2016 Waste Rock and Quarry Monitoring Report, Doris Mine, Hope Bay Project

Prepared for

TMAC Resources Inc.

Prepared by

SRK Consulting (Canada) Inc.
1CT022.009
March 2017

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1 Introduction

Development of the Doris mine has resulted in the development of quarries, use of quarry rock for construction of roads, pads and other infrastructure, and production of waste rock from the underground mine. Monitoring plans are in place to confirm acid rock drainage and metal leaching (ARD/ML) from quarry rock and waste rock remains low and to monitor the chemistry of seepage and runoff associated with these materials.

This report presents results from the 2016 quarry and waste rock monitoring programs. The report is organized as follows:

- A summary of the monitoring requirements is provided in Section 2.
- Results of the geochemical inspections and monitoring of quarry rock solids are summarized in Section 3.
- Results of the geological inspections and monitoring of underground waste rock are summarized in Section 4.
- Results of the seepage surveys around infrastructure areas and downgradient of the waste rock pile are provided in Section 5.
- Detailed technical memorandum on each of these subjects are provided in Appendices A, B and C.

2 Monitoring Requirements

2.1 Quarry Rock

Details on the monitoring program used for quarries and quarry rock along the Doris Windy Road are provided in "*Hope Bay Project Quarry A, B & D Management and Monitoring Plan- Revision 01*" (SRK 2010a). For consistency, those procedures are also used for quarries in the Doris North area. A summary of the requirements is provided as follows:

- Visual inspections and sampling at the quarry face by site geologist when the quarries are in active use;
- Collection and testing of two samples per year from each active quarry for total sulphur analysis, and, if the sulphur content exceeds 0.1%, the samples would be subjected to full acid base accounting (ABA) tests. A subset of samples will be subjected to shake flask extraction tests. The ABA tests would be done on the whole sample and on the -2mm size fraction to determine whether there is any concentration of sulphides in the fine component of the rock;
- Quarry sumps will be monitored as described under the routine site water quality monitoring program;

- After construction, the mined out quarries, and any roads and other infrastructure components that were constructed using the quarry or waste rock since the previous inspection will be inspected by a qualified geologist or geochemist to verify that the rock used in construction was suitable for that purpose. During the inspection, samples will be collected for total sulphur analysis. If the sulphur content exceeds 0.1%, the samples will be subjected to full ABA tests. A subset of samples will be subjected to shake flask extraction tests. Where possible, the testing would be done on the whole sample and on the -2 mm size fraction to determine whether there is any concentration of sulphides in the fine component of the rock;
- A seep survey will be conducted around all infrastructure components that have been constructed of modified within the previous 3 years, and in the mined out quarries. Field pH, electrical conductivity (EC), Eh, and temperature readings will be collected. A minimum of 10% of the samples will be submitted for laboratory analyses, as detailed in the Quarry A, B and D Management and monitoring Plan (SRK 2010a). The seep survey will include all of the rock drains. Reference stations will also be established to provide basis for comparing this to waters that are not influenced by the development activities; and
- An annual quarry monitoring report, including the results and an interpretation of the geochemical data will be prepared and submitted to the NWB by March 31 of the year following sample collection (i.e. within 6 months of collecting the final quarry samples).

2.2 Underground Waste Rock

Monitoring plans for the waste rock are provided in the "*Waste Rock and Ore Management Plan, Hope Bay Project, Nunavut"* (TMAC 2016a and 2016b). The program includes inspection and geochemical monitoring of the waste rock solids and routine monitoring of the pollution collection pond.

A summary of the requirements is provided as follows (TMAC 2016a):

- Inspection of the working face and muck pile by a field geologist to confirm rock types, mineralogical characteristics, and to classify the rock as mineralized or non-mineralized. All of the waste rock will be classified and managed as "mineralized" waste rock and be used as backfill.
- Sampling and testing of the underground waste rock, including ABA on a minimum of one sample per 10,000 tonnes of rock;
- Monitoring and recording the volumes of waste rock mined and placed in the mineralized and non-mineralized areas of the waste rock stockpile, and any non-mineralized waste rock that is removed for use in construction (pending confirmatory test work and approval from NWB);
- Regular water quality monitoring will be carried out at a surveillance monitoring station ST-2 located in the pollution control pond;
- Annual inspections by a qualified geochemist of the designated non-mineralized areas of the waste rock pile to confirm that there are no areas with elevated amounts of sulphide

mineralization, and inspections of the designated mineralized areas of the pile to look for signs of weathering and oxidation of the sulphides;

- Seep surveys along the down-gradient toe of the waste rock pile and below the pollution control ponds and access road throughout operations and for at least 2 years following mining and backfilling activities. The seep survey will be completed at the same time and will follow the same procedures as used for the seep survey around other infrastructure areas. However, given the increased importance of obtaining samples from this area, all distinct seeps in the immediate vicinity of the waste rock pile (i.e. any seeps spaced more than 50 metres apart) will be tested for a full suite of laboratory parameters; and
- An annual waste rock monitoring report, including the results and an interpretation of the geochemical data will be prepared and submitted to the NWB by March 31 of the year following sample collection (i.e. within 6 months of collecting the final quarry samples).

3 Monitoring of Quarry Rock Geochemistry

Details of the 2016 quarry and construction rock monitoring program are presented in Appendix A.

3.1 Sampling and Testing Program

A total of 20 samples of Quarry 2 rock were collected, including:

- 4 run-of-quarry (ROQ) samples; and
- 16 samples from infrastructure components in the Doris North area, including samples from the Tailings Impoundment Area (TIA) access road up to the dyke access, airstrip expansion, Pad T expansion, mill pad reconstruction, and temporary explosives berm by the North Dam.

ROQ samples were collected by TMAC whereas quarry rock samples from infrastructure were collected by SRK. Field contact rinse tests were conducted on the SRK sample set.

All 20 samples were analyzed for total sulphur, of which 17 had sulphur contents above the 0.1% criteria and were submitted for full acid-base accounting (ABA) analysis, including paste pH, sulphate sulphur by hydrochloric acid leach, Modified Sobek NP (MEND 1991), and total inorganic carbon (TIC). Thirteen samples were analyzed by elemental content by aqua regia digestion followed by ICP-MS finish. In addition, 6 samples were submitted for a shake flask extraction (SFE) test using the MEND (2009) method with a 3:1 solid to solution ratio and a 24 hour shaking period. The SFE leachate was analyzed for pH, EC, SO_4, acidity, alkalinity, chloride, ammonia, total dissolved solids (TDS), and low level dissolved metals including mercury and selenium. All analyses were conducted at Maxxam Analytics in Burnaby, BC.

3.2 Results

3.2.1 Quarry 2 Monitoring

The ROQ samples from Quarry 2 were geologically described as basalt with trace amounts of fine-grained pyrite, local hematite alteration and local quartz carbonate alteration. SRK recommends visual inspections of the operational quarry face. Quarry 2 material has been thoroughly characterized through previous investigations and monitoring programs and has been classified as not potentially acid generating (non-PAG) due to its consistently low sulphide content and high neutralization potential.

Results from the one shake flask extraction test were compared to ten times the CCME water quality guidelines for the protection of aquatic life (CCME 2007) to screen for parameters that were elevated in the test leachate. All parameters were below these screening criteria. The pH of the tests were alkaline.

3.2.2 Doris North Area Monitoring

The majority of samples were described as grey-green mafic metavolcanics with trace to no visible sulphides and carbonate alteration/veins. Exceptions included the pad alongside the road to Quarry 3 and large areas of Pad T, which also contained occurrences of pyrite vein material and/or rusty brown weathered surfaces and epidote veins, and the south end of the airstrip expansion, which included rate K-feldspar veins. Previous airstrip construction material also contained K-feldspar veining.

ABA results indicate that the samples are non-PAG according to NP/AP and TIC/AP ratios. Element analysis results were screened for anomalously high parameters through comparison to ten times average crustal abundances of basaltic rocks (Price 1997). Gold and boron had high concentration relative to the crustal abundance. All other parameters were not elevated compared to these screening criteria indicating no appreciable enrichment.

SFE tests were completed on 6 of the construction rock samples submitted for ABA. All SFE tests had alkaline pH ranging from 8.9 to 9.3. The concentration of total ammonia in the leachate from a Pad T sample (16-QR-13) exceeded the screening criteria. This sample along with a sample from the TIA access road (16-QR-04) contained high chloride and nitrate concentrations relative to the other construction rock samples. Chloride and nutrient (ammonia and nitrate) concentrations from the Pad T sample can be attributed to the waste rock stockpile and/or mine vehicle traffic on the pad. The source of chloride from sample on the TIA access road is undefined. The SFE test results indicate that the potential for metal leaching from these samples is low.

4 Monitoring of Waste Rock Geochemistry

Details of the 2016 waste rock monitoring program are presented in Appendix B.

4.1 Sampling and Testing Program

The waste rock monitoring program was initiated by TMAC in December 2015. A total of 152 samples were collected for total sulphur and total inorganic carbon, 96 were collected for extended ABA and element analysis, and 8 were collected for shake flask extraction tests. Samples were primarily a representative mixture of fine and coarse rock fragments of blasted rock (muck) from the underground, however selected samples were collected from the blast face. Samples for SFE were crushed to -1/4" prior to testing while all others were pulverized. All analyses were conducted at Maxxam.

Geological inspections were conducted by site geologists when monitoring samples were collected. Where possible, both the working face and the muck pile were inspected to identify the rock type, quantity of sulphide and carbonate minerals. The data were recorded in geological inspection logs.

In addition, SRK completed an inspection of the waste rock stockpile on the east side of Pad T in June 2016 by walking the perimeter of the stockpile (all surrounding berms) and examining waste rock at the northern end of the stockpile. Neither the previous Newmont waste rock pile (on Pad I and H/J) nor the two active ore stockpiles west of Pad T were inspected since they contained low to high grade ore.

4.2 Results

Mining activities between April 2015 and December 2016 resulted in the placement of approximately 179,100 tonnes of waste rock on Pad T, all of which was managed as mineralized waste rock. No waste rock from the surface stockpile was placed as backfill underground between 2015 and 2016. Throughout the mine life, waste rock will be placed underground as backfill with no waste rock remaining on surface at closure.

Inspections by TMAC geologically identified approximately 15% of the waste rock on surface. On the basis of the sample set, mafic metavolcanics (lithology code 1a) was the dominant rock type, representing 55% of samples, followed by altered mafic metavolcanics (1as, 18%) and diabase (11c, 18%) then quartz vein (12q, 9%). The ore was a mixture of basalt with quartz veins.

Diabase (11c) generally had low sulphur concentrations (maximum 0.06%), however three samples had sulphur levels that were higher than expected (0.3 to 1%) compared to typical concentrations observed in diabase from the Doris area (maximum 0.13%, SRK 2015). TIC levels were uniformly low (maximum 11 kg $CaCO_3$ eq/tonne). Almost all diabase samples were classified as PAG or uncertain on the basis of TIC/AP. Diabase samples with sulphur ≤0.06% have a low risk of ARD based on the occurrence of silicate minerals in the samples. The three samples with higher sulphur levels have not been previously characterized by either static or kinetic test methods. Therefore, based on the static results alone, there is a possibility that it may generate ARD upon weathering.

Quartz vein (12q) had 25th to 75th sulphur concentrations ranging from 0.07 to 0.44%, while 25th to 75th levels of TIC ranged from 1.7 to 44 $CaCO_3$ eq/tonne. Of the 12 samples tested, five were classified as non-PAG, three as having an uncertain potential for ARD and four as PAG.

Altered mafic metavolcanics (1as) had 25th to 75th sulphur concentrations ranging from 0.07 to 0.35%, while TIC values were typically between 199 to 331 kg $CaCO_3$ eq/tonne. All samples were classified as non-PAG with the exception of one sample with anomalously low TIC (11 kg $CaCO_3$ eq/tonne), which was classified as PAG.

Mafic metavolcanics (1a) had 25th to 75th sulphur concentrations ranging from 0.08 to 0.37% with P95 values of 1.4%. The 25th to 75th values for TIC ranged from 5.2 to 190 kg CaCO3 eq/tonne, with 40% of samples with levels less than 20 kg CaCO3 eq/tonne. TIC levels are lower than expected given typical concentrations observed in basalt from the Doris area (25th to 75th values between 167 to 339 kg CaCO3 eq/tonne, SRK 2015b). The lower levels of TIC observed for samples of 1a may be due in part to unidentified samples of Low NP Basalt within the sample set and/or that the SRK (2015b) statistics include samples of both 1a and 1as, the latter rock type which has higher levels of TIC. A total of 17% of the basalt samples were classified as having an uncertain potential for ARD based on TIC/AP ratios, and 18% as PAG. Comparison of TIC and Modified Sobek NP results for samples subjected to full ABA tests indicated that NP was typically greater than TIC, indicating that some NP would be contributed by silicate minerals. As a result, a smaller proportion of the basalt samples (3%) were classified as having an uncertain potential for ARD, and 6% as PAG.

Trace element analyses on the solids indicated that arsenic, lead and sulphur concentrations were enriched relative to typical basalt in a small proportion of the samples.

Shake flask extraction tests indicated chloride, ammonia and nitrate levels indicative of calcium chloride drilling brines and residues from ammonia-based explosives. Concentrations of other trace elements were low in comparison to screening criteria.

5 Seepage Survey

Details of the 2016 seep survey are provided in Appendix C.

5.1 Sampling and Testing Program

The seep survey was carried out between June 11 and June 16, 2016 by SRK in the Doris North area. The program included visual inspection and opportunistic sampling of seepage downstream of Pad T, mill pad reconstruction, the temporary explosives berm by the North dam, tailings impoundment area (TIA) access road, airstrip expansion and the toe of the waste rock stockpile. Peak freshet had already occurred and there were fewer seeps observed than in previous years. A total of 14 seepage sites were established downstream of all infrastructure areas except the temporary explosives berm. Ten of these sites were sampled and submitted to ALS Environmental for analysis of pH, conductivity, sulphate, acidity, alkalinity, chloride, fluoride, nitrate, nitrite, phosphorus, ammonia, total dissolved solids (TDS), total suspended solids (TSS) and low level dissolved metals including mercury and selenium. The waste rock stockpile was inspected but no seepage flow was observed within the stockpile.

5.2 Results

Pad T and mill pad are within Doris camp, which also hosts the waste rock stockpile. Accordingly, seepage sample collected downstream of Doris Camp is referred to as from the waste rock influenced area (WRIA).

A summary of the field measurements is presented in Table 1. The pH at all sites was neutral to near-neutral (6.8 to 7.9). The sample collected within the Waste Rock Influenced Area (16-DC-02) had the highest level of conductivity (6,800 µS/cm). This sample was collected from the berm downstream of Pad G.

Seepage from the WRIA had elevated levels of ammonia, chloride, nitrate, arsenic, copper and selenium concentrations in comparison to seeps from the other infrastructure areas. Chloride levels are attributed to flushing of drilling brines whereas nitrate and ammonia levels to related to blasting residues from the waste rock. It is possible that occurrence of freshet prior to the seepage survey resulted in lower flows at the time of sample collection, resulting in higher concentrations of arsenic, copper and selenium. Further monitoring will establish trends in these parameter concentrations. The majority of this seepage is captured in the water management system implemented at Doris and directed to the TIA.

Table 1: Mean Values for Field Conductivity and Measurements

Site Area	No. of Samples	Conductivity (µS/cm)	pH
		Mean[1]	
Waste Rock Influenced Area	1	6800	7.9
Tail Access Road	2	910	7.7
Airstrip	13	370	7.6
Reference Points	3	240	7.2

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[1]Statistic could not be calculated based on the one sample taken at the Waste Rock Influenced area.

Ammonia, nitrate and chloride concentrations in one sample collected from the TIA access road (16-TLA-02) were higher than seepage from the other quarry rock samples. TMAC confirmed that drilling brines are not used in the quarries and that all construction rock was sourced from Quarry 2. The source chloride is therefore undefined. The ammonia and nitrate are attributable to ammonia-based explosives residues.

6 Conclusions

The results of the quarry rock geochemistry investigation indicated that all of the samples collected and submitted for testing are non-PAG. Element analyses indicated that concentrations of all parameters except gold and boron are within 10 times the average crustal abundance for basaltic rocks indicating no appreciable enrichment. The SFE test for the Pad T sample indicated soluble chloride, nitrate and ammonia levels, which can be attributed to calcium chloride drilling brines and ammonia-based explosives residues from the waste rock stockpile on the pad. SFE test results for the sample from the TIA access road had high chloride levels relative to the other quarry rock samples. TMAC confirmed that drilling brines are not used in the quarries and that all construction rock was sourced from Quarry 2. Accordingly, the source of chloride in the TIA access road sample is undefined.

The results of the 2016 seep survey indicated that there are no major issues with respect to metal leaching and acid rock drainage in seepage associated with infrastructure at Hope Bay. Seepage from waste rock influenced area had elevated levels of ammonia, chloride, nitrate, arsenic, copper and selenium concentrations in comparison to seeps from the infrastructure areas. Chloride concentrations are attributed to flushing of drilling brines and ammonia and nitrate to blasting residues from the waste rock. It is possible that occurrence of freshet prior to the seepage survey resulted in lower flows at the time of sample collection, resulting in higher concentrations of arsenic, copper and selenium. Further monitoring will establish trends in these parameter concentrations. The majority of this seepage is captured in the water management system implemented at Doris and directed to the TIA. One seepage sample along the TIA access road had higher levels of chloride, ammonia and nitrate compared to other quarry rock seepage sites, thereby confirming the quarry rock SFE test results. SRK recommends seepage monitoring along the TIA access road in 2017.

Mining activities between April 2015 and December 2016 resulted in the placement of approximately 179,100 tonnes of waste rock on Pad T, all of which was managed as mineralized waste rock. No waste rock from the surface stockpile was placed as backfill underground between 2015 and 2016. Throughout the mine life, waste rock will be placed underground as backfill with no waste rock remaining on surface at closure. Inspections by TMAC geologically identified approximately 15% of the waste rock on surface, with mafic metavolcanics (1a) as the dominant rock type (55% of the samples), followed by altered mafic volcanic flow (1as, 18%), diabase (11c, 18%) and quartz vein (12q, 9%).

About 35% of the waste rock monitoring mafic metavolcanics samples were either PAG or had uncertain potential for ARD, primarily due to lower than expected TIC levels compared to typical levels in mafic metavolcanics (SRK 2015). Comparison of TIC and Modified Sobek NP results for samples subjected to full ABA tests indicated that NP was typically greater than TIC, indicating that some NP would be contributed by silicate minerals. As a result, a smaller proportion of the basalt samples (3%) were classified as having an uncertain potential for ARD, and 6% as PAG. Based on kinetic test work (SRK 2015b), the risk for metal leaching from this material is expected to be low.

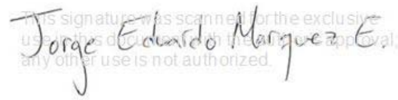
All samples of altered mafic metavolcanics waste rock were classified as non-PAG with the exception of one sample with anomalously low TIC.

Diabase generally had low sulphur concentrations (maximum 0.06%), however three samples had sulphur levels (0.3 to 1%) that were higher than expected compared to typical concentrations observed in diabase waste rock from the Doris area (maximum 0.13%, SRK 2015b). Almost all diabase samples were classified as either PAG or uncertain due to their low TIC content. Diabase samples with sulphur ≤0.06% have a low risk of ARD based on the occurrence of silicate minerals in the samples. The three samples with higher sulphur levels have not been previously characterized by either static or kinetic test methods.

Of the 12 samples quartz vein samples tested, 7 were classified as PAG or uncertain while the remaining samples were classified as non-PAG.

A long term assessment of the anticipated geochemical behaviour of the waste rock in the stockpile on Pad T with respect to acid rock drainage and metal leaching (ARD/ML) was not possible due to the occurrence of high sulphur diabase (11c) that has not been previously geochemically characterized, the high incidence of mafic metavolcanics (1a) with lower TIC content, and insufficient documentation of the volume of waste rock according to rock type. The geochemical behaviour of the waste rock is monitored through the annual seep survey along the downgradient toe of the waste rock and ore stockpile area and routine monitoring of the Pollution Control Pond (PCP).

This report, 2016 Waste Rock and Quarry Monitoring Report, was prepared by



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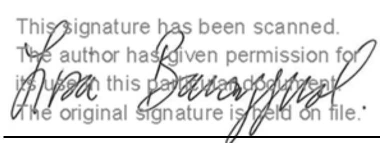

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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

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Appendix A – 2016 Hope Bay Construction Rock Monitoring

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Subject:	2016 Hope Bay Construction Rock Monitoring - FINAL		

1 Introduction

In Fall 2015, TMAC Resources re-initiated mining and construction activities at Doris. Prior to this, mining and quarry development had stopped in 2011 and 2012, respectively. Between fall of 2015 and mid-2016, TMAC constructed the following infrastructure: tailings impoundment area (TIA) access road up to the dyke access, the road to Quarry 3 and adjacent pad, airstrip expansion, Pad T expansion, mill pad reconstruction, and temporary explosives berm by the North Dam. Quarry 2 was the only active quarry during this period.

Prior to development, the rock from Quarry 2 was characterized geochemically (SRK 2008) and classified as not potentially acid generating with low potential for metal leaching. Subsequent construction monitoring of Quarry 2 rock has confirmed these findings (e.g. SRK 2012). To confirm these results and assess the ARD potential of the fine fraction produced when this material was blasted, further characterization and monitoring was completed during quarrying activities and post-construction. This memo documents the results of the 2016 quarry rock characterization and monitoring program.

Monitoring requirements for quarries and quarry rock associated with the Doris Mine and Doris-Windy Road are specified in Water Licence 2AM-DOH1323, Water Licence 2BE-HOP1222, and Framework Agreement signed between TMAC and the Kitikmeot Inuit Association (KIA) for belt-wide land tenure. Details on how the requirements are implemented for quarries and quarry rock associated with the Doris-Windy Road are provided in the Hope Bay Project Quarry A, B & D Management and Monitoring Plan - Revision 01 (SRK 2010). To ensure consistent procedures are followed in all areas of the site, the monitoring procedures in the Quarry A, B & D Management and Monitoring Plan – Revision 01 are also followed for quarries and quarry rock in the Doris North area. TMAC has recently submitted an updated Quarry Management plan to the Nunavut Water Board.

2 Methods

2.1 Quarry Monitoring, Sampling and Analysis

From the fall of 2015 to mid-2016, quarrying operations were active in Quarry 2. Quarry 2 run-of-quarry (ROQ) stockpiles were visually inspected and sampled by a TMAC geologist in January 2017. Field notes were taken to document the lithology, sulphide content and veining. Samples were collected from Quarry 2 at two locations (Stockpiles 1 and 2). At both sites, two samples, one <1 cm fraction and one <2 mm fraction were collected (for a total of 4 samples). Samples labeled as Q22016a were taken at Stockpile 1 while samples labeled as Q22016b were taken at Stockpile 2. These samples were described by a TMAC geologist.

The routine monitoring samples were sent to Maxxam Analytics in Burnaby, BC for sample preparation and total sulphur analysis. Based on the criteria of >0.1 wt. % total sulphur, all samples were submitted for analysis of ABA and trace element content, including paste pH, sulphate sulphur by hydrochloric acid leach, Modified Sobek NP (MEND 1991), and total inorganic carbon (TIC). TIC was determined by using a Leco furnace to directly measure CO_2 gas evolved from HCl treatment of the sample. The <2 mm fraction of sample Q22016A was submitted for a shake flask extraction (SFE) test using the MEND (2009) method with a 3:1 solid to solution ratio and a 24 hour shaking period. The SFE leachate was analyzed for pH, EC, SO_4, acidity, alkalinity, chloride, ammonia, total dissolved solids (TDS), and low level dissolved metals including mercury and selenium. Geochemical analyses were coordinated by SRK.

2.2 Construction Monitoring, Sampling, and Analysis

As previously stated, monitoring of areas where construction rock had been placed during the 2015/2016 construction season included:

- The TIA access road up to the dyke, including the road to Quarry 3 and adjacent pad;
- Airstrip expansion;
- Pad T expansion;
- Mill Pad reconstruction; and
- Temporary explosives berm by the North Dam.

These areas were visually inspected by an SRK geochemist in June 2016 by walking along the edge of the roads and airstrip, walking the perimeter of the explosives berm, mill pad, and Quarry 3 pad, and walking the perimeter and additional transects across Pad T. The inspection of Pad T was limited to areas without waste rock or ore stockpiles. A total of 17 surface rock samples, including one field duplicate, were collected from the surface material in the areas inspected (Attachment A). Samples 16-QR-14 and 16-QR-15 are field duplicates. Photographs of the areas inspected are included in Attachment B.

The samples collected were visually described by SRK. Field notes were taken to document the lithology, visible sulphide content and veining. At each sample site two fractions (<1 cm and

<2 mm) were collected by sieving. While at site, SRK conducted contact tests (1:1 solid to deionized water ratio) using a split of the <2 mm fraction. The pH and EC of these leachates were recorded.

Both fractions of all samples were shipped to Maxxam Analytics for sample preparation and analysis. The <1 cm samples were submitted for acid base accounting and the < 2 mm samples were used for shake flask extraction testing. All <1 cm samples were analysed for total sulphur by Leco. Fourteen samples (including field duplicates 16-QR-14 and 16-QR-15) had total sulphur levels >0.1% and were submitted for full ABA as described in Section 2.1 and trace element content by aqua regia digestion followed by ICP-MS finish.

Five samples were selected by SRK for SFE testing based on field contact tests (rinse EC and pH) and sample location. SFE tests were performed on the <2 mm fraction using the MEND (2009) method as described in Section 2.1.

2.3 Quality Assurance and Control

All results passed Maxxam's QA/QC criteria including the use of duplicate measurements and reference material. All results were reviewed by SRK for quality assurance. Standards were checked and were within tolerance ranges. Ion balances were calculated and were within an acceptable range. All results were deemed acceptable.

QA/QC samples for the ABA data included one set of field duplicate sampled by SRK (16-QR-14 and 16-QR-15) and two sample splits generated by the lab (16-QR-01 and 16-QR-14). Relative percent differences (RPD) were calculated to assess reproducibility of results. Less than 10% of the parameters with concentrations above analytical uncertainty (10 times the detection limit) had RPD values greater than 30%, indicating good reproducibility.

Two splits of samples 16-QR-04 and Q22106A were generated by the lab for QA/QC of shake flask extraction test results. For sample 16-QR-04, more than 10% of the trace metal concentrations that were above analytical uncertainty (10 times the detection limit) had RPD percentages greater than 30%, indicating poor reproducibility of results. Sample Q22016A and its sample split passed the RPD criteria, indicating better reproducibility of SFE samples for the quarry rock sample.

pH and EC measurements by SRK on a blank of the deionized water used for the field contact tests confirmed the quality of the water. RPD values ranged from 7 to 25% between the field and laboratory rinse tests.

3 Results

3.1 Quarry Monitoring

The Quarry 2 ROQ samples (Q22016a and Q22016b) collected by TMAC were geologically described as basalt with trace amounts of fine-grained pyrite, local hematite alteration and local quartz carbonate alteration. Sample Q22016b contained more pyrite (~0.5-1%) and higher content (though still weak to moderate) of hematite and quartz carbonate alteration than Q22016a.

3.1.1 Static Testing

The ABA results of Quarry 2 ROQ rock samples are presented in Table 1 and included in Attachment C. Total sulphur contents ranged between 0.15 and 0.18% S. Low sulphate content was detected for all samples (0.02 to 0.04% as S). Sulphur content was slightly higher in the finer size fraction (< 2 mm) however overall sulphur levels were uniformly low for both size fractions. Sulphide-sulphur, calculated as the difference between total and sulphate sulphur, was used to calculate the acid potential (AP) of the samples (Table 1).

Modified NP levels ranged from 97 to 160 kg $CaCO_3$/t. Levels of NP values were higher than TIC, the latter which ranged from 77 to 140 kg $CaCO_3$/t. This suggests that silicates, that are not expected to be highly reactive under field conditions, contributed to the buffering capacity in the test. All samples were classified as non-potentially acid generating (non-PAG) on the basis of TIC/AP and NP/AP (ratios greater than 3).

3.1.2 Shake Flask Extraction Tests

A summary of the SFE test results for the <2 mm fraction of Q22016a is presented in Table 2, with complete results presented in Attachment C. These tests provide an indication of the soluble load of the sample. Concentrations in sample leachate are dependent on the solid to water ratio, the amount of time the material has been allowed to weather, the amount of time the water is in contact with the waste material, the grain size distribution of the material, and the presence of secondary minerals that may control or limit concentrations. Therefore, they cannot be directly compared to discharge water quality guidelines but are compared to ten times the guidelines.

The pH was alkaline (8.9). Parameters were compared to ten times CCME water quality guidelines for the protection of aquatic life (CCME 2007) to screen for parameters that were elevated in the test leachate. All parameters were below these screening criteria. Due to the high water to rock ratio, these tests are considered dilute and concentrations of contact water may be higher than those in the SFE leachates.

Table 1: Acid Base Accounting Results for the 2016 Quarry 2 Rock Samples

Area	Sample ID	Paste pH	Total S	Sulphate Sulphur	Sulphide Sulphur	AP	TIC	Modified NP	TIC/AP	NP/AP
		pH Units	wt%	wt%	wt%	Kg $CaCO_3$/t	Kg $CaCO_3$/t	Kg $CaCO_3$/t	-	-
Quarry 2	Q2-2016a	8.7	0.16	0.04	0.12	5	100	120	20	23
		8.9	0.18	0.03	0.15	5.6	130	150	23	27
	Q2-2016b	9.2	0.15	0.02	0.13	4.7	77	97	16	21
		8.9	0.18	0.02	0.16	5.6	140	160	24	28

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Notes:

AP is acid generation potential, calculated from Total Sulphur

NP is neutralization potential.

Sulphide Sulphur calculated from the difference of Total Sulphur and Sulphate Sulphur.

Table 2: Shake Flask Extraction Results for Quarry 2 Rock Sample (< 2 mm fraction)

°Parameter	Unit	*Screening Criteria	Q22016a
pH	pH Units	*6.5-9*	8.9
EC	uS/cm	-	230
TDS	mg/L	-	120
Total Hardness (as $CaCO_3$)	mg/L	-	26
Total Alkalinity	mg/L	-	36
SO_4	mg/L	-	28
Cl	mg/L	*1200 mg/L*	23
Nitrate	mg N/L	*30 mg N/L*	1.7
Total Ammonia	mg/L	*0.55***	0.012
Al	mg/L	*1*	0.32
As	mg/L	*0.05*	0.0017
Cd	mg/L	*0.0008****	<0.000005
Cu	mg/L	*0.02****	0.0015
Fe	mg/L	*3*	0.0088
Pb	mg/L	*0.01****	0.000037
Hg	mg/L	*0.000026*	<0.00005
Mo	mg/L	*0.073*	0.003
Ni	mg/L	*0.25****	0.000085
Se	mg/L	*0.01*	0.0012
Tl	mg/L	*0.008*	0.000007
Zn	mg/L	*0.3*	0.00019

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Notes:

°All element concentrations are given as dissolved

*Comparisons to ten times the CCME water quality guidelines for the protection of aquatic life are intended for screening purposes and are not directly applicable because SFE tests do not represent natural waters.
Values in bold indicates value exceeds respective water quality guideline for the parameter.
**Guideline for ammonia is pH and temperature dependent. Standard room temperature (20ºC) was used given laboratory conditions and average pH of 9.1 for all SFE samples. This guideline value is approximate.
***Guideline calculated based on the average hardness of the SFE samples of 42 mg $CaCO_3$ mg/L

3.2 Construction Monitoring

3.2.1 Visual Observations

The material used for construction/expansion of pads, roads, the airstrip and the temporary explosives berm was expected to be that characteristic of Quarry 2, i.e. grey-green mafic metavolcanics with trace to no visible sulphides and carbonate alteration/veins. The majority of the areas met these expectations. Exceptions were:

- The pad alongside the road to Quarry 3 (off the east side of the TIA access road), where several instances of pyrite vein material were observed along with numerous rusty brown weathered surfaces and epidote veins. One sample was collected for analysis from the NE corner of the pad (16-QR-05).
- The south end of the airstrip expansion, where the crushed metavolcanic rock included fragments of vein quartz and metavolcanic fragments that were cut by rare K-feldspar veins. One sample was collected from the south end of the airstrip (16-QR-12). Previous airstrip construction material also contained K-feldspar veining.
- Large areas of Pad T, where the crushed metavolcanic rock included fragments of vein quartz, epidote veins, and rusty brown weathered surfaces. Six samples were collected from the Pad T including five that fit this description (16-QR-08, 16-QR-13, 16-QR-14, 16-QR-16 and 16-QR-17) and one sample that was more typical of Quarry 2 material (19-QR-09). During the site visit, SRK understood from TMAC that Pad T had been constructed from Quarry 2 rock in addition to waste rock from underground. TMAC subsequently confirmed that Pad T was constructed from Quarry 2 rock only.

Samples were taken preferentially in areas where the rock diverged from the expected rock type based on the visual observations. Visual observations of all the samples collected from each of the inspected areas are provided in Attachment D. TMAC has confirmed that all construction materials were sourced from Quarry 2.

3.2.2 Contact Test Results

Results of the contact tests conducted by SRK are presented in Table 3. EC ranged from 92 to 4,800 µS/cm. The samples with the highest EC values were sample 16-QR-16 (4,800 µS/cm) taken from the center of Pad T, 16-QR-12 (2,700 µS/cm) taken from the south end of the airstrip, 16-QR-04 (1,500 µS/cm) taken from the south end of the TIA access road, and 16-QR-06 (1,000 µS/cm) taken from the mill pad. These measurements were taken into consideration when selecting samples for SFE tests.

The rinse pH values were near-neutral to alkaline ranging from 7.7 to 8.6. All rinse pH values were lower than the paste pH values (Table 1).

Table 3: Rinse Test Results for 2016 Construction Rock Samples (<2 mm fraction)

Area	Sample ID	Field Rinse Tests		*Laboratory Rinse Test
		pH	EC	EC
Temp. Explosives Berm	16-QR-01	8.1	170	-
TIA Access Road	16-QR-02	8.4	290	-
	16-QR-03	8.6	470	-
	16-QR-04	8	1,500	1,300
Quarry 3 pad	16-QR-05	8.4	260	-
Mill pad	16-QR-06	8.4	1,000	810
	16-QR-07	8.4	960	-
Airstrip	16-QR-10	8.2	150	-
	16-QR-11	8.3	92	-
	16-QR-12	8.4	430	470
Pad T	16-QR-08	8.2	570	-
	16-QR-09	7.7	900	1,000
	16-QR-13	8	2,700	-
	16-QR-14	8.6	400	-
	16-QR-16	7.7	4,800	-
	16-QR-17	8.2	240	-
BLANK		5.3	7	-

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Notes:
*Laboratory rinse tests were carried out on a selected number of samples for confirmation.

3.2.3 Static Testing

The ABA results for the 16 construction rock samples are presented in Table 4 and Attachment D. Of the 16 construction rock samples, 13 of them contained total sulphur contents above the 0.1% criteria and were submitted for full ABA analysis. Total sulphur ranged from 0.06 to 0.24%. Low sulphate content was detected for all samples (0.02 to 0.04% as S) indicating sulphide-sulphur was the dominant sulphur species (Figure 1). Sulphide-sulphur, calculated as the difference between total sulphur and sulphate, was used to calculate the AP of the samples (Table 4).

Modified NP and TIC levels ranged from 71 to 160 and 61 to 140 kg $CaCO_3$/t, respectively. Modified NP levels were greater than TIC with the exception of sample 16-QR-07 (mill pad) (Table 4, Figure 2). Lower NP values relative to TIC suggest that silicates contributed to the buffering capacity in the test. Greater TIC values relative to NP suggest the occurrence of iron-bearing carbonates which do not contribute net neutralization potential as they both produce and consume acid. All samples were classified as non-PAG on the basis of TIC/AP and NP/AP (Table 4, Figure 3 and Figure 4).

Table 4: Acid Base Accounting Results for the 2016 Construction Rock Samples (<1 cm fraction)

Area	Sample ID	Paste pH	Total S	Sulphate Sulphur	Sulphide Sulphur	AP	TIC	Mod. ABA NP	TIC/AP	NP/AP
		pH Units	wt%	wt%	wt%	Kg $CaCO_3$/t	Kg $CaCO_3$/t	Kg $CaCO_3$/t	-	-
Temp. Explosives Berm	16-QR-01	8.9	0.11	0.03	0.08	3.4	110	130	32	37
TIA Access Road	16-QR-02	9.5	0.11	0.02	0.09	3.4	75	89	22	26
	16-QR-03	-	0.09	-	-	2.8	-	-	-	-
	16-QR-04	9.1	0.12	0.03	0.09	3.8	97	120	26	32
Quarry 3 pad	16-QR-05	9.3	0.24	0.04	0.2	7.5	81	93	11	12
Mill pad	16-QR-06	-	0.09	-	-	2.8	-	-	-	-
	16-QR-07	9.2	0.12	0.03	0.09	3.8	100	76	27	20
Airstrip	16-QR-10	-	0.1	-	-	3.1	-	-	-	-
	16-QR-11	-	0.08	-	-	2.5	-	-	-	-
	16-QR-12	9.3	0.15	0.02	0.13	4.7	61	71	13	15
Pad T	16-QR-08	-	0.1	-	-	3.1	-	-	-	-
	16-QR-09	-	0.06	-	-	1.9	-	-	-	-
	16-QR-13	8.7	0.15	0.03	0.12	4.7	110	120	23	26
	16-QR-14	9.2	0.13	0.03	0.1	4.1	99	110	24	28
	16-QR-16	8.3	0.12	0.03	0.09	3.8	130	150	34	39
	16-QR-17	8.9	0.16	0.04	0.12	5	110	130	22	26

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Notes:

AP is acid generation potential, calculated from Total Sulphur

NP is neutralization potential.

Sulphide Sulphur calculated from the difference of Total Sulphur and Sulphate Sulphur.

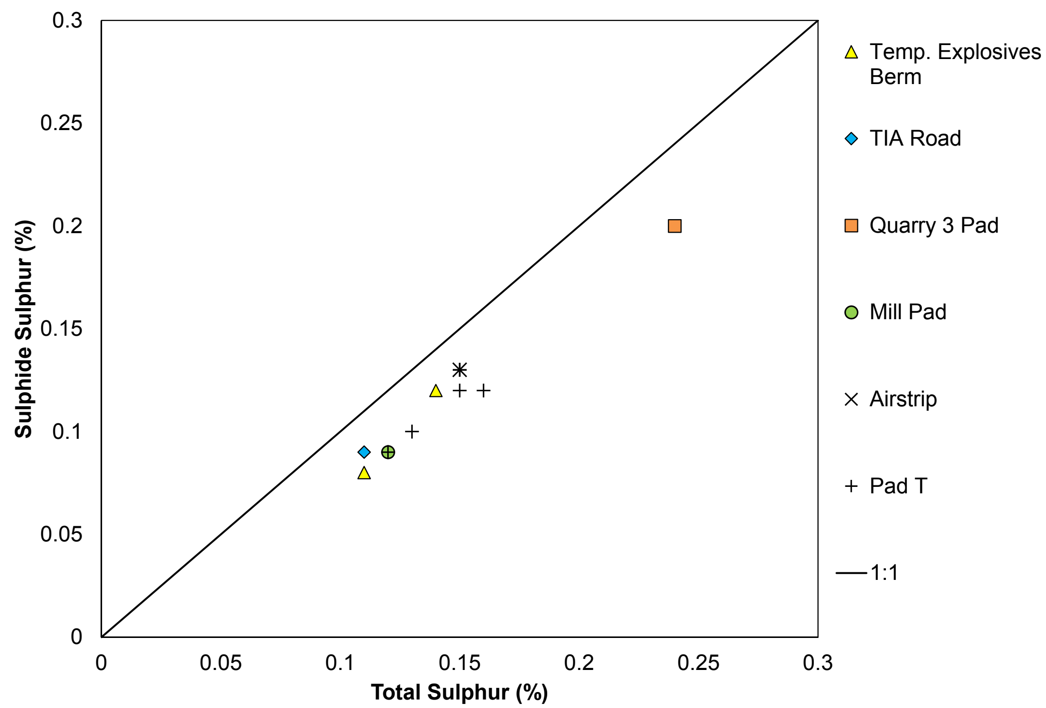

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Figure 1: Total Sulphur vs. Calculated Sulphide Sulphur

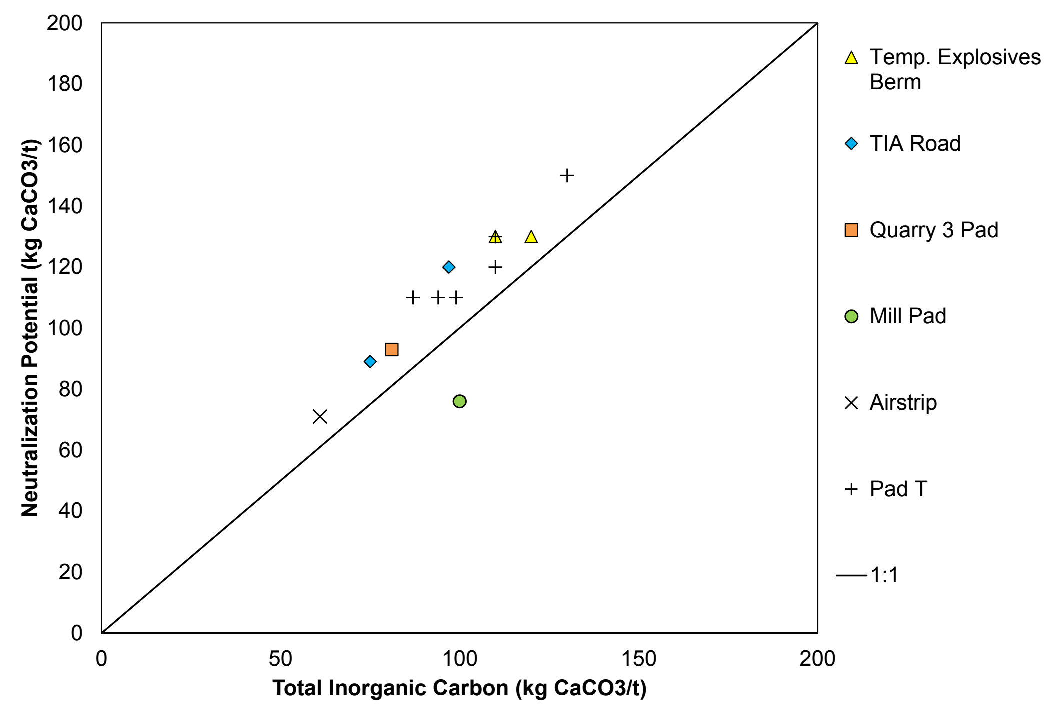

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Figure 2: Total Inorganic Carbon vs. Modified Neutralization Potential

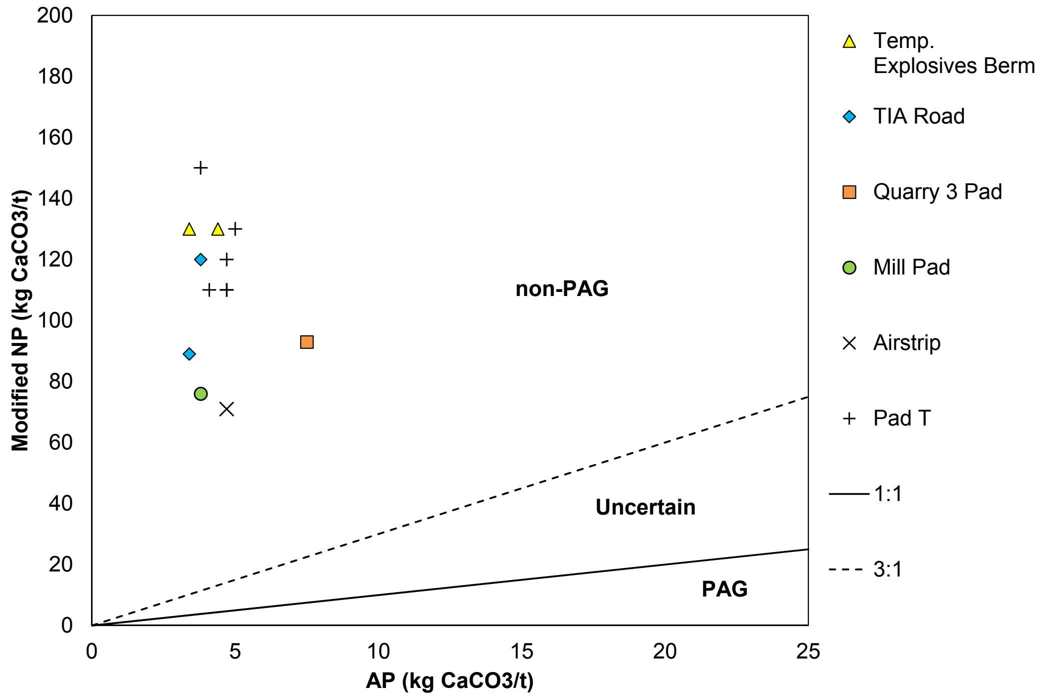

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Figure 3: Acid Generation Potential vs. Modified Neutralization Potential

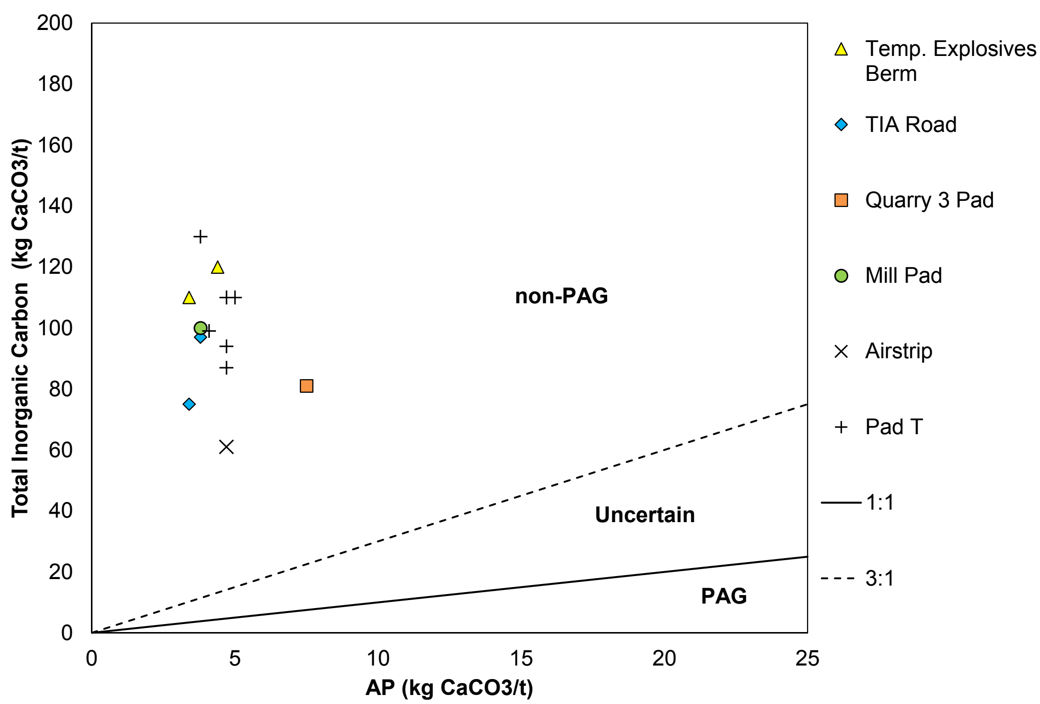

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Figure 4: Acid Generation Potential vs. Total Inorganic Carbon

3.2.4 Elemental Analyses

Results of the elemental analysis of the ten construction rock samples with total sulphur levels >0.1% are provided in Attachment D. Selected results are provided in Table 5.

The data were compared to ten times the average crustal abundance for basaltic rocks (Price 1997) as a means of screening the data for anomalously high values. Selenium could not be assessed because the detection limits were high in comparison to these screening criteria. Gold and boron had high concentration relative to the crustal abundance. All other parameters were not elevated compared to these screening criteria indicating no appreciable enrichment.

Table 5: Selected Results of Metals Analysis of Construction Rock Samples

Parameter	*Average Crustal Abundance (Basaltic Rocks)*	16-QR-01	16-QR-02	16-QR-04	16-QR-05	16-QR-07	16-QR-12	16-QR-13	16-QR-14	16-QR-16	16-QR-17
Mo	1.5	0.2	0.1	0.2	0.1	0.1	0.2	0.1	0.1	<0.1	0.2
Cu	87	130	130	110	170	140	130	120	200	140	130
Pb	6	1.2	0.6	1.4	14	0.7	0.5	0.6	1.1	0.4	1.8
Zn	105	88	67	74	80	77	67	66	75	62	78
Ni	130	63	64	59	62	63	73	62	62	60	67
Fe	86500	7.1	5.3	5.7	6.1	5.9	4.8	5.9	5.2	5.5	6.7
As	2	3.7	0.8	3.8	5.3	0.9	7.2	1.4	3.1	<0.5	0.7
Au	0.004	<0.5	<0.5	<0.5	<0.5	<0.5	**0.6**	<0.5	<0.5	**1.1**	<0.5
Cd	0.22	<0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.3	0.1	0.1
B	5	<20	<20	<20	<20	24	<20	<20	**75**	<20	<20
Al	78000	3.9	2.9	3.1	3.3	3.2	2.6	3.3	2.9	3.1	3.7
Hg	0.09	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tl	0.21	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Se	0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0.7**

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Note:

Average crustal abundance for basaltic rocks from Price (1997).

3.2.5 Shake Flask Extraction Tests

Shake flask extraction tests were completed on 5 of the 10 construction rock samples with total sulphur levels >0.1%. The SFE results are summarized in Table 6.

All SFE tests had alkaline pH ranging from 8.9 to 9.3. Conductivity was highest for sample 16-QR-13 (collected on the north side of Pad T and along the western extent of the waste rock stockpile), with chloride and nitrate being the dominant ions. High chloride concentrations were also observed for sample 16-QR-04 (TIA access road). The source of chloride and nitrates are calcium chloride drilling brines and ammonia-based explosives residues, respectively. TMAC confirmed that drilling brines are not used in the quarries and a review of construction material tracking records indicated that all construction rock was sourced from Quarry 2. Chloride and nitrate concentrations from sample 16-QR-13 can be attributed to the waste rock stored on Pad T or mine vehicle traffic on the pad. The source of chloride from sample 16-QR-04 on the TIA access road is undefined.

SFE results were compared to ten times the CCME guidelines for the protection of aquatic life (CCME 2007) as screening criteria to evaluate parameters that were elevated in the test leachate. The concentration of total ammonia in the leachate from sample 16-QR-13 (Pad T sample previously discussed) exceeded the screening criteria. As with nitrate, the source of ammonia is residues from explosives.

Due to the high water to rock ratio, SFE tests are considered dilute and concentrations of contact water may be higher than those in the test leachates. However, results indicate that the potential for metal leaching from these samples is low.

Table 6: Shake Flask Extraction Results for the 2016 Construction Rock Samples (< 2 mm fraction)

°Parameter	Unit	*Screening Criteria	16-QR-04	16-QR-05	16-QR-07	16-QR-12	16-QR-13
Area			TIA Access Road	Quarry 3 Pad	Mill Pad	Airstrip	Pad T
pH	pH Units	6.5-9	8.9	9.3	9.3	9.2	9
EC	uS/cm	-	560	130	320	260	1200
TDS	mg/L	-	270	70	150	140	650
Total Hardness (as CaCO3)	mg/L	-	44	24	22	21	100
Total Alkalinity	mg/L	-	30	31	31	37	20
SO4	mg/L	-	28	7.6	25	27	33
Cl	mg/L	1200 mg/L	110	9.7	57	23	210
Nitrate	mg N/L	30 mg N/L	8.8	1.7	1.7	4.8	29
Total Ammonia	mg/L	0.55**	0.49	0.29	0.18	0.053	**0.92**
Al	mg/L	1.00	0.5	0.57	0.44	0.35	0.23
As	mg/L	0.05	0.00057	0.0013	0.00048	0.002	0.000094
Cd	mg/L	0.0008***	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Cu	mg/L	0.02***	0.00072	0.0021	0.00037	0.0013	0.00023
Fe	mg/L	3.00	0.3	0.33	0.037	0.013	0.009
Pb	mg/L	0.01***	0.000098	0.00019	0.00001	0.000006	<0.000005
Hg	mg/L	0.00	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Mo	mg/L	0.07	0.0034	0.0026	0.0025	0.0037	0.0014
Ni	mg/L	0.25***	0.00029	0.00041	0.000027	0.000025	<0.00002
Se	mg/L	0.01	0.00081	0.00075	0.0013	0.00083	0.00068
Tl	mg/L	0.01	0.00001	0.000003	0.000018	0.000005	0.000094
Zn	mg/L	0.30	0.0011	0.00096	0.0011	0.00012	0.00017

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Notes:

°All element concentrations are given as dissolved
*Comparisons to ten times the CCME water quality guidelines for the protection of aquatic life are intended for screening purposes and are not directly applicable because SFE tests do not represent natural waters.
Values in bold indicates value exceeds respective water quality guideline for the parameter.
**Guideline for ammonia is pH and temperature dependent. Standard room temperature (20ºC) was used given laboratory conditions and average pH of 9.1 for all SFE samples. This guideline value is approximate.
***Guideline calculated based on the average hardness of the SFE samples of 42 mg CaCO3 mg/L

4 Conclusions

The results of the Quarry 2 and construction rock monitoring program indicate that all the samples collected and submitted for testing are non-PAG and have a low risk for metal leaching. Elemental analyses indicates no appreciable enrichment compared to average crustal abundance for basaltic rocks. Shake flask extraction tests indicated higher chloride levels compared to other quarry rock samples for selected samples from Pad T and the TIA road. Nutrient (nitrate and ammonia) levels in the shake flask extraction leachate from the Pad T sample were also high compared to other quarry rock samples, with ammonia levels also above the screening criteria. Brines (the source of chloride) are used for drilling within the underground mine, however TMAC confirmed drilling brines are not used in the quarries. TMAC also confirmed that all construction rock was sourced from Quarry 2. Therefore, the source of chloride is in the TIA access road sample (16-QR-04) is undefined. Chloride and nutrients in the Pad T sample could be attributed to the waste rock stored on Pad T or mine vehicle traffic on the pad.

On the basis of the 2016 quarry and construction monitoring program; SRK recommends the following for the 2017 monitoring program:

- Seepage monitoring along the section of TIA access road inspected in 2016.
- Visual geological inspections of active quarry faces.

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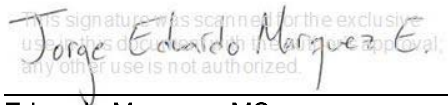

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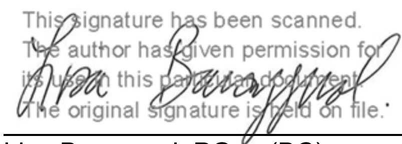
Reviewed by:



Lisa Barazzuol, PGeo (BC)
Senior Consultant (Geochemistry)

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The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

5 References

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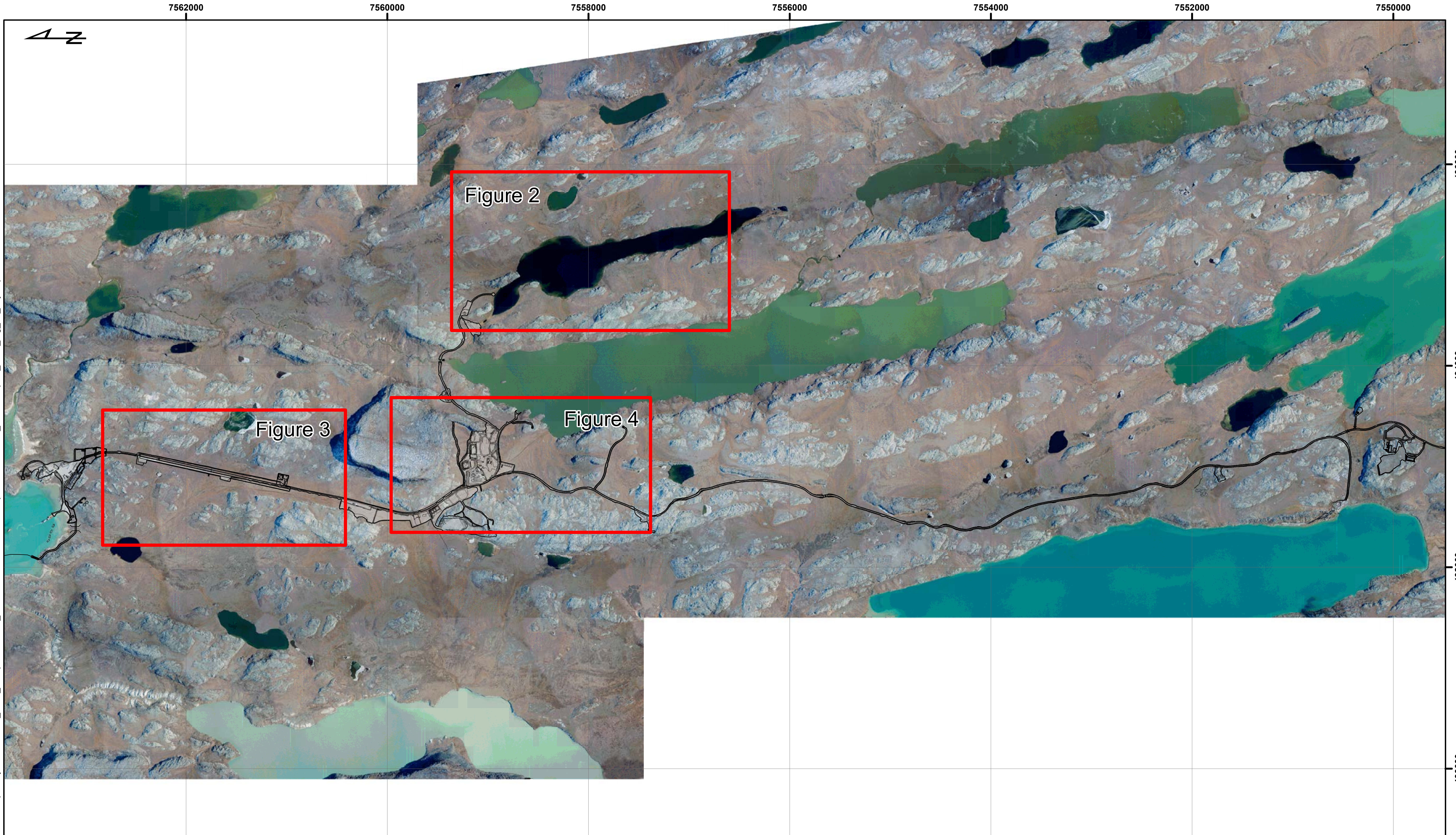
Attachment A – Maps of 2016 Construction Rock Sampling Locations



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2016 Rock Samples

Hope Bay Gold Project

Rock Sample Locations
Key Map

Date:	Approved:	Figure:
March 2017	LB	1

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