing of potential future acidic drainage. The current selection of 5 years on the basis of the average NP depletion time is believed to be a conservative (short) assumption. On-going humidity cell testing and a better understanding of the waste rock mineralogy and contributions to NP will be utilized to update the ARD on-set time for modeling efforts.

Surface Areas and Permafrost

The reactive surface area in both models as defined by scaling assumptions and, for the waste rock model, the active zone thickness, is a critical assumption in the model with high sensitivity. Direct estimation of the effective surface area is challenging. Some experience based guidance may be possible from expected rock behaviour during blasting. However, this parameter should continue to be managed through the use of sensitivity analysis. If a field test pile is to be constructed, comparison of representative lab data and field data may provide an indirect confirmation or assessment of this and other scaling factors. Thermal modeling of the waste rock stockpile is planned to estimate the expected active zone thickness of the waste rock stockpile, including global warming conditions. Modeling will also include an assessment of thermal effects from sulphide oxidation to evaluate the assumption that these effects are inconsequential for the relatively low-sulfide rock at Mary River and do not limit freeze-back into the waste rock stockpile.

A related issue to permafrost aggradation, active zone development and water flows through the system is the fate of water infiltrating into the permafrost zone of the stockpile. Currently, modeling assumes a steady state where flows into the pile equal flows out. However, water loses to permafrost formation are likely especially following placement of fresh rock. In the event a field test pile is constructed, instrumentation and monitoring will be utilized to provide data on the magnitude, duration and importance of such losses in the model. This work also will allow direct measurement of solute concentrations, which then can be used to calibrate the mass-balance modeling approach.

Mineralogy

Results determined by the model are equilibrated with respect to selected solid phases. In order to conduct the equilibration step, assumptions must be made with respect to sorption and precipitation reactions that may occur. With increased quality of site data, additional modeling considerations may be possible to improve predicted model results. Presently precipitation of assumed solid phases has been carried out using equilibrium thermodynamic assumptions in PHREEQC for a limited range of solutes; no sorption is currently modeled. Additional mineralogical work on post operational humidity cells is planned that could improve the understanding of metal leaching in the context of metal sorption and solid phase precipitation behaviour.

Section 6.0 - PROPOSED VERIFICATION AND OPERATIONAL MONITORING OF WASTE ROCK STORAGE AREA AND OPEN PIT (POST-2014)

A preliminary verification and operational monitoring program is proposed for the post-2014 period when the commencement of pre-strip and mining of the open pit is scheduled to commence. This program will be subject to further adjustment based on the results of the 2012-2014 work. The results of the verification and operational monitoring program will help to confirm long-term predictions related to, for example, active zone thickness/permafrost aggradation and waste rock/pit water quality. The monitoring program results will be carefully tracked over time, particularly during early years of operation, to ensure that condtions correspond with the predictions made. Trends showing potential divergence between predicted and actual conditions will be identified early on so that appropriate corrective actions can be evaluated and implemented as necessary to minimize potential environmental risk.

6.1 PHYSICAL MONITORING

It is expected that the Waste Rock Storage Area and open pit will be geotechnically stable based on the conservative design basis and parameters that will be adopted. It is the responsibility of the pit supervisors to visit all working areas every shift to check for working area hazards. Therefore, dumps and pit walls are inspected every shift and any hazardous conditions are reported.

6.2 TEMPERATURE MONITORING

Once the waste rock dump has sufficiently developed, ground temperature cables (GTCs) will be installed at locations within the dump footprint to monitor cooling within the dump and to measure seasonal variation in active zone thickness. The focus of the temperature monitoring will be on confirming active zone thicknesses and geometries across waste rock materials distributed throughout the waste rock dump. GTCs are typically installed in nests, with individual GTCs installed at different depths and measured several times annually to capture seasonal variation in active zone thickness. This approach has been effectively used at the Ekati Mine over the last decade.

6.3 ENVIRONMENTAL MONITORING

6.3.1 INSTRUMENTED TEST PILES

A program of carefully designed field test pads and laboratory columns should be considered as soon as waste rock becomes available, prior to or at the commencement of mining activiites. This program can assist in simulating and predicting drainage chemistry from the proposed waste rock stockpile and provide a relationship between kinetic test work and actual scaled up field conditions. In the absence of available waste rock to conduct a field test pad program, it is recommended that during the summer of 2012, field reconnaissance work be conducted to identify any suitable exposures of hanging wall and foot wall waste rock that could be mined on a small scale for the purpose of test pad construction and operation during 2013.

6.3.2 WASTE ROCK GEOCHEMISTRY

The technique for the identification and segregation of PAG and non-PAG waste rock will be refined based on the results of the 2012-2014 characterization program. It is likely that the identication will be based on a combination of analytical techniques that rely on both field visual observations, and on-site sulphur analyses of blasthole cuttings and of samples of blasted rock. For the purpose of validation of field results, an adequate percentage of samples will be sent to an external independent laboratory for standard ABA parameters.

The main objectives of geochemical monitoring will be to confirm the general geochemical characteristics of the waste rock prior to deposition in the waste rock pile. Initially, individual blast patterns or blasted rock piles will be differentiated on the basis of PAG vs. non-PAG, or some range therein. Once the individual blasts are identified, then the waste rock from those blasts can be managed appropriately in accordance with the waste rock management plan for the operation. Operational experience at other mining operations such as Diavik, Ekati, and Voiseys Bay provides evidence that this type of operational sampling and monitoring can provide adequate characterization of waste rock. As confidence builds during the iniitial confirmatory phase of operational geochemical sampling, it is anticipated that the frequency and intensitiy of sampling can be adjusted accordingly.

6.3.3 SEEPAGE AND PIT WATER MONITORING

Based on topographic and natural drainage considerations, preliminary locations for seepage monitoring will be established around the toe of the dump. Prior to construction of the waste rock dump, multi-year baseline samples will be collected at these locations interprteted to be near the toe of the dump and to represent natural drainage pathways. Actual locations will be selected based on field reconnaissance during construction. Samples will be collected at a minimum twice annually (mid-summer and late summer). A comprehensive seepage monitoring protocol and training program will be established to ensure consistant and high quality results are obtained from the program.

Similarly a pit sump monitoring program will also be implemented to monitor flows pumped from the open pit sump and to analyze for effluent quality parameters.

6.3.4 AQUATIC EFFECTS MONITORING

An extensive aquatic effects monitoring program (AEMP) has been developed that is designed to detect any changes to the aquatic environment downstream of the Deposit No. 1 waste rock storage area and open pit sump discharge outfall.

SECTION 7.0 - SUMMARY OF PROPOSED GEOCHEMICAL CHARACTERIZATION PROGRAM

7.1 IMPLEMENTATION SCHEDULE

The implementation schedule for the waste rock geological and geochemical characterization program (the Program) as described in Sections 3.0, 4.0, and 5.0 is presented in Table 7-1. The proposed verification and operational monitoring program described in Section 6.0 for the post 2014 period will be modified based on the results obtained from the 2012-2014 Program.

7.2 DATA MANAGEMENT AND REPORTING

Report updates for the Program will be provided in March of each year as part of annual reporting requirements. The reports will present the latest results for the previous calendar year including collected waste rock geology and geochemistry data, data interpretation, updates of the waste rock and pit water quality modeling, and the results of related work studies that are described in Sections 3.0, 4.0, and 5.0, herein.

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Table 7-1. Geochemical Characterization Program - Implementation Schedule 2012 to 2014

		Refer to Report Section	Description	Q1-2012	Q2-2012	Q3-2112	Q4-2012	Q1-2013	Q2-2013	Q3-2113	Q4-2013	Q1-2014	Q2-2114	Q3-2014	Q4-2014
1.0	**DRILLING PROGRAM**														
1.01	**Execute Drilling Program**	3.2.2, 3.3	2,000 - 3,000 m drill program utilizting rotary core rig focussed on footwall and hanging wall of the deposit.												
1.02	**Core Logging**	3.3	Log and sample core in accordance to established methods.												
1.03	**Field Scale Geological Interpretation**	3.3	Utilizing new information obtained from from drill logs, revise geological maps and cross-sections of the footwall and hanging wall of the deposit.												
2.0	**PREDICTIVE GEOCHEMICAL SAMPLING AND TESTING PROGRAMS**														
2.01	**Sampling**	4.1, 4.5	Systematic sampling of 2012 drill core of footwall and hanging wall based on established methods.												
2.02	**Static Testing**	4.2, 4.5	Static testing of select 2012 drill cores using established analytical methodologies.												
2.03	**Mineralogy**	4.3, 4.5	Detailed mineralogical characterization by R-XRD, optical microscopy, and SEM.												
2.04	**PAG Segregation**	4.5	Ongoing synthesis of available data to assess importance and ability to segregate PAG materials												
2.05	**Kinetic Testing - ongoing work**	4.4	Continuation of kinetic test initiated in May 2011.												
2.06	**Kinetic Testing - from 2012 drill core**	4.4, 4.5	Continued expansion of laboratory kinetic test work program,												
			Upgrade and ongoing sampling of lystimeters, monitoring wells, and seepage.												
			Assess feasibility of field waste rock test piles.												
			If feasible, construct and sample test piles.												
3.0	**WATER QUALITY PREDICTIONS - WASTE ROCK AND PIT**														
3.01	**Hydrology**	5.4	Collect additional hydrological data.												
3.02	**Source Terms**	5.4	Better quantify source terms for pit and waste rock models												
3.03	**Proportion of PAG**	5.4	Better quantify proportion of PAG in waste rock pile and pit walls.												
3.04	**ARD On-Set Time**	5.4	Improve understanding of ARD on-set times.												
3.05	**Surface Areas and Permafrost**	5.4	Improve understanding of surface area scaling values, active zone thickness, and water infiltration into waste rock pile. Conduct thermal modeling of waste rock pile.												
3.06	**Mineralogy**	5.4	Incorporate processes of metal sorption and solid phase precipitation behaviour.												
4.0	**Reporting Updates**														
4.01	**Interim Waste Rock Geochemiscal Charcterization Report**	7.2	Annual report updates that present latest results of geochemical characterization program including waste rock geochemistry, waste rock and pit water quality modeling modeling, and related studies. Reports to be provided March 31 of each year.												
4.02	**Waste Rock Water Quality Modeling Report**	7.2													
4.03	**Open Pit Water Quality Modeling Report**	7.2													

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SECTION 8.0 - REFERENCES

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APPENDIX A

SUPPORT FIGURES