Atlantic Gold

Appendix F.2

Fifteen Mile Stream Project - ML/ARD Assessment Report,
Lorax Environmental Services Ltd.

Atlantic Gold

Fifteen Mile Stream Project – ML/ARD Assessment Report

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LORAX
ENVIRONMENTAL

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1. Introduction

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1 Introduction

The Fifteen Mile Stream (FMS) project is a proposed gold mine owned by Atlantic Mining Nova Scotia Corporation (AMNS) who is preparing an Environmental Impact Statement (EIS) that will be submitted to the Canadian Environmental Assessment Agency (CEAA) and Nova Scotia Environment (NSE) as part of the project's regulatory requirements. Lorax Environmental Services Ltd. (Lorax) was retained by AMNS to conduct a geochemical study to characterize mine material such as waste rock, ore, and tailings. This study considers material properties that may change water quality due to metal leaching and acid rock drainage (ML/ARD). The geochemical characterization of FMS samples will also support the development of geochemical source terms for water quality modelling and provide direction for material management decisions associated with these materials.

ML/ARD is typically associated with the weathering of sulphide-bearing geologic materials. While this is a natural process, the exposure of fresh particle surfaces produced by mining activity enhances the reaction rates associated with ML/ARD.

Following the introduction, a brief summary of the geology of the area is provided in Section 2. Section 3 describes the methodology related to the sample selection/collection as well as geochemical analyses and Section 4 discusses the analytical results. Conclusions are provided in Section 5.

2. Geology

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2 Geology

2.1 Regional Geology

Nova Scotia is divided into two terranes along the east-west trending Cobequid-Chedabucto Fault Zone (FSSI, 2015). The FMS site is within the southern Meguma Terrane, while the Avalon Terrane is located to the north of the fault zone. The Meguma Terrane includes the Cambrian to Ordovician Meguma Group and Late Ordovician to Early Devonian volcanic and sedimentary rocks (FSSI, 2015). After the collision of the Meguma and Avalon terranes in the mid-Devonian period, sedimentary material was deposited over both terranes during the Carboniferous to Early Cretaceous period. The sedimentary units include siliciclastic rocks, calcareous rocks, evaporites, coal, kaolinitic clay, and silica sand (FSSI, 2015).

The majority of the gold mineralization occurs within the units of the Meguma Group. The Meguma Group is divided into the Goldenville Formation and the overlying Halifax Formation. The metamorphic facies in both Meguma Group units vary from greenschist to amphibolite facies. The Goldenville Formation is a greywacke unit that is > 5,600 m thick, while the Halifax Formation is primarily argillite with an average thickness of approximately 4,400 m. Both the Goldenville Formation and the Halifax Formation are made up of deep marine turbidite deposits.

2.2 Site Geology

The Meguma Group is the dominant unit occurring in the area near the FMS site. The Goldenville Formation is further subdivided, from oldest to youngest, into the Moose River Member, the Tangier Member and the Taylors Head Member. Claystone and siltstone are present in the Moose River and Tangier Members but are minor in the Taylors Head Member. Overall there is a decrease in the proportion of fine-grained sediments from the oldest to the youngest units within the Goldenville Formation. The Touquoy, Beaver Dam, and FMS sites are found along the trend of an anticline within the same geologic units. The Moose River-Beaver Dam east-northeast-trending anticline contains both the Touquoy and Beaver Dam gold deposits and may be equivalent to the FMS anticline which contains the FMS site (FSSI, 2015). The anticline forms a dome structure, with both limbs dipping to the north (FSSI, 2015). The metamorphic facies in the FMS region are amphibolite to staurolite facies. The Moose River Member of the Goldenville Formation is the dominant stratigraphic unit that will be disturbed by mining activity in the FMS pit. This unit is comprised of alternating argillite and greywacke units (FSSI, 2015). While many unique lithologies and geologic structures are tracked during core logging, argillite and greywacke along with two interbedded intermediates (argillite- and greywacke-dominated) represent the four major rock types by volume identified on site. In an effort to be consistent with the geological observations from site while simultaneously allowing for a representative and simplified geo-environmental model, these four major rock types are being carried forward in this ML/ARD assessment. A more detailed description of these units is given in Table 3-1.

3. Samples and Analytical Methods

3 Samples and Analytical Methods

3.1 Sample Selection and Collection

3.1.1 Mine Rock Samples

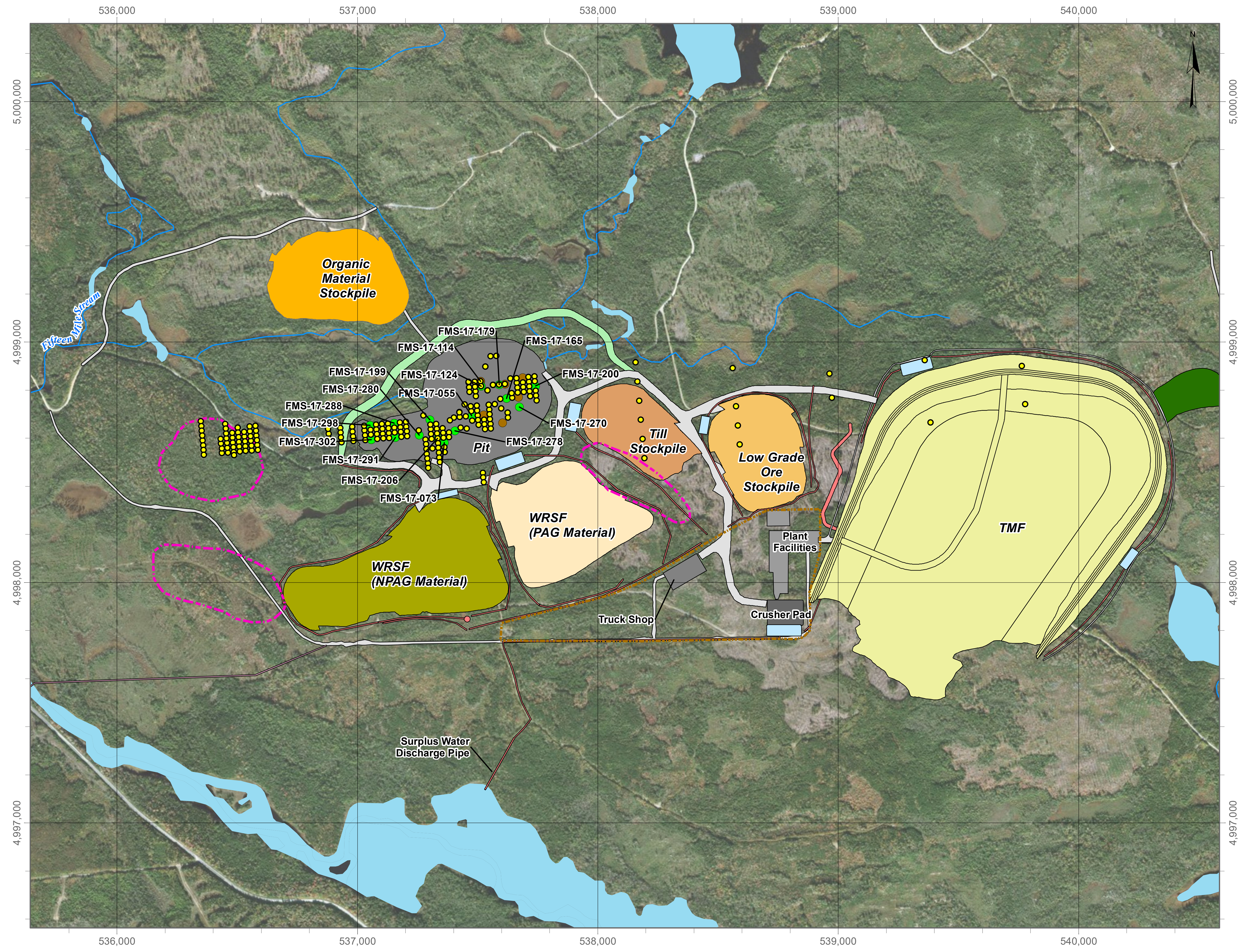
A total of 60 FMS drill core samples have been collected in support of this geochemical assessment. Generally, 1m-intervals were chosen for this sample selection. Static test analyses, including acid base accounting (ABA) and solid phase elements were carried out on all samples, and based on these results, a subset of samples was selected for kinetic testwork (humidity cells). The humidity cell subsamples were also assessed for mineralogy, particle size distribution, shake flask extractions (SFE), and leaching tests. Additional drill core intervals were selected for the initiation of a field bin. A subsample from the material used to fill the field bin was submitted for ABA, solid phase elements, and mineralogy.

When the samples for the geochemical testwork were originally selected, the designation between low-grade ore and waste was based on the Au grade rather than the spatial association with the waste ore zones. Since this time, the spatial extent of the ore shell has been better defined. This has resulted in a greater than anticipated proportion of ore samples in the static testing dataset, as well as some of the humidity cell samples being comprised of a mix of ore and waste intervals. An in-fill sampling and geologic modelling program has since been conducted by AMNS in order to close the spatial gaps identified for the waste rock zone within the pit. This sampling program consisted of 38 additional composite samples collected over 5 m intervals based on the geological block model. The FMS geologic units and sample descriptions are provided in Table 3-1, whereas the sample locations and drill core details are presented in Appendix 3-1. The location of the sampled drill holes is provided in Figure 3-1.

Five humidity cells (HC1 through HC5) were initiated using crushed drill core material covering median to 75th percentile sulphur contents for each of the four lithologies and ore material, as summarized in Table 3-2. Field bin LX-18-FB3 was filled with manually split drill core selected from the four main lithologies in order to represent the expected proportions in the waste rock pile (Table 3-3). The objective of the kinetic testing program is to provide sulphide oxidation and leaching rates to be used as input for the geochemical source term model.

Table 3-1:
FMS Geologic Units and Sample Descriptions

Geologic Unit	Description	Code	No. Samples
Argillite	argillite with < 5% greywacke interbeds	AR	26
Argillite-Greywacke	argillite with 5-49% greywacke interbeds	AG	11
Greywacke-Argillite	greywacke with 20-50% argillite interbeds	GA	14
Greywacke	greywacke with < 20% argillite interbeds	GW	24
Ore	Ore designation is based on the ore shell	Ore	23



LEGEND

● Drillhole Collar
● Sampled - Static Testing
● Sampled - Field Bin

Updated Infrastructure

▨ Access Road
▨ Collection Pond
▨ Crusher Pad
▨ Haul Road
▨ LGSP
▨ Open Pit
▨ Organic Material Stockpile
▨ Plant
▨ Potential Borrow Site
▨ Seloam Brook Diversion
▨ TMF
▨ Till Stockpile
▨ Topsoil Stockpile
▨ Transmission Spur Line
▨ Transmission Spur Line option 2
▨ Plant and Admin Building
▨ Truck Shop
▨ WRSF NPAG
▨ WRSF PAG
▨ Water Management

Coordinate System: NAD 1983 UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983
Units: Meter

1:15,000

0 200 400
Meters

DATE SAVED:	Aug 14, 2019
DRAWN BY:	GM
REVIEWED:	JO
VERSION:	1

CLIENT:

ATLANTICGOLD

LORAX ENVIRONMENTAL

PROJECT:

FMS Project - ML/ARD Assessment Report

TITLE:

FMS Drill Hole Locations

PROJECT #: A490-2 *FIGURE:* 3-1

P:\@Drafting\Touquoy\Drafting Figures\MXD\FMS\Drillhole Collars_20190814.mxd

**Table 3-2:
Summary of FMS Humidity Cell Samples**

Humidity Cell ID	Lithology	Designation	Hole ID	Interval (m)	
				From	*To*
HC 1	AG	waste	FMS-17-124	70	71
		ore	FMS-17-124	82	83
HC 2	AR	waste	FMS-17-055	50	51
		ore	FMS-17-124	130	131
HC 3	GA	waste	FMS-17-073	9	10
		waste	FMS-17-199	29	30
HC 4	GW	waste	FMS-17-124	46	47
		waste	FMS-17-199	5	6
HC 5	Ore	ore	FMS-17-055	83	84
		ore	FMS-17-055	70	71

**Table 3-3:
Summary of Core Proportions Making up the FMS Field Bin Sample**

Lithology	Meters of Drill Core Selected (m)	Proportion in Field Bin (%)
AR	70	53
AG	15	11
GA	18	14
GW	28	21
Total	*131*	*100*

3.1.2 Tailings Samples

Two tailings samples were selected from the metallurgical testing (KM5446) conducted by ALS Laboratories on FMS ore materials in September 2017. These metallurgical tests simulated a split circuit utilizing a hydroflotation and conventional rougher flotation. For geochemical analyses including ABA, solid phase elements, and SFE, weighted composites of the hydrofloat and rougher tailings were provided from two representative test runs (Test 8 and 42).

More recent metallurgical testing (KM5644) including ore composite samples from an expanded mining area was completed in the fall of 2018. Two additional tailings samples representing a conventional mill circuit (Test 10) and a split circuit (Test 6) were provided to Lorax in slurry form for environmental testing. The 2018 conventional tailings material is also being used for saturated column testing, initiated in March 2019, to constrain the geochemical behaviour within the saturated zone of the TMF. This conventional tailings stream is considered representative of the material that will ultimately be deposited in the FMS TMF (Tiver, pers. comm., 2019) and includes a rougher and a cleaner circuit to produce an ore concentrate which will be processed at the Touquoy mill (Figure 3-2).

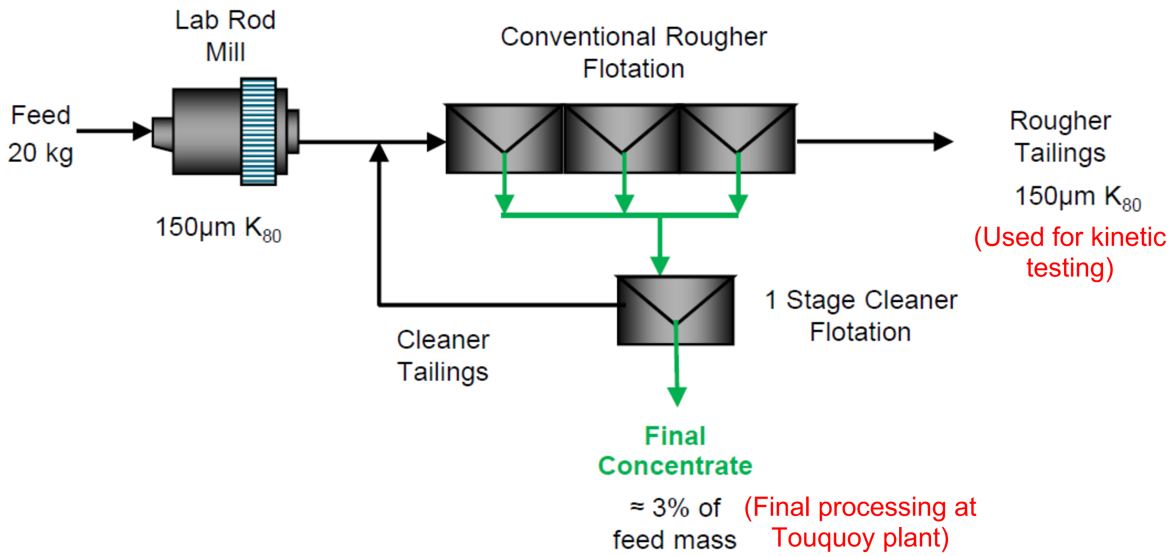


Figure 3-2: Flowsheet for the 2018 metallurgical testing (KM5644) from which the FMS conventional tailings sample was derived.

3.2 Analytical Methods

3.2.1 Static Test Methods

Static tests that were carried out to characterize mine rock, tailings, and overburden samples include acid base accounting (ABA), aqua-regia digestible elemental abundance, mineralogical investigations, and leachate tests. Note that the 38 samples collected as part of the AMNS in-fill sampling program only underwent ABA analysis. The following sections provide a brief overview of all methods utilized. Static testing was conducted at ALS Laboratories for the drill core and the field bin subsample, while the tailings samples were submitted for analysis at SGS Canada Inc.

3.2.1.1 Mineralogy

Mineralogical analyses are useful in determining the significant forms of acid producing minerals (*i.e.*, sulphides) and acid neutralizing minerals (*i.e.*, carbonates and silicates) in a sample. X-ray Diffraction (XRD) with Rietveld-refinement is a standard technique which provides quantitative mineralogical information. All five humidity cell subsamples were submitted to SGS Canada Inc. for mineralogical assessment. Thin sections of the same samples were also investigated by petrographic microscopy at the Lorax laboratory using a Nikon Optiphot polarizing microscope with transmitted and reflected light capabilities. Photomicrographs were taken using a Nikon EOS 70D camera.

The field bin sample was also submitted to SGS Canada Inc. for QEMSCAN (Quantitative Evaluation of Minerals by Scanning Electron Microscopy). This analysis provides information on the modal mineral abundances in addition to information regarding grain sizes and exposure surfaces of the sulphide and carbonate minerals in the sample. Arsenic and sulphur deportment was also investigated during this analysis.

3.2.1.2 Acid-Base Accounting

Acid-base accounting (ABA) consists of a series of static tests (paste pH, sulphur species, neutralization potential and acid potential) which are used to evaluate the acid rock drainage (ARD) potential of materials. As materials undergo weathering, the competing influences of acid-generating and alkalinity-producing reactions will determine whether ARD will result. Acidic drainage at mine sites is typically generated from the oxidation of sulphide minerals, whereas neutralization is typically provided by the dissolution of carbonate minerals. The sulphide sulphur content is estimated by the difference between the total sulphur and sulphate sulphur and is used to derive the acid potential (AP) of site materials. The carbonate NP (CaNP) is calculated using the assumption that the total inorganic carbon (TIC) content is present as calcium carbonate. The modified neutralization potential (NP) is used to represent the NP of the materials for this site. It is a titration-based NP measurement that considers NP from other minerals (*e.g.*, the aluminosilicates) in addition to carbonates. The relative amounts of NP and AP of a sample can be used to evaluate the potential for acid generation giving consideration to standard regulatory criteria classifying mine solid waste as either PAG (potentially acid generating) or NAG (non-acid generating). Consistent with the criteria proposed in Price (2009) to evaluate the likelihood of ARD, materials with a net potential ratio (NPR = NP/AP) less than 2 are classified as PAG, while samples with an NPR ≥ 2 are designated as NAG.

3.2.1.3 Aqua-Regia Digestible Elemental Abundance

Solid phase elemental abundance analyses are conducted on pulverized samples by digesting a sample in aqua regia acid (HNO_3 + 3 HCl). The extract is then diluted and analyzed for metals by inductively coupled plasma mass spectrometry (ICP-MS). Data from these analyses are used to characterize materials and to identify elements of potential environmental concern. The degree of enrichment as compared to average upper continental crust abundance (AUCCA; Rudnick and Gao, 2014) can provide a general indication of the overall metal enrichment. However, enrichment does not necessarily indicate that the element will become problematic, since the leaching rate is highly dependent on other factors, including the metal-phase associations, grain size, the geochemistry of infiltrating waters, and the depositional environment.

3.2.1.4 Short-Term Leach Testing

Short-term leach tests at different water/solids ratios were conducted at SGS Canada Inc. on the FMS material. Metal contents measured in leaching tests provide a measure of the mass of readily soluble metals which will be immediately available for leaching upon exposure to infiltrating water. Shake flask extractions (SFE) consist of agitating a representative sample in water, typically at a water/solids ratio of 3:1, for 24 hours. Standard SFE tests were conducted on the humidity cell samples and the field bin subsample. Additional leach tests were also conducted at 1:1 and 0.5:1 water/solids ratios for the field bin subsample in an effort to better understand mineral solubility limits and the effect of water/solid ratios on drainage chemistry. The leachate chemistry from these tests can be used as a cursory tool in determining the initial leachate chemistry of water in contact with disturbed rock. These tests do not give insight into reaction rates and the timing for delayed onset of ARD.

3.2.2 Particle Size Distribution

Particle size distribution (PSD) analyses were carried out at SGS Canada Inc. to quantify the relative distribution of grain sizes of material placed in the humidity cell tests. It is important to have an estimate of the specific surface area of the humidity cell samples as the kinetic rate at which a material will react is in part dependent on the specific surface area of the sample. The specific surface area is also required when scaling between laboratory and field conditions. Standard mechanical sieving methods were used to characterize the general PSD of samples. No PSD data is available for the field bin sample due to an error in the initial sample preparation.

3.2.3 Kinetic Test Methods

3.2.3.1 Humidity Cells

Humidity cell testing is used to mimic the natural weathering processes that act on crushed rock or tailings material. The results are used as the basis to predict geochemical loading rates from these materials when stored in surface facilities under oxidizing conditions. These experiments provide data on the primary weathering rates of waste materials and, therefore, the results from this type of testing may be used to estimate the rate of acid generation and metal release to the environment. As well, these data may be used to estimate drainage chemistry via upscaling models.

Laboratory-based humidity cells are set up at SGS Canada Inc. These cells are typically composed of a plexiglass cylinder filled with approximately 1 kg of sample crushed to 80% passing <6.4 mm. The contents of the cells are subjected to moist air for three days, followed by dry air for three days (< 10% relative humidity). At the end of each wet/dry cycle, the contents of the cell are leached with 500 mL distilled de-ionized water on the seventh day (Price, 1997; Lapakko, 2003). The purpose of the leaching step is to recover any readily soluble products that have formed due to mineral dissolution or sulphide oxidation in order to determine the dissolved load contributed from the previous week's test. The leachate is then analyzed for pH, alkalinity and any solutes of interest.

3.2.3.2 Field Bin

One field bin containing drill core from FMS was set up near the Touquoy mine site in September 2018 alongside Touquoy (n=2) and Cochrane Hill (n=1) field bins (Figure 3-3). The containers used are industrial-grade, 115L plastic drums that have been tested for this purpose at several other minesites. Approximately 170 kg of drill core for this field bin was selected in proportions to represent the different lithologies expected in the waste rock pile. The drill core samples were combined using the cone and quartering method, whereby the selected drill core intervals were combined and mixed in a large pile which was divided into quarters and opposite quarters were removed to fill the field bin. The remaining material was piled back into a cone and the quartering process was repeated until the bin was full (Figure 3-3). A representative subsample for static testing was collected from the remaining material.

Figure 3-3: Setup of field bins near the Touquoy site (left) and FMS core materials used to construct LX-18-FB3 (right).

Natural precipitation passes through the rock material and drains out of the bottom of the field bin via a small hole that is connected to collection jugs via HDPE tubing. Leachate samples are taken when a sufficient water volume has collected in the collection jug (or otherwise monthly when not frozen) and submitted to Maxxam Laboratories for water quality analysis. The initial sample was collected by manually irrigating the field bin with approximately 3L of distilled water.

3.2.3.3 Saturated Column

Saturated column testwork is used to characterize leachate geochemistry of tailings material under suboxic conditions, which will help inform mine waste management plans and water quality predictions. One saturated column was constructed, housed and sub-sampled at the Lorax laboratory in Vancouver, B.C. The column was constructed using a Plexiglass cylinder (15.0 cm in diameter, 20.0 cm in length; Figure 3-4). The bottom of the column was lined with a dispersion plate, a sheet of non-reactive polyester fabric, and a layer of silica sand (500 g) to allow for the even distribution of water over the surface area of the column bottom prior to contacting the column substrate. The column was equipped with an inlet at the base of the column and one port at the top of the column for sampling. Note that the experiment was designed so that influent entered from the bottom of the column and flowed upward. In other words, the bottom of the column is effectively upgradient and the top of the column is downgradient. This is a standard approach to ensure even flow through the column materials and minimize the risk of uncontrolled gravity-driven drainage and development of preferential flow paths (Jurjovec *et al.,* 2002; Petrunic *et al.,* 2005). The column contains approximately 7 kg of Test 10 tailings material and decanted tailings supernatant was used as influent for the experiment. Representative sub-samples of the tailings and supernatant were collected for static testing and water quality analyses, respectively.

For each sampling event, leachate was collected from the top port of the column and passed through a 0.45 µm cellulose acetate filter before being collected in high-density polyethylene sample bottles. To preserve redox speciation and minimize the potential for oxidation artifacts, sample bottles were purged with nitrogen gas to displace oxygen from the bottles prior to sampling. Approximately 200 - 250 mL of column effluent was collected over 48 hours for each sampling event. Samples were collected bi-weekly for three months then subsequently collected monthly throughout the rest of the experimental period. Following collection, samples were submitted to ALS Environmental Laboratories in Burnaby, B.C. for the following standard analyses:

- Nitrate, nitrite, sulphate, chloride, bromide, fluoride;
- Dissolved organic carbon (DOC), total dissolved phosphorus and ammonia; and
- Dissolved metals (including mercury).

Total alkalinity, pH and conductivity were measured in-house at the Lorax laboratory.

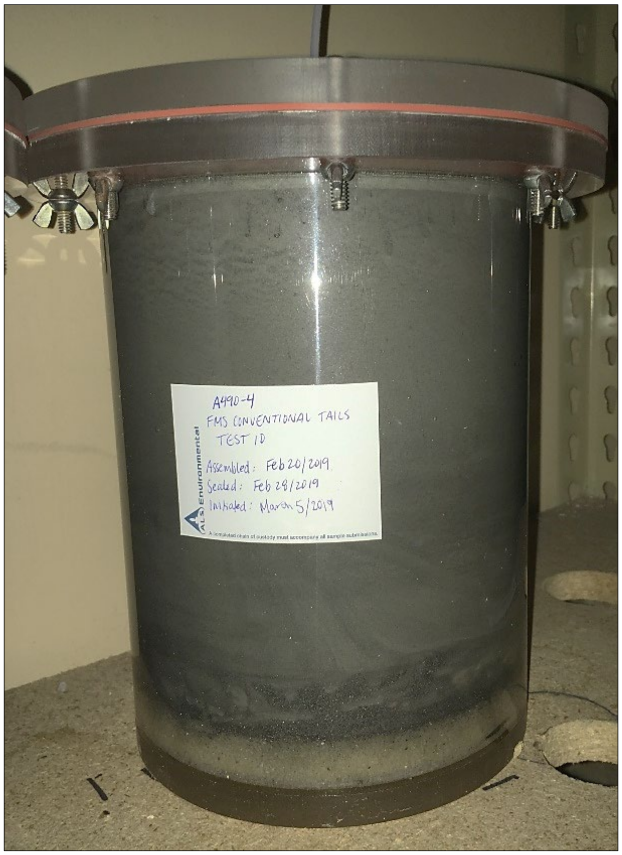


Figure 3-4: Setup of the saturated column at the Lorax laboratory.

3.3 Quality Assurance and Quality Control

Each set of samples submitted for analyses is subjected to an internal laboratory quality assurance and quality control (QA/QC) program. This program includes duplicate samples and analytical standard analysis. Any laboratory duplicate result or standard that does not adhere to the precision specifications for the different parameters triggers a re-analysis.

4. Results

4 Results

Static test analyses were carried out on all samples to determine the geochemical characteristics of materials to be disturbed during development of the proposed FMS Mine. Kinetic tests were carried out on a subset of mine rock samples to predict geochemical behaviour as weathering proceeds. Kinetic test results presented in this section were also used to develop geochemical source terms (Lorax, 2019) for a site-wide water quality model, which is presented under separate cover

4.1 Mine Rock

4.1.1 Static Test Results

4.1.1.1 Mineralogy

Mineralogical investigations as part of the ML/ARD characterization program helps provide information on acid-producing and acid-neutralizing minerals to help interpret static test results and provide a better foundation on which predictions may be based.

Results of the XRD analyses for mine rock samples are summarized in Table 4.1, with the full report results provided in Appendix 4-1. The mineralogical investigation determined that samples are composed primarily of quartz, muscovite, andesine, albite, and chlorite with lesser amounts of biotite, calcite, pyrrhotite, chalcopyrite, pyrite, ilmenite, and spinel. Pyrrhotite is the dominant sulphide mineral (0.9% to 2.4%) and is present in four of the five samples. The one sample where pyrrhotite was not detected by XRD analysis contained minor chalcopyrite (0.3%). Calcite is the dominant carbonate mineral, comprising up to 9.8%; however, two of the five samples do not contain any XRD-detectable carbonates. Additional neutralization capacity may be afforded by silicate phases, including such as chlorite and biotite, which are present in all samples.

Optical microscopy (petrography) was conducted on the five humidity cell subsamples to shed light on textural relationships within FMS waste rock and ore and to allow the identification of trace minerals that may fall below the detection limit of XRD analysis. It is known from site observations and the review of drill hole logs that the greywacke and argillite end-members can be finely-interbedded and occur along a continuum of grain sizes with both material types being represented in all samples, a clear textural distinction had to be made for the purpose of this description. Upon detailed microscopical review, any rock fragments (clasts) within the thin sections that contain primary (*i.e.,* not formed by post-depositional hydrothermal processes) sediment grains of >0.07 mm diameter are herein defined as greywacke clasts. For a waste rock fragment to classify as argillite, all primary minerals in a given clast must fall below this threshold. A grain size of 0.07 mm also roughly corresponds to the transition from the silt to sand particle size.

Table 4.2 provides an overview of key petrographic observations and illustrates that samples HC2 (AR) and HC4 (GW) have the highest relative proportions of argillite and greywacke clasts, respectively. Although HC 3 (GA) is made up of almost equal amounts of argillite and greywacke clasts, it can be said that the rock units defined during core logging correspond well with the grain size proportions identified on a thin section scale. In the following, textural relationships will be discussed across the various subsamples unless observations were made in particular samples.

Both end-member material types show a similar mineral inventory, although the relative mineral abundances vary. As shown by XRD analysis and confirmed by optical methods, the proportion of argillite clasts correlates positively with muscovite/illite and chlorite abundances, and negatively with quartz and feldspar contents. The occurrence of muscovite/illite, chlorite and biotite as matrix (clay) replacement phases in both greywacke and argillite suggests low prograde metamorphism, potentially related to the ore genesis phase.

Argillite aggregates are characterized by an overall finer grain size distribution with a higher relative content of sericite/muscovite and clay minerals. Feldspar and quartz appear as rounded grains and are moderately- to well-sorted. Due to the larger proportion of clay and mica minerals a higher degree of foliation is generally observed in argillite fragments compared with greywacke clasts (Figure 4-1a), although more randomly-oriented textures are present as well (Figure 4-1b).

Table 4.1:
Summary of XRD Results for FMS Humidity Cell Samples

Mineral Phase	Ideal Formula	HC 1	HC 2	HC 3	HC 4	HC 5
		AG	AR	GA	GW	Ore
		(wt %)	(wt %)	(wt %)	(wt %)	(wt %)
Quartz	SiO_2	36.2	30.6	34.9	38.9	39.0
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	29.8	47.1	27.6	16.3	28.1
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$	3.5	2.7	3.6	2.1	3.6
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$	7.6	9.9	7.9	4.1	9.1
Albite	$NaAlSi_3O_8$	8.1	-	15.8	28.0	5.0
Andesine	$Na_{0.6}Ca_{0.4}Al_{1.4}Si_{2.6}O_8$	12.1	8.8	7.2	-	10.4
Calcite	$CaCO_3$	-	-	1.4	9.8	1.6
Pyrrhotite	$Fe_{(1-x)}S$	2.4	0.9	1.2	-	1.0
Chalcopyrite	$CuFeS_2$	-	-	-	0.3	-
Pyrite	FeS_2	-	-	-	-	0.3
Ilmenite	$FeTiO_3$	0.4	-	0.5	0.4	0.4
Spinel	$MgAl_2O_4$	-	-	-	-	1.6

Note: A hyphen indicates the phase was not detected.
Lithology codes: AG – argillite-greywacke, AR – argillite, GA – greywacke-argillite, GW – greywacke.

While low-grade metamorphic minerals such as muscovite/sericite and chlorite commonly make up the groundmass of argillite clasts, some occurrences are dominated by turbid, primary or secondary clay minerals indicating less intense prograde or low-temperature retrograde alteration, respectively. Retrograde clay-alteration is inferred where this dark turbid appearance overprints any prograde mica-alteration patterns (Figure 4-1c), such as biotite. Biotite in argillite samples is commonly distinctly larger-grained than the surrounding groundmass and forms tabular grains that seem to have grown independently of the sedimentary or shistose orientation within the matrix. Secondary ilmenite and magnetite (±rutile, ±hematite) grains make up a significant portion (>50%) of the opaque mineral inventory in most samples and generally display a spongy texture. These phases are mostly found as disseminated lens-like aggregates in argillite clasts.

Greywacke fragments are moderately- to poorly-sorted and primarily composed of rounded quartz and feldspar grains making up >70% of the volume of most fragments. The groundmass is typically composed of fine grained muscovite/sericite ± clay, with patches of chlorite filling interstices (Figure 4-3d). Biotite commonly occurs as a medium- to coarse-grained (0.1 – 0.5 mm) hydrothermal alteration phase that may be anhedral or subhedral. Grain orientation/foliation is noticeable in the more poorly-sorted greywacke clasts and minor or absent in the coarser-grained well-sorted occurrences (Figure 4-1d). Individual quartz and feldspar grains typically make up a range in grain sized from 0.075 to 0.2 mm, however individual monomineralic grain fragments can reach > 0.5 mm in length.

Sulphides are primarily represented by pyrrhotite (>90%) with minor arsenopyrite, pyrite, and chalcopyrite being observed as accessory sulphide phases. Pyrrhotite may occur as hydrothermal fracture fill (Figure 4-2a,b) or, less commonly, as a replacive phase in the argillite and greywacke groundmass. In argillite clasts, it may form elongated grains along the foliation plane of the ambient matrix (Figure 4-2c). Arsenopyrite and chalcopyrite are generally associated with pyrrhotite and mostly occur as secondary precipitates in hydrothermal veins containing quartz ± chlorite ± biotite ± carbonate (Figure 4-2a,b). While pyrrhotite and chalcopyrite generally form an- to subhedral crystals, arsenopyrite more commonly forms euhedral laths or prisms. Arsenopyrite and chalcopyrite appear relatively fresh with little indication of weathering, while pyrrhotite displays minor weathering rims and pitted surfaces (Figure 4-2c). Some larger pyrrhotite grains have undergone considerable fragmentation which may be a result of chemical weathering or physical processes. These fragmented grains have an increased surface area which can be expected to increase sulphide oxidation rates. Pyrite was only observed in HC1, where it most commonly occupies interstitial space and microfractures (Figure 4-2d), although small (<0.1 mm) discrete pyrite grains were occasionally observed. Due to their fine grain-size, sulphide weathering phases could not be conclusively identified by optical methods alone, however it is assumed that a mixture of poorly crystalline or amorphous hydrous ferric oxides (HFO) and clay minerals make up the observed oxidation products.

Table 4.2:
Overview of petrographic observations relevant to the ML/ARD characteristics of the different humidity cell samples

Sample ID	Unit	Greywacke clasts	Argillite clasts	Sulphides (abundance, habit, grain size, occurrence)	Carbonates
HC 1	AG	66%	34%	Pyrrhotite: 2-3%; isometric to elongated an- to subhedral grains; 0.08 - 1.5 mm; relatively fresh with some larger grains heavily fragmented. Pyrite: 0.1-0.5%; anhedral mostly as vein fill, 0.1-0.9 mm; commonly fragmented and partially weathered Chalcopyrite: trace; anhedral blebs exsolved from pyrrhotite, <0.15 mm, unweathered. Arsenopyrite: trace; euhedral prisms, <0.12 mm; mostly as inclusions in larger pyrrhotite grains; fresh.	Rare (<1%) calcite observed replacing feldspar in argillite clasts and associated with coarser-grained alteration patches and hydrothermal veins containing quartz, biotite ± chlorite ± sulphides
HC 2	AR	100%	0%	Pyrrhotite: 1%; isometric to elongated an- to subhedral grains; 0.1 - 1 mm; may occur as hydrothermal vein fill or as oriented masses in argillite and greywacke clasts; partially weathered (pitted). Arsenopyrite: 0.1-0.5%; euhedral prisms and subhedral platy aggregates, 0.05 - 0.8 mm; occurs in association with pyrrhotite in quartz ± carbonate veins; fresh. Chalcopyrite: trace; anhedral blebs exsolved from pyrrhotite, <0.25 mm, fresh.	Rare (<1%) calcite associated with coarser-grained alteration patches and hydrothermal veins containing quartz, biotite ± chlorite ± sulphides
HC 3	GA	47%	53%	Pyrrhotite: 0.5-1%; isometric to elongated an- to subhedral grains; 0.1 - 0.8 mm; may occur as hydrothermal vein fill or as oriented masses in argillite and greywacke clasts; partially weathered (pitted). Arsenopyrite: trace; subhedral platy aggregates, 0.05 - 0.35 mm; occurs in association with pyrrhotite in quartz ± carbonate veins; fresh. Chalcopyrite: trace; anhedral blebs exsolved from pyrrhotite, <0.08 mm, fresh.	Common (>1%) calcite predominantly associated with quartz, biotite ± chlorite ± sulphides as hydrothermal vein fill and in replacive patches.
HC 4	GW	5%	95%	Pyrrhotite: 0.5%; isometric to elongated anhedral grains; 0.05 - 0.6 mm; replacive and as vein fill; relatively fresh with some larger grains showing fragmentation and partially weathered (pitted). Arsenopyrite: trace; euhedral prisms, <0.1 mm; mostly as inclusions in larger Chalcopyrite: trace; anhedral blebs exsolved from pyrrhotite, <0.15 mm, unweathered. pyrrhotite grains; fresh.	Abundant (10%) calcite common in greywacke groundmass replacing clay/mica and feldspar; also associated with quartz and sulphides as hydrothermal vein fill and in replacive patches.
HC 5	Ore	89%	11%	Pyrrhotite: 1-2%; isometric to elongated an- to subhedral grains; 0.1 - 1 mm; may occur as hydrothermal vein fill or as oriented masses in argillite and greywacke clasts; partially weathered and fragmented. Arsenopyrite: 0.1-0.5%; euhedral to subhedral platy aggregates, 0.1 - 0.75 mm; occurs in association with pyrrhotite in quartz ± carbonate veins; fresh. Chalcopyrite: trace; anhedral blebs exsolved from pyrrhotite, <0.25 mm, fresh. Pyrite: trace; anhedral dispersed grains, 0.05-0.15 mm; fresh	Common (>1%) calcite predominantly associated with quartz ± biotite ± sulphides as hydrothermal vein fill and in replacive patches.

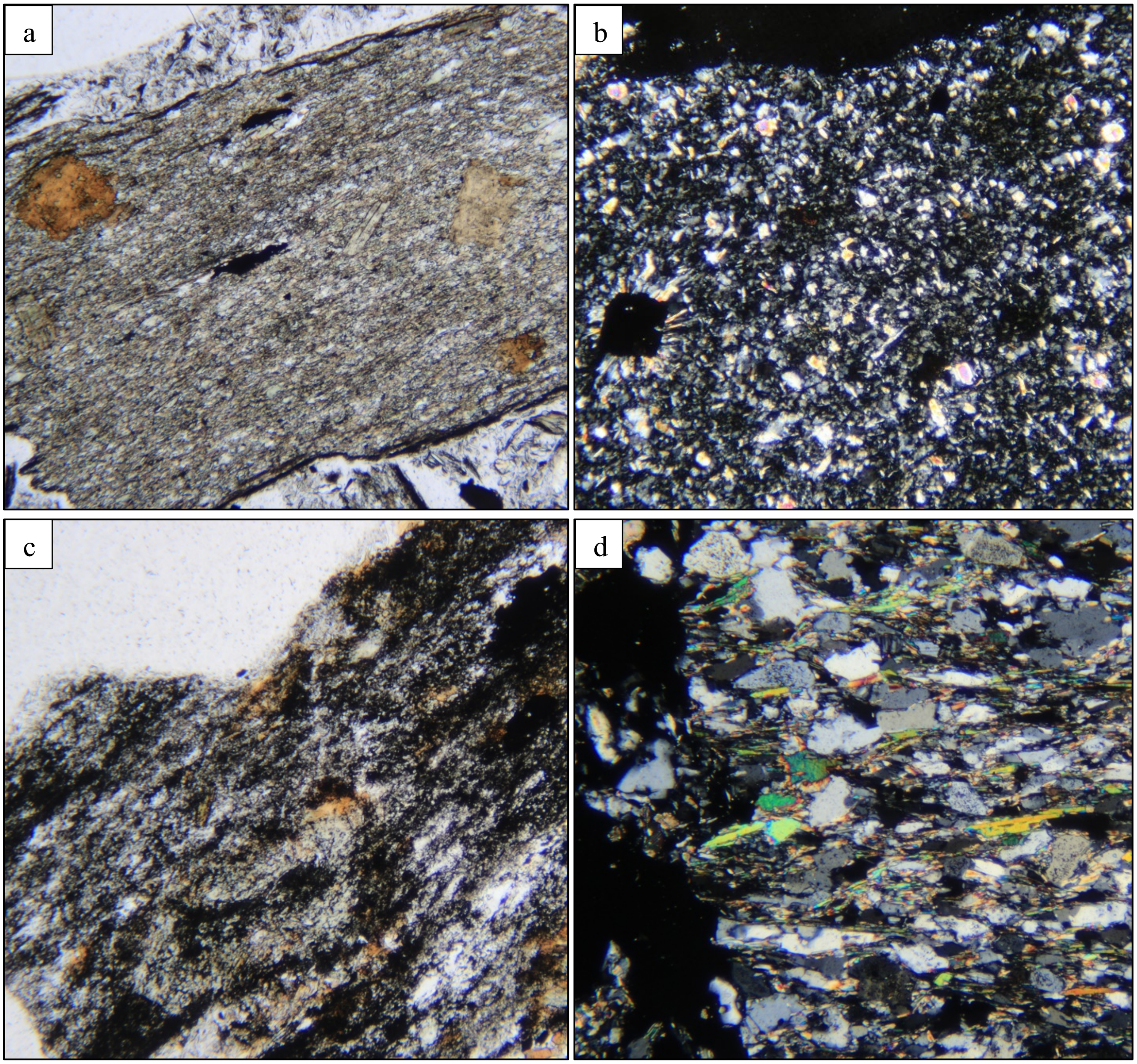


Figure 4-1: Transmitted light photomicrographs from thin sections of FMS humidity cell material. (a) Typical example of a strongly oriented/foliated argillite clast containing hydrothermal biotite (Plane-polarized light = PPL); (b) argillite with randomly-oriented matrix components (crossed polars = XPL); (c) Argillite clast with dark, very fine-grained clay-minerals making up the matrix in between quartz and feldspar grains; (d) Typical example of a moderately-sorted greywacke clast (XPL). Coloured, foliated muscovite/sericite fill interstices between rounded feldspar and quartz grains (grey, brown).

Field of view (FOV) = 1.5 mm.

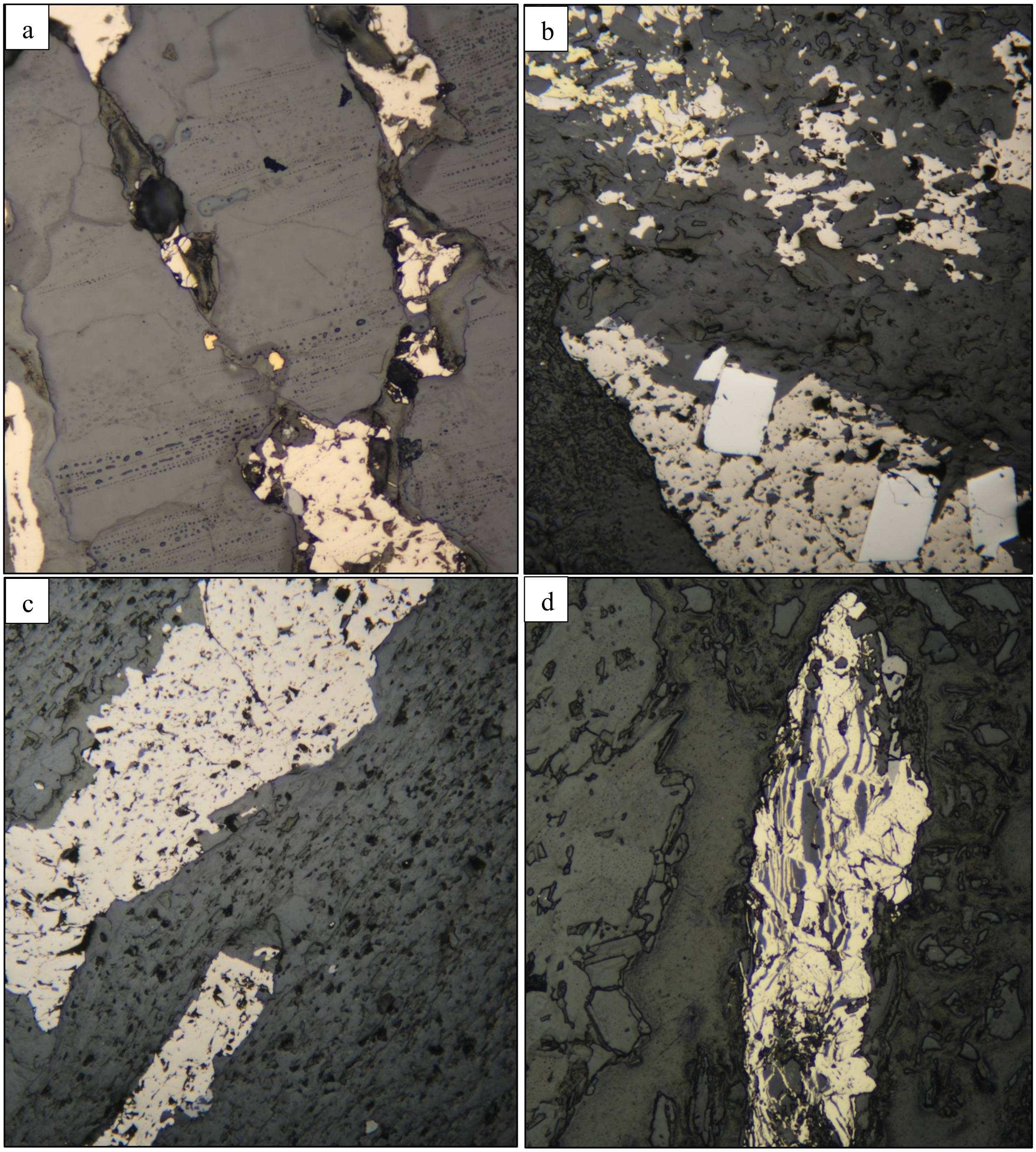


Figure 4-2: **Reflected light photomicrographs from thin sections of FMS humidity cell material. (a) Pyrrhotite (brown) and minor chalcopyrite (yellow) co-precipitated in hydrothermal quartz-chlorite vein; (FOV = 0.5 mm); (b) Hydrothermal vein containing pitted pyrrhotite (brown), exsolved chalcopyrite (yellow), and euhedral arsenopyrite (white prisms); (c) Replacive, elongated pyrrhotite crystals in argillitic matrix; (d) Pyrite precipitate filling microfracture pore space.**

FOV = 1.1 mm unless otherwise stated.

Carbonate phases are primarily represented by calcite and were identified in all samples with HC4 containing significant amounts (~10%). Although discrete subhedral grains were observed, the vast majority of carbonate is present as anhedral patches replacing clay and feldspar or as secondary precipitate in hydrothermal veins. With the exception of HC4 where calcite appears to be ubiquitous, in most samples, calcite occurs in association with secondary quartz ± chlorite ± biotite, commonly embedding pyrrhotite or arsenopyrite.

The field bin subsample (LX-18-FB3) was submitted for QEMSCAN analysis (Appendix 4-1) which is a relatively novel technique to gain more detailed mineralogical information in conjunction with XRD analysis. In general, the modal mineralogy for the field bin sample is in agreement with the results from XRD and petrographic analysis conducted on the humidity cell samples. The modal mineralogy indicates that quartz, plagioclase, and sericite/muscovite are the three main minerals in the sample (>20%, by mass; Figure 4-3). Other common minerals (>1%, by mass) include chlorite, biotite, kaolinite, calcite, Ti-oxides, and K-feldspar. Sulphide minerals present in the sample include pyrrhotite (0.69%), pyrite (0.48%), arsenopyrite (0.076%), sphalerite (0.003%), and other sulphides (0.005%). The amount of pyrite detected in the field bin subsample is in contrast with observations from the petrographic investigation where pyrite was a relatively minor sulphide component. Further, no discrete chalcopyrite was identified by via QEMSCAN. Calcite (2.7%) is the dominant carbonate mineral; although, trace amounts of dolomite (0.002%) were identified in this analysis.

QEMSCAN can also be used to determine the degree of exposure of the mineral grains, which provides an indication of how reactive the mineral is expected to be. The analysis indicates that over 60% of the pyrite surfaces show <10% liberation, while pyrrhotite has a slightly greater proportion of somewhat exposed mineral grains (Figure 4-4). Arsenopyrite was also included due to As being identified as a potential parameter of concern. The majority (77%) of the arsenopyrite is locked inside grains. The exposure of the carbonate grains is variable with 36% of mineral grains being >50% exposed. This suggests that the majority of carbonate is available for the neutralization of acid generated by from sulphide oxidation.

The variability in the grain size of the different minerals is summarized in Figure 4-5. This analysis indicates that pyrite is present dominantly as very fine-grained material with 88% of the grains being ≤ +25µm in size. In contrast, the pyrrhotite grains are larger with approximately half of the grains between +150 µm to +300 µm in size and only 6% ≤ +25µm in size. The majority (72%) of arsenopyrite grains are +150 µm to +212 µm. Almost all (99.4%) of the As present in the field bin subsample is contained within the arsenopyrite. The remaining 0.6% of the As is present in gersdorffite. It should be noted that QEMSCAN analysis is not capable of identifying adsorbed fractions of As which, especially in fine-grained sedimentary materials, may contribute a significant portion to the leachable As inventory. Carbonate grain size is variable, although the majority (74%) of the grains are between +53 µm and +150 µm.

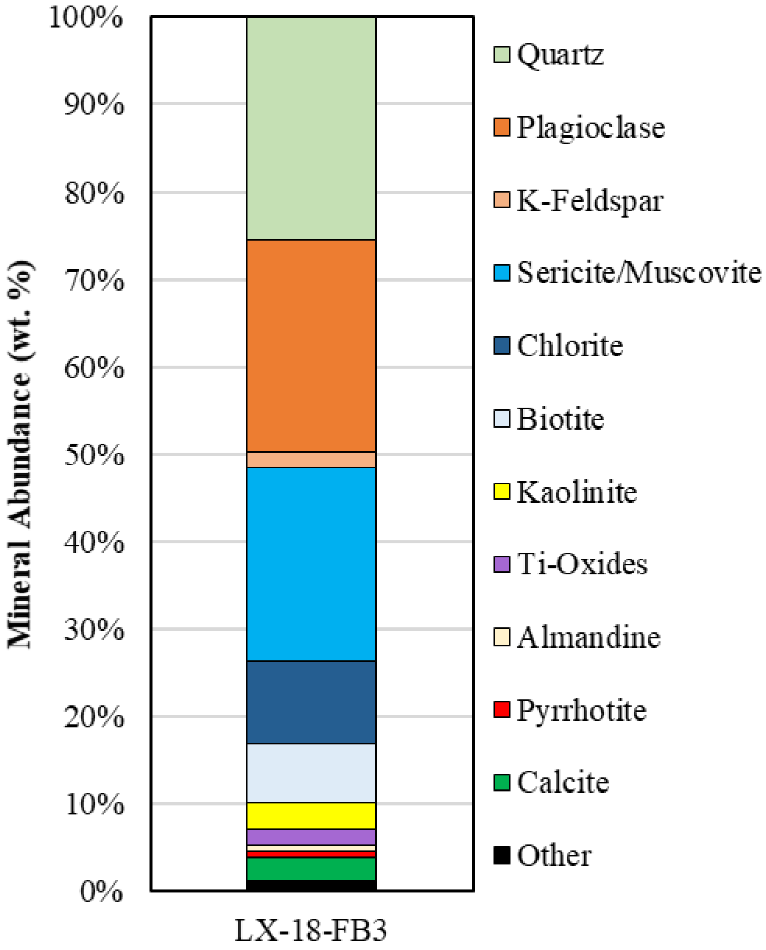


Figure 4-3: Modal Mineralogy of the FMS Field Bin Sample LX-18-FB3. Note that minerals below 0.5% are combined as 'Other' on this figure.

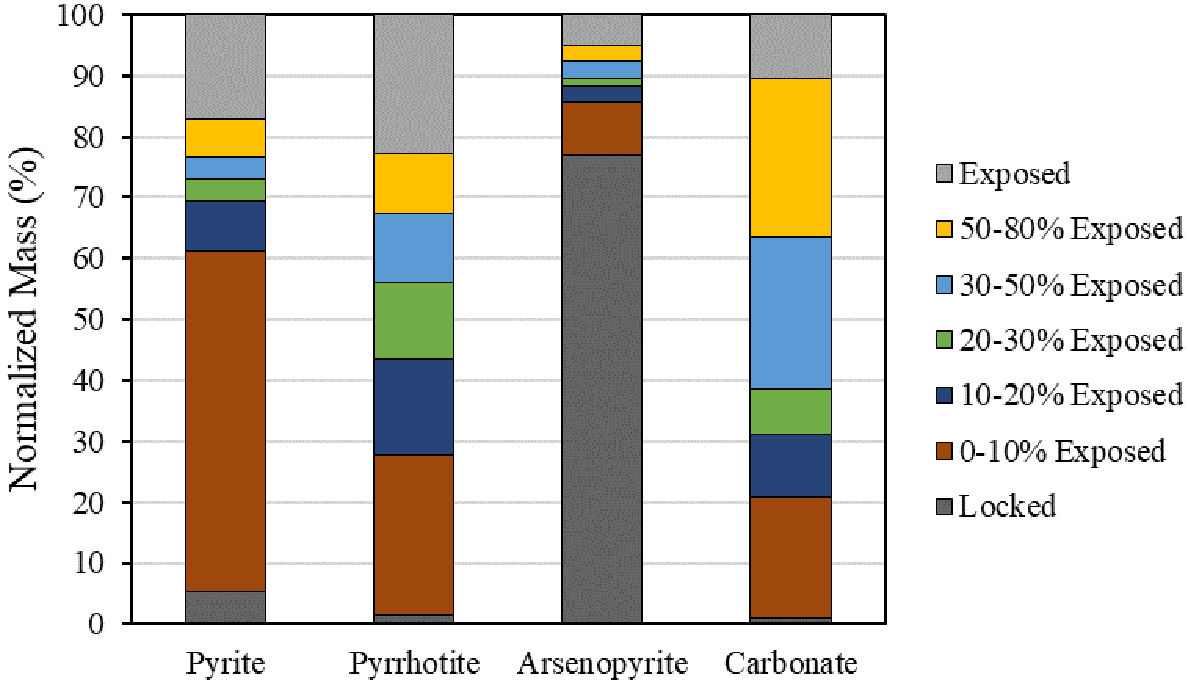


Figure 4-4: Normalized mass of pyrite, pyrrhotite, arsenopyrite, and carbonate grains for different degrees of grain exposure.

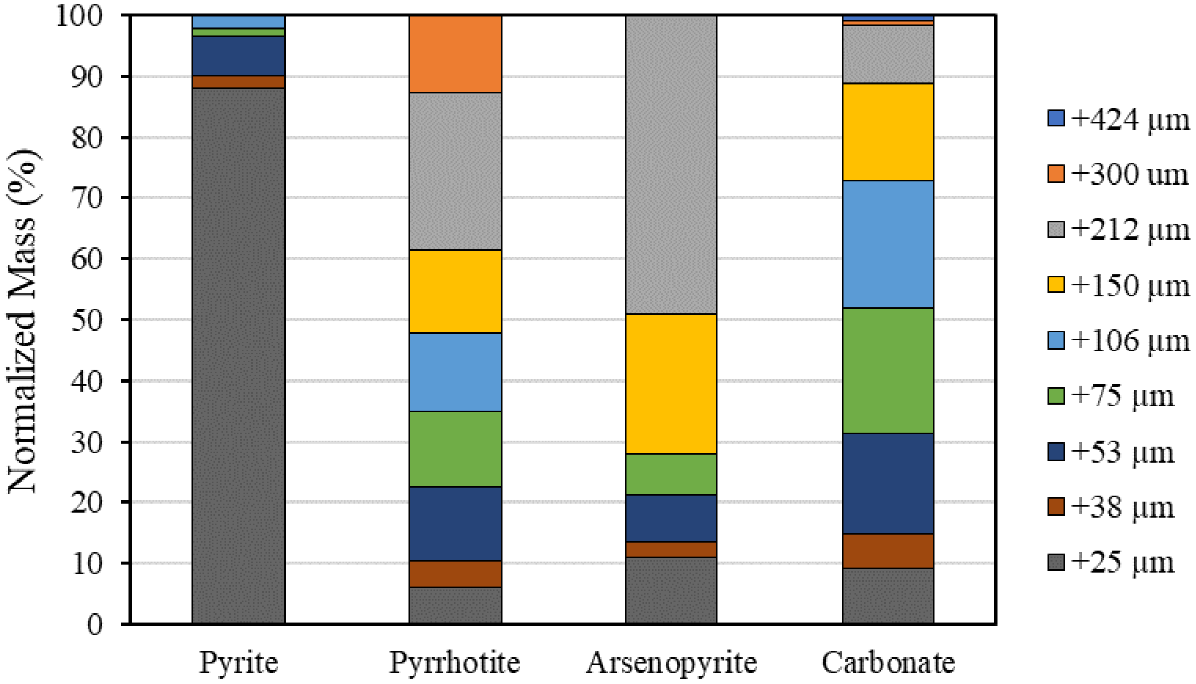


Figure 4-5: Normalized mass of pyrite, pyrrhotite, arsenopyrite, and carbonate grains for different grain sizes.

4.1.1.2 Acid Base Accounting

ARD will only result from the weathering of sulphide-bearing rocks if there is insufficient alkalinity produced to buffer the acidity generated by the sulphide oxidation process. The oxidation of pyrite produces two sources of acid; one from the oxidation of sulphide and the other from the oxidation/hydrolysis of iron. While a variety of mineral dissolution reactions may buffer acid, the minerals most typically responsible for acid neutralization are fast dissolving carbonates such as calcite and dolomite. At a pH < 6.3, the pyrite oxidation and carbonate neutralization reaction is typically expressed as:

$$FeS_2 + 2CaCO_3 + 3.75\ O_2 + 3.5\ H_2O \rightarrow Fe(OH)_3 + 2SO_4^{2-} + 2Ca^{2+} + 2H_2CO_3$$

However, it should be noted that not all carbonate minerals neutralize acid as effectively as others. For example, Fe-bearing carbonate minerals, such as ankerite and siderite, are much less effective at neutralizing acid compared to calcite due to the fact that the Fe^{2+} liberated is oxidized to Fe^{3+}, which then precipitates as $Fe(OH)_3$ producing acidity in the process. As a result, the net capacity of a sample to neutralize acid decreases as the amounts of Fe-bearing carbonates increases (Jambor *et al.,* 2003). Silicate minerals may also contribute to the total neutralizing capacity of a sample; however, rates of silicate dissolution are much slower and thus may limit the ability of these minerals to buffer acid generation.

The full set of ABA analyses for all mine rock samples is presented in Appendix 4-2 and includes paste pH, total S, sulphate S, sulphide S, acid potential (AP), total inorganic C, total C, modified neutralization potential (NP), and fizz rating. A summary of the mine rock ABA results is provided in Table 4-3, with the humidity cell test subsample results presented in Table 4.4.

4.1.1.2.1 Paste pH

Paste pH provides an indication of whether a sample is currently generating acidity at the time of sampling. Paste pH values for all samples range from 7.9 to 9.3, indicating that these samples are not currently acid generating. The ore samples show the widest range of pH values, ranging from 7.9 to 9.2, with a median pH value of 8.7 (Table 4-3).

Table 4-3:
Summary of Acid-Base Accounting Results for FMS Mine Rock Lithologies

Sample Type	Paste pH	Total S	Sulphate S	Sulphide S	TIC	CaNP	Modified NP	NPR
		%	*%*	*%*	*%*	*kg $CaCO_3$/t*	*kg $CaCO_3$/t*	*Mod. NP/AP*
ARGILLITE (AR) n = 26								
Min	7.9	0.11	<0.010	0.10	<0.20	<4.5	<5.0	0.37
Median	8.5	0.36	<0.010	0.35	0.30	6.8	12	1.0
Max	9.0	0.90	0.030	0.88	2.9	66	69	6.8
ARGILLITE-GREYWACKE (AG) n = 11								
Min	8.1	0.050	<0.010	0.040	<0.20	<4.5	8.0	1.0
Median	8.7	0.27	<0.010	0.27	0.50	11	18	2.3
Max	9.1	0.47	0.030	0.46	1.1	25	30	14
GREYWACKE-ARGILLITE (GA) n = 14								
Min	8.2	0.020	<0.010	0.020	<0.20	<4.5	8.0	0.78
Median	8.9	0.28	<0.010	0.27	0.80	18	23	2.4
Max	9.1	0.55	0.020	0.53	1.9	43	47	43
GREYWACKE (GW) n = 24								
Min	8.3	0.040	<0.010	0.030	<0.20	<4.5	10	0.83
Median	8.9	0.19	<0.010	0.18	1.1	25	31	5.0
Max	9.3	0.56	0.020	0.54	5.4	123	128	27
ORE n = 23								
Min	7.9	0.12	<0.010	0.12	<0.20	<4.5	6.0	0.37
Median	8.6	0.44	<0.010	0.42	0.60	14	16	1.1
Max	9.2	1.1	0.030	1.0	2.6	59	61	6.9

Notes: n = number of samples used in statistical distribution.
Values below detection limit were set at the detection limit for calculation of NP, AP, and NPR values.
Sulphate S is calculated using the HCl method.
AP (acid potential) calculated using sulphide S (% non-sulphate S x 31.25).
CaNP (carbonate neutralization potential) calculated using total inorganic carbon (% TIC x (100.09/44.01) x 10).
Modified NP is obtained by the modified Sobek method.
NPR = neutralization potential ratio; calculated as Modified NP / AP.

Table 4.4:
Summary of acid-base accounting results for kinetic test subsamples

Sample ID	Paste pH	Total S	Sulphate S	Sulphide S	Total C	CaNP	Modified NP	NPR
		%	*%*	*%*	*%*	*kg $CaCO_3$/t*	*kg $CaCO_3$/t*	*Mod. NP/AP*
Humidity Cells								
ARGILLITE-GREYWACKE (AG)								
HC1	8.5	0.35	<0.010	0.35	<0.20	<4.5	9.0	1.0
ARGILLITE (AR)								
HC2	8.1	0.59	0.020	0.57	0.25	5.7	9.0	0.63
GREYWACKE-ARGILLITE (GA)								
HC3	8.9	0.51	0.020	0.49	0.50	11	16	1.1
GREYWACKE (GW)								
HC4	8.6	0.23	<0.010	0.22	3.9	88	91	14
ORE								
HC5	8.4	0.59	0.020	0.57	0.55	13	18	1.0
Field Bin								
LX-18-FB3	8.1	0.40	<0.010	0.39	0.25	19	27	2.2

Notes: Humidity cell are made up of two samples. An average value is presented and a 1:1 mixture is assumed.
Values in grey italics are at or below the analytical detection limit. Values were set at the detection limit for calculation of NP, AP, and NPR values.
Sulphate S is calculated using the HCl method.
AP (acid potential) calculated using sulphide S (% non-sulphate S x 31.25).
CaNP (carbonate neutralization potential) calculated using total inorganic carbon (% TIC x (100.09/44.01) x 10).
Modified NP is obtained by the modified Sobek method.
NPR = neutralization potential ratio; calculated as Modified NP / AP.

4.1.1.2.2 Sulphur Species and Acid Potential

The total sulphur (S) contents of the FMS samples vary from 0.040% to 0.90%, excluding the ore samples (Table 4-3). Of the four main waste rock types, the AR samples have the highest median total S content (0.36%) and the GW samples have the lowest (0.19%). Overall, the ore samples have slightly higher total S contents, varying from 0.12% to 1.1% (median: 0.44%). The sulphate S contents are generally low in most samples and typically fall at or below the detection limit (0.01%) but can reach up to 0.030%. Sulphide S contents are strongly correlated with total S (Figure 4-6) and indicate that most of the sulphur present in samples is in the form of sulphide. The sulphide S contents, excluding the ore samples, range from 0.020% in a GA sample up to a maximum of 0.88% in an AR sample, with median values falling between 0.18% (GW samples) and 0.35% (AR samples). In the ore samples, the sulphide S contents range from 0.12% to 1.0% (median: 0.42%).

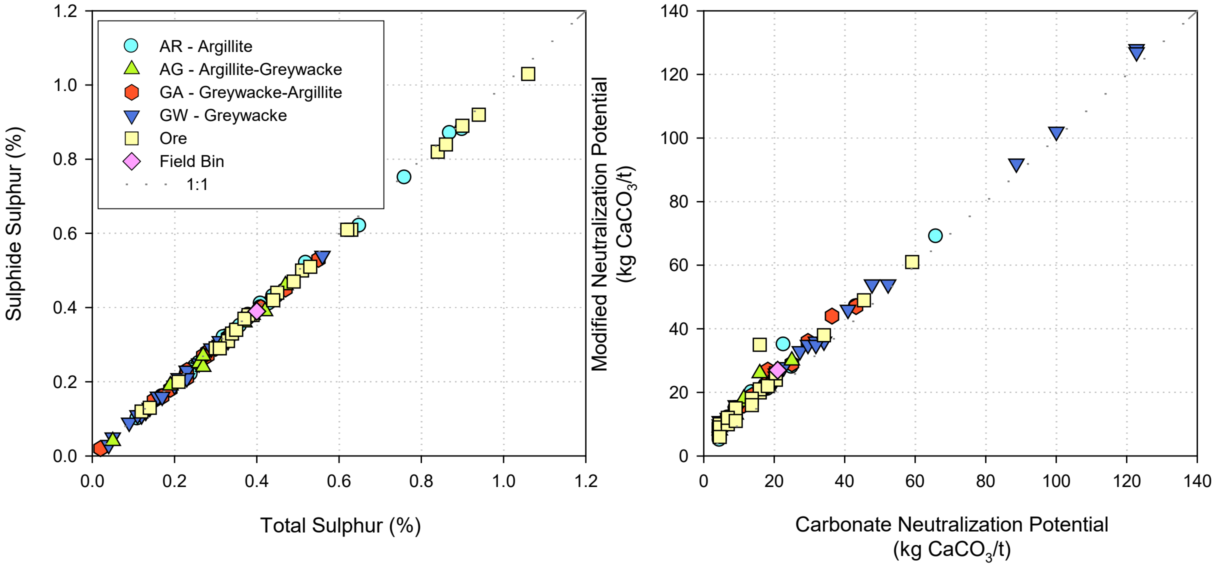


Figure 4-6: Plots showing sulphide sulphur *versus* total sulphur and modified neutralization potential *versus* carbonate neutralization potential for the FMS mine rock samples.

The mineralogy results indicate that the sulphide S is primarily in the form of pyrrhotite and pyrite, both of which are acid generating. The acid potential (AP) of samples is calculated based on the sulphide S values and used in the determination of the neutralization potential ratio (NP/AP) discussed in Section 4.1.1.2.4.

In general, the humidity cell test subsamples are considered to be representative of median to high S contents for the different lithologies and are therefore conservative. Total sulphur contents are generally slightly (HC1, HC4, HC5) to considerably (HC2, HC3) higher than the respective static test populations. The total S values for the latter humidity cells are 0.59%, 0.51% for HC2 and HC3, respectively, while the median values for each of the corresponding static test datasets are 0.36% and 0.28%, respectively. The field bin subsample has total sulphur values (0.4%, Table 4.4) that is higher than median content of any waste rock lithology and can therefore also be considered conservative.

4.1.1.2.3 Neutralization Potential

The total inorganic carbon (TIC) content of the FMS samples ranges from detection level values (<0.20%) up to 5.4%, with the highest median values measured in the GW samples (1.1%; Table 4-3). It is assumed that the inorganic C is present as carbonate minerals and thus TIC values are used to calculate the carbonate neutralization potential (CaNP). The resulting CaNP values of the FMS samples range from detection level values (<5.0 kg $CaCO_3$/t) up to 123 kg $CaCO_3$/t. The GW samples have the highest median CaNP value at 25 kg $CaCO_3$/t, while the AR samples have the lowest median CaNP value (6.8 kg $CaCO_3$/t; Table 4-3). The ore samples have median CaNP values within this range (14 kg $CaCO_3$/t).

The modified NP values are generally consistent with the calculated CaNP values, albeit systematically slightly higher (Figure 4-6, Table 4-3). This suggests that minerals other than carbonates (*i.e.,* silicates) are responsible for acid-neutralization in the modified NP tests. This NP is not as readily available as the CaNP; however, when sulphide values are low, as is the case at FMS, the NP from the dissolution of non-carbonate minerals will contribute to the neutralization of the low rates of acid production. Silicate minerals that act as neutralizing agents may include biotite, chlorite, and certain clay minerals, all of which were identified in the mineralogical analysis. For the remainder of this assessment, modified NP is used as the basis for NPR (NP/AP) calculations in order to quantify a material's ARD potential.

The NP values of the humidity cells are generally close to the median values for the lithologies that they represent, except for HC4 (GW) which has higher NP relative to the median for the GW static test samples. The modified NP for HC4 is 91 kg $CaCO_3$/t, while the median modified NP for the GW population was calculated to be 31 kg $CaCO_3$/t (Table 4.4). The NP of the field bin sample (27 kg $CaCO_3$/t) is within the range of median values observed for the different static test lithologies.

4.1.1.2.4 Neutralization potential ratio

The neutralization potential ratio (NPR) is calculated as the ratio of NP to AP and is presented based on the modified NP (Table 4-3). In the absence of long-term kinetic test data, the NPR value is the most important parameter in the evaluation of a material's likelihood to generate ARD. Adopting guidelines set out in Price (2009), a value >2 is considered to be NAG, whereas a value <2 is considered to be PAG. Figure 4-7 plots the NPR versus total sulphur and modified NP showing weak negative and positive correlations, respectively. These plots suggest that neither modified NP nor total sulphur alone can be used as a reliable proxy NPR and geochemical class.

The PAG and NAG proportions for each of the four major waste rock lithologies and ore samples are given in Table 4-5. There is a marked positive relationship with respect to the proportion of argillite within the lithological unit and the PAG% where the AR unit has the highest relative amount of PAG samples (81%) while the GW unit hosts the lowest (4%). It is important to note that the PAG% presented above assumes equal weighting of each of the static test samples in relation to the overall database. This method of calculation does not take into account the spatial distribution of the samples and is prone to bias where there is spatial clustering of the data. For the purpose of geochemical source term modelling, which requires more spatially representative PAG waste rock tonnages, the NPR values will be integrated into a 3D geological modelling software (Leapfrog^{TM}) to produce an interpolated grade shell at the NPR=2 cutoff. The results and implications of this modelling exercise are presented in Lorax (2019).

All humidity cells are PAG, except for the HC4 (GW) which was classified as NAG. The field bin subsample is NAG with an NPR value of 2.2 (Table 4.4).

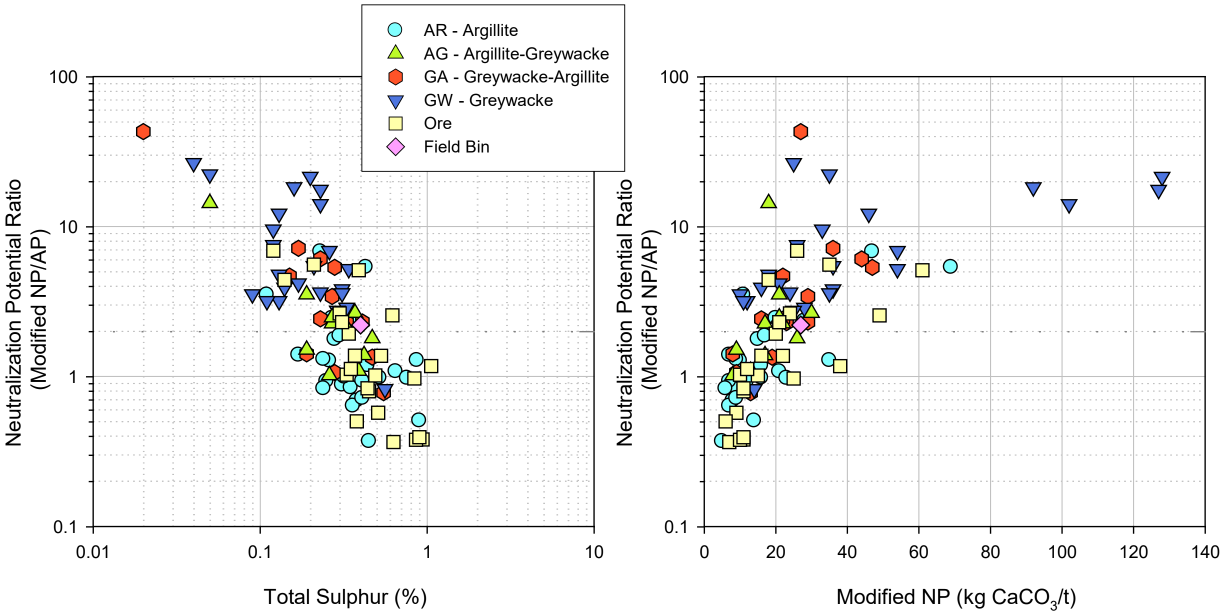


Figure 4-7: Plots showing neutralization potential ratio (NPR) versus total S and modified NP for the FMS mine rock samples.

Table 4-5:
PAG and NAG Proportions of the FMS Mine Rock Units

Unit	**% PAG**	**% NAG**
Argillite (AR)	81%	19%
Argillite-Greywacke (AG)	45%	55%
Greywacke-Argillite (GA)	29%	71%
Greywacke (GW)	4%	96%
Ore	70%	30%
Total (waste rock only)	*53%*	47%

Notes: PAG – Potentially Acid Generating; NAG – Non-Acid Generating. Values are based on equal weighting of static test samples and do not represent volumetric proportions required for source term development.

4.1.1.3 Total Solid Phase Elemental Analysis Results

The results of the total solid phase elemental analysis are presented in Appendix 4-3 and summarized in Table 4.6. Elements that are greater than 3x their respective AUCCA values (Rudnick and Gao, 2014) include Ag, As, Cu, Pb, Sb, and Zn. Solid phase concentrations of Ag, As, Pb, and Sb are enriched by a factor greater than 10 above the AUCCA in one or more samples. It is noteworthy that the elevated As concentrations (>10x AUCCA) occur in all FMS lithologies, while elevated levels of the other elements are limited to the ore samples. Several of the elements have AUCCA that are considerably lower than the analytical detection limit. These include Ag, Bi, Cd, Hg, Sb, Tl, U, and W. Only values that are above 2x the detection limit are considered in Table 4.6 .

The elemental enrichments highlight elements that require additional scrutiny in leaching tests. However, an element present at an elevated concentration in the solid phase may not become a metal leaching issue and vice versa. There are several factors that influence the leaching rates of elements, including the mineral association and stability, as well as the chemistry of the water coming in contact with the rocks. Kinetic test results provide a better indication of the leaching potential.

A summary of the kinetic test samples' total solid phase elemental results is included in Table 4.7. The concentrations of As in humidity cell subsamples are presented as compared to the range for each of the major rock types (Figure 4-8). The As concentrations for HC1 (AG), HC3 (GA), and HC4 (GW) are within the 25th to 75th percentile values for the static test dataset for these units. Arsenic contents are high in HC2 (AR) and HC5 (ore) relative to the respective static test datasets. The As concentration is 1,700 ppm for HC2 and 1,609 ppm for HC5, while the median values are 50 ppm for the AR samples and 178 ppm for the ore samples (Table 4.6). The As content in the field bin subsample (386 ppm) is within the range of the values in the drill core static testing dataset.

Table 4.6:
Summary of solid phase element results for FMS mine rock samples

Sample Type	**Ag**	**As**	**Cu**	**Pb**	**Sb**	**Zn**
	ppm	ppm	ppm	ppm	ppm	ppm
ARGILLITE (AR) n = 17						
Min	<0.20	2.0	24	2.0	<2.0	61
Median	<0.20	50	44	8.0	<2.0	101
Max	0.20	8430	73	30	3.0	117
ARGILLITE-GREYWACKE (AG) n = 4						
Min	<0.20	21	25	2.0	<2.0	93
Median	<0.20	189	31	8.5	<2.0	101
Max	<0.20	1560	36	28	<2.0	114
GREYWACKE-ARGILLITE (GA) n = 6						
Min	<0.20	41	13	8.0	<2.0	74
Median	<0.20	412	32	9.0	<2.0	81
Max	0.30	3850	45	18	2.0	87
GREYWACKE (GW) n = 8						
Min	<0.20	16	14	3.0	<2.0	27
Median	<0.20	66	23	7.5	<2.0	56
Max	<0.20	1070	34	10	3.0	84
ORE n = 25						
Min	<0.20	14	11	3.0	<2.0	39
Median	<0.20	178	36	10	<2.0	87
Max	0.60	5850	101	218	5.0	293
AUCCA	0.053	4.8	28	17	0.4	67

Notes: Values were set at detection limit for calculation of statistical distributions.
AUCCA = average upper continental crust abundance (Rudnick and Gao, 2014).
Values greater than 3x the AUCCA are shaded in light grey; values greater than 10x the AUCCA are shaded in dark grey.

Table 4.7:
Summary of solid phase element results for kinetic test subsamples

Sample ID	Ag	As	Cu	Pb	Sb	Zn
	ppm	ppm	ppm	ppm	ppm	ppm
Humidity Cells						
ARGILLITE-GREYWACKE (AG)						
HC1	<0.20	59	47	10	<2.0	84
ARGILLITE (AR)						
HC2	0.20	1700	49	12	<2.0	92
GREYWACKE-ARGILLITE (GA)						
HC3	<0.20	1785	35	9.0	<2.0	80
GREYWACKE (GW)						
HC4	<0.20	111	29	8.0	<2.0	47
ORE						
HC5	<0.20	1609	47	9.0	<2.0	92
Field Bin						
LX-18-FB3	0.50	386	36	16	<2.0	85
AUCCA	0.053	4.8	28	17	0.4	67

Notes: Humidity cell are made up of two samples. An average value is presented and a 1:1 mixture is assumed.
Values were set at detection limit for calculation of statistical distributions.
AUCCA = average upper continental crust abundance (Rudnick and Gao, 2014);
Values greater than 3x the AUCCA are shaded in light grey; values greater than 10x the AUCCA are shaded in dark grey.

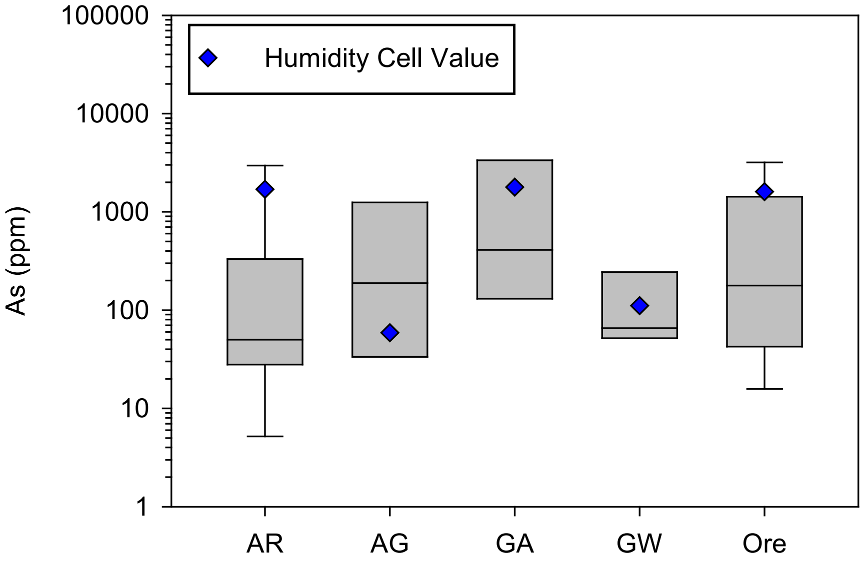


Figure 4-8: Box plots showing the range of As concentrations as compared to the humidity cell subsamples. Box limits represent 25th and 75th percentile levels, the horizontal bar represents the median level, and the whiskers represent the 10th and 90th percentile values.

4.1.1.4 Shake Flask Extraction and Leaching Test Results

The humidity cell subsamples were submitted for the standard shake flask extraction (SFE) test at a 3:1 water/solid ratio, while the field bin subsample was submitted for three leaching tests at different water solid ratios (Table 4.8). The full SFE and leaching test results are provided in Appendix 4-4. The shake flask extraction (SFE) and other leaching test results are compared to the Canadian Council for Ministers of the Environment (CCME) water quality guidelines for the protection of aquatic life (CCME, 2018). These guidelines are used for reference only in order to provide an indication of parameters which are of potential concern in runoff from the excavated material. Different water quality standards may apply at different water monitoring stations within and downstream of the FMS site. It should be noted that, as per the test method protocol, the agitation of the overburden samples in water may release higher concentrations of certain species than what would be expected in contact water drainage.

Parameters that were elevated relative to the CCME guidelines in the leachate from the samples include As in all samples, Al in all samples except for HC4 (GW) and HC5 (ore) subsamples and F in only the 0.5:1 leaching test for the field bin sample. The As concentrations are above 10 times the guideline in the leachate from the HC3 (GA) and HC4 (GW) SFE tests as well as the field bin samples for the 1:1 and 0.5:1 water/solid leaching tests (Table 4.8). The As concentration in the leachate is not directly correlated to the solid phase As content. While HC3 (GA) does have both the highest concentration of As in the solid phase (1,785 ppm) and in the leachate (0.29 mg/L), HC2 (AR) has comparable As in the solid phase (1,700 ppm) and an order of magnitude lower As concentrations in the leachate (0.031 mg/L). In contrast, HC4 (GW) has lower solid phase As content (111 ppm) and relatively high As concentrations in the leachate (0.16 mg/L). The variability of As concentrations in the leachate is not due to differences in pH as the leachate for all samples remained circumneutral (pH range: 7.9 to 8.2). This suggests that the As mobility is more strongly tied to factors other than the solid-phase content, such as time of exposure, mineralogical association and grain liberation.

The leaching tests conducted at different water/solid ratios are intended to identify trends elemental mobility trends under changing environmental conditions. Theoretically, if the dissolved species behaved conservatively and no attenuation or mineral solubility constraints were in effect, a 6-fold increase in concentrations, proportional to the decrease in solid/rock ratio, would be expected. Chloride is commonly used as a conservative tracer and shows an increase by a factor of 6.4 between the 3:1 and 0.5:1 tests.

Table 4.8:
Summary of SFE and Leaching Test Results for FMS Kinetic Test Samples

Parameter	Units	CCME WQG		HC 1	HC 2	HC 3	HC 4	HC 5	LX-18-FB3		
		Short Term	Long Term						3:1	1:1	0.5:1
pH		6.5-9	-	7.87	7.94	8.11	7.99	7.97	8.16	8.02	7.98
Conductivity	µS/cm	-	-	129	134	78	114	154	96	176	301
Chloride	mg/L	640	120	12	14	3	12	8	5	17	32
Fluoride	mg/L	-	0.12	0.060	0.090	< 0.060	< 0.060	0.070	< 0.060	0.12	0.21
Sulphate	mg/L	-	-	9.0	9.0	5.0	3.0	23	7.0	17	32
Dissolved Metals											
Ag	mg/L	-	0.00025	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Al[a]	mg/L	-	0.1	0.13	0.14	0.21	0.099	0.090	0.46	0.32	0.16
As	mg/L	-	0.005	0.0089	0.031	0.29	0.16	0.023	0.044	0.059	0.084
B	mg/L	29	1.5	0.0090	0.0090	0.011	0.022	0.0090	0.011	0.014	0.028
Cd	mg/L	0.001	0.00009	< 0.000003	< 0.000003	< 0.000003	0.000003	0.000003	< 0.000003	< 0.000003	0.000005
Co	mg/L	-	-	0.000073	0.000011	0.000011	0.000025	0.000054	0.000021	0.000063	0.00019
Cr	mg/L	-	0.001	0.00012	0.000080	0.00021	0.00016	0.00010	0.000060	0.000070	0.00015
Cu[b]	mg/L	-	0.002	0.00014	0.00015	0.00024	0.000040	0.00016	0.00023	0.00032	0.0012
Fe	mg/L	-	0.3	< 0.0070	0.0070	0.012	< 0.0070	< 0.0070	< 0.0070	< 0.0070	< 0.0070
Hg	µg/L		0.026	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Mn	mg/L	-	-	0.024	0.013	0.011	0.037	0.044	0.020	0.021	0.045
Mo	mg/L	-	0.073	0.00017	0.00040	0.00015	0.00012	0.00010	0.00015	0.00060	0.0017
Ni[b]	mg/L	-	0.025	0.0015	0.00040	0.00060	0.0025	0.0011	0.00040	0.0012	0.0031
Pb[b]	mg/L	-	0.001	0.000010	0.000020	0.000020	< 0.000010	< 0.000010	< 0.000010	0.000030	0.000030
Sb	mg/L	-	-	0.00030	0.00040	0.00070	0.00030	0.00030	< 0.00020	0.00060	0.0011
Se	mg/L	-	0.001	0.000050	0.000070	< 0.000040	< 0.000040	0.000070	0.000060	0.00012	0.00019
Tl	mg/L	-	0.0008	0.000013	0.0000070	< 0.000005	0.0000070	0.0000070	0.0000060	0.000011	0.000018
U	mg/L	0.033	0.015	0.000042	0.000040	0.000055	0.000076	0.00012	0.000096	0.00028	0.00089
Zn	mg/L	0.037	0.007	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020

Notes: Values shaded in light grey are above the long-term CCME guideline; values shaded in dark grey are above 10x the CCME guideline; no values are above the short-term CCME guidelines.
[a] Aluminum guideline is based on pH > 6.5.
[b] Hardness dependent guidelines are based on a hardness of 10 mg/L.
CCME – Canadian Council for Ministers of the Environment; WQG – Water quality guideline for the protection of aquatic life.

Of the parameters identified as potential parameters of concern, Cu and Sb show the greatest increase between the 3:1 and 0.5:1 tests, by a factor of 5.2 and 5.5, respectively. Cu concentrations increase from 0.00023 mg/L to 0.0012 mg/L, while Sb concentrations increase from <0.0002 mg/L to 0.0011 mg/L. The relative increase in these parameters indicates that these elements are reasonably conservative. In contrast, As increases in concentration by a factor of less than 2 from 0.044 to 0.084 mg/L suggesting that attenuation mechanisms may occur at relatively high water/solid ratios. Interestingly, Al dissolved concentrations decrease significantly with decreasing water/solid ratios (Table 4.8). These test results will be further investigated in the context of field bin leachate data, once available and considered in the derivation of geochemical source terms where applicable.

4.1.1.5 Particle Size Distribution Results

The particle size distribution results for the humidity cell subsamples are presented in Appendix 4-5 and summarized in Figure 4-9. All humidity cell subsamples were crushed to P_{80} < 6.4 mm, in line with the standard particle size for humidity cells (Price, 2009). The PSD results show that the humidity cell subsamples have a similar particle size distribution, although HC4 (GW) has a relatively lower proportion of fines as compared to other humidity cell samples. This is consistent with site observations were argillite-rich material is generally found to be more friable than the greywacke unit.

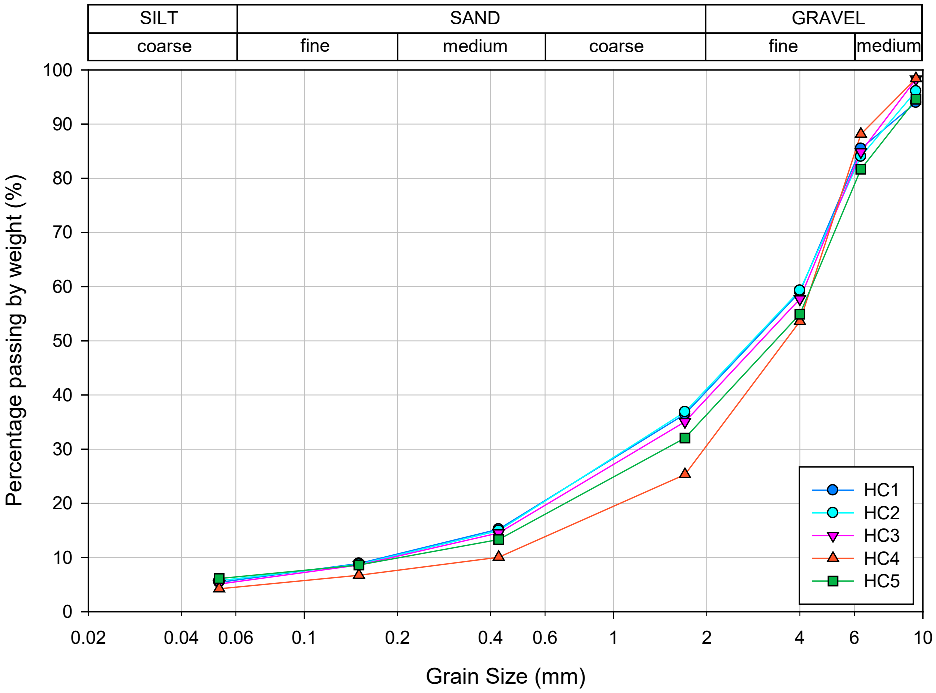


Figure 4-9: FMS Humidity Cell Particle Size Distribution.

4.1.2 Kinetic Test Results

4.1.2.1 Humidity Cells

Laboratory kinetic test procedures are designed to quantify weathering rates under standardized conditions. During the initial cycles of laboratory kinetic testing, sulphate and metals often have highly variable release rates before stabilizing at a relatively constant rate (Sapsford *et al.,* 2009). This variability is a response to exposure of fresh surfaces of crushed material and the dissolution of stored oxidation products that may have accumulated in the samples during storage prior to being placed in a humidity cell. Once exposed mineral surfaces have equilibrated to this environment, stable reaction rates can be determined. Humidity cells often require many weeks to approach geochemical stability, and reaction rates rarely remain constant on a week-to-week basis. It should be noted that aqueous concentrations in the weekly/biweekly rinse water should not be considered as direct predictions of on-site drainage chemistry due to the high water/solid ratio used in this type of testing (Sapsford *et al.,* 2009). In reality, conditions within large-scale mine rock storage facilities are much different with lower water/rock ratios, incomplete flushing of particle surfaces, and secondary minerals frequently reaching saturation and precipitating out of solution. Humidity cell leaching rates are however used in the derivation of geochemical source terms for various FMS site facilities as described in Lorax (2019).

The humidity cell program for the FMS mine rocks consists of five humidity cells covering the four main lithologies (AR, AG, GA, and GW) as well as one ore sample. Sample descriptions are provided in Table 3-2 and experimental methods are described in Section 3.2.3. Static characterization testwork, including mineral identification, ABA, solid phase element determination, and PSD were completed on subsamples of each of the humidity cells (presented in Section 4.1.1). Results of the static testwork show that the subsamples are considered to be representative or conservative with respect to the corresponding lithologies. Humidity cell tests were initiated in August 2018 and, at the time of reporting, had been operated for almost 40 weeks. This represents the full extent of the humidity cell experimental runtime for some samples (HC3, HC4, HC5), while HC1 (AG) and HC2 (AR) are ongoing past the 40 week mark (currently at 50 weeks), since these cells are the most likely candidates to turn acidic and provide loading rates for long-term, low-pH conditions draining off PAG waste rock.

The full set of leachate results are presented in Appendix 4-6 and summarized in the sections below.

4.1.2.1.1 pH and Sulphate Loading

The leachate from all humidity cells remained circum-neutral for the duration of the current test period. All pH values are between 6.5 and 8.1 (Figure 4-10). The lowest pH values were produced in the later experimental cycles of HC1 and HC2 consistently dropping below 7.5. the two greywacke-dominated waste rock samples (HC3 and HC4) show pH values above pH 7.5 throughout most of the experimental duration. Trends observed for pH are also reflected by the alkalinity produced by the individual cells with HC1 and HC2 showing continuously decreasing alkalinity values below 10 mg $CaCO_3$/L. As mentioned previously, the goal of the continued operation of these cells is the production of acidic leachates once all NP is depleted.

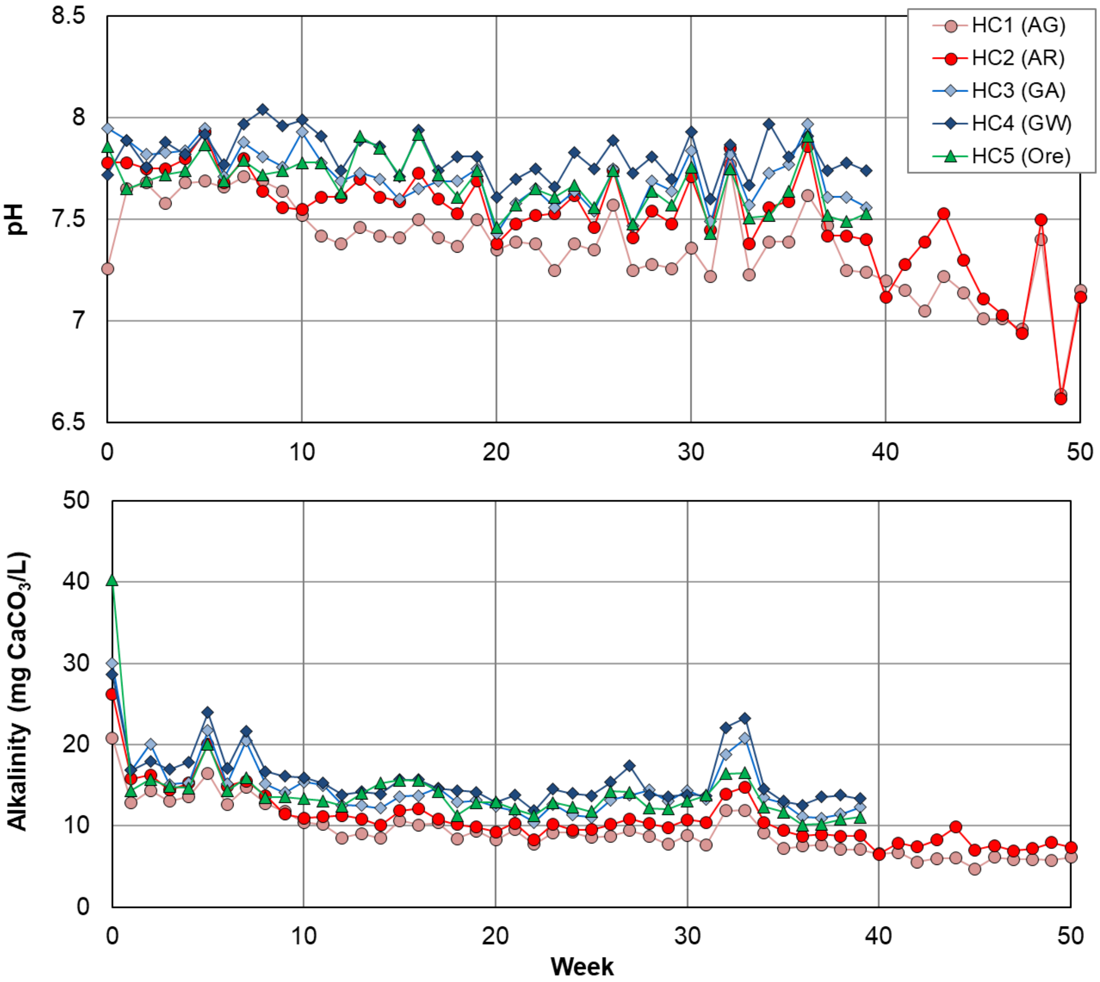


Figure 4-10: pH and alkalinity in leachates from FMS humidity cells

Concentrations measured from humidity cells are susceptible to changes in the volume of water added and collected at the end of each cycle, and hence, concentration data do not provide a strictly quantitative estimate of drainage chemistry. To provide a more functional parameter which can be used to compare results between different humidity cells, sulphate and metal concentrations in the leachate are normalized to the mass of sample in the humidity cell and the volume of leachate collected each week, producing weekly mass loadings (mg solute/kg sample/wk).

Elevated sulphate loading rates are expected in the first few weeks of the test due to dissolution and flushing of readily soluble surface oxidation products (*e.g.,* secondary sulphates). HC5 (ore) has the highest sulphate loading rates in week 0, while the waste rock humidity cells show initial peak sulphate concentrations in week 1 or 2 of the early sampling cycles (Figure 4-11). An interesting trend is evident for all humidity cells: following an early drop in sulphate loading rates after the initial flush, values increase again after week 6 and show somewhat more stable or slightly decreasing values after week 20 of the tests. This signature is inferred to be a result of increasing sulphide oxidation rates after oxidation products have been rinsed from the sulphide surfaces.

Stable sulphate leaching rates are highest in the ore sample (HC5) which releases between 12 and 17 mg/kg/wk after week 20. HC1 (AG) releases the highest sulphate loads of the waste humidity cells with a slightly decreasing trend from 15 mg/kg/wk in week 20 to around 10 mg/kg/wk in more recent sampling cycles. All other waste rock cells release between 5 and 10 mg/kg/wk after week 20. HC 2 (AR) shows a sharp increase in sulphate loads in the most recent sampling cycle (Figure 4-11) which may be explained by the corresponding drop in pH during this time period. Overall, there is no good correlation between the sulphate load and sulphide S (Figure 4-12) showing that for the tested materials sulphide content is not a reliable predictor of sulphate release rates.

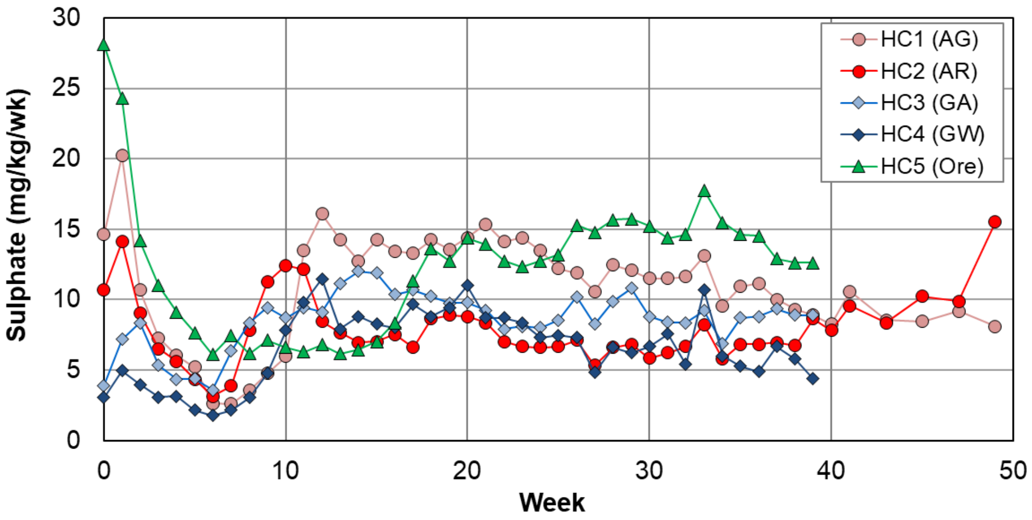


Figure 4-11: Sulphate loading rates in FMS humidity cell leachates

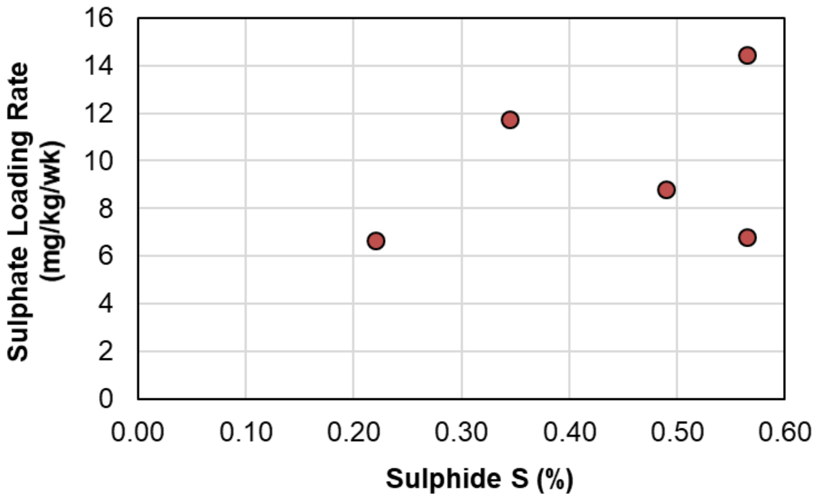


Figure 4-12: Median sulphate loading rate (cycles 20-40) *versus* sulphide S.

4.1.2.1.2 Carbonate Molar Ratio

The carbonate molar ratio (CMR) is a proxy for the rate of carbonate dissolution (NP depletion) and sulphide oxidation occurring in the laboratory test reactor, assuming that the base cations are derived only from the NP source and the sulphate is derived from the oxidation of pyrite. The CMR is calculated as:

$$CMR = \frac{[Ca^{2+}] + [Mg^{2+}]}{[SO_4^{2-}]}$$

In the most simplistic scenario for pyrite oxidation, when carbonate minerals are present, the oxidation-neutralization reaction is pH-dependent. Assuming no Ca and SO_4 are lost to gypsum precipitation, two carbonate consumption reactions can describe the process, including:

at pH < 6.3:

$$FeS_2 + {}^{15}\!/_{4}\,O_2 + {}^{7}\!/_{2}\,H_2O + 2\left[Ca^{2+}, Mg^{2+}\right]CO_3 \longrightarrow Fe(OH)_3 + 2SO_4^{2-} + 2H_2CO_3^0 + 2\left[Ca^{2+}, Mg^{2+}\right]$$

at 6.3<pH<10.3:

$$FeS_2 + {}^{15}\!/_{4}\,O_2 + {}^{7}\!/_{2}\,H_2O + 4\left[Ca^{2+}, Mg^{2+}\right]CO_3 \longrightarrow Fe(OH)_3 + 2SO_4^{2-} + 4HCO_3^{-} + 4\left[Ca^{2+}, Mg^{2+}\right]$$

Neutralization of acidity up to pH levels of 6.3 produce one mole of Ca (+ Mg) for each mole of SO_4 released, producing a CMR = 1.0. At pH levels above 6.3, H_2CO_3 is not the dominant form of inorganic carbon in an aqueous solution and the bicarbonate ion (HCO_3^-) is by far the most abundant. Thus, at near-neutral pH levels, calcium carbonate is less efficient at neutralizing acidity and twice as much carbonate is required to produce a balanced solution. Under these conditions, 4 moles of Ca (+ Mg) are theoretically released relative to 2 moles of SO_4 producing a CMR = 2.0. The relationships derived from these chemical equations assume that pyrite oxidation is the sole source of sulphur and iron in the product that take the form of sulphate and iron hydroxide, respectively. Thus, the oxidation of other sulphide minerals, dissolution of soluble sulphate minerals, the formation of other secondary products, or dissolution of carbonates by dilute waters in the absence of significant sulphide oxidation may alter this relationship (Mattson, 2005). If it is assumed that $Fe(OH)_3$ is produced as a product of pyrrhotite oxidation, the moles of acidity released during this reaction are identical to that of pyrite oxidation (Nicholson, 1994).

By week 11, the CMR for all the humidity cells had decreased to values between 1 and 2 with HC4 periodically producing values above 2 in the later experimental stages (Figure 4-13). This is likely due to more carbonate being dissolved than needed to neutralize acidity generated from sulphide oxidation in this sample. For all other samples, the long-term CMR values suggest carbonate dissolution in response to sulphide oxidation.

The CMR can be used to calculate the CaNP depletion rate which can in turn be used to calculate the amount of time required to consume all available CaNP from the humidity cell samples. It can be assumed that bulk silicate NP will be available to buffer acidity beyond the depletion of carbonate, however for this high-level assessment carbonate depletion was conservatively chosen as the point marking the onset of acidic drainage. In reality, other factors such as water-rock contact and grain liberation are expected to play an important role with respect to ARD timing. For this exercise, the CaNP depletion rate was calculated as follows:

CaNP depletion rate = CMR x Sulphate loading rate (in kg $CaCO_3$/t/wk equivalents)

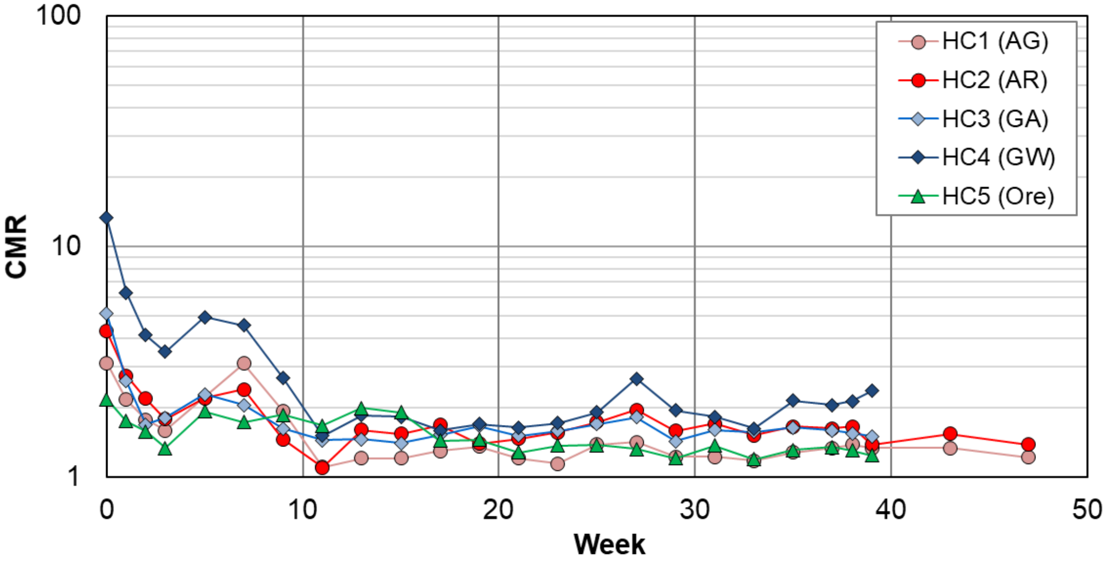


Figure 4-13: CMR values for FMS humidity cell leachate

Note that for the purposes of calculating NP depletion rates and the time for complete depletion of NP, the initial sulphate production rates, which reflect the flushing of non-acid generating surface oxidation products such as gypsum, were not considered. Rather the relatively stable CaNP depletion rates in later cycles of the tests more appropriately reflect depletion based on sulphate produced by sulphide oxidation. This prevents overestimating carbonate depletion rates and thereby underestimating the lag time to the onset of acidic conditions.

No correlation was found of NP depletion rate and solid-phase sulphide or modified NP content. Therefore, the average NP depletion rate was calculated independently of these parameters for the last five available cycles from all humidity cells with CMR data (cycles 33-39) yielding a value of 0.014 kg $CaCO_3$/t/wk. Applying this HC-specific rate to the PAG humidity cell NP values, model results suggest that carbonate depletion times will range from 6 (HC1) to 15 (HC3) years for these cells.

The same CaNP depletion rate was also applied to the range of NP measured in the PAG waste rock samples within the FMS static test population to quantify a range of lag times that can be expected until acidic drainage is released. The result of this exercise is shown in Figure 4-14 and illustrates that it will take approximately 10 years for 50% of all PAG samples to turn acidic. Importantly, up to 40% of all PAG samples are expected to produce acidic contact water within 6 years. The 6-year mark corresponds with the detection limit for CaNP (4.5 kg $CaCO_3$/t) which implies that acidic conditions may develop earlier in these samples. Overall however, these values are conservative as they do not consider the reduced sulphide oxidation rate at colder temperatures or the slowing of oxidation rates due to coating of sulphide minerals over time. A temperature-correction factor of 0.3 has been proposed to estimate the sulphate leaching rate around 10°C versus 22°C (Dockrey and Mattson, 2016).

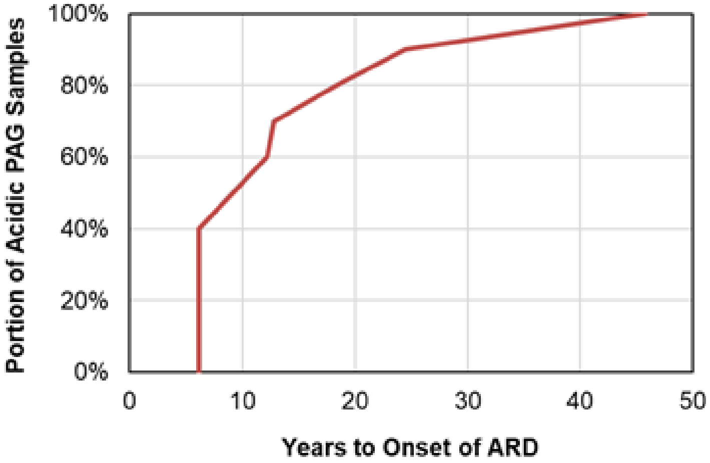


Figure 4-14: Estimate of time to onset of acidic conditions in FMS PAG samples

4.1.2.1.3 Metal Leaching Trends

The trends in leachate mass loading rates over time are provided in Figure 4-15 for selected species. As and Cu were shown to have elevated concentrations with respect to 3x the AUCCA in the mine rocks (Section 4.1.1.3). Although Ni was not identified as a potential parameter of concern in the solid-phase, it is known to be associated with sulphide minerals in Nova Scotian slates (Lund *et al.,* 1987).

The As loading rates are initially highest for HC3 (GA) and HC4 (GW) and decrease from approximately 0.1 to 0.02 (HC3) and 0.005 (HC4) mg/kg/wk. HC3 has relatively high As in the solid phase (1,785 ppm); however, HC4 does not (111 ppm). This indicates that, as already seen for the SFE tests, As mobility does not directly correlate with As content in the solid phase. The other three humidity cells have relatively stable to slightly decreasing As loading rates with values less than or near 0.01 mg/kg/wk. The ore cell (HC5) displays a temporarily increasing As loading rate between weeks 16 and 30 (Figure 4-15). HC1 (AG) has both the lowest As loading rate (approximately 0.004 mg/kg/wk) and the lowest As solid phase concentration (59 ppm).

Cu shows relatively low and erratic loading rates for all humidity cells Cu loading rates most commonly fall between 0.0001 and 0.001 mg/kg/wk with no discernable lithological or temporal trends.

After initially relatively high values (>0.001 mg/kg/wk), Ni loading rates drop around or below 0.0001 mg/kg/wk for most cell with the exception of HC5 (ore) which shows a slight increase in Ni mobility after week 25. It is assumed that Ni loading rates are strongly tied to sulphide oxidation rates with marked increases expected for samples producing acidic drainage after NP has been depleted.

4.1.2.2 Field Bin

Field kinetic testing is used to help predict the drainage chemistry from the mine rock. These tests provide an indication of runoff chemistry under mine site conditions and are conducted at a larger scale relative to humidity cells. The FMS field bin was first sampled following setup in September 2018. This initial sample was collected after irrigating the field bin with distilled water. Subsequent samples were collected in response to natural precipitation events when sufficient leachate is available for analysis, roughly once a month when temperatures are above freezing. Full field bin leachate results are provided in Appendix 4-7.

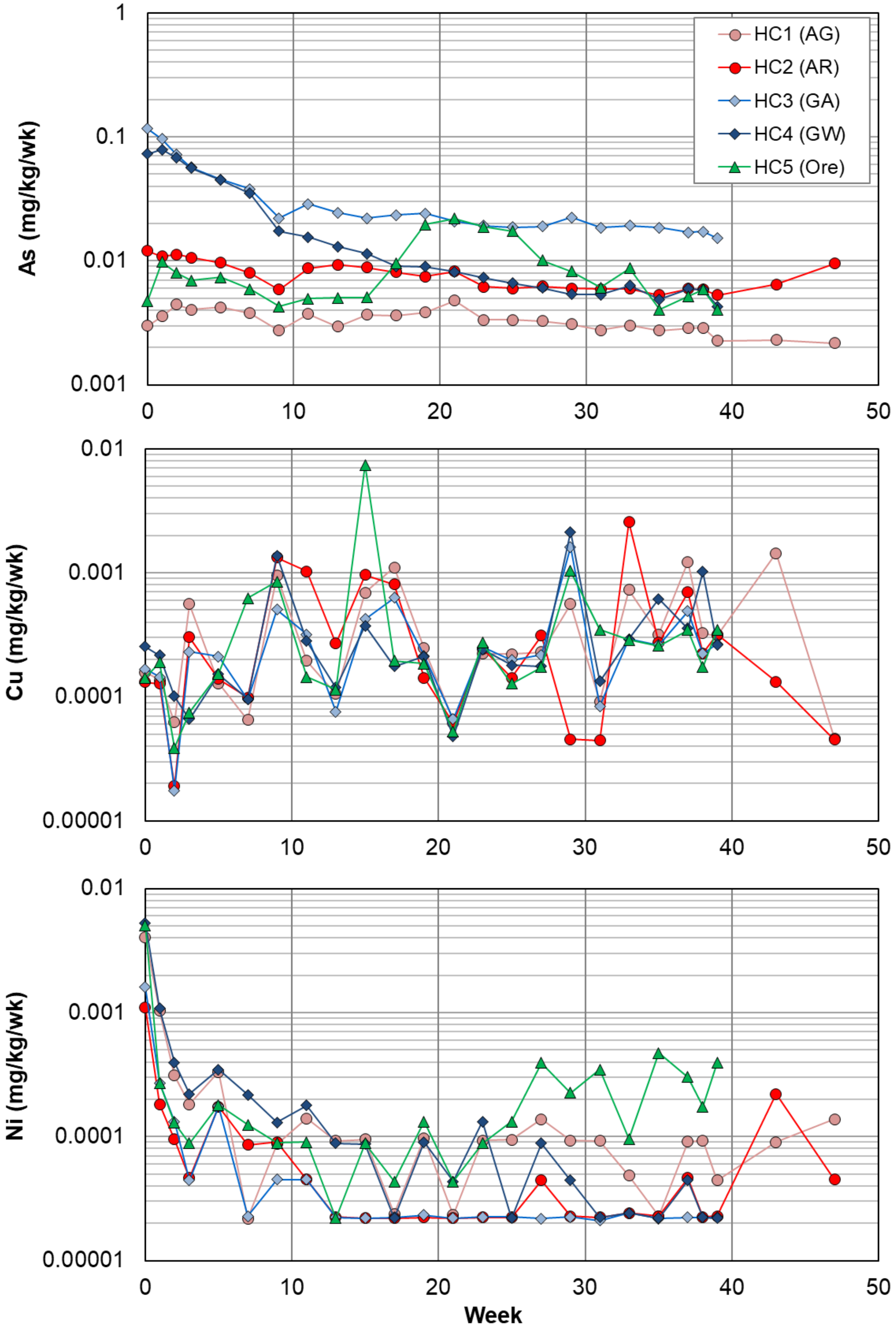


Figure 4-15: As, Cu, and Ni in leachate from the FMS humidity cells

Both median and maximum field bin leachate results are compared to CCME guidelines for the protection of aquatic life to provide an indication of parameters that may be of concern in the leachates (Table 4.9). Median values of field bin leachates (n = 8) do not exceed any short-term nor long-term guidelines. Maximum concentrations observed in the leachates are above long-term CCME guidelines for Cl, Al, As, and Ni. These maxima occur in the first sample collected (September 2018), with the exception of Al. This is expected due to flushing of readily soluble sulphide oxidation products that may have formed prior to field bin installation; therefore, the chemistry of the initial sample is not considered reflective of long-term stable geochemical conditions.

Table 4.9:
Summary of FMS field bin leachate chemistry

Parameter	**Units**	**CCME WQG**		**FB-3 (n=8)**	
		Short Term	Long Term	Median	Maximum
pH	pH	6.5-9	-	7.38	7.73
Conductivity	µS/cm	-	-	190	990
Hardness ($CaCO_3$)	mg/L	-	-	92.5	450
Chloride	mg/L	640	120	5.1	130
Fluoride	mg/L	-	0.12	<0.10	<0.10
Sulphate	mg/L	-	-	57.5	250
Nitrate-N	mg/L	550	13	0.066	0.54
Nitrite-N	mg/L	-	0.06	0.013	0.058
Ammonia-N[a]	mg/L	-	0.14	0.063	0.10
Dissolved Metals					
Al[b]	mg/L	-	0.1	0.011	0.13
As	mg/L	-	0.005	0.0033	0.0064
B	mg/L	29	1.5	<0.050	<0.050
Cd	mg/L	0.001	0.00009	0.000013	0.000088
Ca	mg/L	-	-	34	160
Cr	mg/L	-	0.001	<0.0010	<0.0010
Co	mg/L	-	-	0.0019	0.040
Cu[c]	mg/L	-	0.002	0.00079	0.0020*
Fe	mg/L	-	0.3	<0.050	0.057
Pb[c]	mg/L	-	0.001	<0.00050	0.00050
Mg	mg/L	-	-	1.45	11.0
Mn	mg/L	-	-	0.09	1.4
Mo	mg/L	-	0.073	<0.0020	0.0028
Ni[c]	mg/L	-	0.025	0.0165	0.230
K	mg/L	-	-	2.0	13
Se	mg/L	-	0.001	<0.0010	<0.0010
Ag	mg/L	-	0.00025	<0.00010	<0.00010
Na	mg/L	-	-	1.7	13
Tl	mg/L	-	0.0008	<0.00010	<0.00010
U	mg/L	0.033	0.015	0.00061	0.0015
Zn	mg/L	0.037	0.007	<0.0050	<0.0050

Notes: Values shaded in light grey are above the long-term CCME guideline; no values are above the short-term CCME guidelines.

[a] Ammonia guideline is based on a temperature of 20°C and a pH of 8.5. Guideline is converted from total ammonia to total ammonia-N by multiplying the value by 0.8224.

[b] Aluminum guideline is based on pH > 6.5

[c] Hardness dependent guidelines are based on a hardness of 10 mg/L

CCME – Canadian Council for Ministers of the Environment; WQG – Water quality guideline for the protection of aquatic life

[*] Value was measured at detection limit of <0.002 mg/L

4.2 Tailings

The following provides an overview of the geochemistry of the four FMS tailings samples obtained to date. Only the conventional circuit tailings sample from the 2018 metallurgical tests (Test 10 - KM5644) was used for saturated column testing to assess the material's leaching behaviour under subaqueous conditions.

4.2.1 Static Test Results

4.2.1.1 Acid-Base Accounting Results

All tailings samples have slightly basic paste pH ranging from 8.1 to 8.3 (Table 4-10). With the exception of the Test 42 material, all tailings samples show a total S content of 0.20% or higher with the highest content measured in the 2018 Test 6 (split circuit) sample (0.25%). Sulphate S is below the detection limit in all four samples (<0.01 %). Sulphide S levels are also low (≤0.02%; Table 4-9) in the 2017 tailings samples where sulphide was determined analytically via HNO_3 digestion. This method is known to result in incomplete dissolution of pyrrhotite which was identified in FMS mine rock. Hence, sulphide contents were calculated as non-sulphate S ([Total S] – [sulphate S]) to maintain conservatism for the 2018 samples.

All tailings samples have comparable CaNP and modified NP values (Table 4-10). Similar to trends observed in mine rock, the modified NP values are slightly higher than the CaNP, indicating that minerals other than carbonates may provide some neutralization. The NPR is calculated using the AP based on total S and the modified NP. Both 2017 tailings samples are NAG with NPR values of 2.1 and 5.6. For the 2018 tailings, the split circuit sample (Test 6) has PAG character (NPR = 1.6) while the conventional circuit sample (Test 10) used for kinetic testing is NAG with an NPR of 2.0 (Table 4-10). The full tailings ABA results are included in Appendix 4-8.

**Table 4-10:
Summary of FMS tailings ABA results**

Sample ID	Met. Test ID	Year	Paste pH	Total S	Sulphate S	Sulphide S	CaNP	Modified NP	NPR
				%	%	%	*kg $CaCO_3$/t*	*kg $CaCO_3$/t*	*Mod.NP/ AP*
Test 8	KM5446	2017	8.3	0.21	<0.010	0.020	11	14	2.1
Test 42			8.3	0.085	<0.010	0.010	13	15	5.6
Test 6	KM5644	2018	8.1	0.25	<0.010	0.25	11	12	1.6
Test 10			8.2	0.20	<0.010	0.20	11	12	2.0

Notes:
Sulphate S is determined using the HCl method; Sulphide S is determined using the Sobek 1:7 nitric acid leach with ICP finish;
CaNP (carbonate neutralization potential) calculated using total inorganic carbon (% TIC x (100.09/12.01) x 10);
Modified NP is obtained by the modified Sobek method;
NPR = neutralization potential ratio; calculated as Modified NP / AP.

4.2.1.2 Total Solid Phase Elemental Analysis Results

The solid-phase element concentrations are generally below 3x the AUCCA in the tailings samples (Appendix 4-8). The main element of concern identified with this screening method is As, which is above 10x the AUCCA in the Test 8 sample (2017) and both 2018 tailings samples. At 43 ppm it also exceeds 3x the AUCCA in the Test 42 sample (Table 4-11). The 2018 Test 10 material also showed an enrichment in solid-phase Zn. The detection limit for Se is above 10x the AUCCA so it is unknown if the Se content is indeed elevated in the studied tailings samples.

4.2.1.3 Shake Flask Extraction Results

Tailings SFE results are compared to the CCME water quality guidelines for the protection of aquatic life (CCME, 2018) in order to provide some indication of parameters which may be of potential concern in short-term runoff from the material. Parameters that were elevated relative to the CCME guidelines in the extracts from the tailings samples include Al and As (Table 4-12). Although As is elevated in the solid phase in the tailings samples, the As concentrations in the leachate do not appear to be directly correlated with the solid phase As. This is most evident in the Test 42 sample which shows the lowest solid phase As content (43 ppm) while leaching the highest As concentration of all samples (0.019 mg/L).

Table 4-11:
Summary of solid phase element results for FMS tailings samples

Sample ID	**Units**	**Test 8**	**Test 42**	**Test 6**	**Test 10**	**AUCCC**
Met. Test ID		KM5446		KM5644		
Year		2017		2018		
Ag	ppm	0.030	0.010	0.030	0.030	0.053
As	ppm	176	43	335	225	4.8
Cu	ppm	4.2	3.6	5.4	9.6	28
Pb	ppm	6.4	4.7	4.4	29	17
Sb	ppm	0.13	0.050	0.36	0.35	0.40
Se	ppm	<1.0	<1.0	<1.0	<1.0	0.090
Zn	ppm	90	88	96	209	67

Notes: AUCCA = average upper continental crust abundance (Rudnick and Gao, 2014);
Values greater than 3x the AUCCA are shaded in light grey; values greater than 10x the AUCCA are shaded in dark grey.

**Table 4-12:
Summary of SFE results for FMS tailings samples**

Sample ID	Units	Test 8	Test 42	Test 6	Test 10	CCME WQG	
						Short Term	Long Term
Met. Test ID		KM5446		KM5644			
Year		2017		2018			
pH		8.1	8.2	7.95	7.93	6.5-9	-
Conductivity	µS/cm	134	123	157.48	177.6	-	-
Sulphate	mg/L	18	16	29	30	-	-
Dissolved Metals							
Ag	mg/L	< 0.00005	< 0.00005	< 0.00005	< 0.00005	-	0.00025
Al[a]	mg/L	0.15	0.23	0.13	0.13	-	0.1
As	mg/L	0.013	0.019	0.013	0.0066	-	0.005
B	mg/L	0.0080	0.0070	0.012	0.015	29	1.5
Cd	mg/L	< 0.000003	< 0.000003	0.0000050	0.0000050	0.001	0.00009
Co	mg/L	0.000036	0.000044	0.000032	0.000023	-	-
Cr	mg/L	0.00019	0.00077	0.00015	0.00013	-	0.001
Cu[b]	mg/L	0.00045	0.00038	0.00070	0.0014	-	0.002
Fe	mg/L	0.039	0.061	0.020	0.050	-	0.3
Hg	ug/L	< 0.01	< 0.01	< 0.01	0.020	-	0.026
Mn	mg/L	0.0059	0.0016	0.012	0.011	-	-
Mo	mg/L	0.0025	0.0019	0.0057	0.014	-	0.073
Ni[b]	mg/L	0.00030	0.00020	0.00040	0.00050	-	0.025
Pb[b]	mg/L	0.000050	0.000050	0.000030	0.000020	-	0.001
Sb	mg/L	0.00050	0.00040	< 0.0009	< 0.0009	-	-
Se	mg/L	0.00018	0.00021	0.00033	0.00013	-	0.001
Tl	mg/L	0.0000070	0.0000060	0.0000050	< 0.000005	-	0.0008
U	mg/L	0.00035	0.00033	0.00025	0.00023	0.033	0.015
Zn	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	0.037	0.007

Notes: Values shaded in grey are above the long-term CCME guideline; no values are above the short-term CCME guidelines
[a] Aluminum guideline is based on pH > 6.5
[b] Hardness dependent guidelines are based on a hardness of 10 mg/L
CCME – Canadian Council for Ministers of the Environment;
WQG – Water quality guideline for the protection of aquatic life

4.2.2 Kinetic Test Results

4.2.2.1 Saturated Columns

4.2.2.1.1 Influent Chemistry

As described in Section 3.2.3.3, tailings supernatant was used as the influent source for the saturated column experiment. Supernatant inflow geochemistry is summarized in Table 4-13. Supernatant water reflects general tailings porewater chemistry and is characterized by slightly basic pH and elevated DOC, with the major ion inventory dominated by bicarbonate alkalinity, SO_4, Ca, and K. Fluoride, arsenic, and zinc concentrations in saturated column influent are elevated relative to CCME guidelines. At

0.012 mg/L, arsenic concentrations exceed guidelines by approximately 2.5 times. CCME guidelines are used here merely as a reference point for saturated column testwork. Site wide water quality modelling considering the site-wide water balance and geochemical loading predictions (source terms) will identify whether parameters become an environmental concern.

**Table 4-13:
Summary of Saturated Column Influent Chemistry**

Parameter	Unit	Test 10 Supernatant	CCME WQG	
			Short Term	Long Term
T-Alk	mg/L	79	-	-
pH	s.u.	7.95	6.5-9	-
Conductivity	uS/cm	314	-	-
DOC	mg/L	11.4	-	-
NH_3	mg/L	0.352	-	-
NO_3-N	mg/L	0.0480	-	-
NO_2-N	mg/L	0.0048	-	-
T-PO_4	mg/L	*< 0.002*	-	-
SO_4	mg/L	47.1	-	-
Na	mg/L	11.2	-	-
Ca	mg/L	24.7	-	-
K	mg/L	32.0	-	-
Cl	mg/L	15.0	640	120
Mg	mg/L	3.47	-	-
Si	mg/L	1.66	-	-
F	mg/L	0.284	-	0.12
Al	mg/L	0.0944	-	0.1
Sb	mg/L	0.000305		
As	mg/L	0.0119	-	0.1
Ba	mg/L	0.00664	-	-
Cd	mg/L	*< 0.000005*	0.001	0.00009
Cr	mg/L	*< 0.0001*	-	0.001
Co	mg/L	0.0000094	-	-
Cu	mg/L	*< 0.0001*	-	0.002
Fe	mg/L	*< 0.001*	-	0.3
Pb	mg/L	*< 0.000005*	-	0.001
Li	mg/L	0.00587	-	-
Mn	mg/L	0.0182	-	-
Hg	mg/L	*< 0.000005*	-	0.026
Mo	mg/L	0.0160	-	0.073
Ni	mg/L	0.000762	-	0.025
Se	mg/L	0.000276	-	0.001
Ag	mg/L	*< 0.000005*	-	0.00025
Sr	mg/L	0.160	-	-
Tl	mg/L	0.0000061	-	0.0008
V	mg/L	0.000109	-	-
Zn	mg/L	0.0101	0.037	0.007

Note: Values in grey italics are below detection limit.
All metal concentrations represent the dissolved fraction.
Values shaded in grey are above the long-term CCME guideline; no values are above the short-term CCME guidelines

4.2.2.1.2 Effluent Chemistry

Saturated column testwork is used to help characterize the leachate behaviour of the tailings material fully under saturated conditions. This report provides interim results from the ongoing saturated column test that was initiated in March 2019 and, at the time of reporting, have been running for 18 weeks. A complete set of interim column leachate results are presented in Appendix 4-9 and summarized in this section.

Column effluent is slightly basic through the duration of the current experimental period. All pH values are between 8.05 and 8.31 (Figure 4-16). Total alkalinity shows a gradual increase from 120 mg/L $CaCO_3$ in Week 0 to 160 mg/L $CaCO_3$ in Week 18. Conversely, sulphate concentrations decline from 95 mg/L to near influent concentrations (47 mg/L) by Week 10 (Figure 4-16).

Reducing conditions in column substrate are driven by the oxidation of sulphide minerals and organic compounds. Organic matter in tailings material may be in the form of organic-based mill reagents, detritus entering the TMF, in situ growth of algae/bacteria, or organics provided in the column influent. Indeed, supernatant water quality results show the presence of measurable DOC (~11 mg/L). For the current experimental phase, DOC in leachates is consistently near or below influent concentrations, reaching levels as low as 4.4 mg/L. This indicates that decomposition of DOC by microbial activity is occurring within the column.

The first terminal electron acceptor to be utilized in the absence of oxygen is nitrate (NO_3). The saturated column shows evidence of NO_3 reduction as NO_3 carried in the influent (0.05 mg/L) is completely consumed to concentrations below method detection limit (MDL) values (<0.005) in the first leachate sample (Week 0) Figure 4-17). The dominant nitrogen species in column effluent is ammonia (NH_3), which is a reduced species that typically dominates nitrogen speciation under anaerobic conditions. The persistence of NH_3 in column leachate indicates that conditions are sufficiently reducing (*i.e.,* oxygen is absent) to favor NO_3 reduction and NH_3 stability.

Following denitrification and continued absence of oxygen, the next available electron acceptor and the next reaction in the thermodynamically predicted order of redox reactions is manganese (Mn IV) reduction. In the current experimental phase, there is evidence of the reductive dissolution of Mn-oxides. As labile DOC is readily available within the column and most of the available NO_3 is reduced, bacterially mediated reductive dissolution of Mn-oxides (assumed to be present as MnO_2) is expected to occur, leading to elevated Mn(II) in the leachate. This is demonstrated by the increase in Mn concentrations between column influent (0.018 mg/L) and column leachates (Figure 4-17). Manganese concentrations in leachates show an upward trend from Week 0 through 18, reaching a maximum concentration of 0.114 mg/L in Week 18. While column effluent has detectable Fe concentrations (maximum of 0.0082 mg/L) by Week 4, values are consistently just above or near influent concentrations, indicating that reductive dissolution of Fe is not occurring to any significant extent. This may be due to the availability of more energetically favorable oxidants (*i.e.,* Mn) or Fe-oxides being present in crystalline forms that are not easily accessible for microbial respiration.

The suboxic conditions of the column will inhibit acid generation and metal leaching associated with sulfide oxidation; however, metal leaching can still proceed through other mechanisms, including reductive dissolution reactions, the rinsing of water-soluble oxides, and ion-exchange processes. The most significant trace metal of interest released from the saturated column is arsenic (As), which shows a 3-fold concentration increase compared to influent by Week 18 (Figure 4-18Arsenic concentrations steadily increased from Week 0 through 18, suggesting conditions in the column are trending to favour As release. The maximum As concentrations are reached in Week 18 (0.035 mg/L) and are 7x the CCME guideline. Other elements of interest, such as Co and Ni, show evidence of elevated concentrations in Week 0 but reached near or below influent values by Week 2 (Figure 4-18). This behaviour is consistent with the rinsing of water-soluble oxides and mineral surface bound metals. While Ni concentrations remained near or below influent concentrations (0.00076 mg/L) and well below CCME guidelines (0.025 mg/L) by Week 2, Co concentrations climbed above influent values (0.0000094 mg/L) at Week 10 and continue in an upward trend through Week 18.

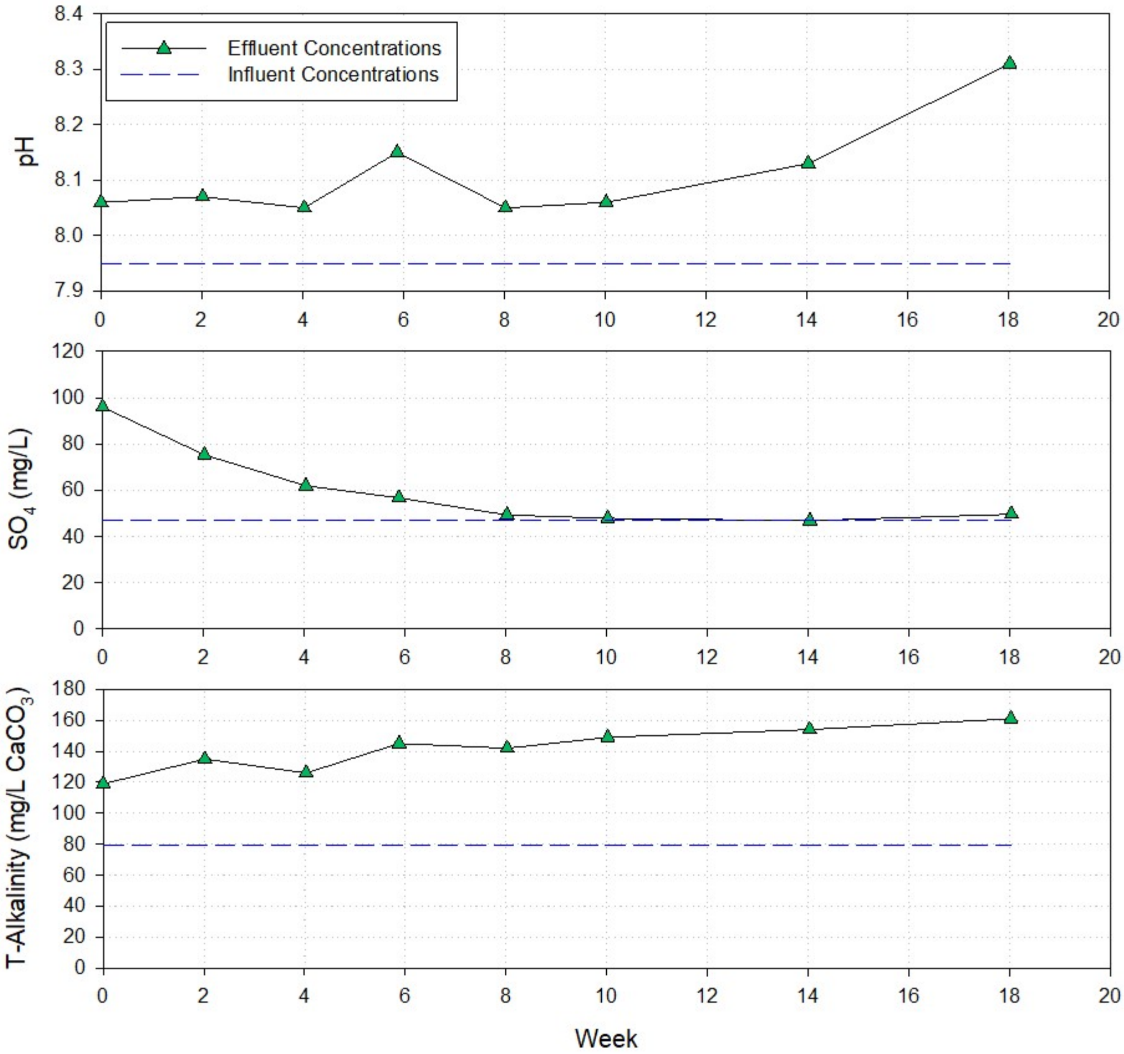


Figure 4-16: Saturated column time series profiles of pH, SO_4, and T-Alkalinity in column effluent over the 18 week experiment period

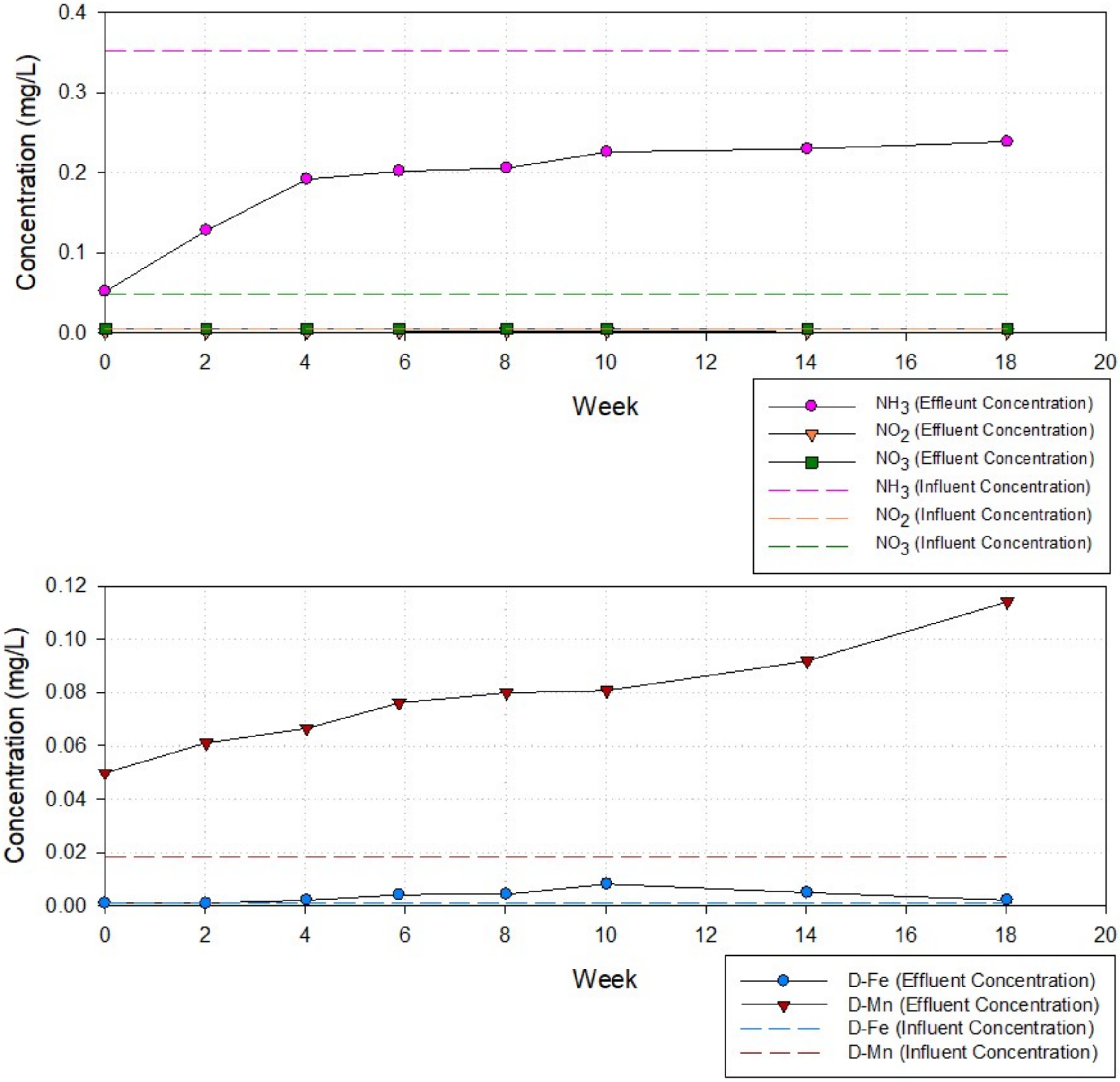


Figure 4-17: Saturated column time series profiles of Nitrogen species, D-Fe, and D-Mn in column effluent over the 18 week experiment period

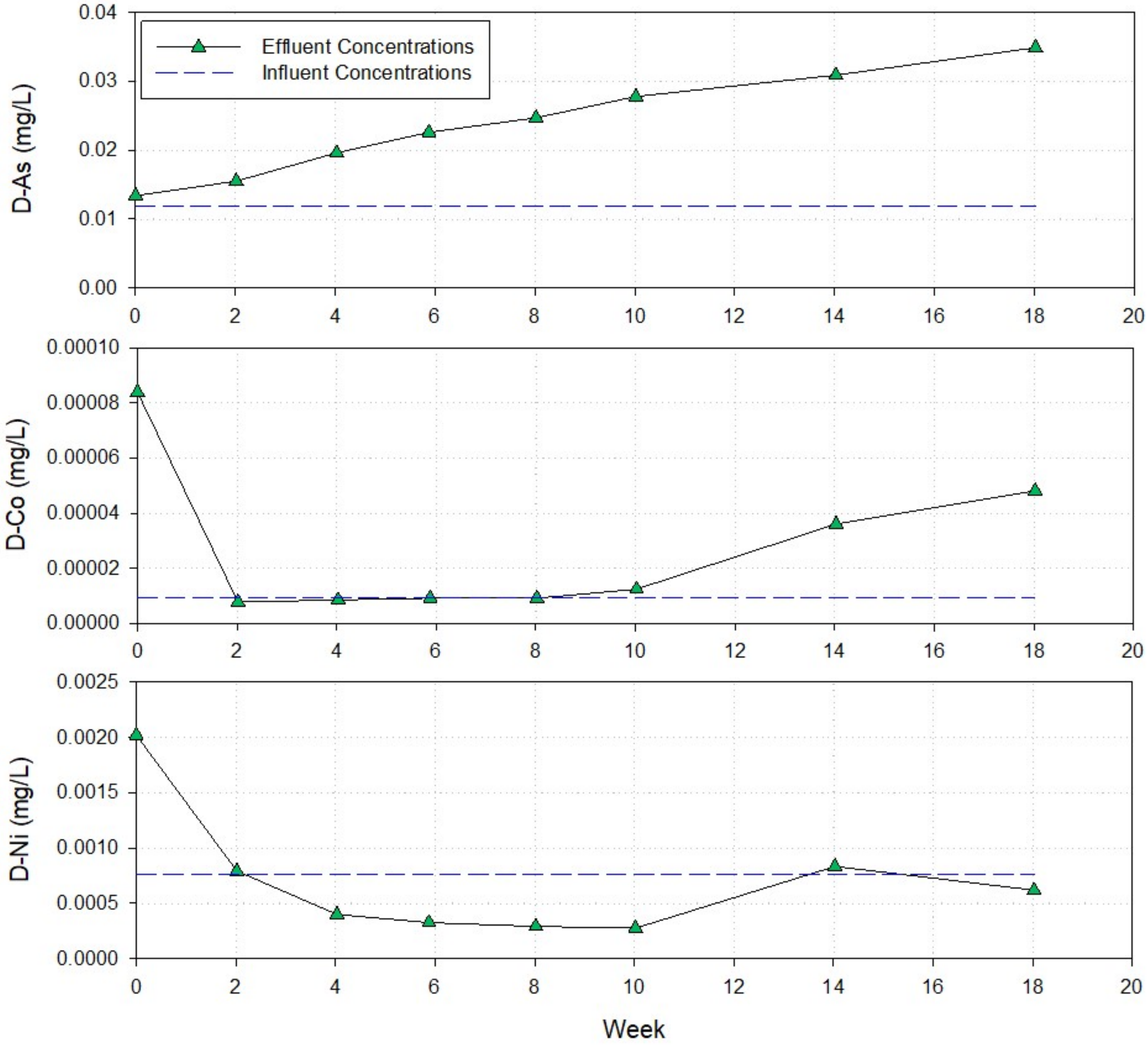


Figure 4-18: Saturated column time series profiles of D-As, D-Co, and D-Ni in column effluent over the 18 week experiment period

5. Conclusions

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5 Conclusions

The ML/ARD characterization of the FMS samples included static test characterization of mine rock and tailings samples. In addition, ongoing kinetic testing on mine rock and tailings samples includes humidity cells, a field bin and a saturated column. The key conclusions of the geochemical characterization include:

- FMS strata that will be mined include argillite (AR) and greywacke (GW) from the Moose River Member, which also hosts the Touquoy deposit to the southwest.
- The FMS mine rock is composed dominantly of quartz, plagioclase, and sericite/muscovite. Pyrrhotite is the main sulphide mineral in the humidity cell samples (up to 2.4 wt. %); however, the QEMSCAN results for the field bin subsample indicate that significant pyrite is also present in this sample. Pyrrhotite is present as coarser grains relative to pyrite, which is dominantly very fine-grained (≤ +25µm in size). Calcite was the main carbonate mineral present; HC4 (GW) contains significant calcite (9.8 wt. %), while the field bin subsample calcite content is 2.7%.
- The QEMSCAN analysis indicated that the majority of As present in the field bin subsample was present in the arsenopyrite. However, 77% of the arsenopyrite is locked within mineral grains and was most commonly observed in hydrothermal veins generally associated with pyrrhotite.
- The total S contents of the mine rock samples vary from 0.020% to 1.1%, including the ore samples. The median total S content of the ore samples is slightly higher relative to the median total S for the four main rock types (0.44 wt. % and 0.27 wt. %, respectively). The total S for the field bin subsample was 0.40%. The majority of the total S is present as sulphide S.
- The GW samples have the highest median modified NP value at 31 kg $CaCO_3$/t, while the AR samples have the lowest (12 kg $CaCO_3$/t). The ore samples have a median modified NP of 16 kg $CaCO_3$/t, while the field bin subsample has a modified NP of 27 kg $CaCO_3$/t.
- Samples from the GW are predominantly NAG (96%) while samples from the other three lithologies have higher PAG proportions. There is a clear relationship of PAG% with the relative amount of argillite contained within the rock type, where the AR unit (<5% greywacke interbeds) shows the highest PAG proportion of 81%.
- Elements of potential concern based on the solid phase elemental analysis include Ag, As, Cu, Pb, Sb, and Zn. These elements, excluding Cu and Zn, are enriched by

a factor greater than 10x above the AUCCA in one or more samples. As is elevated above 10x the AUCCA in all lithologies.

- The SFE results indicate that As and Al are potential parameters of concern in runoff from the mine rock. The elevated As concentrations in the leachate are not correlated to the solid phase As content. Other parameters highlighted in the solid phase analyses were not above the CCME water quality guidelines in the SFE leachate.
- Leachate from all humidity cells remained circum-neutral for the duration of the humidity cell experiments.
- Sulphate loading rates for the humidity cells HC2, HC3, and HC5 begin to stabilize after approximately 15 weeks of humidity cell testing. The highest sulphate release rates were observed in HC5 (ore) with values between 10 and 20 mg/kg/wk. HC1 (AG) showed the highest sulphate loading rates of any waste rock cell for the bulk of the experimental duration, however in more recent analytical cycles HC 2 (AR) has started to exceed HC1 rates.
- An estimated time to NP depletion was determined from the average CMR and sulphate loading rate for stable conditions of the kinetic test. Calculations suggests that the carbonate will be depleted from the FMS mine rock between approximately 6 and 15 years. A conservative estimate for time to NP depletion for the static test samples indicates that approximately 50% of the PAG samples will become acidic within 10 years after exposure to the atmposphere. This estimate does not consider the slower sulphide oxidation rates in colder temperatures, which would be expected to delay the onset of acid generation.
- Of the parameters of concern identified in the solid phase analysis, As had the highest loading rate in the humidity cells. Humidity cell samples with high solid phase As concentrations did not necessarily have high As loading rates.
- Median field bin leachate concentrations do not exceed any short-term nor long-term guidelines. Maximum concentrations observed in the leachates are above respective long-term CCME guidelines for Cl, Al, As, and Ni where maxima occur in the first sample collected (September 2018), with the exception of Al.
- The four tailings samples have variable but relatively low total S contents between 0.085% and 0.25%, dominantly in the form of pyrrhotite. Using total S as the proxy to calculate AP, only the 2018 split circuit sample (Test 6) showed an NPR value below 2 and is therefore classified as PAG. The sample produced by Test 10

representing the conventional flotation circuit, which is expected to be implemented for full-scale operations, is NAG (NPR = 2.0).

- Arsenic is the main parameter of concern in the tailings, due to elevated concentrations in both the solid phase elemental analysis and in the SFE leachate.
- Reducing conditions were established in the saturated column, evidenced by the consumption of DOC, denitrification, NH_3 stability, and Mn-oxide reduction.
- The most significant trace metal of interest released in the saturated column leachate is As. Arsenic concentrations steadily increased from Week 0 through 18, suggesting conditions in the column are trending to favour As release. The maximum As concentrations reached (0.035 mg/L) are 7x the CCME guideline.

6. Closure

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6 Closure

This report has been prepared for AMNS for the ML/ARD assessment of the FMS project. Please contact the undersigned should you require any additional information or clarification on the contents of this report.

Sincerely,

LORAX ENVIRONMENTAL SERVICES LTD.

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Appendices

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Appendix 3-1:
Sample Locations and Drill Core Details

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Appendix 3-1: Sample Locations and Drill Core Details

Hole ID	From (m)	To (m)	Lithology	Grade
FMS-17-055	5	6	AR	Waste
FMS-17-055	15	16	AR	Waste
FMS-17-055	25	26	AR	Ore
FMS-17-055	30	31	AR	Ore
FMS-17-055	43	44	AR	Ore
FMS-17-055	50	51	AR	Waste
FMS-17-055	55	56	AR	Ore
FMS-17-055	70	71	AR	Ore
FMS-17-055	83	84	AG	Ore
FMS-17-055	90	91	GW	Ore
FMS-17-055	98	99	AR	Ore
FMS-17-055	111	112	GW	Ore
FMS-17-055	120	121	AR	Waste
FMS-17-055	126	127	AR	Waste
FMS-17-073	9	10	GA	Waste
FMS-17-073	15	16	AR	Waste
FMS-17-073	22	23	GW	Waste
FMS-17-073	30	31	GW	Waste
FMS-17-073	33	34	AR	Waste
FMS-17-073	37	38	AR	Waste
FMS-17-073	44	45	AR	Waste
FMS-17-078	20	25	AR	Ore
FMS-17-078	40	45	AR	Waste
FMS-17-114	23	28	AG	Waste
FMS-17-114	55	60	AG	Waste
FMS-17-124	34	35	AR	Waste
FMS-17-124	40	41	AG	Waste
FMS-17-124	46	47	GW	Waste
FMS-17-124	50	51	AR	Waste
FMS-17-124	53	54	AR	Waste
FMS-17-124	60	61	AR	Waste
FMS-17-124	67	68	AR	Waste
FMS-17-124	70	71	AG	Waste
FMS-17-124	73	74	GA	Waste
FMS-17-124	82	83	AG	Ore
FMS-17-124	89	90	AR	Ore
FMS-17-124	106	107	AR	Ore
FMS-17-124	122	123	AR	Ore
FMS-17-124	130	131	AR	Ore
FMS-17-124	140	141	GA	Ore
FMS-17-124	145	146	AR	Ore
FMS-17-165	10	11	AR	Waste
FMS-17-165	16	17	GA	Waste
FMS-17-165	18	19	GW	Waste
FMS-17-165	21	22	GA	Waste
FMS-17-165	26	27	GA	Waste
FMS-17-165	30	31	AR	Waste
FMS-17-165	40	41	AR	Ore
FMS-17-165	55	56	AR	Ore
FMS-17-165	65	66	GW	Ore
FMS-17-165	83	84	AG	Ore
FMS-17-165	95	96	AG	Waste
FMS-17-165	110	111	GW	Waste
FMS-17-179	25	30	GW	Waste
FMS-17-199	5	6	GW	Waste
FMS-17-199	10	11	GW	Waste
FMS-17-199	20	21	GW	Waste
FMS-17-199	29	30	GA	Waste

Appendix 3-1: Sample Locations and Drill Core Details

Hole ID	From (m)	To (m)	Lithology	Grade
FMS-17-199	39	40	AG	Waste
FMS-17-199	80	81	AR	Waste
FMS-17-200	7	8	GW	Waste
FMS-17-200	13	14	AR	Waste
FMS-17-200	20	21	GW	Waste
FMS-17-200	27	28	AG	Waste
FMS-17-200	35	36	GA	Waste
FMS-17-206	40	45	AR	Waste
FMS-17-270	55	60	AG	Ore
FMS-17-274	20	25	GW	Waste
FMS-17-274	65	70	AR	Waste
FMS-17-274	100	105	AG	Waste
FMS-17-278	80	85	GW	Waste
FMS-17-280	42	47	GW	Waste
FMS-17-288	20	25	AG	Waste
FMS-17-288	45	50	GW	Waste
FMS-17-291	35	40	GA	Waste
FMS-17-298	20	25	GW	Waste
FMS-17-298	40	45	AR	Ore
FMS-17-302	20	25	AR	Waste
FMS-17-302	40	45	GW	Waste
FMS-18-388	45	50	GA	Waste
FMS-18-388	70	75	AR	Waste
FMS-18-388	110	115	AR	Waste
FMS-18-388	175	180	GW	Waste
FMS-18-389	20	25	AR	Waste
FMS-18-389	40	45	GA	Waste
FMS-18-389	75	80	GA	Waste
FMS-18-389	115	120	GW	Waste
FMS-18-416	20	25	GW	Waste
FMS-18-416	40	45	GW	Waste
FMS-18-416	75	80	GA	Waste
FMS-18-416	115	120	AR	Waste
FMS-18-416	145	150	GW	Waste
FMS-18-423	20	25	GA	Waste
FMS-18-423	40	45	AG	Waste
FMS-18-423	80	85	GW	Waste
FMS-18-440	45	50	GA	Waste
FMS-18-440	70	75	GW	Waste
FMS-18-440	110	115	AG	Waste

Appendix 4-1:
Mineralogy Results

APPENDIX 4-1-1: XRD RESULTS

APPENDIX 4-1-2: QEMSCAN RESULTS

Atlantic Gold

Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for:	*SGS Canada Inc*
Project Number/ LIMS No.	*14094-01B/MI4520-OCT18*
Batch No.	*1827 CH-FMS*
Sample Receipt:	*October 19, 2018*
Sample Analysis:	*October 26, 2018*
Reporting Date:	*October 30, 2018*

Instrument:	BRUKER AXS D8 Advance Diffractometer
Test Conditions:	Co radiation, 40 kV, 35 mA Regular Scanning: Step: 0.02°, Step time: 1s, 2θ range: 3-80°
Interpretations :	PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPlus Eva and Topas software.
Detection Limit :	0.5-2%. Strongly dependent on crystallinity.

Contents:

1) Method Summary
2) Quantitative XRD Results
3) XRD Pattern(s)

Kim Gibbs, H.B.Sc., P.Geo.
Senior Mineralogist

Huyun Zhou, Ph.D., P.Geo.
Senior Mineralogist

ACCREDITATION: SGS Minerals Services Lakefield is accredited to the requirements of ISO/IEC 17025 for specific tests as listed on our scope of accreditation, including geochemical, mineralogical and trade mineral tests. To view a list of the accredited methods, please visit the following website and search SGS Canada - Minerals Services - Lakefield: http://palcan.scc.ca/SpecsSearch/GLSearchForm.do.

SGS Minerals
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P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0
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Member of the SGS Group (SGS SA)

Method Summary

The Rietveld Method of Mineral Identification by XRD (ME-LR-MIN-MET-MN-D05) method used by SGS Minerals Services is accredited to the requirements of ISO/IEC 17025.

Mineral Identification and Interpretation:

Mineral identification and interpretation involves matching the diffraction pattern of an unknown material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) database and released on software as Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds, except when internal standards have been added by request. Mineral proportions may be strongly influenced by crystallinity, crystal structure and preferred orientations. Mineral or compound identification and quantitative analysis results should be accompanied by supporting chemical assay data or other additional tests.

Quantitative Rietveld Analysis:

Quantitative Rietveld Analysis is performed by using Topas 4.2 (Bruker AXS), a graphics based profile analysis program built around a non-linear least squares fitting system, to determine the amount of different phases present in a multicomponent sample. Whole pattern analyses are predicated by the fact that the X-ray diffraction pattern is a total sum of both instrumental and specimen factors. Unlike other peak intensity-based methods, the Rietveld method uses a least squares approach to refine a theoretical line profile until it matches the obtained experimental patterns.

Rietveld refinement is completed with a set of minerals specifically identified for the sample. Zero values indicate that the mineral was included in the refinement calculations, but the calculated concentration was less than 0.05wt%. Minerals not identified by the analyst are not included in refinement calculations for specific samples and are indicated with a dash.

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WARNING: The sample(s) to which the findings recorded herein (the "Findings") relate was(were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted.

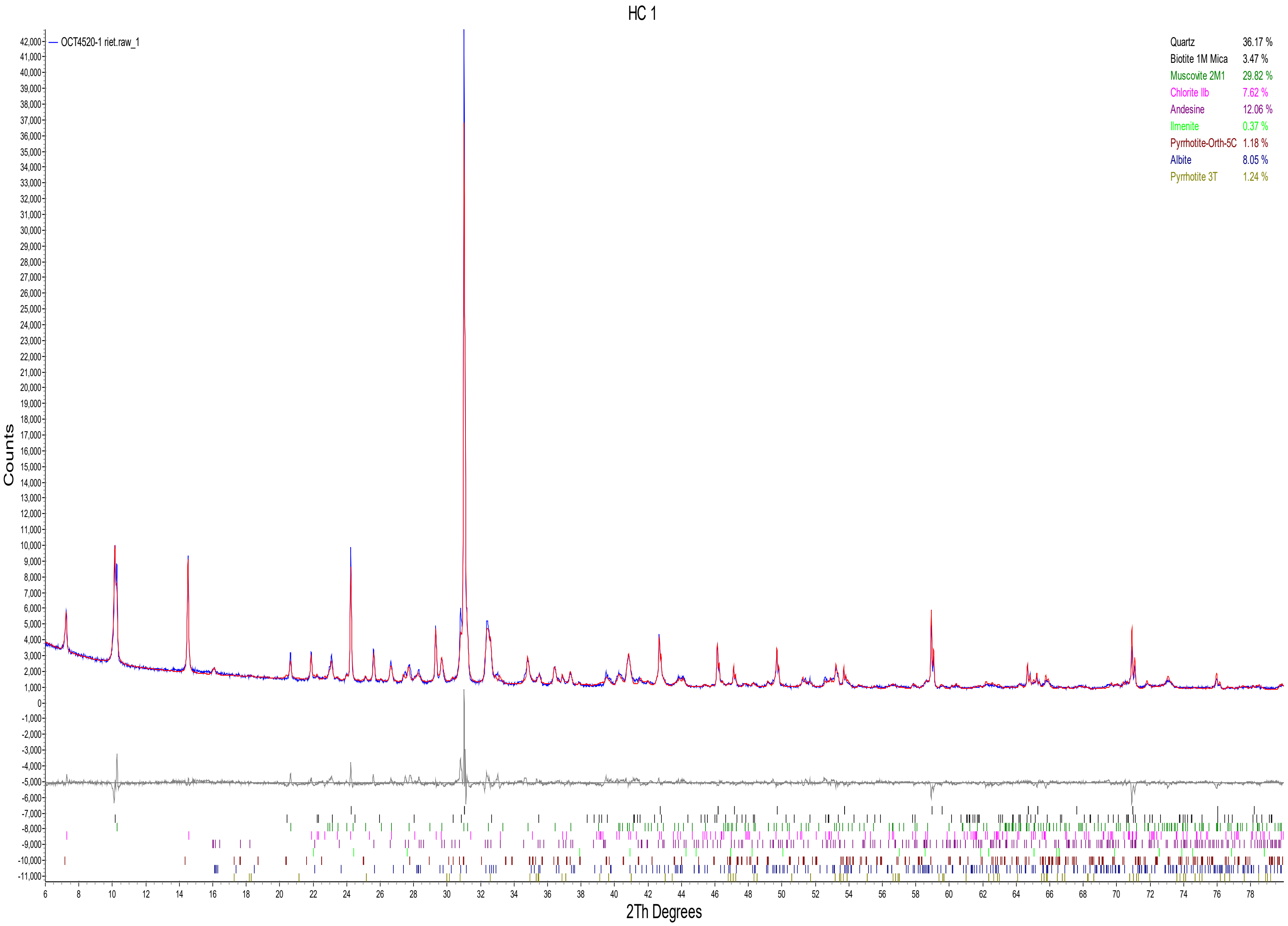
Summary of Rietveld Quantitative Analysis X-Ray Diffraction Results

Mineral/ Compound	**Formula**	**HC 1** **OCT4520-01** (wt %)	**HC 2** **OCT4520-02** (wt %)	**HC 3** **OCT4520-03** (wt %)	**HC 4** **OCT4520-04** (wt %)	**HC 5** **OCT4520-05** (wt %)
Quartz	SiO_2	36.2	30.6	34.9	38.9	39.0
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$	3.5	2.7	3.6	2.1	3.6
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	29.8	47.1	27.6	16.3	28.1
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$	7.6	9.9	7.9	4.1	9.1
Andesine	$Na_{0.6}Ca_{0.4}Al_{1.4}Si_{2.6}O_8$	12.1	8.8	7.2	-	10.4
Albite	$NaAlSi_3O_8$	8.1	-	15.8	28.0	5.0
Ilmenite	$FeTiO_3$	0.4	-	0.5	0.4	0.4
Pyrrhotite	$Fe_{(1-x)}S$	2.4	0.9	1.2	-	1.0
Calcite	$CaCO_3$	-	-	1.4	9.8	1.6
Chalcopyrite	$CuFeS_2$	-	-	-	0.3	-
Spinel	$MgAl_2O_4$	-	-	-	-	1.6
Pyrite	FeS_2	-	-	-	-	0.3
Maghemite	$\gamma\text{-}Fe_2O_3$	-	-	-	-	-
Dolomite	$CaMg(CO_3)_2$	-	-	-	-	-
Chlorapatite	$Ca_5(PO_4)_3Cl$	-	-	-	-	-
TOTAL		100	100	100	100	100

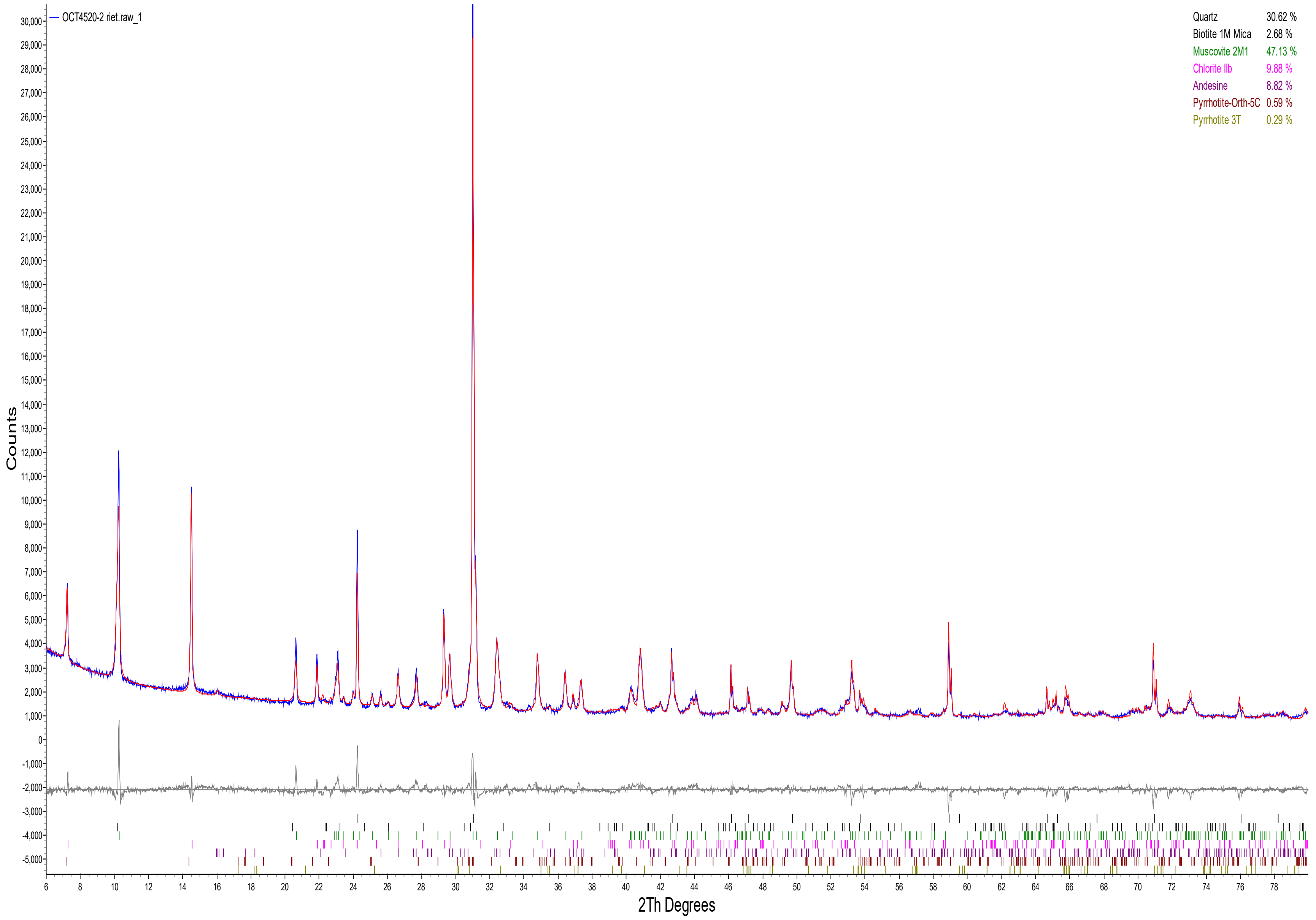
Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.

Dashes indicate that the mineral was not identifed by the analyst and not included in the refinement calculation for the sample.

The weight percent quantities indicated have been normalized to a sum of 100%. The quantity of amorphous material has not been determined.


HC 1
OCT4520-1 riet.raw_1
Quartz 36.17 %
Biotite 1M Mica 3.47 %
Muscovite 2M1 29.82 %
Chlorite IIb 7.62 %
Andesine 12.06 %
Ilmenite 0.37 %
Pyrrhotite-Orth-5C 1.18 %
Albite 8.05 %
Pyrrhotite 3T 1.24 %
Counts
2Th Degrees

HC 2


OCT4520-2 riet.raw_1
Quartz 30.62 %
Biotite 1M Mica 2.68 %
Muscovite 2M1 47.13 %
Chlorite IIb 9.88 %
Andesine 8.82 %
Pyrrhotite-Orth-5C 0.59 %
Pyrrhotite 3T 0.29 %
Counts
30,000
29,000
28,000
27,000
26,000
25,000
24,000
23,000
22,000
21,000
20,000
19,000
18,000
17,000
16,000
15,000
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
-1,000
-2,000
-3,000
-4,000
-5,000
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
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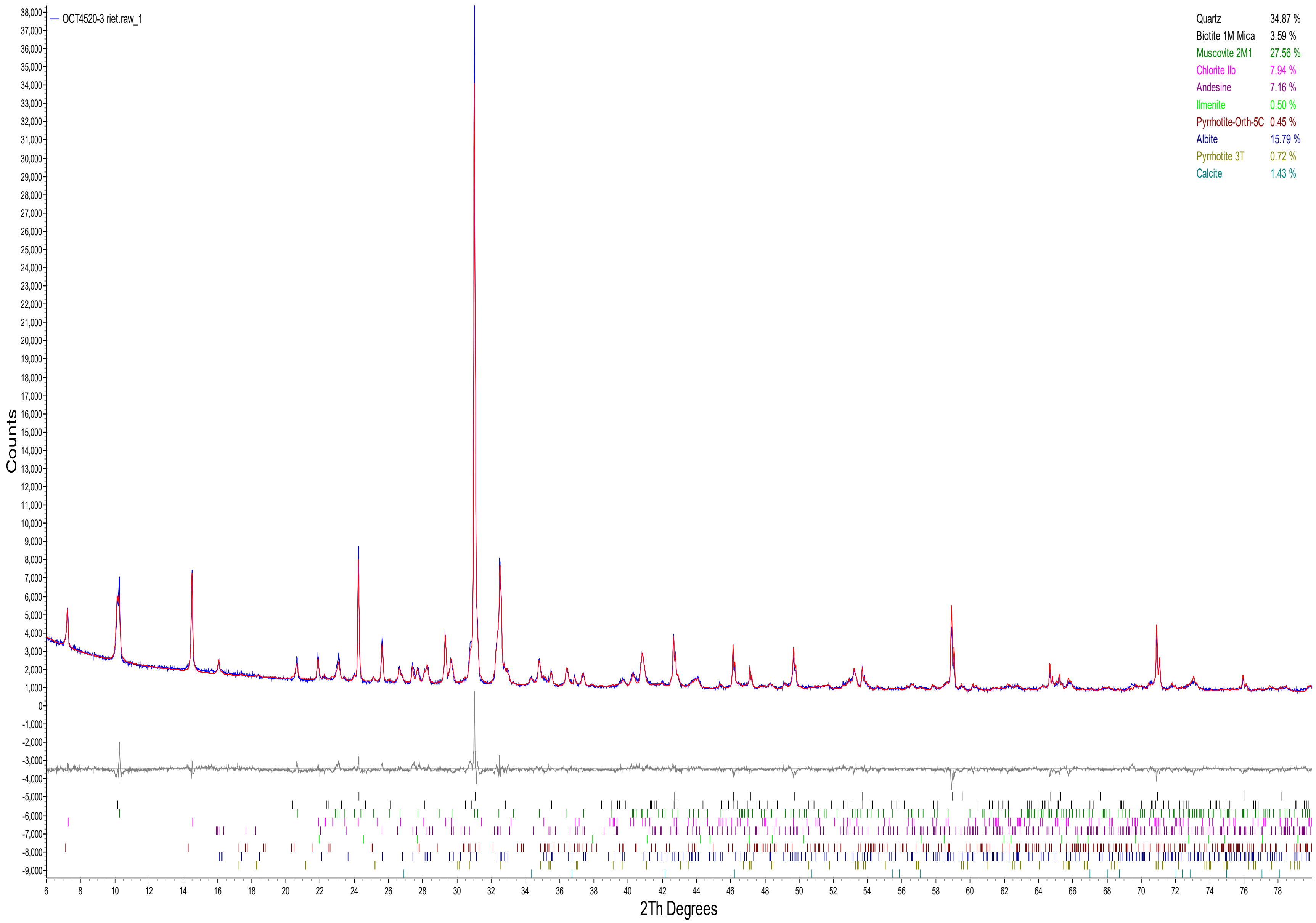
54
56
58
60
62
64
66
68
70
72
74
76
78
2Th Degrees

HC 3


OCT4520-3 riet.raw_1
Quartz 34.87 %
Biotite 1M Mica 3.59 %
Muscovite 2M1 27.56 %
Chlorite IIb 7.94 %
Andesine 7.16 %
Ilmenite 0.50 %
Pyrrhotite-Orth-5C 0.45 %
Albite 15.79 %
Pyrrhotite 3T 0.72 %
Calcite 1.43 %
Counts
38,000
37,000
36,000
35,000
34,000
33,000
32,000
31,000
30,000
29,000
28,000
27,000
26,000
25,000
24,000
23,000
22,000
21,000
20,000
19,000
18,000
17,000
16,000
15,000
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
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4,000
3,000
2,000
1,000
0
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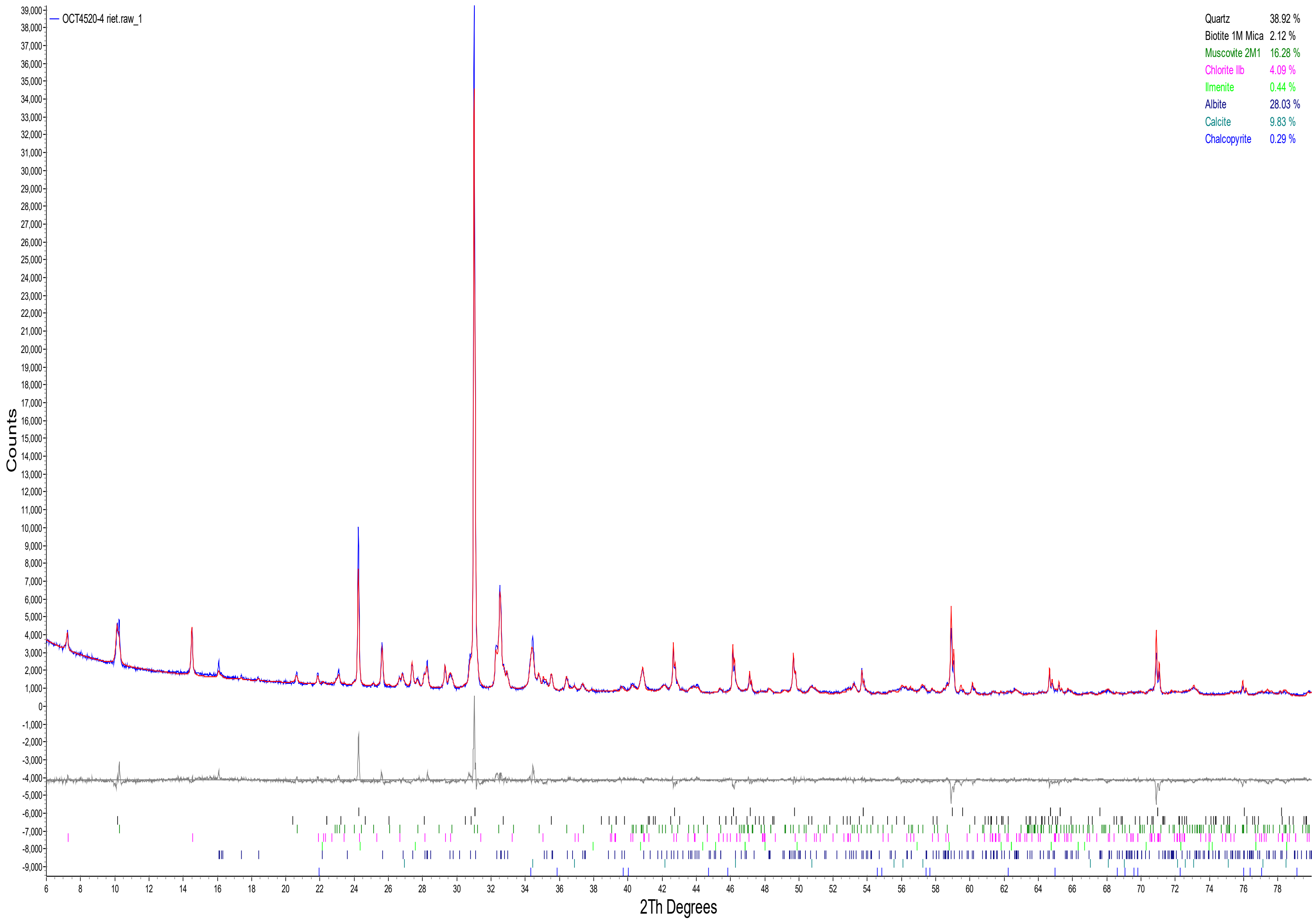
-7,000
-8,000
-9,000
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
66
68
70
72
74
76
78
2Th Degrees

HC 4


OCT4520-4 riet.raw_1
Quartz 38.92 %
Biotite 1M Mica 2.12 %
Muscovite 2M1 16.28 %
Chlorite IIb 4.09 %
Ilmenite 0.44 %
Albite 28.03 %
Calcite 9.83 %
Chalcopyrite 0.29 %
Counts
39,000
38,000
37,000
36,000
35,000
34,000
33,000
32,000
31,000
30,000
29,000
28,000
27,000
26,000
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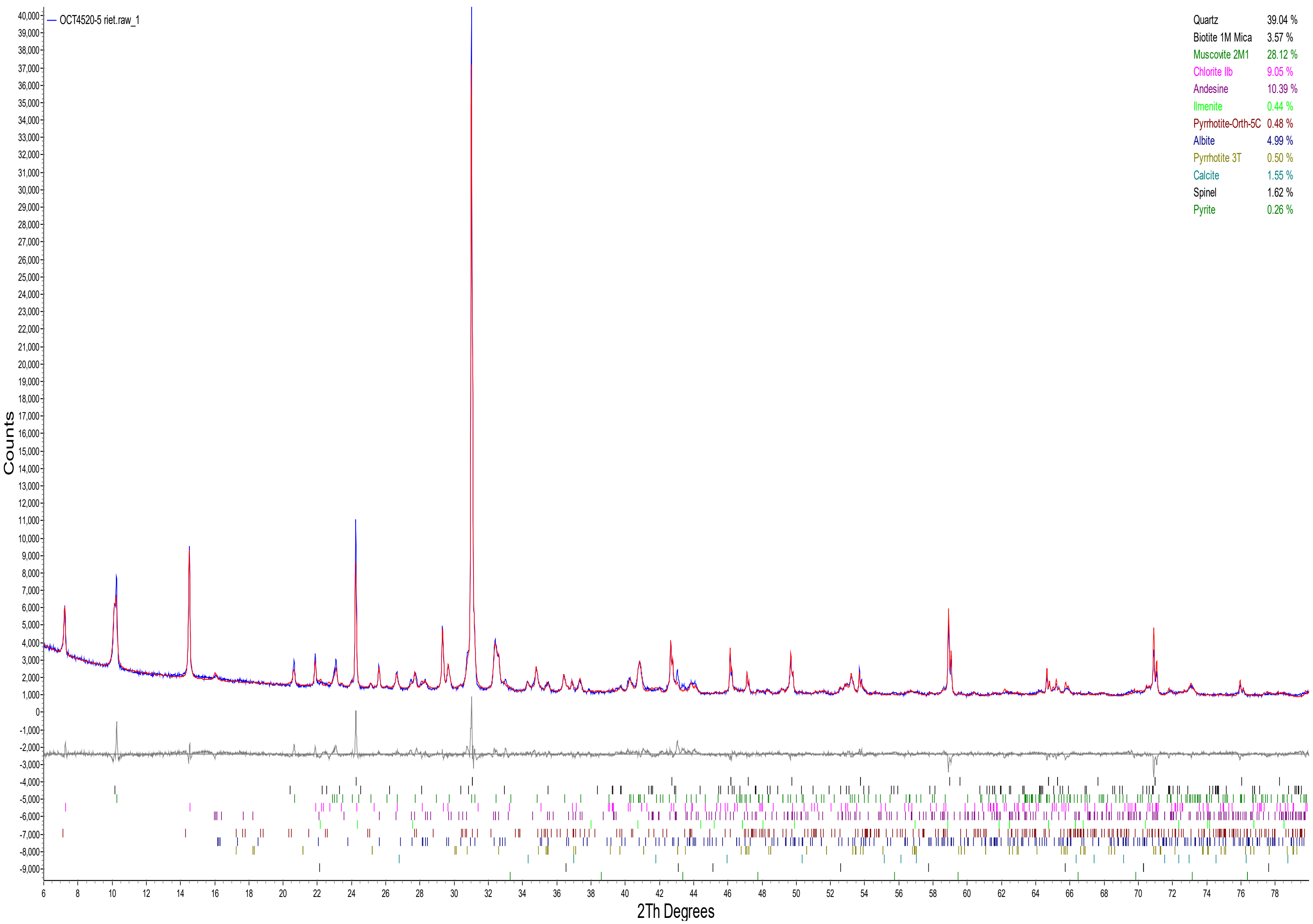
76
78
2Th Degrees

HC 5


OCT4520-5 riet.raw_1
Quartz 39.04 %
Biotite 1M Mica 3.57 %
Muscovite 2M1 28.12 %
Chlorite IIb 9.05 %
Andesine 10.39 %
Ilmenite 0.44 %
Pyrrhotite-Orth-5C 0.48 %
Albite 4.99 %
Pyrrhotite 3T 0.50 %
Calcite 1.55 %
Spinel 1.62 %
Pyrite 0.26 %
Counts
40,000
39,000
38,000
37,000
36,000
35,000
34,000
33,000
32,000
31,000
30,000
29,000
28,000
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50
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64
66
68
70
72
74
76
78
2Th Degrees

QEMSCAN DATA

prepared for:

Lorax Environmental Services Ltd

CA20I-14936-01
MI7013-OCT18
August 20, 2019

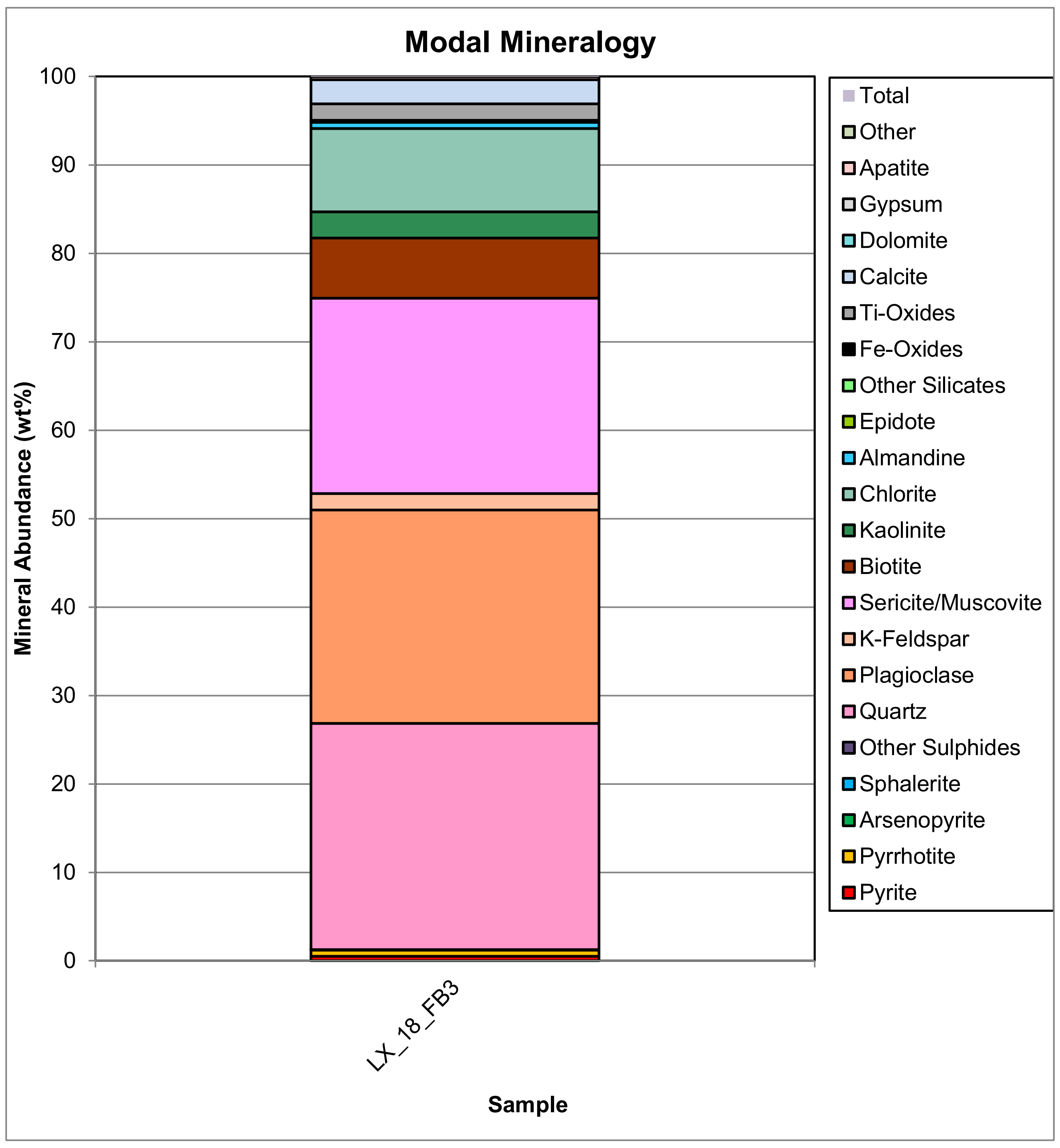
Prepared by:

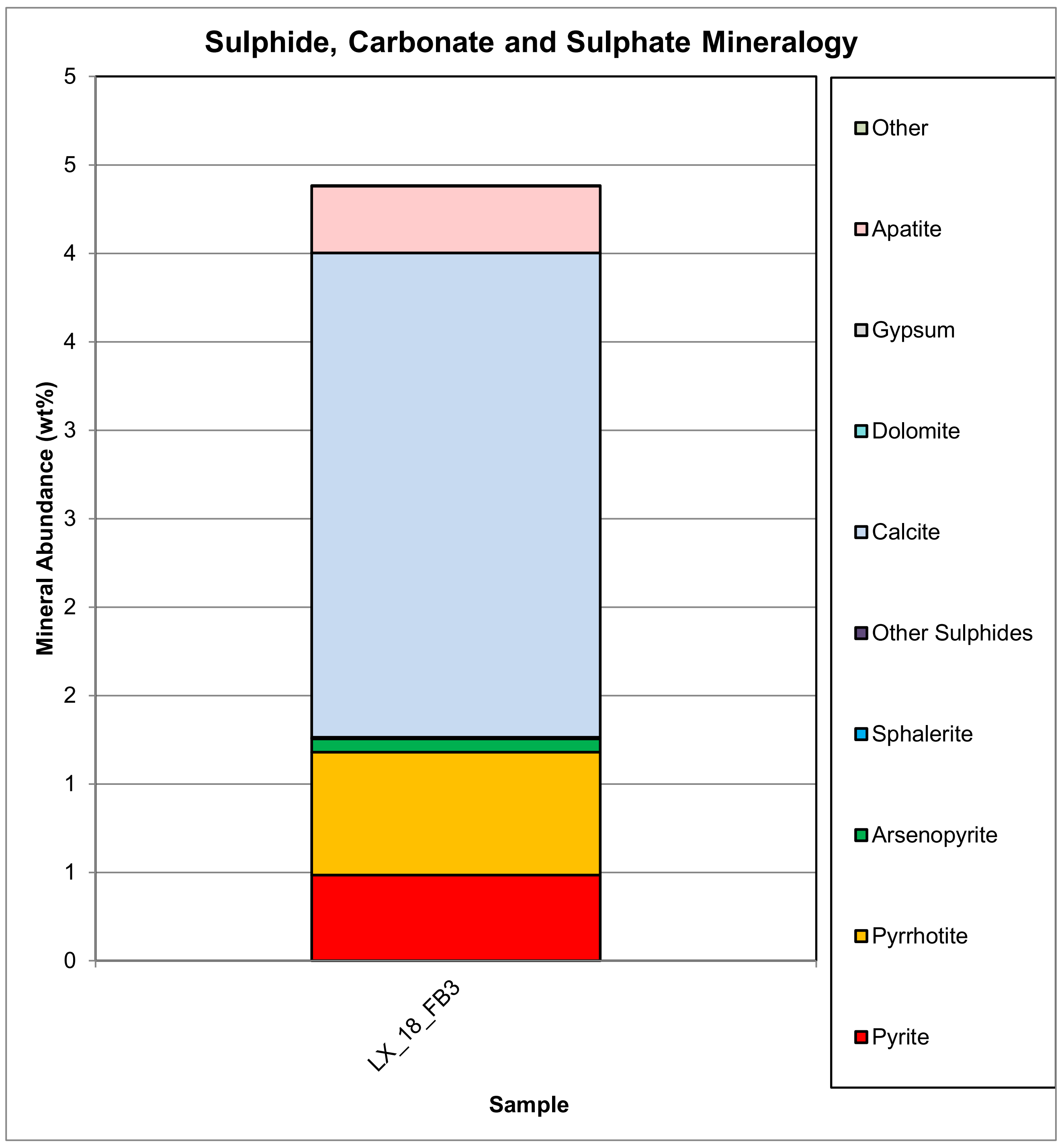
Lain Glossop/Sarah Prout
Senior Mineralogist/Senior Mineralogist

SGS Canada
3260 Production Way
Burnaby, BC
Canada, V5A 4W4

Lorax Environmental Services Ltd
CA20I-14936-01
MI7013-OCT18

Mineral Mass %	LX_18_FB3
Pyrite	0.48
Pyrrhotite	0.69
Arsenopyrite	0.08
Sphalerite	0.00
Other Sulphides	0.01
Quartz	25.6
Plagioclase	24.1
K-Feldspar	1.83
Sericite/Muscovite	22.1
Biotite	6.81
Kaolinite	2.95
Chlorite	9.40
Almandine	0.72
Epidote	0.08
Other Silicates	0.13
Fe-Oxides	0.01
Ti-Oxides	1.85
Calcite	2.74
Dolomite	0.00
Gypsum	0.00
Apatite	0.38
Other	0.00
Total	**100**





Lorax Environmental Services Ltd
CA20I-14936-01
MI7013-OCT18

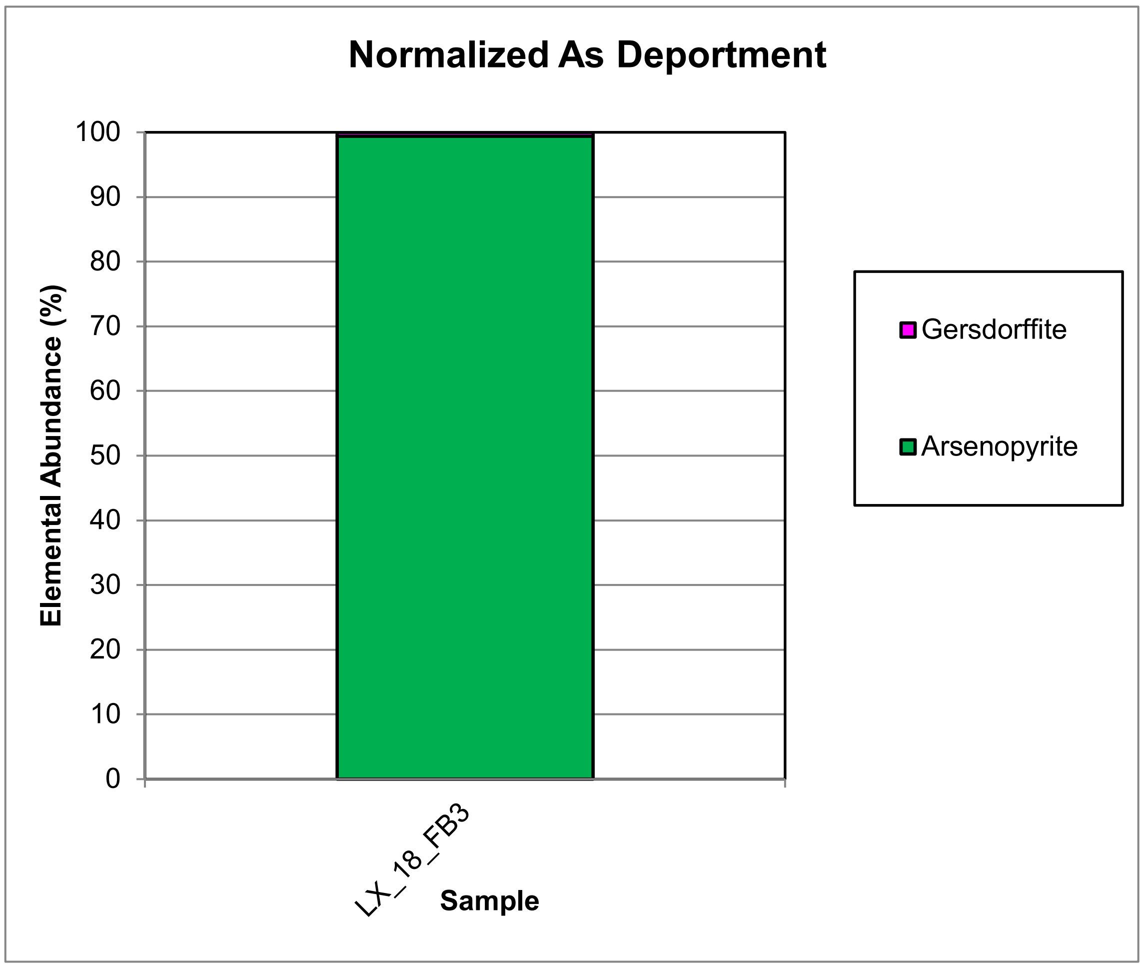
As Deportment

Absolute

Mineral M	LX_18_FB3
Arseno	0.03
Gersdo	0.00
Total	0.03

Normalized

Mineral M	LX_18_FB3
Arseno	99.4
Gersdo	0.57
Total	100



Lorax Environmental Services Ltd
CA20I-14936-01
MI7013-OCT18

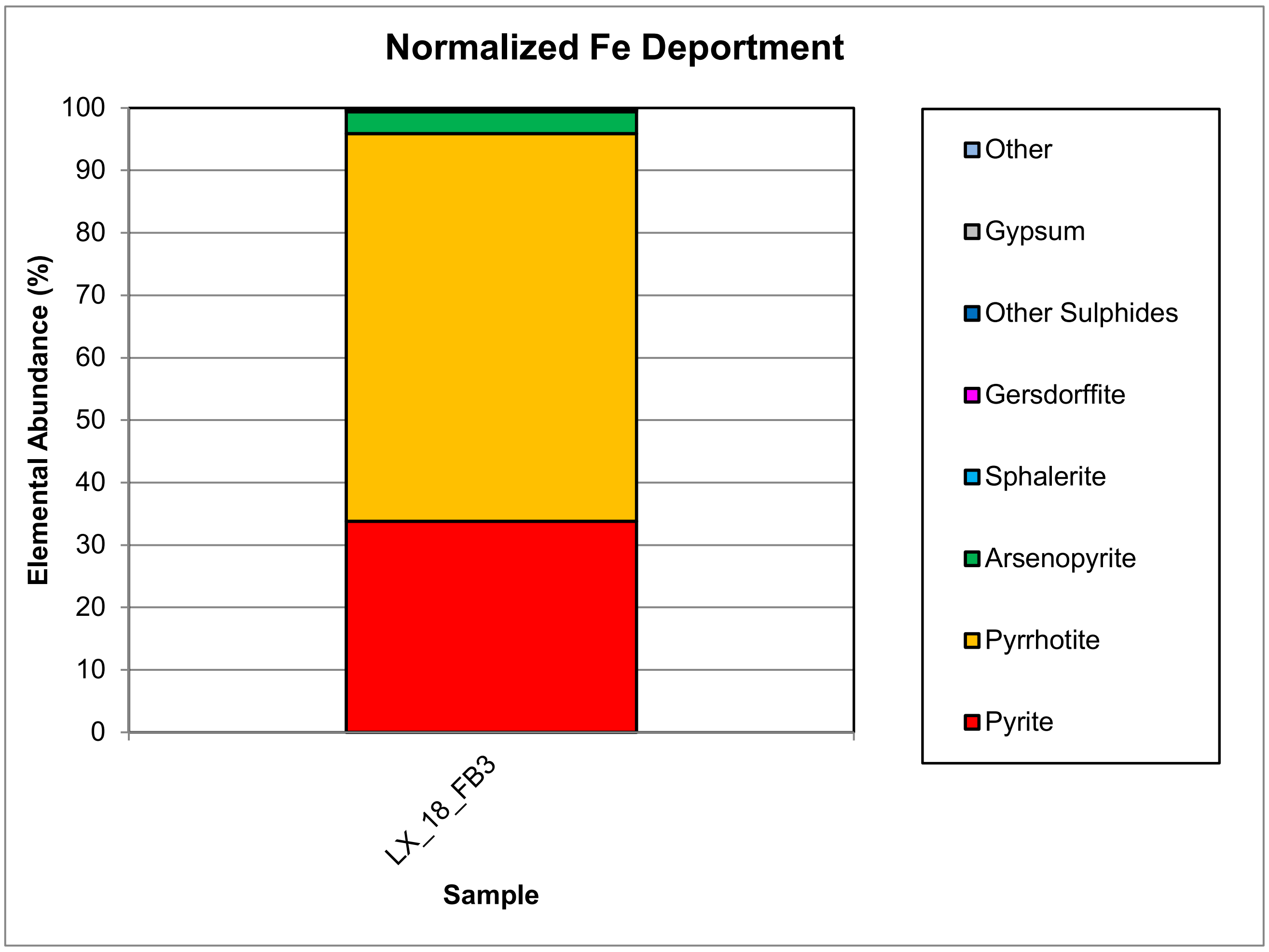
S Deportment

Absolute

Mineral	**LX_18_FB3**
Pyrite	0.14
Pyrrhoti	0.26
Arseno|	0.01
Sphaler	0.00
Gersdo	0.00
Other S	0.00
Gypsun	0.00
Other	0.00
Total	0.42

Normalized

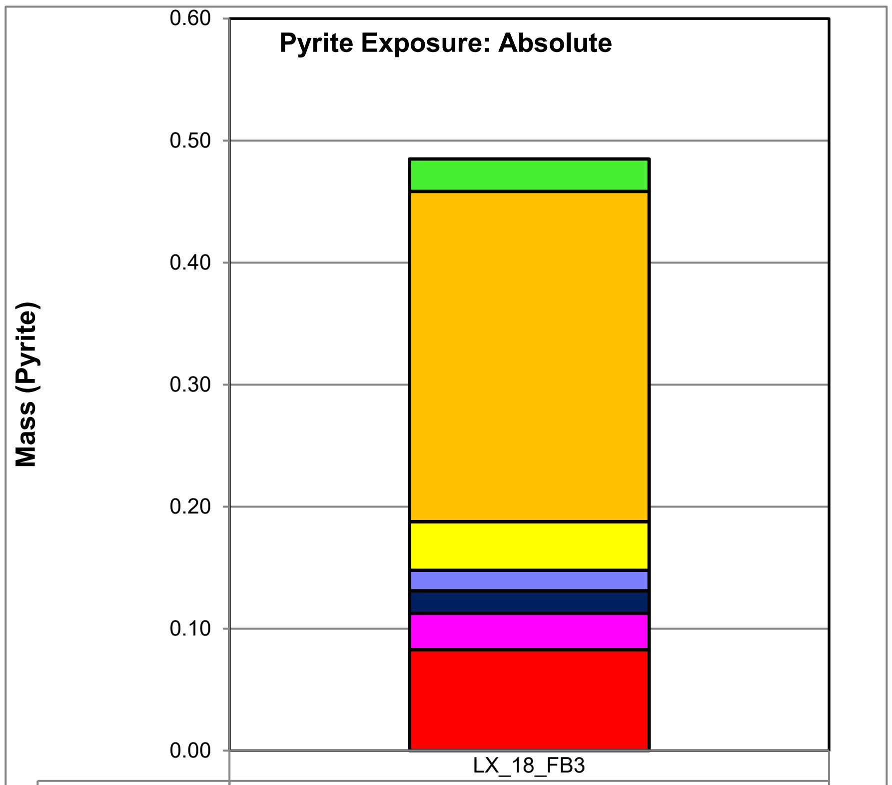
Mineral	**LX_18_FB3**
Pyrite	33.8
Pyrrhoti	62.1
Arseno|	3.53
Sphaler	0.25
Gersdo	0.02
Other S	0.30
Gypsun	0.03
Other	0.02
Total	100



High Definition Mineralogical Analysis using QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscopy)

Pyrite Exposure

Pyrite Exposure: Absolute



	LX_18_FB3
🟩 Locked	0.03
🟧 0-10% Exposed	0.27
🟨 10-20% Exposed	0.04
🟪 20-30% Exposed	0.02
⬛ 30-50% Exposed	0.02
🟪 50-80% Exposed	0.03
🟥 Exposed	0.08

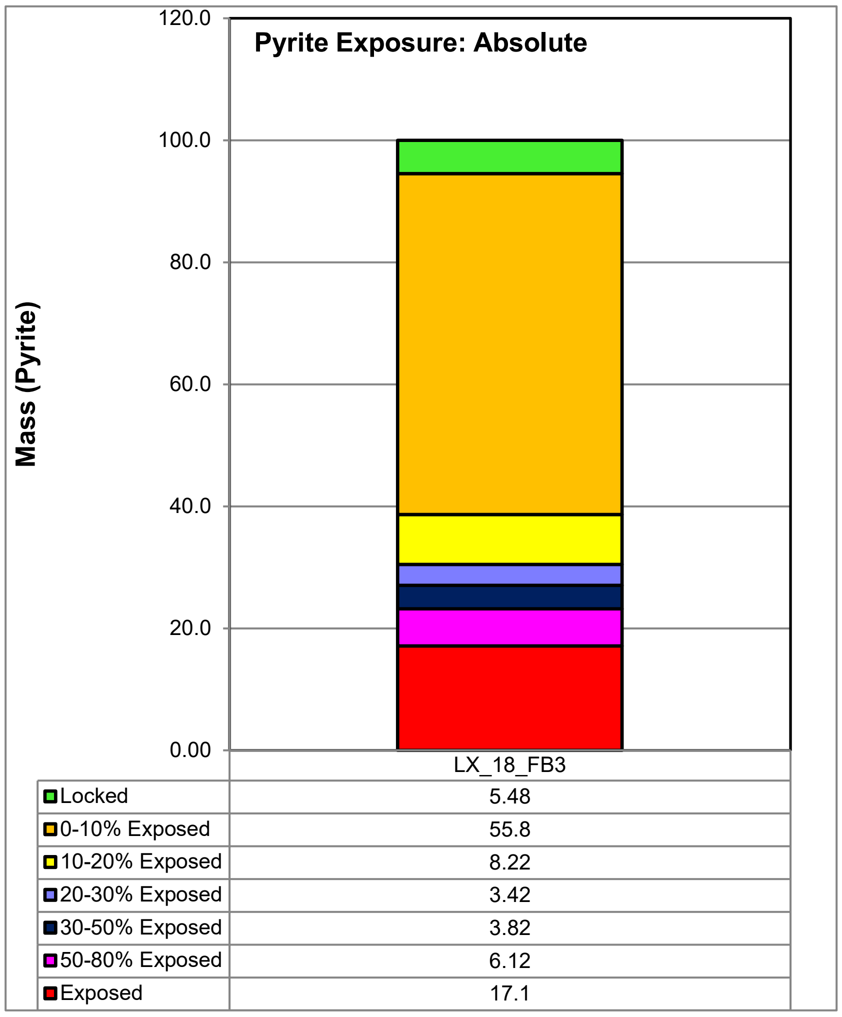
Absolute Mass of Pyrite Across Samples

Mineral Name	LX_18_FB3	LX_18_FB4
Exposed	0.08	0.00
50-80% Exposed	0.03	0.00
30-50% Exposed	0.02	0.00
20-30% Exposed	0.02	0.01
10-20% Exposed	0.04	0.41
0-10% Exposed	0.27	0.16
Locked	0.03	0.02
Total	0.48	0.60

High Definition Mineralogical Analysis using QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscopy)

Pyrite Exposure
Pyrite Exposure: Absolute

Pyrite Exposure: Normalized



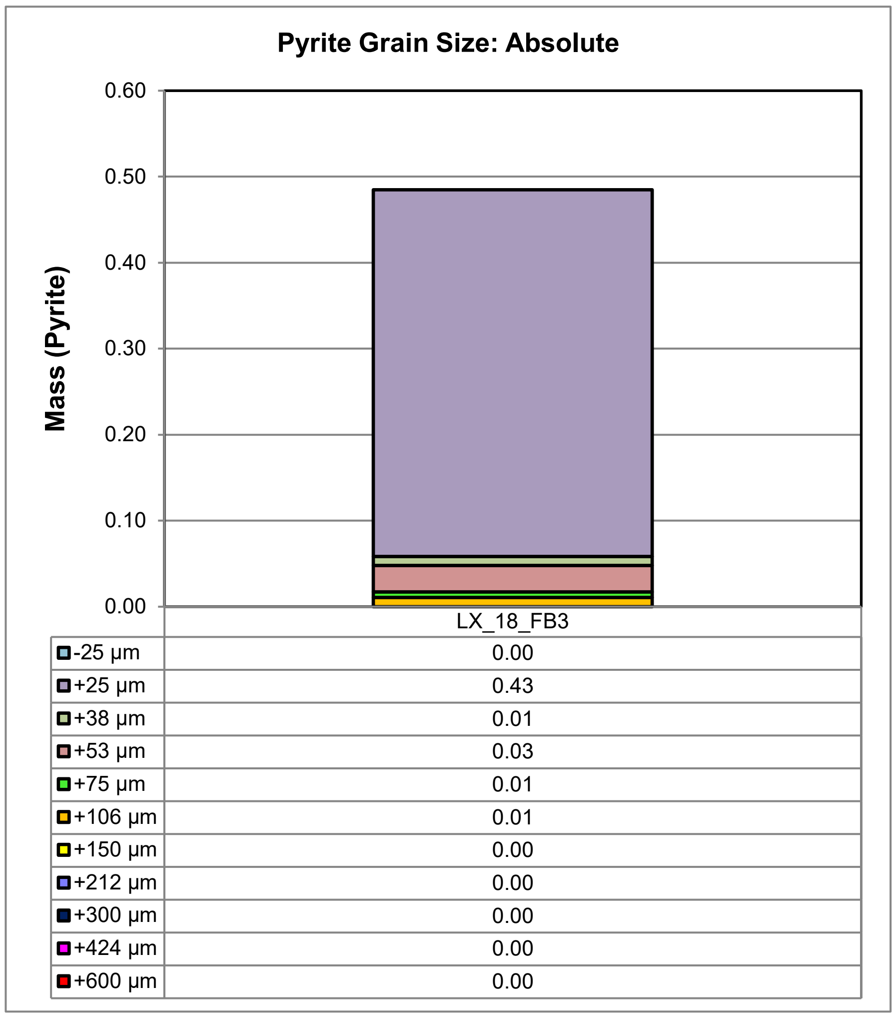
Normalized Mass of Pyrite Across Samples

Mineral Name	LX_18_FB3
Exposed	17.1
50-80% Exposed	6.12
30-50% Exposed	3.82
20-30% Exposed	3.42
10-20% Exposed	8.22
0-10% Exposed	55.8
Locked	5.48
Total	100.0

High Definition Mineralogical Analysis using QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscopy)

Pyrite Grain Size

Pyrite Grain Size: Absolute



	LX_18_FB3
■ -25 µm	0.00
■ +25 µm	0.43
■ +38 µm	0.01
■ +53 µm	0.03
■ +75 µm	0.01
■ +106 µm	0.01
■ +150 µm	0.00
■ +212 µm	0.00
■ +300 µm	0.00
■ +424 µm	0.00
■ +600 µm	0.00

Absolute Mass of Pyrite Across Samples

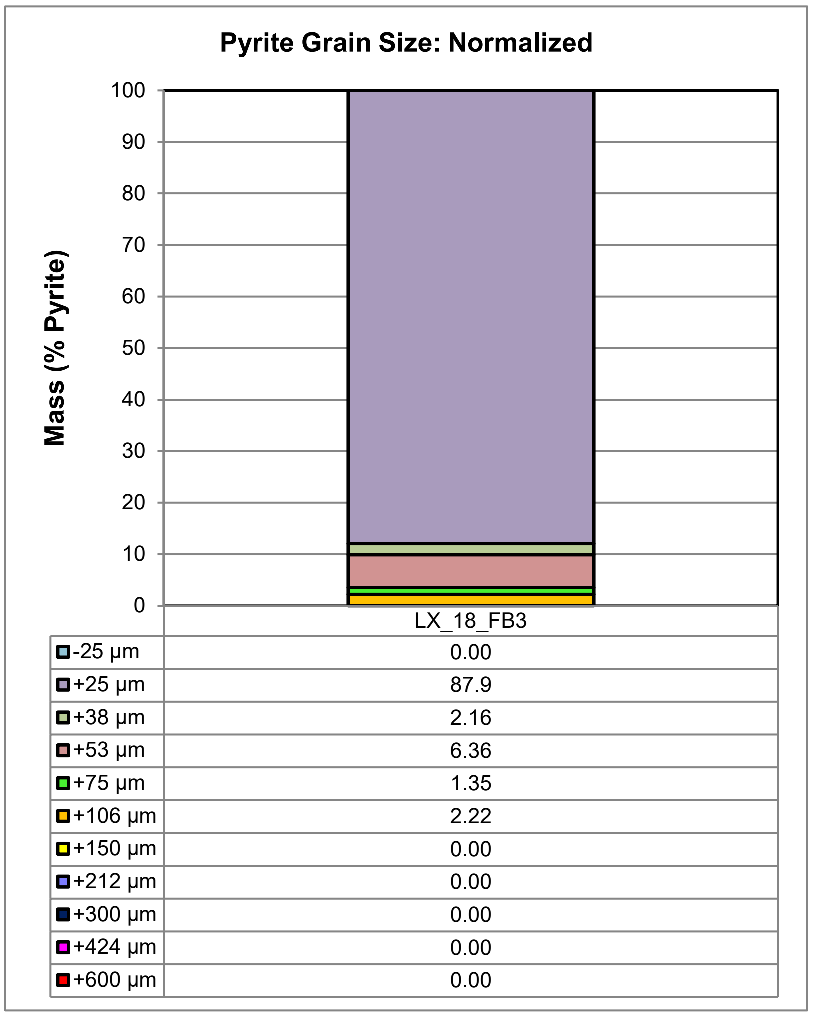
Mineral Name	LX_18_FB3
+600 µm	0.00
+424 µm	0.00
+300 µm	0.00
+212 µm	0.00
+150 µm	0.00
+106 µm	0.01
+75 µm	0.01
+53 µm	0.03
+38 µm	0.01
+25 µm	0.43
-25 µm	0.00
Total	0.48

High Definition Mineralogical Analysis using QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscopy)

Pyrite Grain Size

Pyrite Grain Size: Absolute

Pyrite Grain Size: Normalized



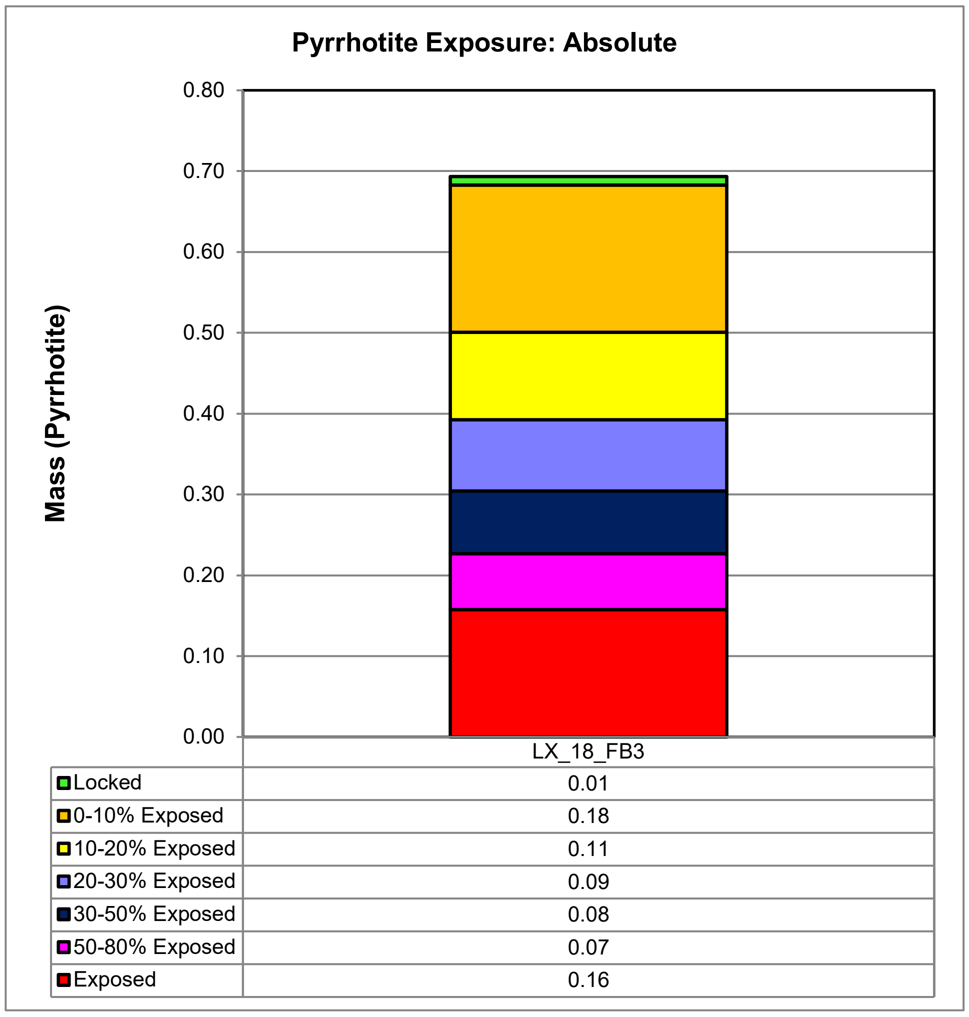
Normalized Mass of Pyrite Across Samples

Mineral Name	**LX_18_FB3**
+600 µm	0.00
+424 µm	0.00
+300 µm	0.00
+212 µm	0.00
+150 µm	0.00
+106 µm	2.22
+75 µm	1.35
+53 µm	6.36
+38 µm	2.16
+25 µm	87.9
-25 µm	0.00
Total	100.0

High Definition Mineralogical Analysis using QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscopy)

Pyrrhotite Exposure

Pyrrhotite Exposure: Absolute



Absolute Mass of Pyrrhotite Across Samples

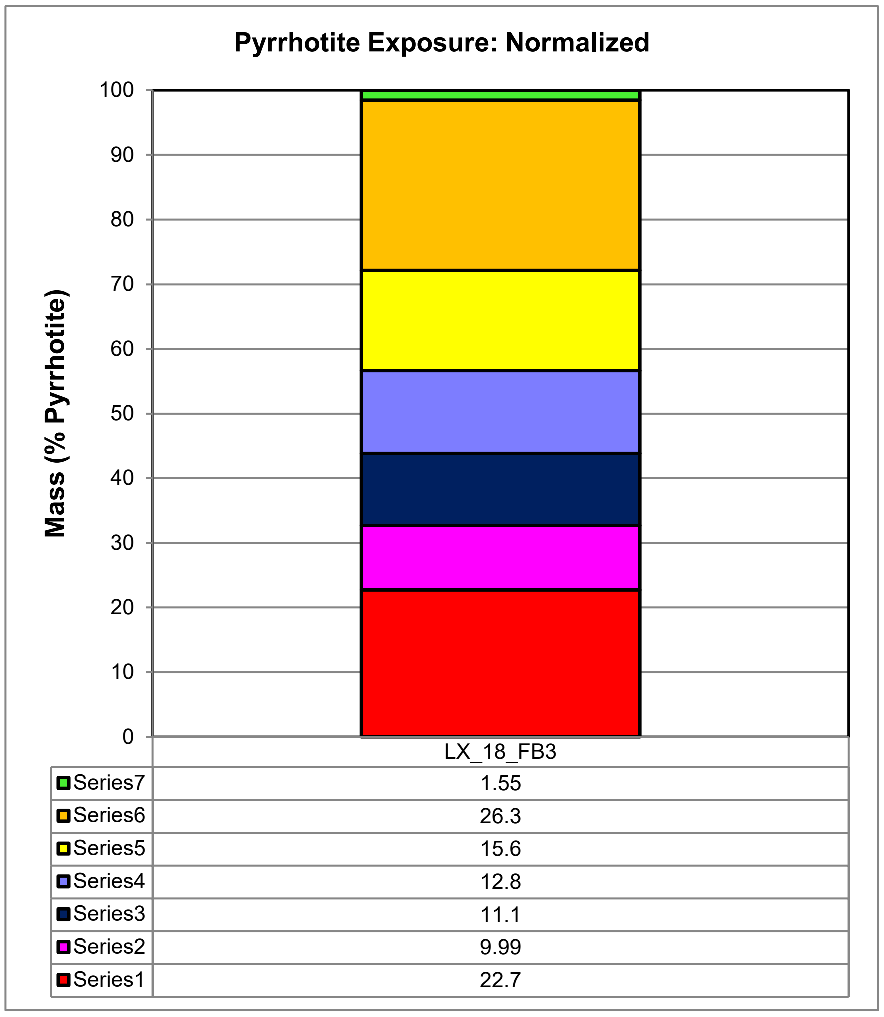
Mineral Name	LX_18_FB3
Exposed	0.16
50-80% Exposed	0.07
30-50% Exposed	0.08
20-30% Exposed	0.09
10-20% Exposed	0.11
0-10% Exposed	0.18
Locked	0.01
Total	0.69

High Definition Mineralogical Analysis using QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscopy)

Pyrrhotite Exposure

Pyrrhotite Exposure: Absolute

Pyrrhotite Exposure: Normalized



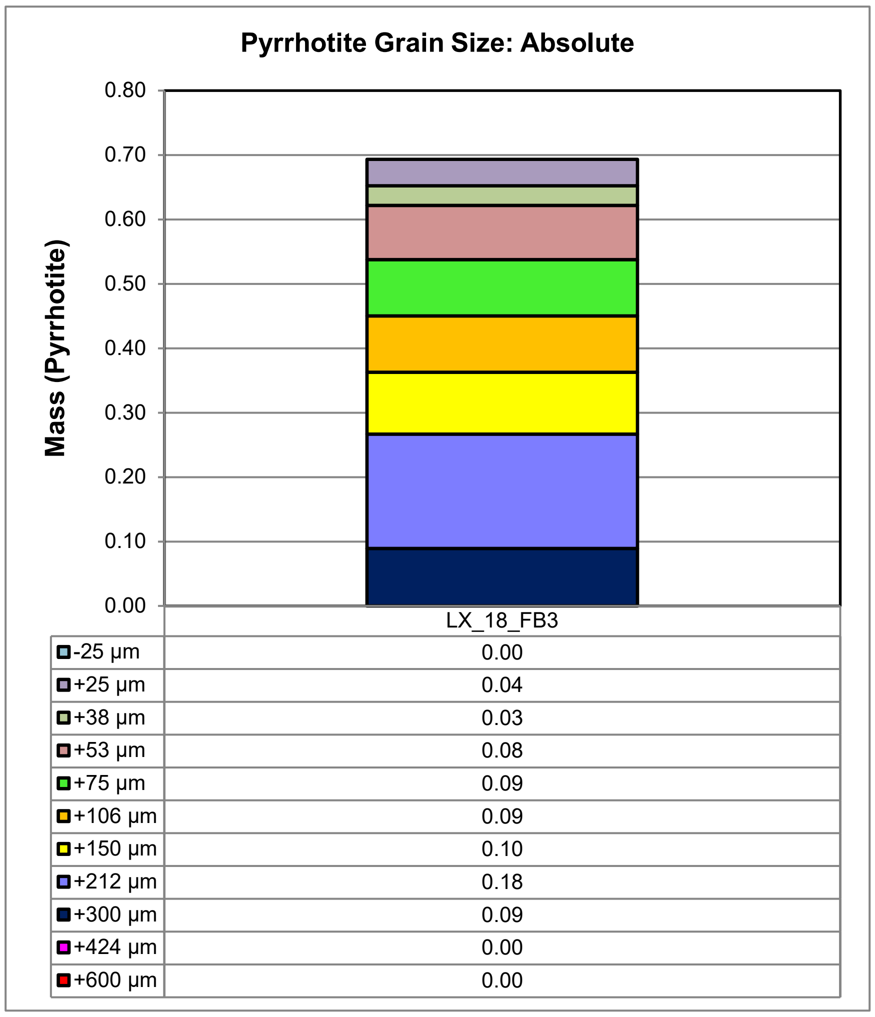
Normalized Mass of Pyrrhotite Across Samples

Mineral Name	**LX_18_FB3**
Exposed	22.7
50-80% Exposed	9.99
30-50% Exposed	11.1
20-30% Exposed	12.8
10-20% Exposed	15.6
0-10% Exposed	26.3
Locked	1.55
Total	100.0

High Definition Mineralogical Analysis using QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscopy)

Pyrrhotite Grain Size

Pyrrhotite Grain Size: Absolute



	LX_18_FB3
■ -25 µm	0.00
■ +25 µm	0.04
■ +38 µm	0.03
■ +53 µm	0.08
■ +75 µm	0.09
■ +106 µm	0.09
■ +150 µm	0.10
■ +212 µm	0.18
■ +300 µm	0.09
■ +424 µm	0.00
■ +600 µm	0.00

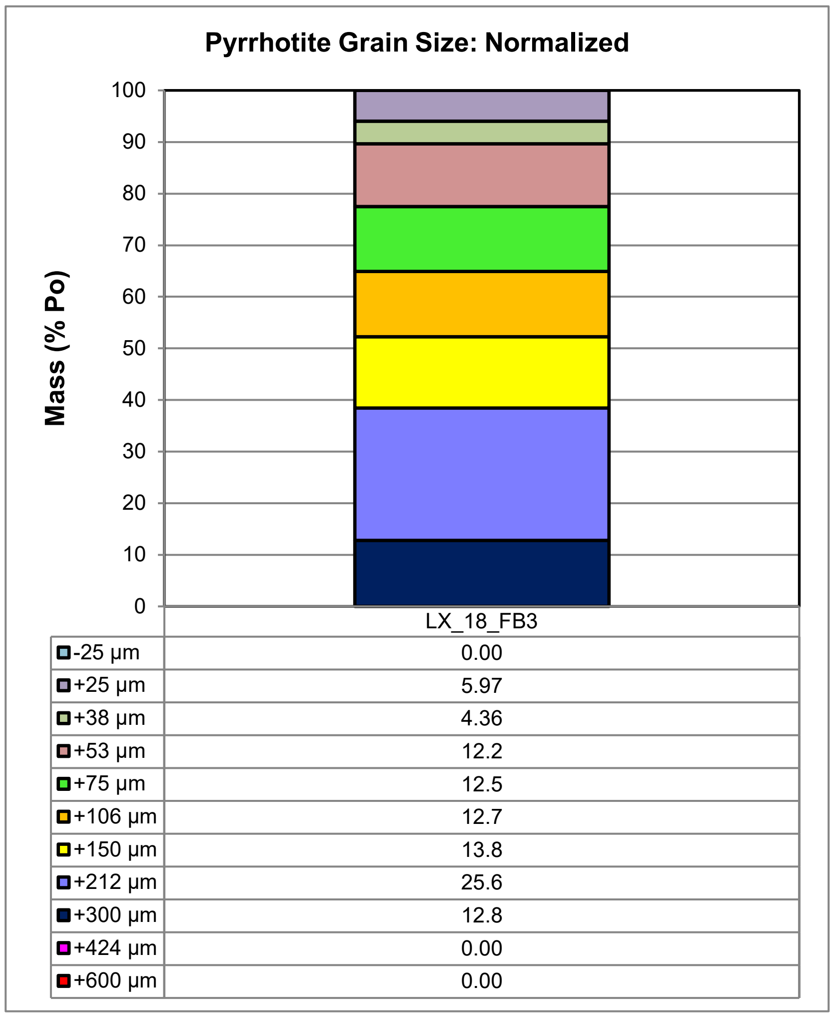
Absolute Mass of Pyrrhotite Across Samples

Mineral Name	LX_18_FB3
+600 µm	0.00
+424 µm	0.00
+300 µm	0.09
+212 µm	0.18
+150 µm	0.10
+106 µm	0.09
+75 µm	0.09
+53 µm	0.08
+38 µm	0.03
+25 µm	0.04
-25 µm	0.00
Total	0.69

High Definition Mineralogical Analysis using QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscopy)

Pyrrhotite Grain Size
Pyrrhotite Grain Size: Absolute

Pyrrhotite Grain Size: Normalized



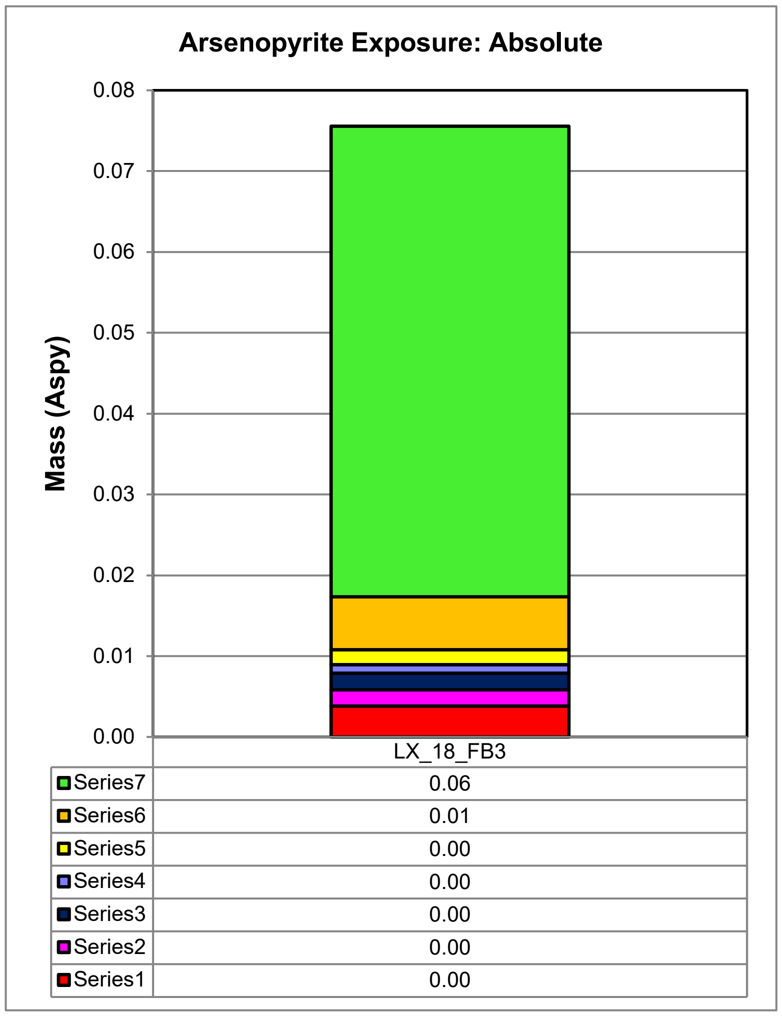
Normalized Mass of Pyrrhotite Across Samples

Mineral Name	LX_18_FB3
+600 µm	0.00
+424 µm	0.00
+300 µm	12.8
+212 µm	25.6
+150 µm	13.8
+106 µm	12.7
+75 µm	12.5
+53 µm	12.2
+38 µm	4.36
+25 µm	5.97
-25 µm	0.00
Total	100.0

High Definition Mineralogical Analysis using QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscopy)

Arsenopyrite Exposure

Arsenopyrite Exposure: Absolute



Absolute Mass of Arsenopyrite Across Samples

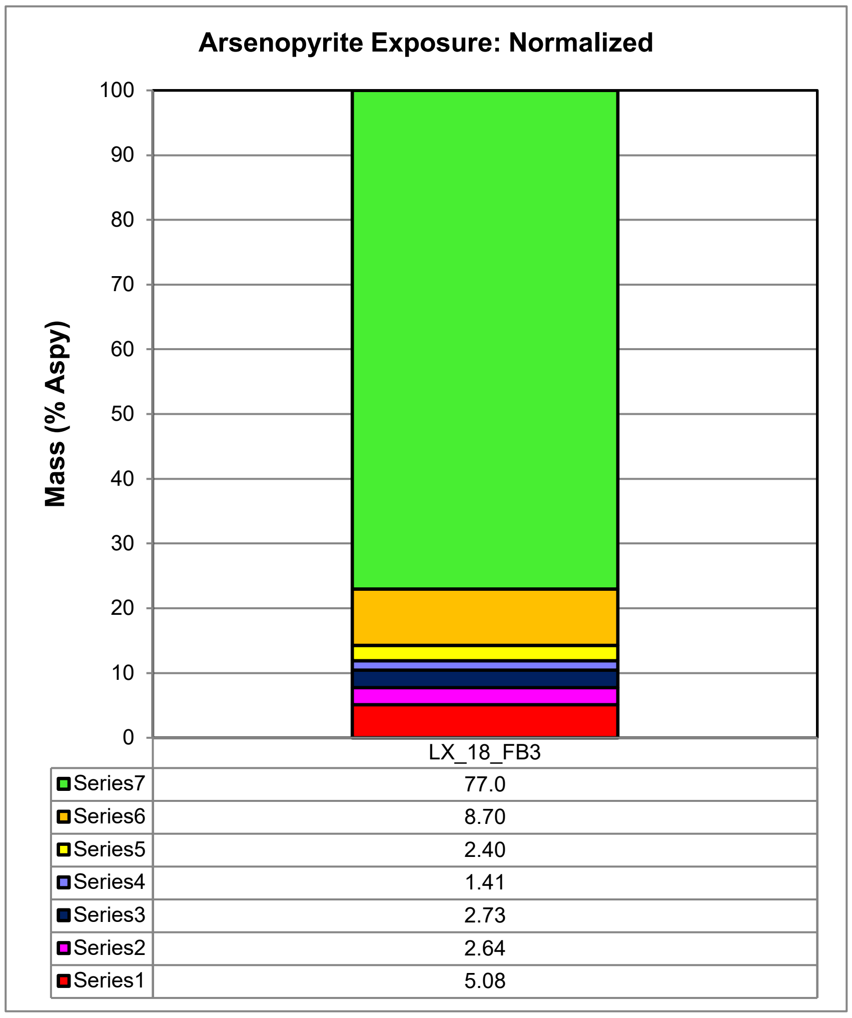
Mineral Name	LX_18_FB3
Exposed	0.00
50-80% Exposed	0.00
30-50% Exposed	0.00
20-30% Exposed	0.00
10-20% Exposed	0.00
0-10% Exposed	0.01
Locked	0.06
Total	0.08

High Definition Mineralogical Analysis using QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscopy)

Arsenopyrite Exposure

Arsenopyrite Exposure: Absolute

Arsenopyrite Exposure: Normalized



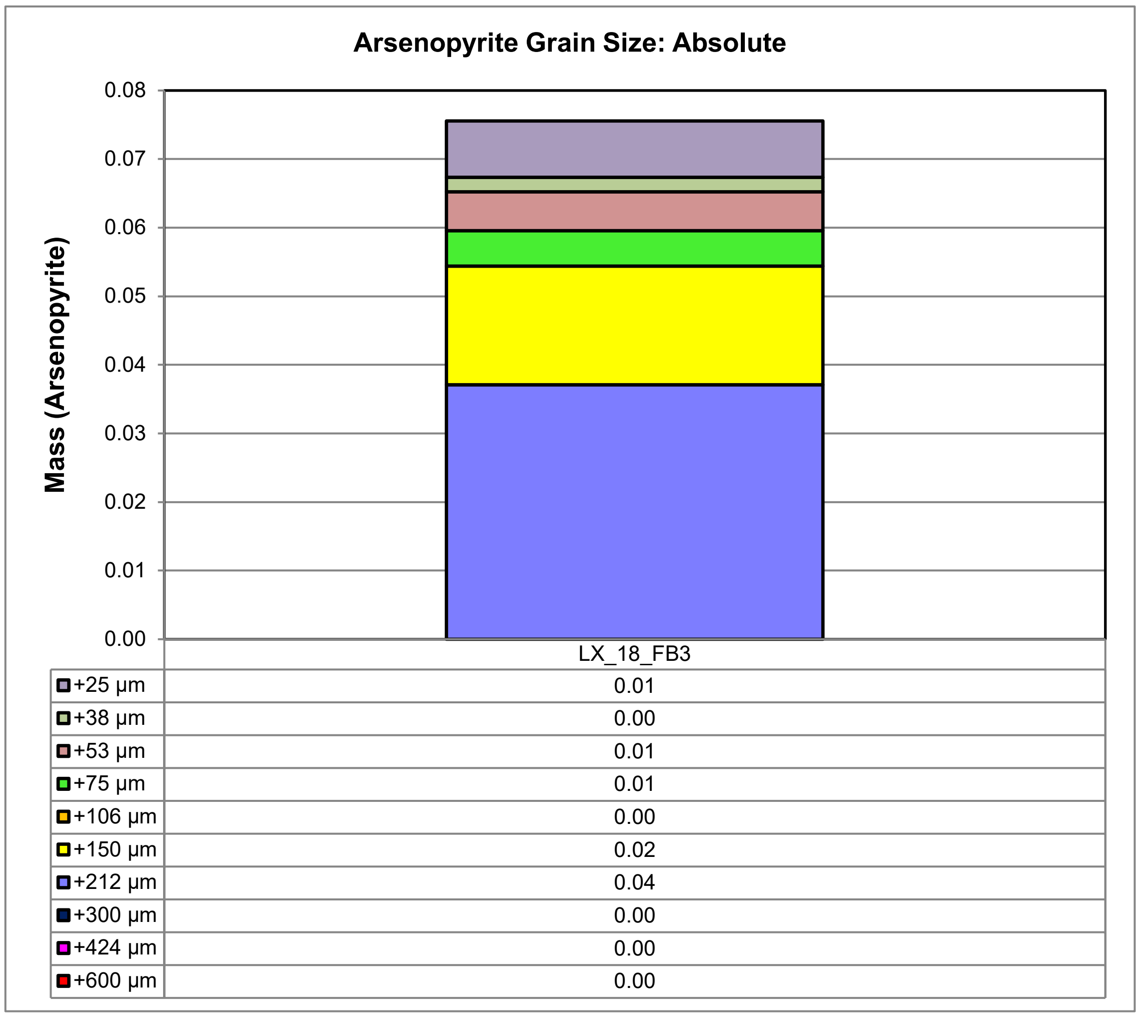
Normalized Mass of Arsenopyrite Across Samples

Mineral Name	LX_18_FB3
Exposed	5.08
50-80% Exposed	2.64
30-50% Exposed	2.73
20-30% Exposed	1.41
10-20% Exposed	2.40
0-10% Exposed	8.70
Locked	77.0
Total	100.0

High Definition Mineralogical Analysis using QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscopy)

Arsenopyrite Grain Size

Arsenopyrite Grain Size: Absolute



Absolute Mass of Arsenopyrite Across Samples

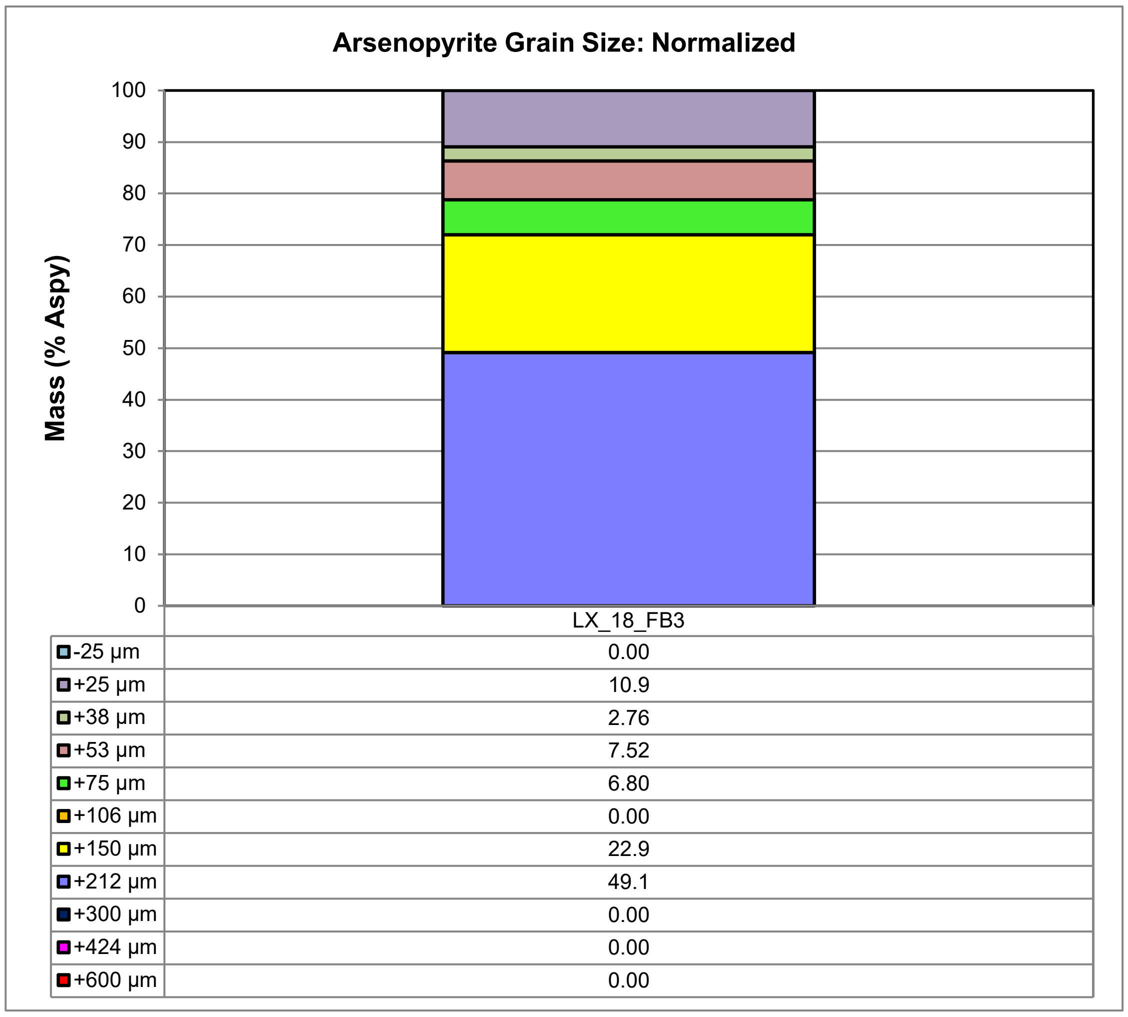
Mineral Name	**LX_18_FB3**
+600 µm	0.00
+424 µm	0.00
+300 µm	0.00
+212 µm	0.04
+150 µm	0.02
+106 µm	0.00
+75 µm	0.01
+53 µm	0.01
+38 µm	0.00
+25 µm	0.01
-25 µm	0.00
Total	0.08

High Definition Mineralogical Analysis using QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscopy)

Arsenopyrite Grain Size

Arsenopyrite Grain Size: Absolute

Arsenopyrite Grain Size: Normalized



	LX_18_FB3
■ -25 µm	0.00
■ +25 µm	10.9
■ +38 µm	2.76
■ +53 µm	7.52
■ +75 µm	6.80
■ +106 µm	0.00
■ +150 µm	22.9
■ +212 µm	49.1
■ +300 µm	0.00
■ +424 µm	0.00
■ +600 µm	0.00

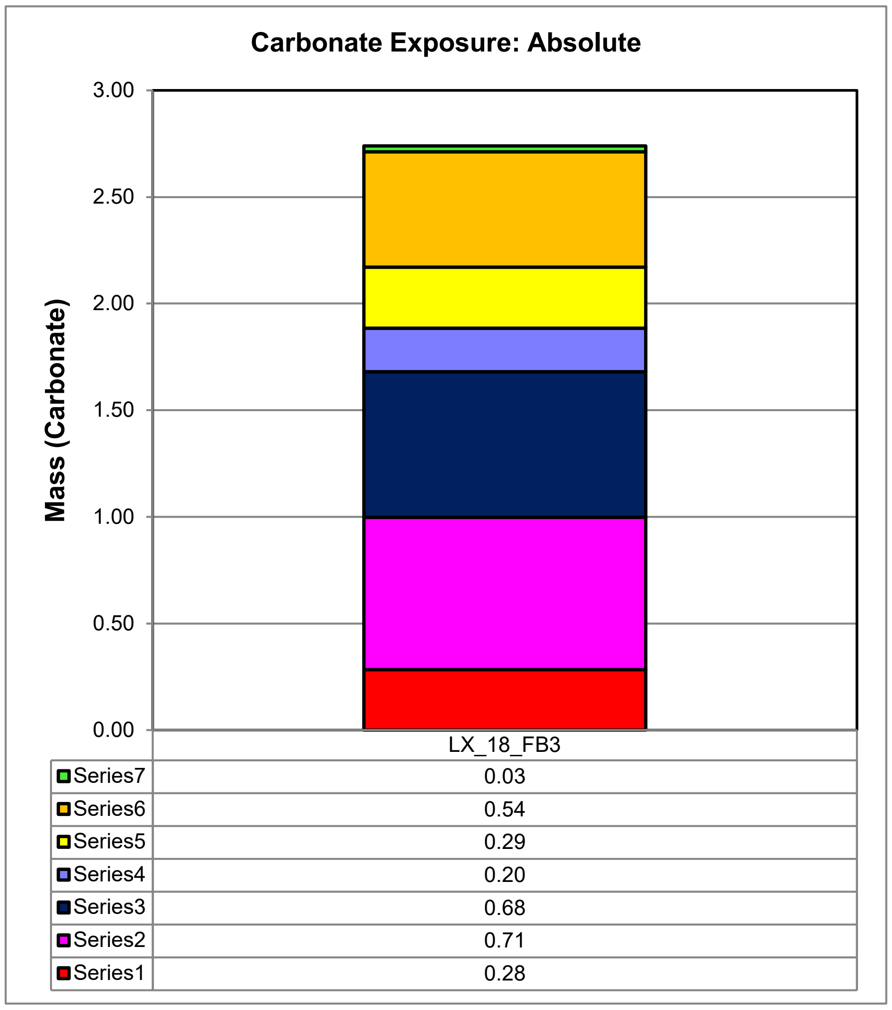
Normalized Mass of Arsenopyrite Across Samples

Mineral Name	LX_18_FB3
+600 µm	0.00
+424 µm	0.00
+300 µm	0.00
+212 µm	49.1
+150 µm	22.9
+106 µm	0.00
+75 µm	6.80
+53 µm	7.52
+38 µm	2.76
+25 µm	10.9
-25 µm	0.00
Total	100.0

High Definition Mineralogical Analysis using QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscopy)

Carbonate Exposure

Carbonate Exposure: Absolute



Absolute Mass of Carbonate Across Samples

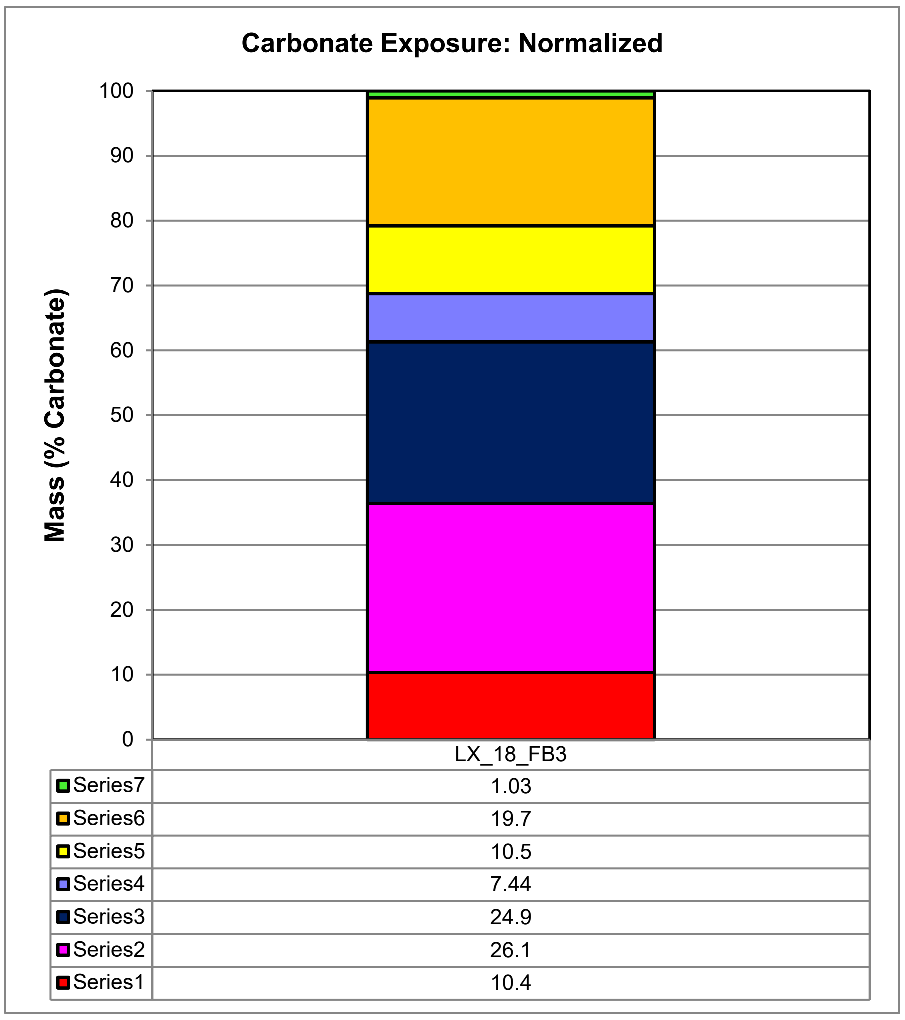
Mineral Name	**LX_18_FB3**
Exposed	0.28
50-80% Exposed	0.71
30-50% Exposed	0.68
20-30% Exposed	0.20
10-20% Exposed	0.29
0-10% Exposed	0.54
Locked	0.03
Total	2.74

High Definition Mineralogical Analysis using QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscopy)

Carbonate Exposure

Carbonate Exposure: Absolute

Carbonate Exposure: Normalized



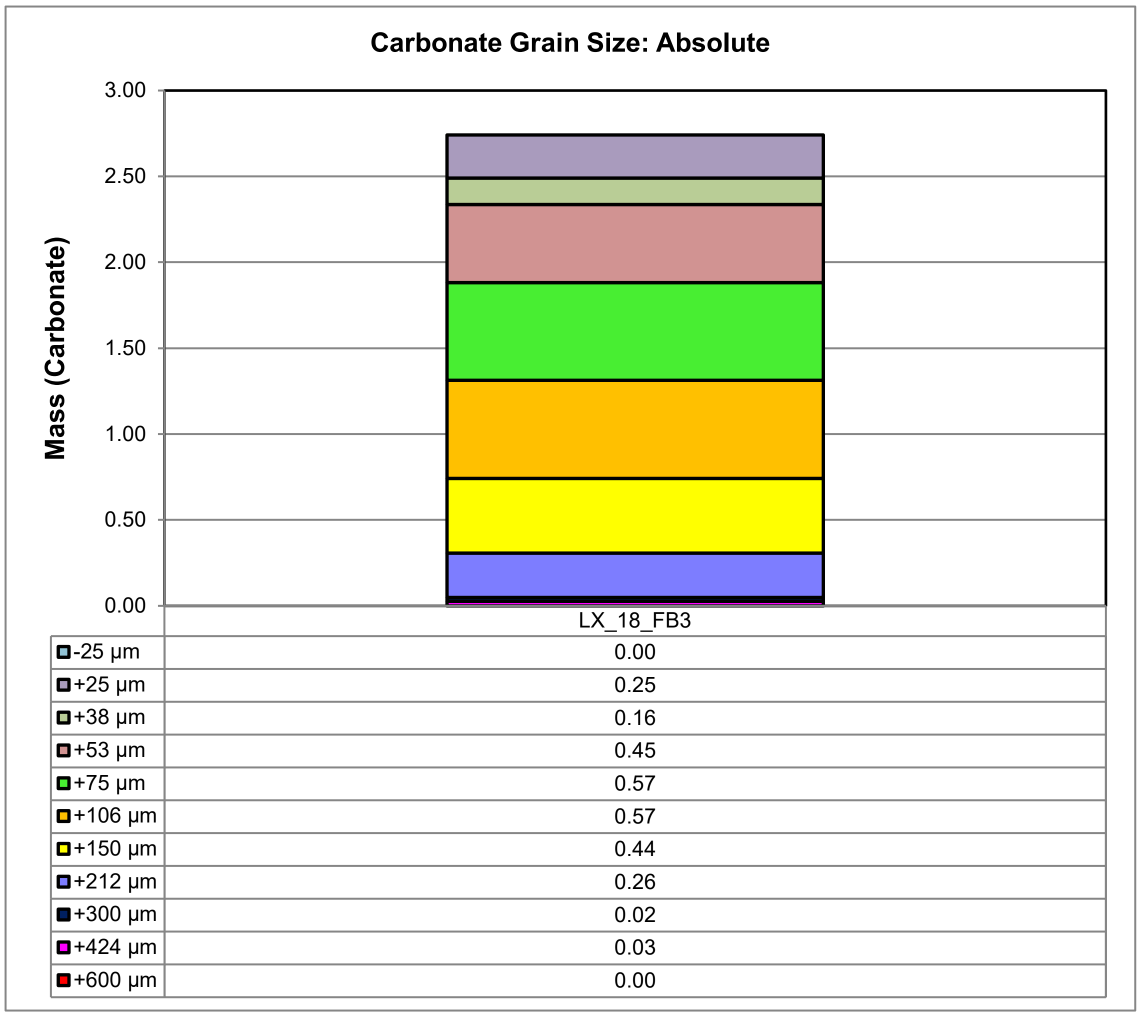
Normalized Mass of Carbonate Across Samples

Mineral Name	LX_18_FB3
Exposed	10.4
50-80% Exposed	26.1
30-50% Exposed	24.9
20-30% Exposed	7.44
10-20% Exposed	10.5
0-10% Exposed	19.7
Locked	1.03
Total	100.0

High Definition Mineralogical Analysis using QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscopy)

Carbonate Grain Size

Carbonate Grain Size: Absolute



	LX_18_FB3
🟦 -25 µm	0.00
🟪 +25 µm	0.25
🟩 +38 µm	0.16
🟥 +53 µm	0.45
🟩 +75 µm	0.57
🟧 +106 µm	0.57
🟨 +150 µm	0.44
🟦 +212 µm	0.26
⬛ +300 µm	0.02
🟪 +424 µm	0.03
🟥 +600 µm	0.00

Absolute Mass of Carbonate Across Samples

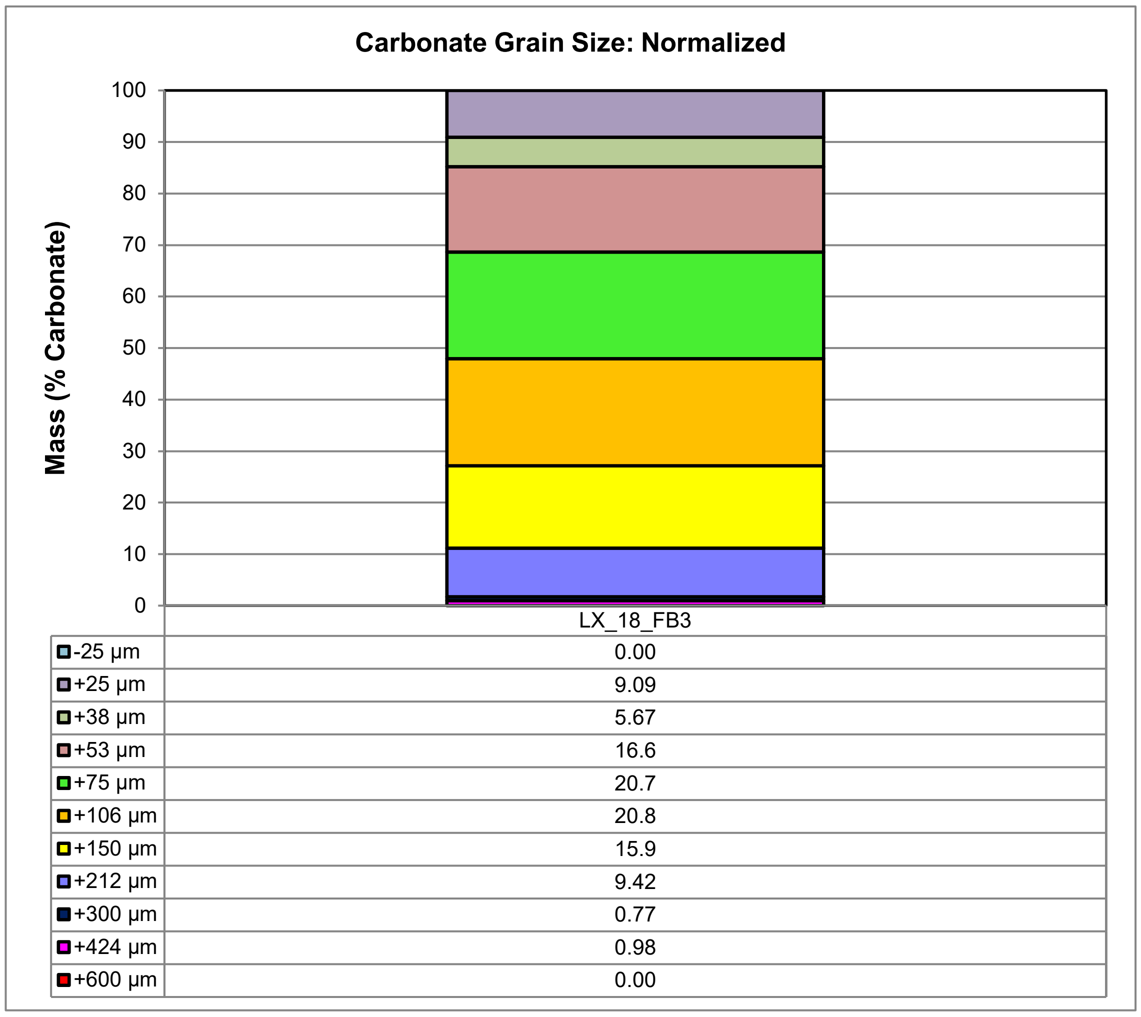
Mineral Name	LX_18_FB3	LX_18_FB4
+600 µm	0.00	0.00
+424 µm	0.03	0.02
+300 µm	0.02	0.00
+212 µm	0.26	0.01
+150 µm	0.44	0.03
+106 µm	0.57	0.12
+75 µm	0.57	0.11
+53 µm	0.45	0.12
+38 µm	0.16	0.05
+25 µm	0.25	0.11
-25 µm	0.00	0.00
Total	2.74	0.58

High Definition Mineralogical Analysis using QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscopy)

Carbonate Grain Size

Carbonate Grain Size: Absolute

Carbonate Grain Size: Normalized



	LX_18_FB3
■ -25 µm	0.00
■ +25 µm	9.09
■ +38 µm	5.67
■ +53 µm	16.6
■ +75 µm	20.7
■ +106 µm	20.8
■ +150 µm	15.9
■ +212 µm	9.42
■ +300 µm	0.77
■ +424 µm	0.98
■ +600 µm	0.00

Normalized Mass of Carbonate Across Samples

Mineral Name	LX_18_FB3	LX_18_FB4
+600 µm	0.00	0.00
+424 µm	0.98	3.68
+300 µm	0.77	0.00
+212 µm	9.42	2.48
+150 µm	15.9	5.17
+106 µm	20.8	21.1
+75 µm	20.7	18.6
+53 µm	16.6	20.6
+38 µm	5.67	8.66
+25 µm	9.09	19.7
-25 µm	0.00	0.00
Total	100.0	100.0

Appendix X 4-2:
Acid-Base Accounting Results

Atlantic Gold

Hole ID	**From**	**To**	**Lithology**	**Grade**	**Paste pH**	**Total S**	**Sulphate S**	**Sulphide S**	**TIC**	**CaNP**	**Modified NP**	**NPR**
	m	m				%	%	%	% CO2	kg CaCO3/t	kg CaCO3/t	
FMS-17-124	40	41	AG	Waste	8.3	0.26	0.01	0.25	<0.2	4.5	8	1.0
FMS-17-124	70	71	AG	Waste	8.7	0.19	<0.01	0.19	<0.2	4.5	9	1.5
FMS-17-199	39	40	AG	Waste	8.8	0.27	0.03	0.24	0.5	11.4	17	2.3
FMS-17-165	95	96	AG	Waste	8.1	0.39	0.01	0.38	0.4	9.1	13	1.1
FMS-17-200	27	28	AG	Waste	8.7	0.42	0.03	0.39	0.5	11.4	17	1.4
FMS-17-114	23	28	AG	Waste	8.6	0.32	0.01	0.31	0.8	18.2	22	2.3
FMS-17-114	55	60	AG	Waste	8.5	0.27	<0.01	0.27	0.7	15.9	21	2.5
FMS-17-274	100	105	AG	Waste	8.9	0.05	0.01	0.04	0.5	11.4	18	14.4
FMS-17-288	20	25	AG	Waste	9.1	0.19	<0.01	0.19	0.7	15.9	21	3.5
FMS-18-423	40	45	AG	Waste	9	0.47	0.01	0.46	0.7	15.9	26	1.8
FMS-18-440	110	115	AG	Waste	9	0.37	0.01	0.36	1.1	25.0	30	2.7
# Samples	11											
Min					*8.1*	*0.050*	*0.010*	*0.040*	*0.20*	*4.5*	*8.0*	*1.0*
10th PCTL					*8.3*	*0.19*	*0.010*	*0.19*	*0.20*	*4.5*	*9.0*	*1.1*
Median					*8.7*	*0.27*	*0.010*	*0.27*	*0.50*	*11*	*18*	*2.3*
90th PCTL					*9.0*	*0.42*	*0.030*	*0.39*	*0.80*	*18*	*26*	*3.5*
Max					*9.1*	*0.47*	*0.030*	*0.46*	*1.1*	*25*	*30*	*14*
FMS-17-055	5	6	AR	Waste	7.9	0.45	0.02	0.43	<0.2	4.5	5	0.4
FMS-17-055	15	16	AR	Waste	8.6	0.43	0.02	0.41	2.9	65.9	69	5.4
FMS-17-055	50	51	AR	Waste	8.3	0.31	0.02	0.29	0.2	4.5	8	0.9
FMS-17-055	120	121	AR	Waste	8.2	0.27	0.01	0.26	0.6	13.6	20	2.5
FMS-17-055	126	127	AR	Waste	8.4	0.28	0.01	0.27	0.4	9.1	15	1.8
FMS-17-073	15	16	AR	Waste	8.8	0.35	0.01	0.34	0.2	4.5	9	0.8
FMS-17-073	33	34	AR	Waste	8.9	0.25	0.01	0.24	<0.2	4.5	7	0.9
FMS-17-073	37	38	AR	Waste	8.8	0.38	0.01	0.37	<0.2	4.5	8	0.7
FMS-17-073	44	45	AR	Waste	8.8	0.36	0.01	0.35	<0.2	4.5	7	0.6
FMS-17-124	34	35	AR	Waste	8.2	0.44	0.01	0.43	0.5	11.4	16	1.2
FMS-17-124	50	51	AR	Waste	8.5	0.26	0.01	0.25	0.2	4.5	10	1.3
FMS-17-124	53	54	AR	Waste	8.4	0.24	0.01	0.23	<0.2	4.5	6	0.8
FMS-17-124	60	61	AR	Waste	8	0.24	0.02	0.22	0.2	4.5	9	1.3
FMS-17-165	10	11	AR	Waste	8.1	0.9	0.02	0.88	0.4	9.1	14	0.5
FMS-17-199	80	81	AR	Waste	8.3	0.65	0.03	0.62	0.8	18.2	21	1.1
FMS-17-124	67	68	AR	Waste	8.5	0.17	0.01	0.16	<0.2	4.5	7	1.4
FMS-17-165	30	31	AR	Waste	8.4	0.3	0.01	0.29	0.6	13.6	17	1.9
FMS-17-200	13	14	AR	Waste	8.9	0.11	0.01	0.1	0.3	6.8	11	3.5
FMS-17-078	40	45	AR	Waste	8.6	0.87	<0.01	0.87	1	22.7	35	1.3
FMS-17-206	40	45	AR	Waste	8.7	0.32	<0.01	0.32	0.2	4.5	10	1.0
FMS-18-389	20	25	AR	Waste	8.5	0.52	<0.01	0.52	0.5	11.4	16	1.0
FMS-17-274	65	70	AR	Waste	8.5	0.76	0.01	0.75	0.8	18.2	23	1.0
FMS-17-302	20	25	AR	Waste	8.2	0.38	<0.01	0.38	1.1	25.0	28	2.4
FMS-18-416	115	120	AR	Waste	9	0.23	0.01	0.22	1.9	43.2	47	6.8
FMS-18-388	70	75	AR	Waste	9	0.41	<0.01	0.41	0.3	6.8	12	0.9
FMS-18-388	110	115	AR	Waste	8.8	0.41	0.01	0.4	0.2	4.5	9	0.7
# Samples	26											
Min					*7.9*	*0.11*	*0.010*	*0.10*	*0.20*	*4.5*	*5.0*	*0.37*
10th PCTL					*8.2*	*0.24*	*0.010*	*0.22*	*0.20*	*4.5*	*7.0*	*0.67*
Median					*8.5*	*0.36*	*0.010*	*0.35*	*0.30*	*6.8*	*12*	*1.0*
90th PCTL					*8.9*	*0.71*	*0.020*	*0.69*	*1.1*	*24*	*32*	*3.0*
Max					*9.0*	*0.90*	*0.030*	*0.88*	*2.9*	*66*	*69*	*6.8*

Hole ID	**From**	**To**	**Lithology**	**Grade**	**Paste pH**	**Total S**	**Sulphate S**	**Sulphide S**	**TIC**	**CaNP**	**Modified NP**	**NPR**
	m	m				%	%	%	% CO2	kg CaCO3/t	kg CaCO3/t	
FMS-17-073	9	10	GA	Waste	8.9	0.55	0.02	0.53	0.4	9.1	13	0.8
FMS-17-124	73	74	GA	Waste	8.4	0.28	<0.01	0.28	1.9	43.2	47	5.4
FMS-17-165	16	17	GA	Waste	8.8	0.28	0.01	0.27	0.2	4.5	9	1.1
FMS-17-165	21	22	GA	Waste	8.5	0.23	0.02	0.21	0.5	11.4	16	2.4
FMS-17-165	26	27	GA	Waste	8.2	0.33	0.01	0.32	0.8	18.2	23	2.3
FMS-17-199	29	30	GA	Waste	8.8	0.47	0.02	0.45	0.6	13.6	19	1.4
FMS-17-200	35	36	GA	Waste	9	0.17	0.01	0.16	1.3	29.6	36	7.2
FMS-18-389	40	45	GA	Waste	8.8	0.3	0.01	0.29	0.8	18.2	22	2.4
FMS-18-389	75	80	GA	Waste	8.9	0.19	0.01	0.18	<0.2	4.5	8	1.4
FMS-18-416	75	80	GA	Waste	8.9	0.41	0.01	0.4	1.1	25.0	29	2.3
FMS-18-423	20	25	GA	Waste	9.1	0.23	<0.01	0.23	1.6	36.4	44	6.1
FMS-17-291	35	40	GA	Waste	9.1	0.02	<0.01	0.02	0.8	18.2	27	43.2
FMS-18-440	45	50	GA	Waste	8.9	0.27	<0.01	0.27	1.1	25.0	29	3.4
FMS-18-388	45	50	GA	Waste	8.8	0.15	<0.01	0.15	0.8	18.2	22	4.7
# Samples	14											
Min					*8.2*	*0.020*	*0.010*	*0.020*	*0.20*	*4.5*	*8.0*	*0.78*
10th PCTL					*8.4*	*0.16*	*0.010*	*0.15*	*0.26*	*5.9*	*10*	*1.2*
Median					*8.9*	*0.28*	*0.010*	*0.27*	*0.80*	*18*	*23*	*2.4*
90th PCTL					*9.1*	*0.45*	*0.020*	*0.44*	*1.5*	*34*	*42*	*6.9*
Max					*9.1*	*0.55*	*0.020*	*0.53*	*1.9*	*43*	*47*	*43*
FMS-17-073	22	23	GW	Waste	9.3	0.04	0.01	0.03	0.9	20.5	25	26.7
FMS-17-073	30	31	GW	Waste	9.3	0.09	<0.01	0.09	<0.2	4.5	10	3.6
FMS-17-124	46	47	GW	Waste	8.4	0.26	0.01	0.25	2.3	52.3	54	6.9
FMS-17-165	18	19	GW	Waste	8.6	0.23	<0.01	0.23	4.4	100.1	102	14.2
FMS-17-165	110	111	GW	Waste	8.7	0.14	0.01	0.13	0.4	9.1	16	3.9
FMS-17-199	5	6	GW	Waste	8.8	0.2	0.01	0.19	5.4	122.8	128	21.6
FMS-17-199	10	11	GW	Waste	8.6	0.33	0.02	0.31	1	22.7	28	2.9
FMS-17-199	20	21	GW	Waste	8.3	0.23	<0.01	0.23	5.4	122.8	127	17.7
FMS-17-200	7	8	GW	Waste	8.6	0.23	0.02	0.21	0.9	20.5	24	3.7
FMS-17-200	20	21	GW	Waste	9.1	0.13	0.01	0.12	1.8	40.9	46	12.3
FMS-17-278	80	85	GW	Waste	9.2	0.12	0.01	0.11	0.9	20.5	26	7.6
FMS-17-179	25	30	GW	Waste	8.3	0.34	0.01	0.33	2.1	47.8	54	5.2
FMS-18-389	115	120	GW	Waste	9.2	0.12	0.01	0.11	1.2	27.3	33	9.6
FMS-17-280	42	47	GW	Waste	9	0.05	<0.01	0.05	1.3	29.6	35	22.4
FMS-17-274	20	25	GW	Waste	8.4	0.56	0.02	0.54	0.4	9.1	14	0.8
FMS-17-288	45	50	GW	Waste	8.7	0.29	<0.01	0.29	0.9	20.5	25	2.8
FMS-17-298	20	25	GW	Waste	9.1	0.21	<0.01	0.21	1.4	31.8	36	5.5
FMS-17-302	40	45	GW	Waste	9.2	0.13	0.01	0.12	0.3	6.8	12	3.2
FMS-18-416	20	25	GW	Waste	9	0.13	0.01	0.12	0.6	13.6	18	4.8
FMS-18-416	40	45	GW	Waste	8.9	0.31	0.01	0.3	1.5	34.1	36	3.8
FMS-18-416	145	150	GW	Waste	8.7	0.31	<0.01	0.31	1.4	31.8	35	3.6
FMS-18-423	80	85	GW	Waste	8.9	0.16	<0.01	0.16	3.9	88.7	92	18.4
FMS-18-440	70	75	GW	Waste	9	0.17	0.01	0.16	0.7	15.9	21	4.2
FMS-18-388	175	180	GW	Waste	9.1	0.11	<0.01	0.11	0.2	4.5	11	3.2
# Samples	24											
Min					*8.3*	*0.040*	*0.010*	*0.030*	*0.20*	*4.5*	*10*	*0.83*
10th PCTL					*8.4*	*0.096*	*0.010*	*0.096*	*0.33*	*7.5*	*13*	*3.0*
Median					*8.9*	*0.19*	*0.010*	*0.18*	*1.1*	*25*	*31*	*5.0*
90th PCTL					*9.2*	*0.32*	*0.017*	*0.31*	*4.3*	*97*	*99*	*21*
Max					*9.3*	*0.56*	*0.020*	*0.54*	*5.4*	*123*	*128*	*27*

Hole ID	**From**	**To**	**Lithology**	**Grade**	**Paste pH**	**Total S**	**Sulphate S**	**Sulphide S**	**TIC**	**CaNP**	**Modified NP**	**NPR**
	m	m				%	%	%	% CO2	kg CaCO3/t	kg CaCO3/t	
FMS-17-055	83	84	AG	Ore	8.2	0.84	0.02	0.82	0.9	20.5	25	1.0
FMS-17-055	70	71	AR	Ore	8.6	0.33	0.02	0.31	0.2	4.5	10	1.0
FMS-17-124	106	107	AR	Ore	7.9	0.63	0.02	0.61	0.2	4.5	7	0.4
FMS-17-124	82	83	AG	Ore	8.3	0.51	0.01	0.5	0.2	4.5	9	0.6
FMS-17-165	83	84	AG	Ore	8.9	0.34	0.01	0.33	0.7	15.9	20	1.9
FMS-17-055	25	26	AR	Ore	8.7	0.45	0.01	0.44	0.3	6.8	11	0.8
FMS-17-055	30	31	AR	Ore	8.7	0.3	0.01	0.29	0.9	20.5	24	2.6
FMS-17-055	43	44	AR	Ore	8.5	0.94	0.02	0.92	0.3	6.8	11	0.4
FMS-17-055	55	56	AR	Ore	8.1	1.06	0.03	1.03	1.5	34.1	38	1.2
FMS-17-055	98	99	AR	Ore	8.1	0.44	0.02	0.42	0.3	6.8	11	0.8
FMS-17-124	89	90	AR	Ore	8.9	0.31	0.02	0.29	0.7	15.9	21	2.3
FMS-17-124	122	123	AR	Ore	8.2	0.49	0.02	0.47	0.4	9.1	15	1.0
FMS-17-124	130	131	AR	Ore	7.9	0.86	0.02	0.84	0.3	6.8	10	0.4
FMS-17-124	145	146	AR	Ore	8.2	0.53	0.02	0.51	0.8	18.2	22	1.4
FMS-17-165	40	41	AR	Ore	8.2	0.62	0.01	0.61	2	45.5	49	2.6
FMS-17-165	55	56	AR	Ore	8.7	0.39	0.01	0.38	2.6	59.1	61	5.1
FMS-17-124	140	141	GA	Ore	8.9	0.38	<0.01	0.38	<0.2	4.5	6	0.5
FMS-17-055	90	91	GW	Ore	8.8	0.12	<0.01	0.12	0.9	20.5	26	6.9
FMS-17-055	111	112	GW	Ore	9.1	0.21	0.01	0.2	0.7	15.9	35	5.6
FMS-17-165	65	66	GW	Ore	9.2	0.14	0.01	0.13	0.6	13.6	18	4.4
FMS-17-270	55	60	AG	Ore	8.8	0.35	0.01	0.34	0.3	6.8	12	1.1
FMS-17-078	20	25	AR	Ore	8.3	0.9	0.01	0.89	0.4	9.1	11	0.4
FMS-17-298	40	45	AR	Ore	8.6	0.37	<0.01	0.37	0.6	13.6	16	1.4
# Samples	23											
Min					*7.9*	*0.12*	*0.010*	*0.12*	*0.20*	*4.5*	*6.0*	*0.37*
10th PCTL					*8.1*	*0.23*	*0.010*	*0.22*	*0.20*	*4.5*	*9.2*	*0.39*
Median					*8.6*	*0.44*	*0.010*	*0.42*	*0.60*	*14*	*16*	*1.1*
90th PCTL					*8.9*	*0.89*	*0.020*	*0.88*	*1.4*	*31*	*37*	*5.0*
Max					*9.2*	*1.1*	*0.030*	*1.0*	*2.6*	*59*	*61*	*6.9*
Field Bin												
LX-18-FB3			Various	Waste	8.1	0.4	0.01	0.39	0.25	21	27	2.2

Notes:

Values were set at the detection limit for calculation of NP, AP, and NPR values.

Sulphate S is calculated using the HCl method.

AP (acid potential) calculated using sulphide S (% non-sulphate S x 31.25);

CaNP (carbonate neutralization potential) calculated using total inorganic carbon (% TIC x (100.09/44.01) x 10);

Modified NP is obtained by the modified Sobek method.

NPR = neutralization potential ratio; calculated as Modified NP / AP

Appendix 4-3: Solid-phase Elemental Analysis Results

Atlantic Gold

Hole ID	From	To	Lithology	Grade	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	Hg	K	La	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sr	Th	Ti	Tl	U	V	W	Zn
	m	m			ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	%	ppm	%	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm
					53	8.2	4.8	17	628	2.1	0.16	2.6	0.090	17	92	28	3.9	18	0.050	0.050	2.3	31	1.5	774	1.1	2.4	47	655	17	621	0.40	14	320	11	0.38	0.90	2.7	97	1.9	67
FMS-17-124	40	41	AG	Waste	<0.2	2.61	21	<10	70	<0.5	2	0.27	<0.5	20	34	25	5.05	10	<0.005	<1	0.59	30	1.26	485	1	0.02	37	580	2	0.28	<2	4	10	<20	0.11	<10	<10	36	<10	107
FMS-17-124	70	71	AG	Waste	<0.2	2.54	71	<10	80	<0.5	2	0.27	<0.5	21	35	36	4.44	10	<0.005	1	0.64	30	1.17	573	<1	0.04	39	500	10	0.22	<2	4	14	<20	0.12	<10	<10	34	<10	93
FMS-17-199	39	40	AG	Waste	<0.2	2.51	1560	<10	70	<0.5	<2	0.66	<0.5	14	39	25	4.49	10	<0.005	<1	0.6	20	1.53	779	1	0.02	41	750	28	0.3	<2	4	15	<20	0.08	<10	<10	36	<10	94
FMS-17-165	95	96	AG	Waste	<0.2	2.7	306	<10	60	0.5	<2	0.44	<0.5	21	35	36	5.29	10	<0.005	<1	0.56	30	1.48	676	<1	0.02	44	480	7	0.43	<2	4	13	<20	0.09	<10	<10	34	<10	114
FMS-17-200	27	28	AG	Waste	<0.2	2.33	22	<10	50	<0.5	<2	0.65	<0.5	20	33	43	4.78	10	<0.005	<1	0.4	30	1.12	518	1	0.02	38	560	6	0.46	<2	4	13	<20	0.09	<10	<10	33	<10	100
# Samples	5																																							
Min					*0.20*	*2.3*	*21*	*10*	*50*	*0.50*	*2.0*	*0.27*	*0.50*	*14*	*33*	*25*	*4.4*	*10*	*0.0050*	*1.0*	*0.40*	*20*	*1.12*	*485*	*1.0*	*0.020*	*37*	*480*	*2.0*	*0.22*	*2.0*	*4.0*	*10.0*	*20*	*0.080*	*10*	*10*	*33*	*10*	*93*
10th PCTL					*0.20*	*2.4*	*21*	*10*	*54*	*0.50*	*2.0*	*0.27*	*0.50*	*16*	*33*	*25*	*4.5*	*10*	*0.0050*	*1.0*	*0.46*	*24*	*1.14*	*498*	*1.0*	*0.020*	*37*	*488*	*3.6*	*0.24*	*2.0*	*4.0*	*11.2*	*20*	*0.084*	*10*	*10*	*33*	*10*	*93*
Median					*0.20*	*2.5*	*71*	*10*	*70*	*0.50*	*2.0*	*0.44*	*0.50*	*20*	*35*	*36*	*4.8*	*10*	*0.0050*	*1.0*	*0.59*	*30*	*1.3*	*573*	*1.0*	*0.020*	*39*	*560*	*7.0*	*0.30*	*2.0*	*4.0*	*13*	*20*	*0.090*	*10*	*10*	*34*	*10*	*100*
90th PCTL					*0.20*	*2.7*	*1058*	*10*	*76*	*0.50*	*2.0*	*0.66*	*0.50*	*21*	*37*	*40*	*5.2*	*10*	*0.0050*	*1.0*	*0.62*	*30*	*1.5*	*738*	*1.0*	*0.032*	*43*	*682*	*21*	*0.45*	*2.0*	*4.0*	*15*	*20*	*0.12*	*10*	*10*	*36*	*10*	*111*
Max					*0.20*	*2.7*	*1560*	*10*	*80*	*0.50*	*2.0*	*0.66*	*0.50*	*21*	*39*	*43*	*5.3*	*10*	*0.0050*	*1.0*	*0.64*	*30*	*1.5*	*779*	*1.0*	*0.040*	*44*	*750*	*28*	*0.46*	*2.0*	*4.0*	*15*	*20*	*0.12*	*10*	*10*	*36*	*10*	*114*
FMS-17-055	5	6	AR	Waste	<0.2	2.56	47	<10	40	0.6	<2	0.15	<0.5	11	29	38	4.9	10	<0.005	<1	0.36	20	1.32	528	1	0.02	33	460	11	0.48	<2	3	6	<20	0.06	<10	<10	25	<10	103
FMS-17-055	15	16	AR	Waste	<0.2	1.79	50	<10	70	<0.5	2	2.63	<0.5	12	29	52	3.78	10	<0.005	<1	0.58	30	0.85	882	<1	0.02	30	500	6	0.45	<2	4	21	<20	0.1	<10	<10	29	<10	67
FMS-17-055	50	51	AR	Waste	<0.2	2.41	1580	<10	30	0.6	<2	0.26	<0.5	22	23	24	4.77	10	<0.005	<1	0.25	20	1.27	490	<1	0.01	37	440	4	0.32	<2	2	7	<20	0.03	<10	<10	20	<10	104
FMS-17-055	120	121	AR	Waste	<0.2	2.64	429	<10	50	0.9	<2	0.71	<0.5	20	30	47	4.88	10	<0.005	<1	0.42	30	1.34	664	1	0.02	42	470	13	0.29	<2	3	17	<20	0.04	<10	<10	27	<10	96
FMS-17-055	126	127	AR	Waste	<0.2	2.39	43	<10	50	0.7	<2	0.51	<0.5	16	29	42	4.67	10	<0.005	<1	0.35	20	1.18	554	<1	0.02	39	450	15	0.3	<2	3	12	<20	0.04	<10	<10	26	<10	90
FMS-17-073	15	16	AR	Waste	<0.2	2.64	29	<10	60	<0.5	<2	0.29	<0.5	20	36	51	5.04	10	<0.005	<1	0.54	30	1.41	593	<1	0.02	43	470	8	0.38	<2	4	9	<20	0.09	<10	<10	35	<10	101
FMS-17-073	33	34	AR	Waste	<0.2	2.77	49	<10	60	<0.5	<2	0.18	<0.5	20	34	39	5.11	10	<0.005	<1	0.55	30	1.5	557	<1	0.02	44	520	4	0.3	<2	4	10	<20	0.09	<10	<10	33	<10	112
FMS-17-073	37	38	AR	Waste	<0.2	2.68	2	<10	70	<0.5	<2	0.22	<0.5	19	36	56	5.17	10	<0.005	<1	0.62	30	1.44	588	<1	0.02	45	520	5	0.42	<2	4	8	<20	0.1	<10	<10	35	<10	107
FMS-17-073	44	45	AR	Waste	<0.2	2.38	6	<10	50	<0.5	<2	0.17	<0.5	18	29	42	4.5	10	<0.005	<1	0.49	30	1.25	491	<1	0.02	38	450	5	0.38	<2	3	9	<20	0.08	<10	<10	26	<10	95
FMS-17-124	34	35	AR	Waste	<0.2	1.69	7	<10	40	<0.5	<2	0.53	<0.5	15	25	44	3.69	10	<0.005	<1	0.36	30	0.83	378	<1	0.02	27	390	7	0.44	<2	3	12	<20	0.07	<10	<10	25	<10	72
FMS-17-124	50	51	AR	Waste	<0.2	2.47	27	<10	70	<0.5	<2	0.33	<0.5	17	31	41	4.72	10	<0.005	<1	0.55	30	1.2	489	1	0.02	35	440	3	0.29	<2	4	10	<20	0.09	<10	<10	29	<10	96
FMS-17-124	53	54	AR	Waste	<0.2	2.89	133	<10	50	<0.5	<2	0.19	<0.5	29	34	49	5.59	10	<0.005	<1	0.41	30	1.44	547	<1	0.02	45	570	12	0.32	<2	3	10	<20	0.07	<10	<10	30	<10	117
FMS-17-124	60	61	AR	Waste	0.2	2.67	235	<10	40	<0.5	2	0.29	<0.5	23	32	48	5.07	10	<0.005	<1	0.43	30	1.36	550	1	0.02	36	430	30	0.27	<2	3	13	<20	0.07	<10	<10	28	<10	104
FMS-17-165	10	11	AR	Waste	<0.2	2.27	61	<10	50	<0.5	<2	0.5	<0.5	30	28	73	5.12	10	<0.005	<1	0.41	30	1.11	497	<1	0.02	63	510	10	0.94	<2	3	10	<20	0.07	<10	<10	28	<10	94
FMS-17-199	80	81	AR	Waste	<0.2	1.44	8430	<10	30	<0.5	<2	0.84	<0.5	12	16	37	3.34	<10	<0.005	<1	0.16	10	0.87	544	1	0.01	29	280	10	0.7	3	1	13	<20	0.01	<10	<10	14	<10	61
FMS-17-124	67	68	AR	Waste	0.2	2.87	714	<10	50	<0.5	<2	0.21	<0.5	28	35	32	5.33	10	<0.005	<1	0.49	30	1.42	560	<1	0.02	52	470	2	0.23	<2	4	11	<20	0.07	<10	<10	30	<10	110
FMS-17-165	30	31	AR	Waste	0.2	2.45	82	<10	40	0.7	<2	0.64	<0.5	23	26	45	4.96	10	<0.005	<1	0.22	30	1.24	547	<1	0.02	40	550	17	0.34	<2	2	11	<20	0.01	<10	<10	21	<10	106
FMS-17-200	13	14	AR	Waste	<0.2	2.59	83	<10	70	<0.5	<2	0.35	<0.5	17	34	21	4.72	10	<0.005	<1	0.64	30	1.32	579	<1	0.02	38	460	3	0.13	<2	4	10	<20	0.1	<10	<10	34	<10	103
# Samples	18																																							
Min					*0.20*	*1.4*	*2.0*	*10*	*30*	*0.50*	*2.0*	*0.15*	*0.50*	*11*	*16*	*21*	*3.3*	*10*	*0.0050*	*1.0*	*0.16*	*10*	*0.83*	*378*	*1.0*	*0.010*	*27*	*280*	*2.0*	*0.13*	*2.0*	*1.0*	*6.0*	*20*	*0.010*	*10*	*10*	*14.0*	*10*	*61*
10th PCTL					*0.20*	*1.8*	*7*	*10*	*37*	*0.50*	*2.0*	*0.18*	*0.50*	*12*	*24*	*30*	*3.8*	*10*	*0.0050*	*1.0*	*0.24*	*20*	*0.86*	*490*	*1.0*	*0.017*	*30*	*418*	*3.0*	*0.26*	*2.0*	*2.0*	*7.7*	*20*	*0.024*	*10*	*10*	*21*	*10*	*71*
Median					*0.20*	*2.5*	*56*	*10*	*50*	*0.50*	*2.0*	*0.31*	*0.50*	*20*	*30*	*43*	*4.9*	*10*	*0.0050*	*1.0*	*0.43*	*30*	*1.3*	*549*	*1.0*	*0.020*	*39*	*465*	*8*	*0.33*	*2.0*	*3.0*	*10*	*20*	*0.070*	*10*	*10*	*28*	*10*	*102*
90th PCTL					*0.20*	*2.8*	*974*	*10*	*70*	*0.70*	*2.0*	*0.7*	*0.50*	*28*	*35*	*53*	*5.2*	*10*	*0.0050*	*1.0*	*0.59*	*30*	*1.4*	*614*	*1.0*	*0.020*	*47*	*529*	*16*	*0.55*	*2.0*	*4.0*	*14*	*20*	*0.10*	*10*	*10*	*34*	*10*	*111*
Max					*0.20*	*2.9*	*8430*	*10*	*70*	*0.90*	*2.0*	*2.6*	*0.50*	*30*	*36*	*73*	*5.6*	*10*	*0.0050*	*1.0*	*0.64*	*30*	*1.5*	*882*	*1.0*	*0.020*	*63*	*570*	*30*	*0.9*	*3.0*	*4.0*	*21*	*20*	*0.10*	*10*	*10*	*35*	*10*	*117*
FMS-17-073	9	10	GA	Waste	<0.2	1.78	399	<10	40	<0.5	<2	0.46	<0.5	14	26	38	3.88	<10	<0.005	<1	0.33	30	0.86	454	1	0.03	30	480	9	0.57	<2	3	13	<20	0.05	<10	<10	27	<10	79
FMS-17-124	73	74	GA	Waste	<0.2	1.82	3850	<10	60	<0.5	<2	1.77	<0.5	15	27	13	3.51	10	<0.005	<1	0.5	20	0.94	675	<1	0.03	28	460	8	0.31	2	4	34	<20	0.06	<10	<10	30	<10	74
FMS-17-165	16	17	GA	Waste	0.3	2.05	161	<10	50	<0.5	<2	0.33	<0.5	19	27	17	3.99	10	<0.005	<1	0.41	30	0.97	399	<1	0.02	27	470	8	0.3	<2	3	11	<20	0.06	<10	<10	27	<10	87
FMS-17-165	21	22	GA	Waste	<0.2	1.98	41	<10	40	<0.5	<2	0.53	<0.5	15	31	32	3.96	10	<0.005	1	0.34	30	0.95	494	1	0.03	28	440	10	0.26	<2	4	13	<20	0.06	<10	<10	33	<10	82
FMS-17-165	26	27	GA	Waste	<0.2	1.99	424	<10	40	<0.5	<2	0.86	<0.5	18	26	45	4.08	10	<0.005	<1	0.32	20	0.99	585	<1	0.02	38	410	18	0.37	<2	3	14	<20	0.04	<10	<10	26	<10	81
FMS-17-199	29	30	GA	Waste	<0.2	2.03	3170	<10	70	<0.5	<2	0.71	<0.5	15	31	32	3.83	10	<0.005	<1	0.56	30	1.19	505	<1	0.03	34	690	9	0.51	<2	3	14	<20	0.06	<10	<10	31	<10	80
FMS-17-200	35	36	GA	Waste	<0.2	1.89	14	<10	50	<0.5	2	1.38	<0.5	15	26	27	3.66	10	<0.005	1	0.37	20	0.93	584	<1	0.02	27	410	9	0.18	<2	3	24	<20	0.08	<10	<10	25	<10	78
# Samples	7																																							
Min					*0.20*	*1.8*	*14.0*	*10*	*40*	*0.50*	*2.0*	*0.33*	*0.50*	*14*	*26*	*13*	*3.5*	*10*	*0.0050*	*1.0*	*0.32*	*20*	*0.86*	*399*	*1.0*	*0.020*	*27*	*410*	*8.0*	*0.18*	*2.0*	*3.0*	*11.0*	*20*	*0.040*	*10*	*10*	*25.0*	*10*	*74*
10th PCTL					*0.20*	*1.8*	*30*	*10*	*40*	*0.50*	*2.0*	*0.41*	*0.50*	*15*	*26*	*15*	*3.6*	*10*	*0.0050*	*1.0*	*0.33*	*20*	*0.90*	*432*	*1.0*	*0.020*	*27*	*410*	*8.0*	*0.23*	*2.0*	*3.0*	*12.2*	*20*	*0.046*	*10*	*10*	*26*	*10*	*76*
Median					*0.20*	*2.0*	*399*	*10*	*50*	*0.50*	*2.0*	*0.71*	*0.50*	*15*	*27*	*32*	*3.9*	*10*	*0.0050*	*1.0*	*0.37*	*30*	*1.0*	*505*	*1.0*	*0.030*	*28*	*460*	*9*	*0.31*	*2.0*	*3.0*	*14*	*20*	*0.060*	*10*	*10*	*27*	*10*	*80*
90th PCTL					*0.24*	*2.0*	*3442*	*10*	*64*	*0.50*	*2.0*	*1.5*	*0.50*	*18*	*31*	*41*	*4.0*	*10*	*0.0050*	*1.0*	*0.52*	*30*	*1.1*	*621*	*1.0*	*0.030*	*36*	*564*	*13*	*0.53*	*2.0*	*4.0*	*28*	*20*	*0.07*	*10*	*10*	*32*	*10*	*84*
Max					*0.30*	*2.1*	*3850*	*10*	*70*	*0.50*	*2.0*	*1.8*	*0.50*	*19*	*31*	*45*	*4.1*	*10*	*0.0050*	*1.0*	*0.6*	*30*	*1.2*	*675*	*1.0*	*0.030*	*38*	*690*	*18*	*0.6*	*2.0*	*4.0*	*34*	*20*	*0.08*	*10*	*10*	*33*	*10*	*87*

Hole ID	**From**	**To**	**Lithology**	**Grade**	**Ag**	**Al**	**As**	**B**	**Ba**	**Be**	**Bi**	**Ca**	**Cd**	**Co**	**Cr**	**Cu**	**Fe**	**Ga**	**Hg**	**Hg**	**K**	**La**	**Mg**	**Mn**	**Mo**	**Na**	**Ni**	**P**	**Pb**	**S**	**Sb**	**Sc**	**Sr**	**Th**	**Ti**	**Tl**	**U**	**V**	**W**	**Zn**
	m	**m**			**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**%**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
FMS-17-073	22	23	GW	Waste	<0.2	2.14	50	<10	60	<0.5	<2	0.96	<0.5	19	38	25	3.63	10	<0.005	<1	0.5	30	1.16	653	<1	0.03	35	700	4	0.05	<2	5	20	<20	0.09	<10	<10	41	<10	79
FMS-17-073	30	31	GW	Waste	<0.2	2.11	71	<10	60	<0.5	<2	0.31	<0.5	15	35	14	3.65	10	<0.005	<1	0.59	30	1.14	463	<1	0.03	34	700	3	0.11	<2	4	11	<20	0.09	<10	<10	36	<10	84
FMS-17-124	46	47	GW	Waste	<0.2	1.33	57	<10	50	<0.5	<2	2.07	<0.5	10	20	34	2.72	<10	<0.005	<1	0.36	20	0.65	765	<1	0.03	22	300	8	0.28	<2	3	27	<20	0.07	<10	<10	22	<10	53
FMS-17-165	18	19	GW	Waste	<0.2	0.7	16	<10	20	<0.5	<2	4.03	<0.5	7	11	18	1.64	<10	<0.005	<1	0.12	20	0.33	1105	<1	0.03	12	280	9	0.26	<2	1	79	<20	0.02	<10	<10	11	<10	27
FMS-17-165	110	111	GW	Waste	<0.2	1.79	60	<10	100	<0.5	<2	0.51	<0.5	15	36	16	3.14	10	<0.005	1	0.7	20	0.89	462	<1	0.04	25	410	4	0.15	<2	6	19	<20	0.13	<10	<10	49	<10	68
FMS-17-199	5	6	GW	Waste	<0.2	0.88	165	<10	20	<0.5	<2	4.85	<0.5	7	14	24	1.91	<10	<0.005	<1	0.16	20	0.55	1080	<1	0.03	17	540	8	0.23	<2	2	83	<20	0.03	<10	<10	16	<10	40
FMS-17-199	10	11	GW	Waste	<0.2	1.39	1070	<10	30	<0.5	<2	1.05	<0.5	10	22	24	2.72	<10	<0.005	1	0.2	20	0.82	421	<1	0.04	26	560	10	0.36	3	2	15	<20	0.02	<10	<10	22	<10	59
FMS-17-199	20	21	GW	Waste	<0.2	1.02	270	<10	20	<0.5	<2	5.03	<0.5	7	18	22	2.07	<10	<0.005	<1	0.13	20	0.59	980	<1	0.03	19	520	7	0.26	<2	2	46	<20	0.01	<10	<10	18	<10	40
FMS-17-200	7	8	GW	Waste	<0.2	1.55	36	<10	50	<0.5	<2	0.93	<0.5	14	24	32	3.06	10	<0.005	<1	0.4	20	0.76	440	<1	0.03	27	330	12	0.25	<2	4	12	<20	0.09	<10	<10	29	<10	62
FMS-17-200	20	21	GW	Waste	<0.2	1.49	14	<10	50	<0.5	<2	1.78	<0.5	16	25	15	2.83	10	<0.005	<1	0.35	20	0.74	569	1	0.03	22	420	6	0.14	<2	3	26	<20	0.07	<10	<10	27	<10	63
# Samples	10																																							
Min					*0.20*	*0.70*	*14*	*10*	*20*	*0.50*	*2.0*	*0.31*	*0.50*	*7.0*	*11*	*14*	*1.6*	*10*	*0.0050*	*1.0*	*0.12*	*20*	*0.33*	*421*	*1.0*	*0.030*	*12*	*280*	*3.0*	*0.050*	*2.0*	*1.0*	*11*	*20*	*0.010*	*10*	*10*	*11*	*10*	*27*
10th PCTL					*0.20*	*0.86*	*16*	*10*	*20*	*0.50*	*2.0*	*0.49*	*0.50*	*7.0*	*14*	*15*	*1.9*	*10*	*0.0050*	*1.0*	*0.13*	*20*	*0.53*	*438*	*1.0*	*0.030*	*17*	*298*	*3.9*	*0.10*	*2.0*	*1.9*	*12*	*20*	*0.019*	*10*	*10*	*16*	*10*	*39*
Median					*0.20*	*1.4*	*59*	*10*	*50*	*0.50*	*2.0*	*1.4*	*0.50*	*12*	*23*	*23*	*2.8*	*10*	*0.0050*	*1.0*	*0.36*	*20*	*0.75*	*611*	*1.0*	*0.030*	*24*	*470*	*7.5*	*0.24*	*2.0*	*3.0*	*23*	*20*	*0.070*	*10*	*10*	*25*	*10*	*61*
90th PCTL					*0.20*	*2.1*	*350*	*10*	*64*	*0.50*	*2.0*	*4.9*	*0.50*	*16*	*36*	*32*	*3.6*	*10*	*0.0050*	*1.0*	*0.60*	*30*	*1.1*	*1083*	*1.0*	*0.040*	*34*	*700*	*10*	*0.29*	*2.1*	*5.1*	*79*	*20*	*0.094*	*10*	*10*	*42*	*10*	*80*
Max					*0.20*	*2.1*	*1070*	*10*	*100*	*0.50*	*2.0*	*5.0*	*0.50*	*19*	*38*	*34*	*3.7*	*10*	*0.0050*	*1.0*	*0.70*	*30*	*1.2*	*1105*	*1.0*	*0.040*	*35*	*700*	*12*	*0.36*	*3.0*	*6.0*	*83*	*20*	*0.13*	*10*	*10*	*49*	*10*	*84*
FMS-17-055	83	84	AG	*Ore*	<0.2	2.05	2380	<10	60	<0.5	<2	0.91	<0.5	18	29	70	4.73	10	<0.005	<1	0.51	20	1.03	545	<1	0.02	44	430	7	0.81	<2	4	13	<20	0.06	<10	<10	30	<10	78
FMS-17-055	70	71	AR	*Ore*	<0.2	2.44	837	<10	60	<0.5	<2	0.33	<0.5	16	31	24	4.73	10	<0.005	<1	0.47	30	1.26	551	<1	0.02	33	460	11	0.36	<2	3	11	<20	0.07	<10	<10	28	<10	105
FMS-17-124	106	107	AR	*Ore*	<0.2	2.34	4380	<10	50	<0.5	<2	0.26	<0.5	23	29	36	4.98	10	<0.005	<1	0.51	30	1.23	458	<1	0.01	41	430	3	0.64	5	3	8	<20	0.06	<10	<10	25	<10	97
FMS-17-124	82	83	AG	*Ore*	<0.2	1.85	47	<10	60	<0.5	<2	0.35	<0.5	16	29	58	3.96	10	<0.005	<1	0.55	30	0.95	443	<1	0.02	32	440	10	0.54	<2	4	9	<20	0.1	<10	<10	30	<10	75
FMS-17-165	83	84	AG	*Ore*	<0.2	1.77	94	<10	60	<0.5	<2	0.76	<0.5	14	27	26	3.4	10	<0.005	<1	0.53	20	0.89	553	1	0.03	23	470	9	0.38	<2	4	18	<20	0.08	<10	<10	34	<10	67
FMS-17-055	25	26	AR	*Ore*	<0.2	2.27	178	<10	50	<0.5	<2	0.37	<0.5	15	30	53	4.7	10	<0.005	<1	0.4	30	1.14	538	<1	0.02	50	480	10	0.47	<2	3	12	<20	0.07	<10	<10	28	<10	90
FMS-17-055	30	31	AR	*Ore*	0.2	2.08	990	<10	50	<0.5	<2	0.88	<0.5	23	28	28	4.08	10	<0.005	<1	0.41	30	1.03	607	2	0.01	38	510	32	0.33	<2	3	12	<20	0.06	<10	<10	25	<10	83
FMS-17-055	43	44	AR	*Ore*	<0.2	2.28	1820	<10	50	<0.5	<2	0.37	<0.5	30	27	59	5.1	10	<0.005	<1	0.44	30	1.17	481	<1	0.01	47	420	3	0.88	<2	3	10	<20	0.05	<10	<10	23	<10	94
FMS-17-055	55	56	AR	*Ore*	<0.2	2.45	1300	<10	40	0.5	<2	1.51	<0.5	14	29	101	6.02	10	<0.005	<1	0.36	30	1.29	737	<1	0.02	49	440	5	1.3	<2	3	15	<20	0.04	<10	<10	24	<10	105
FMS-17-055	98	99	AR	*Ore*	<0.2	2.41	95	<10	50	0.7	<2	0.41	<0.5	21	28	44	4.85	10	<0.005	<1	0.36	30	1.2	815	1	0.01	40	440	15	0.45	<2	3	11	<20	0.06	<10	<10	26	<10	100
FMS-17-124	89	90	AR	*Ore*	<0.2	2.27	47	<10	70	<0.5	<2	0.74	<0.5	13	34	34	4.42	10	<0.005	<1	0.57	30	1.12	612	<1	0.02	37	470	7	0.35	<2	4	11	<20	0.1	<10	<10	32	<10	89
FMS-17-124	122	123	AR	*Ore*	<0.2	2.14	1340	<10	60	0.6	<2	0.49	<0.5	17	28	37	3.98	10	<0.005	<1	0.46	20	1.18	530	<1	0.02	29	350	19	0.51	<2	3	9	<20	0.07	<10	<10	24	<10	87
FMS-17-124	130	131	AR	*Ore*	0.2	2.04	1820	<10	60	0.5	<2	0.42	<0.5	25	25	74	4.33	10	<0.005	<1	0.56	30	1.03	443	2	0.03	46	400	19	0.87	<2	2	14	<20	0.08	<10	<10	24	<10	79
FMS-17-124	145	146	AR	*Ore*	<0.2	2.54	5850	<10	40	0.8	<2	0.79	<0.5	20	27	22	5.12	10	<0.005	<1	0.23	30	1.44	846	<1	0.02	42	500	14	0.54	4	2	22	<20	0.01	<10	<10	22	<10	98
FMS-17-165	40	41	AR	*Ore*	0.3	1.77	1520	<10	30	0.5	3	1.96	<0.5	29	17	48	4.12	<10	<0.005	<1	0.17	20	0.9	879	<1	0.01	52	600	25	0.68	<2	2	27	<20	<0.01	<10	<10	13	<10	92
FMS-17-165	55	56	AR	*Ore*	0.6	1.13	204	<10	30	0.6	3	2.46	<0.5	20	12	36	2.53	<10	<0.005	1	0.24	30	0.43	982	<1	0.02	34	590	67	0.44	<2	2	25	<20	<0.01	<10	<10	9	<10	72
FMS-17-124	140	141	GA	*Ore*	<0.2	2.58	17	<10	150	0.8	<2	0.13	0.7	17	43	39	4.47	10	<0.005	1	1.47	10	1.2	246	1	0.07	33	450	218	0.53	<2	8	6	<20	0.21	<10	<10	61	<10	293
FMS-17-055	90	91	GW	*Ore*	<0.2	1.08	61	<10	40	<0.5	<2	0.9	<0.5	8	19	15	2.07	<10	<0.005	1	0.34	20	0.48	439	<1	0.03	15	310	6	0.13	<2	3	16	<20	0.05	<10	<10	22	<10	39
FMS-17-055	111	112	GW	*Ore*	<0.2	1.22	38	<10	50	<0.5	<2	1.28	<0.5	10	18	21	2.42	<10	<0.005	<1	0.36	20	0.55	545	<1	0.03	18	300	10	0.23	<2	2	19	<20	0.07	<10	<10	20	<10	50
FMS-17-165	65	66	GW	*Ore*	<0.2	1.96	977	<10	80	<0.5	<2	0.63	<0.5	20	33	11	3.49	10	<0.005	<1	0.62	20	1.01	538	<1	0.03	31	430	6	0.15	<2	5	13	<20	0.08	<10	<10	43	<10	79
# Samples	20																																							
Min					*0.20*	*1.1*	*17*	*10*	*30*	*0.50*	*2.0*	*0.13*	*0.50*	*8*	*12*	*11*	*2.1*	*10*	*0.0050*	*1.0*	*0.17*	*10*	*0.4*	*246*	*1.0*	*0.010*	*15*	*300*	*3.0*	*0.13*	*2.0*	*2.0*	*6.0*	*20*	*0.010*	*10*	*10*	*9*	*10*	*39*
10th PCTL					*0.20*	*1.2*	*46*	*10*	*39*	*0.50*	*2.0*	*0.32*	*0.50*	*13*	*18*	*20*	*2.5*	*10*	*0.0050*	*1.0*	*0.24*	*20*	*0.5*	*443*	*1.0*	*0.010*	*23*	*346*	*4.8*	*0.22*	*2.0*	*2.0*	*8.9*	*20*	*0.010*	*10*	*10*	*19*	*10*	*65*
Median					*0.20*	*2.1*	*907*	*10*	*50*	*0.50*	*2.0*	*0.69*	*0.50*	*18*	*28*	*37*	*4.4*	*10*	*0.0050*	*1.0*	*0.45*	*30*	*1.1*	*545*	*1.0*	*0.020*	*38*	*440*	*10.0*	*0.49*	*2.0*	*3.0*	*13*	*20*	*0.065*	*10*	*10*	*25*	*10*	*88*
90th PCTL					*0.21*	*2.5*	*2580*	*10*	*71*	*0.71*	*2.1*	*1.56*	*0.50*	*25*	*33*	*70*	*5.1*	*10*	*0.0050*	*1.0*	*0.58*	*30*	*1.3*	*849*	*1.1*	*0.030*	*49*	*518*	*36*	*0.87*	*2.2*	*4.1*	*22*	*20*	*0.100*	*10*	*10*	*35*	*10*	*105*
Max					*0.60*	*2.6*	*5850*	*10*	*150*	*0.80*	*3.0*	*2.46*	*0.70*	*30*	*43*	*101*	*6.0*	*10*	*0.0050*	*1.0*	*1.47*	*30*	*1.4*	*982*	*2.0*	*0.070*	*52*	*600*	*218*	*1.30*	*5.0*	*8.0*	*27*	*20*	*0.210*	*10*	*10*	*61*	*10*	*293*
Field Bin																																								
LX-18-FB3					<0.5	2	386	<10	50	<0.5	<2	1.03	<0.5	19	29	36	4.08	10	<0.005	<1	0.41	30	1.06	611	<1	0.02	35	490	16	0.4	<2	3	24	<20	0.06	<10	<10	27	<10	85

Notes:

Values were set at the limit for calculation of statistical distributions;

AUCCC = average upper continental crust concentrations (Rudnick and Gao, 2014);

Values greater than 3x the AUCCC are shaded in light yellow; values greater than 10x the AUCCC are shaded in red.

Appendix 4-4:
Shake Flask Extraction and Leaching Test Results

Atlantic Gold

Appendix 4-4: Shake Flask Extraction and Leaching Test Results

			CCME WQG							LX-18-FB3		
Sample ID			**Short Term**	**Long Term**	**HC 1**	**HC 2**	**HC 3**	**HC 4**	**HC 5**	**Water to Solid Ratio**		
										3:1	**1:1**	**0.5:1**
Parameter	**Method**	**Units**										
Volume Nanopure Water		mL	-	-	750	750	750	750	750	750	500	350
Sample Weight		g	-	-	250	250	250	250	250	250	500	700
pH	meter	-	6.5-9	-	7.87	7.94	8.11	7.99	7.97	8.16	8.02	7.98
Redox	meter	mV	-	-	362	352	345	347	353	265	312	314
Conductivity	meter	µS/cm	-	-	129	134	78	114	154	96	176	301
Acidity (to pH 4.5)	titration	mg $CaCO_3$/L	-	-	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Total Acidity (to pH 8.3)	titration	mg $CaCO_3$/L	-	-	1.5	1.4	0.8	1.3	1.5	2.3	2.8	3.0
Alkalinity	titration	mg $CaCO_3$/L	-	-	32.4	31.1	29.9	34.9	36.6	29.4	40.4	55.0
Chloride	Colour	mg/L	640	120	12	14	3	12	8	5	17	32
Fluoride	IC	mg/L	-	0.12	0.060	0.090	< 0.06	< 0.06	0.070	< 0.06	0.12	0.21
Sulphate	Turbidity	mg/L	-	-	9	9	5	3	23	7	17	32
Ion Balance												
Major Anions	Calc	meq/L	-	-	1.18	1.21	0.79	1.10	1.44	0.87	1.65	2.68
Major Cations	Calc	meq/L	-	-	1.19	1.22	0.77	1.07	1.43	0.93	1.70	2.74
Difference	Calc	meq/L	-	-	-0.02	-0.01	0.01	0.03	0.01	-0.06	-0.05	-0.06
Balance (%)	Calc	%	-	-	-0.6%	-0.4%	0.8%	1.3%	0.3%	-3.3%	-1.6%	-1.1%
Dissolved Metals												
Hardness $CaCO_3$		mg/L	-	-	47.2	47.2	27.6	44.4	60.6	35.8	61.3	95.3
Aluminum Al[a]	ICP-MS	mg/L	-	0.1	0.134	0.140	0.206	0.099	0.090	0.462	0.319	0.155
Antimony Sb	ICP-MS	mg/L	-	-	0.0003	0.0004	0.0007	0.0003	0.0003	< 0.0002	0.0006	0.0011
Arsenic As	ICP-MS	mg/L	-	0.005	0.0089	0.0307	0.285	0.161	0.0228	0.0443	0.0592	0.0838
Barium Ba	ICP-MS	mg/L	-	-	0.00236	0.00179	0.00112	0.00192	0.00236	0.00129	0.00270	0.00534
Beryllium Be	ICP-MS	mg/L	-	-	< 0.000007	< 0.000007	< 0.000007	< 0.000007	< 0.000007	< 0.000007	< 0.000007	< 0.000007
Bismuth Bi	ICP-MS	mg/L	-	-	< 0.000007	< 0.000007	< 0.000007	< 0.000007	< 0.000007	< 0.000007	< 0.000007	< 0.000007
Boron B	ICP-MS	mg/L	29	1.5	0.009	0.009	0.011	0.022	0.009	0.011	0.014	0.028
Cadmium Cd	ICP-MS	mg/L	0.001	0.00009	< 0.000003	< 0.000003	< 0.000003	0.000003	0.000003	< 0.000003	< 0.000003	0.000005
Calcium Ca	ICP-MS	mg/L	-	-	17.1	17.8	10.3	16.6	22.8	13.2	22.2	34.0
Chromium Cr	ICP-MS	mg/L	-	0.001	0.00012	0.00008	0.00021	0.00016	0.00010	0.00006	0.00007	0.00015
Cobalt Co	ICP-MS	mg/L	-	-	0.000073	0.000011	0.000011	0.000025	0.000054	0.000021	0.000063	0.000194
Copper Cu[b]	ICP-MS	mg/L	-	0.002	0.00014	0.00015	0.00024	0.00004	0.00016	0.00023	0.00032	0.00119
Iron Fe	ICP-MS	mg/L	-	0.3	< 0.007	0.007	0.012	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
Lead Pb[b]	ICP-MS	mg/L	-	0.001	0.00001	0.00002	0.00002	< 0.00001	< 0.00001	< 0.00001	0.00003	0.00003
Lithium Li	ICP-MS	mg/L	-	-	0.0044	0.0034	0.0032	0.0030	0.0050	0.0034	0.0066	0.0109
Magnesium Mg	ICP-MS	mg/L	-	-	1.11	0.628	0.426	0.727	0.906	0.691	1.44	2.55
Manganese Mn	ICP-MS	mg/L	-	-	0.0237	0.0133	0.0112	0.0373	0.0443	0.0201	0.0211	0.0445
Mercury Hg	ICP-MS	µg/L	-	0.026	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Molybdenum Mo	ICP-MS	mg/L	-	0.073	0.00017	0.00040	0.00015	0.00012	0.00010	0.00015	0.00060	0.00166
Nickel Ni[b]	ICP-MS	mg/L	-	0.025	0.0015	0.0004	0.0006	0.0025	0.0011	0.0004	0.0012	0.0031
Phosphorus P	ICP-MS	mg/L	-	-	0.015	0.014	< 0.003	0.003	0.004	< 0.003	< 0.003	0.004
Potassium K	ICP-MS	mg/L	-	-	5.95	6.30	3.99	3.04	4.58	4.08	9.79	17.5
Selenium Se	ICP-MS	mg/L	-	0.001	0.00005	0.00007	< 0.00004	< 0.00004	0.00007	0.00006	0.00012	0.00019
Silicon Si	ICP-MS	mg/L	-	-	1.04	0.94	1.37	1.33	0.87	1.14	1.47	1.87
Silver Ag	ICP-MS	mg/L	-	0.00025	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Sodium Na	ICP-MS	mg/L	-	-	1.78	2.30	2.06	1.95	2.01	1.41	4.27	8.34
Strontium Sr	ICP-MS	mg/L	-	-	0.156	0.137	0.0223	0.0737	0.159	0.0855	0.183	0.313
Sulphur (S)	ICP-MS	mg/L	-	-	4.5	4.0	1.9	1.7	9.7	3.9	9.0	17.1
Thallium Tl	ICP-MS	mg/L	-	0.0008	0.000013	0.000007	< 0.000005	0.000007	0.000007	0.000006	0.000011	0.000018
Tin Sn	ICP-MS	mg/L	-	-	0.00079	0.00086	0.00071	0.00065	0.00086	0.00053	0.00149	0.00300
Titanium Ti	ICP-MS	mg/L	-	-	0.00044	0.00042	0.00086	0.00015	0.00009	0.00018	0.00026	0.00017
Uranium U	ICP-MS	mg/L	0.033	0.015	0.000042	0.000040	0.000055	0.000076	0.000119	0.000096	0.000281	0.000892
Vanadium V	ICP-MS	mg/L	-	-	0.00045	0.00039	0.00107	0.00060	0.00020	0.00093	0.00102	0.00075
Zinc Zn	ICP-MS	mg/L	0.037	0.007	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Zirconium Zr	ICP-MS	mg/L	-	-	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002

Notes:

Values shaded in light grey are above the long-term CCME guideline; values shaded in dark grey are above 10x the CCME guideline; no values are above the short-term CCME guidelines

[a] Aluminum guideline is based on pH > 6.5

[b] Hardness dependent guidelines are based on a hardness of 10 mg/L

CCME – Canadian Council for Ministers of the Environment; WQG – Water quality guideline for the protection of aquatic life

Appendix 4-5:
Particle Size Distribution Results

Atlantic Gold

Appendix 4-5: Particle Size Distribution Results

Cell # 1

Sieve	Aperture	Weight Retained		
Designation				**Cumulative**
	(mm)	**(g)**	**(%)**	**(%)**
+3/8"	9.500	6.00	6.0%	6.0%
- 3/8" +1/4"	6.300	8.50	8.5%	14.5%
-1/4" + 5	4.000	26.40	26.5%	41.0%
5 + 10	1.700	22.50	22.5%	63.5%
-10 + 35	0.425	21.20	21.2%	84.8%
-48 + 100	0.150	6.30	6.3%	91.1%
-200 + 270	0.053	3.50	3.5%	94.6%
-270	-0.053	5.40	5.4%	100.0%
TOTAL		99.80	100.0%	

Cell # 2

Sieve	Aperture	Weight Retained		
Designation				**Cumulative**
	(mm)	**(g)**	**(%)**	**(%)**
+3/8"	9.500	3.90	3.9%	3.9%
- 3/8" +1/4"	6.300	12.00	12.1%	16.0%
-1/4" + 5	4.000	24.60	24.7%	40.7%
5 + 10	1.700	22.30	22.4%	63.1%
-10 + 35	0.425	21.80	21.9%	85.0%
-48 + 100	0.150	6.20	6.2%	91.3%
-200 + 270	0.053	3.00	3.0%	94.3%
-270	-0.053	5.70	5.7%	100.0%
TOTAL		99.50	100.0%	

Cell # 3

Sieve	Aperture	Weight Retained		
Designation				**Cumulative**
	(mm)	**(g)**	**(%)**	**(%)**
+3/8"	9.500	1.70	1.7%	1.7%
- 3/8" +1/4"	6.300	13.40	13.5%	15.2%
-1/4" + 5	4.000	27.10	27.3%	42.5%
5 + 10	1.700	22.60	22.7%	65.2%
-10 + 35	0.425	20.50	20.6%	85.8%
-48 + 100	0.150	5.90	5.9%	91.8%
-200 + 270	0.053	3.50	3.5%	95.3%
-270	-0.053	4.70	4.7%	100.0%
TOTAL		99.40	100.0%	

Cell # 4

Sieve	Aperture	Weight Retained		
Designation				**Cumulative**
	(mm)	**(g)**	**(%)**	**(%)**
+3/8"	9.500	1.60	1.6%	1.6%
- 3/8" +1/4"	6.300	10.20	10.3%	11.9%
-1/4" + 5	4.000	34.40	34.7%	46.6%
5 + 10	1.700	28.10	28.4%	75.0%
-10 + 35	0.425	15.20	15.3%	90.3%
-48 + 100	0.150	3.30	3.3%	93.6%
-200 + 270	0.053	2.50	2.5%	96.2%
-270	-0.053	3.80	3.8%	100.0%
TOTAL		99.10	100.0%	

Cell # 5

Sieve	Aperture	Weight Retained		
Designation				**Cumulative**
	(mm)	**(g)**	**(%)**	**(%)**
+3/8"	9.500	5.40	5.5%	5.5%
- 3/8" +1/4"	6.300	12.90	13.1%	18.5%
-1/4" + 5	4.000	26.70	27.1%	45.6%
5 + 10	1.700	22.80	23.1%	68.7%
-10 + 35	0.425	18.70	18.9%	87.6%
-48 + 100	0.150	4.70	4.8%	92.4%
-200 + 270	0.053	2.50	2.5%	94.9%
-270	-0.053	5.00	5.1%	100.0%
TOTAL		98.70	100.0%	

Appendix 4-6:
Kinetic Test Results

Atlantic Gold

Appendix 4-6: Kinetic Test Results

Cell No.	Sample ID	Sample Type	Method Reference	Column Dimensions		Column Packing			Total Volume of Initial Flushings	Flushing Rate/Weekly Input*	Temp	Sampling Frequency	Start-up Date	Sampling Day	Operation Procedure
				Inner Diameter (cm)	**Length (cm)**	**Dry Wt. of Sample (kg)**	**Other Materials Used**	**Column Material**	**(mL)**	**(mL)**	**(°C)**		**2018**		
HC 1	Cell # 1	Waste Rock	MEND	10.20	25.50	1.00	Acrylic perforated disk & nylon mesh	Acrylic	500	500	20-22 °C	Weekly	24-Aug	Friday	Flood Leach
HC 2	Cell # 2	Waste Rock	MEND	10.20	25.50	1.00	Acrylic perforated disk & nylon mesh	Acrylic	500	500	20-22 °C	Weekly	24-Aug	Friday	Flood Leach
HC 3	Cell # 3	Waste Rock	MEND	10.20	25.50	1.00	Acrylic perforated disk & nylon mesh	Acrylic	500	500	20-22 °C	Weekly	24-Aug	Friday	Flood Leach
HC 4	Cell # 4	Waste Rock	MEND	20.00	10.50	1.00	Acrylic perforated disk & nylon mesh	Acrylic	500	500	20-22 °C	Weekly	24-Aug	Friday	Flood Leach
HC 5	Cell # 5	Ore	MEND	10.20	25.50	1.00	Acrylic perforated disk & nylon mesh	Acrylic	500	500	20-22 °C	Weekly	24-Aug	Friday	Flood Leach

Appendix 4-6: Kinetic Test Results
HC 1

Date	Cycle	Volume mL		pH	Cond.	Acidity	Acidity	Alkalinity	Sulphate	Chloride	Fluoride	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu
	No.	Input	Output			(pH 4.5)	(pH 8.3)					CaCO3												
					umhos/cm	mgCaCO3/L	mgCaCO3/L	mgCaCO3/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
24-Aug-18	0	500	375	7.26	382	#N/A	4.8	20.8	39	54	0.14	127	0.029	0.0003	0.0080	0.00889	0.000027	0.000024	0.013	0.000037	44.9	0.00004	0.00107	0.00042
31-Aug-18	1	500	470	7.65	268	#N/A	3.7	12.8	43	32	0.11	96.8	0.113	0.0006	0.0076	0.00478	<0.0000035	<0.0000035	0.016	0.000064	34.1	<0.000015	0.000129	0.00029
07-Sep-18	2	500	445	7.68	129	#N/A	2.5	14.4	24	8	0.09	44.3	0.181	0.0006	0.0100	0.00192	<0.0000035	<0.0000035	0.028	<0.0000015	15.6	<0.000015	0.000042	0.00014
14-Sep-18	3	500	455	7.58	84	#N/A	1.7	13.0	16	2	0.07	26.5	0.141	0.0005	0.0089	0.00110	0.000008	<0.0000035	0.018	<0.0000015	9.36	0.00016	0.000036	0.00123
21-Sep-18	4	500	465	7.68	70	#N/A	2.3	13.6	13															
28-Sep-18	5	500	475	7.69	62	#N/A	1.6	16.5	11	1	<0.03	25.4	0.179	0.0004	0.0089	0.00107	<0.0000035	<0.0000035	0.006	<0.0000015	9.04	<0.000015	0.000046	0.00027
05-Oct-18	6	500	440	7.66	54	#N/A	1.8	12.6	6															
12-Oct-18	7	500	435	7.71	52	#N/A	3.8	14.7	6	<0.5	<0.03	19.4	0.169	0.0003	0.0087	0.00085	<0.0000035	<0.0000035	0.005	<0.0000015	6.94	0.00017	0.000037	0.00015
19-Oct-18	8	500	445	7.69	51	#N/A	1.7	12.8	8															
26-Oct-18	9	500	435	7.64	50	#N/A	1.5	11.8	11	<0.5	<0.03	22.2	0.152	0.0003	0.0063	0.00084	<0.0000035	<0.0000035	0.005	0.000004	8.02	0.00003	0.000048	0.00218
02-Nov-18	10	500	460	7.52	60	#N/A	1.7	10.4	13															
09-Nov-18	11	500	465	7.42	94	#N/A	2.6	10.2	29	<0.5	<0.03	33.3	0.080	0.0002	0.0080	0.00135	<0.0000035	<0.0000035	0.004	0.000004	12.1	<0.000015	0.000054	0.00042
16-Nov-18	12	500	435	7.38	125	#N/A	1.6	8.6	37															
23-Nov-18	13	500	460	7.46	106	#N/A	2.4	9.1	31	<0.5	<0.03	38.9	0.078	<0.0001	0.0064	0.00161	0.000007	<0.0000035	0.002	<0.0000015	14.4	<0.000015	0.000063	0.00023
30-Nov-18	14	500	440	7.42	96	#N/A	2.0	8.5	29															
07-Dec-18	15	500	475	7.41	96	#N/A	4.3	10.6	30	<0.5	0.07	37.7	0.073	<0.0001	0.0077	0.00153	<0.0000035	<0.0000035	0.005	0.000003	14.1	<0.000015	0.000053	0.00146
14-Dec-18	16	500	480	7.50	95	#N/A	3.6	10.1	28															
21-Dec-18	17	500	475	7.41	98	#N/A	4.0	10.4	28	<0.5	<0.03	37.7	0.065	<0.0001	0.0076	0.00183	<0.0000035	<0.0000035	0.002	0.000015	14.3	<0.000015	0.000086	0.00232
28-Dec-18	18	500	475	7.37	98	#N/A	1.9	8.4	30															
04-Jan-19	19	500	485	7.50	95	#N/A	3.5	9.4	28	<0.5	<0.03	39.5	0.066	<0.0001	0.0079	0.00185	<0.0000035	<0.0000035	0.003	<0.0000015	15.0	0.00004	0.000095	0.00051
11-Jan-19	20	500	480	7.35	94	#N/A	2.7	8.3	30															
18-Jan-19	21	500	465	7.39	83	#N/A	1.7	9.6	33	<0.5	<0.03	41.3	0.099	<0.0001	0.0103	0.00156	<0.0000035	<0.0000035	0.003	0.000032	15.7	<0.000015	0.000054	0.00014
25-Jan-19	22	500	470	7.38	99	#N/A	1.8	7.7	30															
01-Feb-19	23	500	465	7.25	101	#N/A	2.9	9.2	31	<0.5	<0.03	37.0	0.057	<0.0001	0.0072	0.00149	<0.0000035	<0.0000035	0.003	0.000020	14.0	<0.000015	0.000062	0.00048
08-Feb-19	24	500	465	7.38	93	#N/A	3.0	9.2	29															
15-Feb-19	25	500	470	7.35	90	#N/A	1.7	8.6	26	<0.5	<0.03	37.3	0.056	<0.0001	0.0071	0.00155	<0.0000035	<0.0000035	0.008	0.000018	14.3	<0.000015	0.000061	0.00047
22-Feb-19	26	500	440	7.57	87	#N/A	3.2	8.7	27															
01-Mar-19	27	500	460	7.25	84	#N/A	2.5	9.4	23	<0.5	<0.03	33.9	0.059	<0.00045	0.0071	0.00129	<0.0000035	<0.0000035	0.004	0.000007	13.0	<0.00004	0.000057	0.0005
08-Mar-19	28	500	445	7.28	85	#N/A	3.4	8.8	28															
15-Mar-19	29	500	465	7.26	79	#N/A	2.8	7.8	26	<0.5	<0.03	33.1	0.050	<0.00045	0.0066	0.00134	<0.0000035	<0.0000035	0.003	0.000022	12.7	<0.00004	0.000063	0.0012
22-Mar-19	30	500	460	7.36	82	#N/A	3.5	8.9	25															
29-Mar-19	31	500	460	7.22	79	#N/A	2.6	7.7	25	<0.5	<0.03	31.8	0.046	<0.00045	0.0060	0.00127	<0.0000035	<0.0000035	0.002	0.000032	12.2	<0.00004	0.000050	0.0002
05-Apr-19	32	500	465	7.77	81	#N/A	4.6	11.9	25															
12-Apr-19	33	500	485	7.23	85	#N/A	2.0	11.9	27	<0.5	0.08	33.0	0.046	<0.00045	0.0062	0.00120	<0.0000035	<0.0000035	0.003	0.000012	12.7	<0.00004	0.000064	0.0015
19-Apr-19	34	500	455	7.39	75	#N/A	2.1	9.2	21															
26-Apr-19	35	500	455	7.39	74	#N/A	2.9	7.2	24	<0.5	<0.03	32.0	0.049	<0.00045	0.0060	0.00131	<0.0000035	<0.0000035	0.005	0.000009	12.3	<0.00004	0.000075	0.0007
03-May-19	36	500	465	7.62	75	#N/A	2.8	7.6	24															
10-May-19	37	500	455	7.47	74	#N/A	1.6	7.7	22	<0.5	<0.03	30.5	0.048	<0.00045	0.0063	0.00126	<0.0000035	<0.0000035	0.002	0.000005	11.8	<0.00004	0.000120	0.0027
17-May-19	38	500	465	7.25	73	#N/A	2.6	7.1	20	<0.5	<0.03	28.8	0.046	<0.00045	0.0062	0.00112	<0.0000035	<0.0000035	<0.001	0.000009	11.1	<0.00004	0.000092	0.0007
24-May-19	39	500	445	7.24	69	#N/A	3.1	7.1	20	<0.5	<0.03	27.7	0.041	<0.00045	0.0051	0.00101	<0.0000035	<0.0000035	0.003	<0.0000015	10.7	<0.00004	0.000067	0.0007
31-May-19	40	500	460	7.20	69	#N/A	2.7	6.6	18															
07-Jun-19	41	500	460	7.15				6.8	23															
14-Jun-19	42	500	470	7.05				5.6																
21-Jun-19	43	500	450	7.22				6.0	19			26.5	0.045	<0.00045	0.0051	0.00106	<0.0000035	<0.0000035	0.002	0.000003	10.2	<0.00004	0.000108	0.0032
28-Jun-19	44	500	465	7.14				6.0																
05-Jul-19	45	500	445	7.01				4.7	19															
12-Jul-19	46	500	460	7.01				6.2																
19-Jul-19	47	500	460	6.96				5.9	20			25.4	0.037	<0.00045	0.0047	0.00102	<0.0000035	<0.0000035	0.003	0.000003	9.77	<0.00004	0.000052	<0.0001
26-Jul-19	48	500	465	7.40				5.9																
02-Aug-19	49	500	450	6.64				5.8	18															
09-Aug-19	50	500	440	7.15				6.2																

Jun 07/19. Change in analytical schedule.

Appendix 4-6: Kinetic Test Results
HC 1

Date	**Cycle**	**Volume mL**		**pH**	**Cond.**	**Acidity**	**Acidity**	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output			(pH 4.5)	(pH 8.3)					CaCO3												
					umhos/cm	mgCaCO3/L	mgCaCO3/L	mgCaCO3/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Loads	**mg/kg**																							
24-Aug-18	0			7.26					14.625	20.25	0.0525	47.625	0.010875	0.0001125	0.003	0.00333375	0.000010125	0.000009	0.004875	0.000013875	16.8375	0.000015	0.00040125	0.0001575
31-Aug-18	1			7.65					20.21	15.04	0.0517	45.496	0.05311	0.000282	0.003572	0.0022466	0.000001645	0.000001645	0.00752	0.00003008	16.027	0.00000705	0.00006063	0.0001363
07-Sep-18	2			7.68					10.68	3.56	0.04005	19.7135	0.080545	0.000267	0.00445	0.0008544	1.5575E-06	1.5575E-06	0.01246	6.675E-07	6.942	0.000006675	0.00001869	0.0000623
14-Sep-18	3			7.58					7.28	0.91	0.03185	12.0575	0.064155	0.0002275	0.0040495	0.0005005	0.00000364	1.5925E-06	0.00819	6.825E-07	4.2588	0.0000728	0.00001638	0.00055965
21-Sep-18	4			7.68					6.045															
28-Sep-18	5			7.69					5.225	0.475	0.01425	12.065	0.085025	0.00019	0.0042275	0.00050825	1.6625E-06	1.6625E-06	0.00285	7.125E-07	4.294	0.000007125	0.00002185	0.00012825
05-Oct-18	6			7.66					2.64															
12-Oct-18	7			7.71					2.61	0.2175	0.01305	8.439	0.073515	0.0001305	0.0037845	0.00036975	1.5225E-06	1.5225E-06	0.002175	6.525E-07	3.0189	0.00007395	0.000016095	0.00006525
19-Oct-18	8			7.69					3.56															
26-Oct-18	9			7.64					4.785	0.2175	0.01305	9.657	0.06612	0.0001305	0.0027405	0.0003654	1.5225E-06	1.5225E-06	0.002175	0.00000174	3.4887	0.00001305	0.00002088	0.0009483
02-Nov-18	10			7.52					5.98															
09-Nov-18	11			7.42					13.485	0.2325	0.01395	15.4845	0.0372	0.000093	0.00372	0.00062775	1.6275E-06	1.6275E-06	0.00186	0.00000186	5.6265	0.000006975	0.00002511	0.0001953
16-Nov-18	12			7.38					16.095															
23-Nov-18	13			7.46					14.26	0.23	0.0138	17.894	0.03588	0.000046	0.002944	0.0007406	0.00000322	0.00000161	0.00092	0.00000069	6.624	0.0000069	0.00002898	0.0001058
30-Nov-18	14			7.42					12.76															
07-Dec-18	15			7.41					14.25	0.2375	0.03325	17.9075	0.034675	0.0000475	0.0036575	0.00072675	1.6625E-06	1.6625E-06	0.002375	0.000001425	6.6975	0.000007125	0.000025175	0.0006935
14-Dec-18	16			7.5					13.44															
21-Dec-18	17			7.41					13.3	0.2375	0.01425	17.9075	0.030875	0.0000475	0.00361	0.00086925	1.6625E-06	1.6625E-06	0.00095	0.000007125	6.7925	0.000007125	0.00004085	0.001102
28-Dec-18	18			7.37					14.25															
04-Jan-19	19			7.5					13.58	0.2425	0.01455	19.1575	0.03201	0.0000485	0.0038315	0.00089725	1.6975E-06	1.6975E-06	0.001455	7.275E-07	7.275	0.0000194	0.000046075	0.00024735
11-Jan-19	20			7.35					14.4															
18-Jan-19	21			7.39					15.345	0.2325	0.01395	19.2045	0.046035	0.0000465	0.0047895	0.0007254	1.6275E-06	1.6275E-06	0.001395	0.00001488	7.3005	0.000006975	0.00002511	0.0000651
25-Jan-19	22			7.38					14.1															
01-Feb-19	23			7.25					14.415	0.2325	0.01395	17.205	0.026505	0.0000465	0.003348	0.00069285	1.6275E-06	1.6275E-06	0.001395	0.0000093	6.51	0.000006975	0.00002883	0.0002232
08-Feb-19	24			7.38					13.485															
15-Feb-19	25			7.35					12.22	0.235	0.0141	17.531	0.02632	0.000047	0.003337	0.0007285	0.000001645	0.000001645	0.00376	0.00000846	6.721	0.00000705	0.00002867	0.0002209
22-Feb-19	26			7.57					11.88															
01-Mar-19	27			7.25					10.58	0.23	0.0138	15.594	0.02714	0.000207	0.003266	0.0005934	0.00000161	0.00000161	0.00184	0.00000322	5.98	0.0000184	0.00002622	0.00023
08-Mar-19	28			7.28					12.46															
15-Mar-19	29			7.26					12.09	0.2325	0.01395	15.3915	0.02325	0.00020925	0.003069	0.0006231	1.6275E-06	1.6275E-06	0.001395	0.00001023	5.9055	0.0000186	0.000029295	0.000558
22-Mar-19	30			7.36					11.5															
29-Mar-19	31			7.22					11.5	0.23	0.0138	14.628	0.02116	0.000207	0.00276	0.0005842	0.00000161	0.00000161	0.00092	0.00001472	5.612	0.0000184	0.000023	0.000092
05-Apr-19	32			7.77					11.625															
12-Apr-19	33			7.23					13.095	0.2425	0.0388	16.005	0.02231	0.00021825	0.003007	0.000582	1.6975E-06	1.6975E-06	0.001455	0.00000582	6.1595	0.0000194	0.00003104	0.0007275
19-Apr-19	34			7.39					9.555															
26-Apr-19	35			7.39					10.92	0.2275	0.01365	14.56	0.022295	0.00020475	0.00273	0.00059605	1.5925E-06	1.5925E-06	0.002275	0.000004095	5.5965	0.0000182	0.000034125	0.0003185
03-May-19	36			7.62					11.16															
10-May-19	37			7.47					10.01	0.2275	0.01365	13.8775	0.02184	0.00020475	0.0028665	0.0005733	1.5925E-06	1.5925E-06	0.00091	0.000002275	5.369	0.0000182	0.0000546	0.0012285
17-May-19	38			7.25					9.3	0.2325	0.01395	13.392	0.02139	0.00020925	0.002883	0.0005208	1.6275E-06	1.6275E-06	0.000465	0.000004185	5.1615	0.0000186	0.00004278	0.0003255
24-May-19	39			7.24					8.9	0.2225	0.01335	12.3265	0.018245	0.00020025	0.0022695	0.00044945	1.5575E-06	1.5575E-06	0.001335	6.675E-07	4.7615	0.0000178	0.000029815	0.0003115
31-May-19	40			7.2					8.28															
07-Jun-19	41			7.15					10.58															
14-Jun-19	42			7.05																				
21-Jun-19	43			7.22					8.55			11.925	0.02025	0.0002025	0.002295	0.000477	0.000001575	0.000001575	0.0009	0.00000135	4.59	0.000018	0.0000486	0.00144
28-Jun-19	44			7.14																				
05-Jul-19	45			7.01					8.455															
12-Jul-19	46			7.01																				
19-Jul-19	47			6.96					9.2			11.684	0.01702	0.000207	0.002162	0.0004692	0.00000161	0.00000161	0.00138	0.00000138	4.4942	0.0000184	0.00002392	0.000046
26-Jul-19	48			7.4																				
02-Aug-19	49			6.64					8.1															

Appendix 4-6: Kinetic Test Results
HC 1

Date	Cycle	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.																							
		mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
24-Aug-18	0	0.010	0.00003	0.0087	3.53	0.147	<0.005	0.00039	0.0108	0.029	17.4	0.00012	1.22	<0.000025	6.86	0.481	14.8	0.000053	0.00224	<0.000025	0.000232	0.00023	<0.001	<0.001
31-Aug-18	1	<0.0035	<0.000005	0.0052	2.82	0.0424	<0.005	0.00080	0.0022	0.012	10.8	0.00013	1.41	<0.000025	4.40	0.347	15.7	0.000016	0.00115	<0.000025	0.000463	0.00054	<0.001	<0.001
07-Sep-18	2	<0.0035	0.00003	0.0029	1.30	0.0157	<0.005	0.00085	0.0007	<0.0015	6.50	0.00013	1.33	<0.000025	1.97	0.150	9.5	0.000007	0.00061	<0.000025	0.000271	0.00076	<0.001	<0.001
14-Sep-18	3	0.043	0.00005	0.0021	0.772	0.0122	0.02	0.00036	0.0004	0.003	4.24	0.00013	1.02	<0.000025	1.00	0.0977	5.0	0.000008	0.00035	0.00007	0.000213	0.00075	<0.001	<0.001
21-Sep-18	4																							
28-Sep-18	5	0.010	0.00002	0.0021	0.678	0.0134	0.02	0.00015	0.0007	<0.0015	3.29	0.00004	1.20	<0.000025	0.56	0.0796	4.0	<0.0000025	0.00020	<0.000025	0.000296	0.00092	<0.001	<0.001
05-Oct-18	6																							
12-Oct-18	7	<0.0035	0.00003	0.0017	0.510	0.0105	<0.005	0.00009	<0.00005	<0.0015	2.50	<0.00002	1.02	<0.000025	0.38	0.0550	2.7	0.000005	0.00008	0.00017	0.000153	0.00082	<0.001	<0.001
19-Oct-18	8																							
26-Oct-18	9	0.016	<0.000005	0.0015	0.522	0.00319	0.05	0.00028	0.0002	0.003	2.65	0.00007	0.79	<0.000025	0.38	0.0504	3.5	<0.0000025	0.00011	0.00070	0.000262	0.00091	<0.001	<0.001
02-Nov-18	10																							
09-Nov-18	11	<0.0035	0.00002	0.0016	0.755	0.00116	<0.005	0.00021	0.0003	<0.0015	2.22	<0.00002	0.82	<0.000025	0.28	0.0914	8.9	0.000007	0.00009	0.00006	0.000710	0.00041	<0.001	<0.001
16-Nov-18	12																							
23-Nov-18	13	<0.0035	<0.000005	0.0014	0.712	0.00136	<0.005	0.00027	0.0002	0.005	2.40	<0.00002	0.77	<0.000025	0.24	0.0888	10.6	0.000012	0.00012	<0.000025	0.000633	0.00031	<0.001	<0.001
30-Nov-18	14																							
07-Dec-18	15	<0.0035	<0.000005	0.0012	0.592	0.00177	<0.005	0.00050	0.0002	<0.0015	2.39	<0.00002	0.87	<0.000025	0.18	0.0801	9.8	<0.0000025	0.00008	<0.000025	0.000530	0.00032	<0.001	<0.001
14-Dec-18	16																							
21-Dec-18	17	<0.0035	<0.000005	0.0010	0.497	0.00218	<0.005	0.00033	<0.00005	<0.0015	2.38	<0.00002	0.82	<0.000025	0.17	0.0730	10.2	<0.0000025	0.00006	<0.000025	0.000501	0.00027	<0.001	<0.001
28-Dec-18	18																							
04-Jan-19	19	<0.0035	0.00001	0.0010	0.510	0.00146	<0.005	0.00259	0.0002	<0.0015	2.32	0.00005	0.68	<0.000025	0.20	0.0690	12.6	<0.0000025	0.00002	<0.000025	0.000359	0.00023	<0.001	<0.001
11-Jan-19	20																							
18-Jan-19	21	<0.0035	<0.000005	0.0012	0.517	0.00042	<0.005	0.00038	<0.00005	<0.0015	2.23	<0.00002	0.72	<0.000025	0.21	0.0687	11.1	<0.0000025	0.00007	<0.000025	0.000401	0.00021	<0.001	<0.001
25-Jan-19	22																							
01-Feb-19	23	<0.0035	<0.000005	0.0017	0.483	0.00090	<0.005	0.00459	0.0002	<0.0015	1.77	<0.00002	0.71	<0.000025	0.22	0.0637	12.6	<0.0000025	0.00006	<0.000025	0.000350	0.00016	<0.001	<0.001
08-Feb-19	24																							
15-Feb-19	25	<0.0035	<0.000005	0.0010	0.394	0.00114	<0.005	0.00038	0.0002	<0.0015	1.95	<0.00002	0.73	<0.000025	0.24	0.0482	11.9	0.000007	<0.00005	0.00007	0.000233	0.00018	<0.001	<0.001
22-Feb-19	26																							
01-Mar-19	27	<0.0035	<0.000005	0.0027	0.350	0.00087	<0.005	0.00038	0.0003	<0.0015	1.73	<0.00002	0.64	<0.000025	0.23	0.0455	9.6	<0.0000025	0.00009	<0.000025	0.000187	0.00015	<0.001	<0.001
08-Mar-19	28																							
15-Mar-19	29	<0.0035	0.00012	0.0010	0.336	0.00127	<0.005	0.00030	0.0002	<0.0015	1.64	<0.00002	0.62	<0.000025	0.12	0.0416	9.7	<0.0000025	0.00019	<0.000025	0.000185	0.00016	<0.001	<0.001
22-Mar-19	30																							
29-Mar-19	31	<0.0035	<0.000005	0.0013	0.329	0.00101	<0.005	0.00028	0.0002	<0.0015	1.52	<0.00002	0.59	<0.000025	0.16	0.0387	11.2	0.000010	<0.00003	<0.000025	0.000131	0.00011	<0.001	<0.001
05-Apr-19	32																							
12-Apr-19	33	<0.0035	<0.000005	0.0009	0.326	0.00100	<0.005	0.00210	0.0001	0.006	1.46	<0.00002	0.59	<0.000025	0.12	0.0387	7.3	0.000009	0.00006	0.00010	0.000228	0.00012	<0.001	<0.001
19-Apr-19	34																							
26-Apr-19	35	<0.0035	0.00002	0.0011	0.297	0.00196	<0.005	0.00076	<0.00005	<0.0015	1.53	<0.00002	0.61	<0.000025	0.18	0.0353	10.4	0.000010	0.00006	<0.000025	0.000129	0.00018	<0.001	<0.001
03-May-19	36																							
10-May-19	37	0.029	<0.000005	0.0009	0.290	0.00429	<0.005	0.00029	0.0002	<0.0015	1.45	<0.00002	0.60	<0.000025	0.16	0.0317	9.3	0.000009	<0.00003	<0.000025	0.000131	0.00012	<0.001	<0.001
17-May-19	38	<0.0035	0.00001	0.0009	0.262	0.00142	<0.005	0.00025	0.0002	<0.0015	1.38	<0.00002	0.59	<0.000025	0.15	0.0302	7.9	0.000009	<0.00003	<0.000025	0.000086	0.00011	<0.001	<0.001
24-May-19	39	<0.0035	<0.000005	0.0010	0.258	0.00134	<0.005	0.00027	0.0001	<0.0015	1.37	<0.00002	0.59	<0.000025	0.15	0.0283	7.8	0.000009	<0.00003	<0.000025	0.000078	0.00010	<0.001	<0.001
31-May-19	40																							
07-Jun-19	41																							
14-Jun-19	42																							
21-Jun-19	43	0.063	<0.000005	0.0007	0.245	0.00399	<0.005	0.00028	0.0002	<0.0015	1.33	<0.00002	0.48	<0.000025	0.16	0.0239	5.4	0.000007	<0.00003	<0.000025	0.000092	0.00009	<0.001	<0.001
28-Jun-19	44																							
05-Jul-19	45																							
12-Jul-19	46																							
19-Jul-19	47	<0.0035	0.00002	0.0008	0.241	0.00185	<0.005	0.00089	0.0003	<0.0015	1.27	<0.00002	0.50	<0.000025	0.10	0.0210	7.5	0.000008	<0.00003	<0.000025	0.000090	0.00007	<0.001	<0.001
26-Jul-19	48																							
02-Aug-19	49																							
09-Aug-19	50																							

Jun 07/19. Change in analytica

Appendix 4-6: Kinetic Test Results
HC 1

Date	**Cycle**	**Fe**	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
	No.																							
		mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Loads	**mg/kg**																							
24-Aug-18	0	0.00375	0.00001125	0.0032625	1.32375	0.055125	0.001875	0.00014625	0.00405	0.010875	6.525	0.000045	0.4575	0.000009375	2.5725	0.180375	5.55	0.000019875	0.00084	0.000009375	0.000087	0.00008625	0.000375	0.000375
31-Aug-18	1	0.001645	0.00000235	0.002444	1.3254	0.019928	0.00235	0.000376	0.001034	0.00564	5.076	0.0000611	0.6627	0.00001175	2.068	0.16309	7.379	0.00000752	0.0005405	0.00001175	0.00021761	0.0002538	0.00047	0.00047
07-Sep-18	2	0.0015575	0.00001335	0.0012905	0.5785	0.0069865	0.002225	0.00037825	0.0003115	0.0006675	2.8925	0.00005785	0.59185	0.000011125	0.87665	0.06675	4.2275	0.000003115	0.00027145	0.000011125	0.000120595	0.0003382	0.000445	0.000445
14-Sep-18	3	0.019565	0.00002275	0.0009555	0.35126	0.005551	0.0091	0.0001638	0.000182	0.001365	1.9292	0.00005915	0.4641	0.000011375	0.455	0.0444535	2.275	0.00000364	0.00015925	0.00003185	0.000096915	0.00034125	0.000455	0.000455
21-Sep-18	4																							
28-Sep-18	5	0.00475	0.0000095	0.0009975	0.32205	0.006365	0.0095	0.00007125	0.0003325	0.0007125	1.56275	0.000019	0.57	0.000011875	0.266	0.03781	1.9	1.1875E-06	0.000095	0.000011875	0.0001406	0.000437	0.000475	0.000475
05-Oct-18	6																							
12-Oct-18	7	0.0015225	0.00001305	0.0007395	0.22185	0.0045675	0.002175	0.00003915	0.00002175	0.0006525	1.0875	0.0000087	0.4437	0.000010875	0.1653	0.023925	1.1745	0.000002175	0.0000348	0.00007395	0.000066555	0.0003567	0.000435	0.000435
19-Oct-18	8																							
26-Oct-18	9	0.00696	0.000002175	0.0006525	0.22707	0.00138765	0.02175	0.0001218	0.000087	0.001305	1.15275	0.00003045	0.34365	0.000010875	0.1653	0.021924	1.5225	1.0875E-06	0.00004785	0.0003045	0.00011397	0.00039585	0.000435	0.000435
02-Nov-18	10																							
09-Nov-18	11	0.0016275	0.0000093	0.000744	0.351075	0.0005394	0.002325	0.00009765	0.0001395	0.0006975	1.0323	0.0000093	0.3813	0.000011625	0.1302	0.042501	4.1385	0.000003255	0.00004185	0.0000279	0.00033015	0.00019065	0.000465	0.000465
16-Nov-18	12																							
23-Nov-18	13	0.00161	0.0000023	0.000644	0.32752	0.0006256	0.0023	0.0001242	0.000092	0.0023	1.104	0.0000092	0.3542	0.0000115	0.1104	0.040848	4.876	0.00000552	0.0000552	0.0000115	0.00029118	0.0001426	0.00046	0.00046
30-Nov-18	14																							
07-Dec-18	15	0.0016625	0.000002375	0.00057	0.2812	0.00084075	0.002375	0.0002375	0.000095	0.0007125	1.13525	0.0000095	0.41325	0.000011875	0.0855	0.0380475	4.655	1.1875E-06	0.000038	0.000011875	0.00025175	0.000152	0.000475	0.000475
14-Dec-18	16																							
21-Dec-18	17	0.0016625	0.000002375	0.000475	0.236075	0.0010355	0.002375	0.00015675	0.00002375	0.0007125	1.1305	0.0000095	0.3895	0.000011875	0.08075	0.034675	4.845	1.1875E-06	0.0000285	0.000011875	0.000237975	0.00012825	0.000475	0.000475
28-Dec-18	18																							
04-Jan-19	19	0.0016975	0.00000485	0.000485	0.24735	0.0007081	0.002425	0.00125615	0.000097	0.0007275	1.1252	0.00002425	0.3298	0.000012125	0.097	0.033465	6.111	1.2125E-06	0.0000097	0.000012125	0.000174115	0.00011155	0.000485	0.000485
11-Jan-19	20																							
18-Jan-19	21	0.0016275	0.000002325	0.000558	0.240405	0.0001953	0.002325	0.0001767	0.00002325	0.0006975	1.03695	0.0000093	0.3348	0.000011625	0.09765	0.0319455	5.1615	1.1625E-06	0.00003255	0.000011625	0.000186465	0.00009765	0.000465	0.000465
25-Jan-19	22																							
01-Feb-19	23	0.0016275	0.000002325	0.0007905	0.224595	0.0004185	0.002325	0.00213435	0.000093	0.0006975	0.82305	0.0000093	0.33015	0.000011625	0.1023	0.0296205	5.859	1.1625E-06	0.0000279	0.000011625	0.00016275	0.0000744	0.000465	0.000465
08-Feb-19	24																							
15-Feb-19	25	0.001645	0.00000235	0.00047	0.18518	0.0005358	0.00235	0.0001786	0.000094	0.000705	0.9165	0.0000094	0.3431	0.00001175	0.1128	0.022654	5.593	0.00000329	0.0000235	0.0000329	0.00010951	0.0000846	0.00047	0.00047
22-Feb-19	26																							
01-Mar-19	27	0.00161	0.0000023	0.001242	0.161	0.0004002	0.0023	0.0001748	0.000138	0.00069	0.7958	0.0000092	0.2944	0.0000115	0.1058	0.02093	4.416	0.00000115	0.0000414	0.0000115	0.00008602	0.000069	0.00046	0.00046
08-Mar-19	28																							
15-Mar-19	29	0.0016275	0.0000558	0.000465	0.15624	0.00059055	0.002325	0.0001395	0.000093	0.0006975	0.7626	0.0000093	0.2883	0.000011625	0.0558	0.019344	4.5105	1.1625E-06	0.00008835	0.000011625	0.000086025	0.0000744	0.000465	0.000465
22-Mar-19	30																							
29-Mar-19	31	0.00161	0.0000023	0.000598	0.15134	0.0004646	0.0023	0.0001288	0.000092	0.00069	0.6992	0.0000092	0.2714	0.0000115	0.0736	0.017802	5.152	0.0000046	0.0000138	0.0000115	0.00006026	0.0000506	0.00046	0.00046
05-Apr-19	32																							
12-Apr-19	33	0.0016975	0.000002425	0.0004365	0.15811	0.000485	0.002425	0.0010185	0.0000485	0.00291	0.7081	0.0000097	0.28615	0.000012125	0.0582	0.0187695	3.5405	0.000004365	0.0000291	0.0000485	0.00011058	0.0000582	0.000485	0.000485
19-Apr-19	34																							
26-Apr-19	35	0.0015925	0.0000091	0.0005005	0.135135	0.0008918	0.002275	0.0003458	0.00002275	0.0006825	0.69615	0.0000091	0.27755	0.000011375	0.0819	0.0160615	4.732	0.00000455	0.0000273	0.000011375	0.000058695	0.0000819	0.000455	0.000455
03-May-19	36																							
10-May-19	37	0.013195	0.000002275	0.0004095	0.13195	0.00195195	0.002275	0.00013195	0.000091	0.0006825	0.65975	0.0000091	0.273	0.000011375	0.0728	0.0144235	4.2315	0.000004095	0.00001365	0.000011375	0.000059605	0.0000546	0.000455	0.000455
17-May-19	38	0.0016275	0.00000465	0.0004185	0.12183	0.0006603	0.002325	0.00011625	0.000093	0.0006975	0.6417	0.0000093	0.27435	0.000011625	0.06975	0.014043	3.6735	0.000004185	0.00001395	0.000011625	0.00003999	0.00005115	0.000465	0.000465
24-May-19	39	0.0015575	0.000002225	0.000445	0.11481	0.0005963	0.002225	0.00012015	0.0000445	0.0006675	0.60965	0.0000089	0.26255	0.000011125	0.06675	0.0125935	3.471	0.000004005	0.00001335	0.000011125	0.00003471	0.0000445	0.000445	0.000445
31-May-19	40																							
07-Jun-19	41																							
14-Jun-19	42																							
21-Jun-19	43	0.02835	0.00000225	0.000315	0.11025	0.0017955	0.00225	0.000126	0.00009	0.000675	0.5985	0.000009	0.216	0.00001125	0.072	0.010755	2.43	0.00000315	0.0000135	0.00001125	0.0000414	0.0000405	0.00045	0.00045
28-Jun-19	44																							
05-Jul-19	45																							
12-Jul-19	46																							
19-Jul-19	47	0.00161	0.0000092	0.000368	0.11086	0.000851	0.0023	0.0004094	0.000138	0.00069	0.5842	0.0000092	0.23	0.0000115	0.046	0.00966	3.45	0.00000368	0.0000138	0.0000115	0.0000414	0.0000322	0.00046	0.00046
26-Jul-19	48																							
02-Aug-19	49																							

Appendix 4-6: Kinetic Test Results
HC 2

Date	Cycle	Volume mL		pH	Cond.	Acidity	Acidity	Alkalinity	Sulphate	Chloride	Fluoride	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu	Fe
	No.	Input	Output			(pH 4.5)	(pH 8.3)					CaCO3													
					umhos/cm	mgCaCO3/L	mgCaCO3/L	mgCaCO3/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
24-Aug-18	0	500	345	7.78	417	#N/A	4.0	26.2	31	63	0.16	138	0.054	0.0009	0.0349	0.00637	0.000268	0.000283	0.017	0.000073	52.0	0.00006	0.000113	0.00038	0.020
31-Aug-18	1	500	455	7.78	261	#N/A	3.5	15.8	31	40	0.13	89.1	0.140	0.0004	0.0239	0.00335	*<0.0000035*	*<0.0000035*	0.021	0.000004	33.3	*<0.000015*	0.000011	0.00028	*<0.0035*
07-Sep-18	2	500	475	7.75	127	#N/A	2.7	16.3	19	11	0.12	43.4	0.216	0.0004	0.0236	0.00148	*<0.0000035*	*<0.0000035*	0.014	*<0.0000015*	16.2	*<0.000015*	0.000013	0.00004	0.008
14-Sep-18	3	500	465	7.75	83	#N/A	1.6	14.4	14	2	0.09	26.0	0.165	0.0003	0.0228	0.00083	*<0.0000035*	*<0.0000035*	0.013	*<0.0000015*	9.75	0.00012	0.000012	0.00065	0.010
21-Sep-18	4	500	470	7.80	69	#N/A	2.4	15.3	12																
28-Sep-18	5	500	435	7.93	58	#N/A	1.4	20.1	10	1	0.06	22.8	0.201	0.0003	0.0221	0.00070	*<0.0000035*	*<0.0000035*	0.008	0.000003	8.56	*<0.000015*	0.000004	0.00032	0.016
05-Oct-18	6	500	450	7.68	57	#N/A	1.9	14.9	7																
12-Oct-18	7	500	430	7.80	60	#N/A	3.6	15.5	9	*<0.5*	*<0.03*	22.5	0.155	0.0002	0.0186	0.00070	*<0.0000035*	*<0.0000035*	0.006	*<0.0000015*	8.41	*<0.000015*	0.000081	0.00023	0.011
19-Oct-18	8	500	460	7.64	74	#N/A	1.9	13.7	17																
26-Oct-18	9	500	450	7.56	89	#N/A	1.7	11.5	25	*<0.5*	*<0.03*	38.1	0.131	*<0.0001*	0.0130	0.00100	*<0.0000035*	*<0.0000035*	0.007	0.000004	14.3	0.00004	0.000072	0.00295	0.018
02-Nov-18	10	500	460	7.55	89	#N/A	1.7	11.0	27																
09-Nov-18	11	500	450	7.61	86	#N/A	2.4	11.2	27	*<0.5*	*<0.03*	30.8	0.088	*<0.0001*	0.0194	0.00091	*<0.0000035*	*<0.0000035*	0.005	0.000004	11.6	0.00004	0.000012	0.00228	*<0.0035*
16-Nov-18	12	500	445	7.61	86	#N/A	1.3	11.3	19																
23-Nov-18	13	500	450	7.70	76	#N/A	2.1	10.9	17	*<0.5*	*<0.03*	28.4	0.115	*<0.0001*	0.0207	0.00071	*<0.0000035*	*<0.0000035*	0.003	0.000003	10.7	*<0.000015*	0.000006	0.00060	*<0.0035*
30-Nov-18	14	500	435	7.61	66	#N/A	1.7	10.1	16																
07-Dec-18	15	500	440	7.59	65	#N/A	4.1	11.9	16	*<0.5*	*<0.03*	25.6	0.085	*<0.0001*	0.0201	0.00064	*<0.0000035*	*<0.0000035*	0.004	0.000006	9.65	*<0.000015*	0.000009	0.00219	*<0.0035*
14-Dec-18	16	500	470	7.73	68	#N/A	3.1	12.1	16																
21-Dec-18	17	500	440	7.60	68	#N/A	3.5	10.8	15	*<0.5*	*<0.03*	26.3	0.075	*<0.0001*	0.0184	0.00065	*<0.0000035*	*<0.0000035*	0.003	0.000008	10.0	0.00012	0.000033	0.00184	*<0.0035*
28-Dec-18	18	500	455	7.53	73	#N/A	1.8	10.2	19																
04-Jan-19	19	500	445	7.69	69	#N/A	3.3	9.9	20	*<0.5*	*<0.03*	29.0	0.071	*<0.0001*	0.0168	0.00068	*<0.0000035*	*<0.0000035*	0.003	*<0.0000015*	11.0	*<0.000015*	0.000041	0.00032	*<0.0035*
11-Jan-19	20	500	440	7.38	67	#N/A	2.7	9.3	20																
18-Jan-19	21	500	440	7.48	61	#N/A	1.6	10.3	19	*<0.5*	*<0.03*	29.0	0.096	*<0.0001*	0.0187	0.00073	*<0.0000035*	*<0.0000035*	0.004	0.000011	11.0	*<0.000015*	0.000004	0.00014	*<0.0035*
25-Jan-19	22	500	440	7.52	67	#N/A	1.8	8.3	16																
01-Feb-19	23	500	445	7.53	66	#N/A	2.8	10.2	15	*<0.5*	*<0.03*	24.4	0.065	*<0.0001*	0.0139	0.00062	*<0.0000035*	*<0.0000035*	0.003	0.000006	9.20	*<0.000015*	0.000012	0.00055	*<0.0035*
08-Feb-19	24	500	440	7.62	63	#N/A	3.0	9.5	15																
15-Feb-19	25	500	445	7.46	63	#N/A	1.7	9.5	15	*<0.5*	*<0.03*	27.0	0.059	*<0.0001*	0.0135	0.00060	*<0.0000035*	*<0.0000035*	0.008	0.000008	10.3	*<0.000015*	0.000011	0.00032	*<0.0035*
22-Feb-19	26	500	445	7.74	62	#N/A	3.0	10.2	16																
01-Mar-19	27	500	445	7.41	58	#N/A	2.2	10.9	12	*<0.5*	*<0.03*	24.4	0.070	*<0.00045*	0.0140	0.00065	*<0.0000035*	*<0.0000035*	0.003	*<0.0000015*	9.29	*<0.00004*	0.000011	0.0007	*<0.0035*
08-Mar-19	28	500	440	7.54	58	#N/A	3.2	10.3	15																
15-Mar-19	29	500	455	7.48	55	#N/A	2.2	9.8	15	*<0.5*	*<0.03*	24.7	0.056	*<0.00045*	0.0132	0.00055	*<0.0000035*	*<0.0000035*	0.003	0.000009	9.45	*<0.00004*	0.000004	*<0.0001*	*<0.0035*
22-Mar-19	30	500	450	7.71	59	#N/A	3.1	10.8	13																
29-Mar-19	31	500	445	7.45	59	#N/A	2.3	10.5	14	*<0.5*	*<0.03*	24.9	0.059	*<0.00045*	0.0133	0.00066	*<0.0000035*	*<0.0000035*	0.004	0.000003	9.49	*<0.00004*	*<0.000002*	*<0.0001*	*<0.0035*
05-Apr-19	32	500	445	7.85	59	#N/A	4.5	14.0	15																
12-Apr-19	33	500	485	7.38	68	#N/A	2.0	14.8	17	*<0.5*	*<0.03*	26.9	0.049	*<0.00045*	0.0123	0.00046	*<0.0000035*	*<0.0000035*	0.003	0.000005	10.3	*<0.00004*	0.000033	0.0053	*<0.0035*
19-Apr-19	34	500	445	7.56	57	#N/A	1.9	10.5	13																
26-Apr-19	35	500	455	7.59	59	#N/A	2.6	9.4	15	*<0.5*	*<0.03*	25.9	0.054	*<0.00045*	0.0116	0.00066	*<0.0000035*	*<0.0000035*	0.004	*<0.0000015*	9.92	*<0.00004*	0.000014	0.0006	*<0.0035*
03-May-19	36	500	455	7.86	59	#N/A	2.6	8.8	15																
10-May-19	37	500	465	7.42	59	#N/A	1.6	8.9	15	*<0.5*	*<0.03*	25.4	0.048	*<0.00045*	0.0128	0.00053	*<0.0000035*	*<0.0000035*	0.003	0.000004	9.76	*<0.00004*	0.000029	0.0015	0.019
17-May-19	38	500	450	7.42	63	#N/A	2.4	8.7	15	*<0.5*	*<0.03*	25.8	0.049	*<0.00045*	0.0130	0.00052	*<0.0000035*	*<0.0000035*	0.002	*<0.0000015*	9.95	*<0.00004*	0.000035	0.0005	*<0.0035*
24-May-19	39	500	455	7.40	66	#N/A	3.0	8.8	19	*<0.5*	*<0.03*	27.3	0.044	*<0.00045*	0.0116	0.00076	*<0.0000035*	*<0.0000035*	0.003	0.000007	10.5	*<0.00004*	0.000026	0.0007	*<0.0035*
31-May-19	40	500	460	7.12	71	#N/A	3.3	6.6	17																
07-Jun-19	41	500	455	7.28				7.9	21																
14-Jun-19	42	500	475	7.39				7.5																	
21-Jun-19	43	500	440	7.53				8.3	19			30.6	0.049	*<0.00045*	0.0147	0.00070	*<0.0000035*	*<0.0000035*	0.003	*<0.0000015*	11.8	*<0.00004*	0.000043	0.0003	0.152
28-Jun-19	44	500	460	7.30				9.8																	
05-Jul-19	45	500	445	7.11				7.1	23																
12-Jul-19	46	500	445	7.03				7.6																	
19-Jul-19	47	500	450	6.94				6.9	22			31.8	0.044	*<0.00045*	0.0211	0.00057	*<0.0000035*	*<0.0000035*	0.003	*<0.0000015*	12.3	*<0.00004*	0.000013	*<0.0001*	*<0.0035*
26-Jul-19	48	500	450	7.50				7.2																	
02-Aug-19	49	500	470	6.62				7.9	33																
09-Aug-19	50	500	435	7.12				7.4																	

Jun 07/19. Change in analytical schedule.

Appendix 4-6: Kinetic Test Results
HC 2

Date	Cycle	Volume mL		pH	Cond.	Acidity	Acidity	Alkalinity	Sulphate	Chloride	Fluoride	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu	Fe
	No.	Input	Output			(pH 4.5)	(pH 8.3)					CaCO3													
					umhos/cm	mgCaCO3/L	mgCaCO3/L	mgCaCO3/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Loads	**mg/kg**																								
24-Aug-18	0			7.78					10.695	21.735	0.0552	47.61	0.01863	0.0003105	0.0120405	0.00219765	0.00009246	0.000097635	0.005865	0.000025185	17.94	0.0000207	0.000038985	0.0001311	0.0069
31-Aug-18	1			7.78					14.105	18.2	0.05915	40.5405	0.0637	0.000182	0.0108745	0.00152425	1.5925E-06	1.5925E-06	0.009555	0.00000182	15.1515	0.000006825	0.000005005	0.0001274	0.0015925
07-Sep-18	2			7.75					9.025	5.225	0.057	20.615	0.1026	0.00019	0.01121	0.000703	1.6625E-06	1.6625E-06	0.00665	7.125E-07	7.695	0.000007125	0.000006175	0.000019	0.0038
14-Sep-18	3			7.75					6.51	0.93	0.04185	12.09	0.076725	0.0001395	0.010602	0.00038595	1.6275E-06	1.6275E-06	0.006045	6.975E-07	4.53375	0.0000558	0.00000558	0.00030225	0.00465
21-Sep-18	4			7.80					5.64																
28-Sep-18	5			7.93					4.35	0.435	0.0261	9.918	0.087435	0.0001305	0.0096135	0.0003045	1.5225E-06	1.5225E-06	0.00348	0.000001305	3.7236	0.000006525	0.00000174	0.0001392	0.00696
05-Oct-18	6			7.68					3.15																
12-Oct-18	7			7.80					3.87	0.215	0.0129	9.675	0.06665	0.000086	0.007998	0.000301	0.000001505	0.000001505	0.00258	0.000000645	3.6163	0.00000645	0.00003483	0.0000989	0.00473
19-Oct-18	8			7.64					7.82																
26-Oct-18	9			7.56					11.25	0.225	0.0135	17.145	0.05895	0.000045	0.00585	0.00045	0.000001575	0.000001575	0.00315	0.0000018	6.435	0.000018	0.0000324	0.0013275	0.0081
02-Nov-18	10			7.55					12.42																
09-Nov-18	11			7.61					12.15	0.225	0.0135	13.86	0.0396	0.000045	0.00873	0.0004095	0.000001575	0.000001575	0.00225	0.0000018	5.22	0.000018	0.0000054	0.001026	0.001575
16-Nov-18	12			7.61					8.455																
23-Nov-18	13			7.70					7.65	0.225	0.0135	12.78	0.05175	0.000045	0.009315	0.0003195	0.000001575	0.000001575	0.00135	0.00000135	4.815	0.00000675	0.0000027	0.00027	0.001575
30-Nov-18	14			7.61					6.96																
07-Dec-18	15			7.59					7.04	0.22	0.0132	11.264	0.0374	0.000044	0.008844	0.0002816	0.00000154	0.00000154	0.00176	0.00000264	4.246	0.0000066	0.00000396	0.0009636	0.00154
14-Dec-18	16			7.73					7.52																
21-Dec-18	17			7.60					6.6	0.22	0.0132	11.572	0.033	0.000044	0.008096	0.000286	0.00000154	0.00000154	0.00132	0.00000352	4.4	0.0000528	0.00001452	0.0008096	0.00154
28-Dec-18	18			7.53					8.645																
04-Jan-19	19			7.69					8.9	0.2225	0.01335	12.905	0.031595	0.0000445	0.007476	0.0003026	1.5575E-06	1.5575E-06	0.001335	6.675E-07	4.895	0.000006675	0.000018245	0.0001424	0.0015575
11-Jan-19	20			7.38					8.8																
18-Jan-19	21			7.48					8.36	0.22	0.0132	12.76	0.04224	0.000044	0.008228	0.0003212	0.00000154	0.00000154	0.00176	0.00000484	4.84	0.0000066	0.00000176	0.0000616	0.00154
25-Jan-19	22			7.52					7.04																
01-Feb-19	23			7.53					6.675	0.2225	0.01335	10.858	0.028925	0.0000445	0.0061855	0.0002759	1.5575E-06	1.5575E-06	0.001335	0.00000267	4.094	0.000006675	0.00000534	0.00024475	0.0015575
08-Feb-19	24			7.62					6.6																
15-Feb-19	25			7.46					6.675	0.2225	0.01335	12.015	0.026255	0.0000445	0.0060075	0.000267	1.5575E-06	1.5575E-06	0.00356	0.00000356	4.5835	0.000006675	0.000004895	0.0001424	0.0015575
22-Feb-19	26			7.74					7.12																
01-Mar-19	27			7.41					5.34	0.2225	0.01335	10.858	0.03115	0.00020025	0.00623	0.00028925	1.5575E-06	1.5575E-06	0.001335	6.675E-07	4.13405	0.0000178	0.000004895	0.0003115	0.0015575
08-Mar-19	28			7.54					6.6																
15-Mar-19	29			7.48					6.825	0.2275	0.01365	11.2385	0.02548	0.00020475	0.006006	0.00025025	1.5925E-06	1.5925E-06	0.001365	0.000004095	4.29975	0.0000182	0.00000182	0.0000455	0.0015925
22-Mar-19	30			7.71					5.85																
29-Mar-19	31			7.45					6.23	0.2225	0.01335	11.0805	0.026255	0.00020025	0.0059185	0.0002937	1.5575E-06	1.5575E-06	0.00178	0.000001335	4.22305	0.0000178	0.00000089	0.0000445	0.0015575
05-Apr-19	32			7.85					6.675																
12-Apr-19	33			7.38					8.245	0.2425	0.01455	13.0465	0.023765	0.00021825	0.0059655	0.0002231	1.6975E-06	1.6975E-06	0.001455	0.000002425	4.9955	0.0000194	0.000016005	0.0025705	0.0016975
19-Apr-19	34			7.56					5.785																
26-Apr-19	35			7.59					6.825	0.2275	0.01365	11.7845	0.02457	0.00020475	0.005278	0.0003003	1.5925E-06	1.5925E-06	0.00182	6.825E-07	4.5136	0.0000182	0.00000637	0.000273	0.0015925
03-May-19	36			7.86					6.825																
10-May-19	37			7.42					6.975	0.2325	0.01395	11.811	0.02232	0.00020925	0.005952	0.00024645	1.6275E-06	1.6275E-06	0.001395	0.00000186	4.5384	0.0000186	0.000013485	0.0006975	0.008835
17-May-19	38			7.42					6.75	0.225	0.0135	11.61	0.02205	0.0002025	0.00585	0.000234	0.000001575	0.000001575	0.0009	0.000000675	4.4775	0.000018	0.00001575	0.000225	0.001575
24-May-19	39			7.40					8.645	0.2275	0.01365	12.4215	0.02002	0.00020475	0.005278	0.0003458	1.5925E-06	1.5925E-06	0.001365	0.000003185	4.7775	0.0000182	0.00001183	0.0003185	0.0015925
31-May-19	40			7.12					7.82																
07-Jun-19	41			7.28					9.555																
14-Jun-19	42			7.39																					
21-Jun-19	43			7.53					8.36			13.464	0.02156	0.000198	0.006468	0.000308	0.00000154	0.00000154	0.00132	0.00000066	5.192	0.0000176	0.00001892	0.000132	0.06688
28-Jun-19	44			7.30																					
05-Jul-19	45			7.11					10.235																
12-Jul-19	46			7.03																					
19-Jul-19	47			6.94					9.9			14.31	0.0198	0.0002025	0.009495	0.0002565	0.000001575	0.000001575	0.00135	0.000000675	5.535	0.000018	0.00000585	0.000045	0.001575
26-Jul-19	48			7.50																					
02-Aug-19	49			6.62					15.51																

Appendix 4-6: Kinetic Test Results
HC 2

Date	Cycle No.	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
		mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
24-Aug-18	0	0.00025	0.0070	2.05	0.0768	0.01	0.00116	0.0032	0.042	17.6	0.00023	1.14	0.00005	8.59	0.432	12.1	0.000262	0.00294	0.00009	0.000478	0.00025	*<0.001*	*<0.001*
31-Aug-18	1	0.00002	0.0038	1.41	0.0182	*<0.005*	0.00113	0.0004	0.008	10.7	0.00018	1.35	*<0.000025*	6.17	0.295	12.4	0.000009	0.00119	*<0.000025*	0.000489	0.00056	*<0.001*	*<0.001*
07-Sep-18	2	0.00006	0.0021	0.688	0.00963	*<0.005*	0.00085	0.0002	*<0.0015*	6.72	0.00012	1.45	*<0.000025*	2.80	0.137	8.2	0.000006	0.00078	0.00041	0.000280	0.00066	*<0.001*	*<0.001*
14-Sep-18	3	0.00004	0.0014	0.399	0.00710	0.02	0.00061	0.0001	*<0.0015*	3.91	0.00013	1.10	*<0.000025*	1.22	0.0884	4.2	0.000005	0.00048	0.00007	0.000213	0.00067	*<0.001*	*<0.001*
21-Sep-18	4																						
28-Sep-18	5	0.00003	0.0014	0.353	0.00639	*<0.005*	0.00039	0.0004	*<0.0015*	3.14	0.00006	1.19	*<0.000025*	0.74	0.0665	3.3	*<0.0000025*	0.00028	0.00022	0.000174	0.00080	*<0.001*	*<0.001*
05-Oct-18	6																						
12-Oct-18	7	0.00004	0.0013	0.364	0.00750	*<0.005*	0.00032	0.0002	*<0.0015*	2.66	0.00004	1.04	*<0.000025*	0.48	0.0634	3.9	*<0.0000025*	0.00019	*<0.000025*	0.000254	0.00062	*<0.001*	*<0.001*
19-Oct-18	8																						
26-Oct-18	9	0.00002	0.0016	0.553	0.00998	0.04	0.00059	0.0002	*<0.0015*	3.08	0.00014	0.78	*<0.000025*	0.61	0.0850	8.7	*<0.0000025*	0.00019	0.00094	0.000576	0.00051	*<0.001*	*<0.001*
02-Nov-18	10																						
09-Nov-18	11	0.00002	0.0013	0.467	0.00773	*<0.005*	0.00030	0.0001	*<0.0015*	2.09	*<0.00002*	0.77	*<0.000025*	0.30	0.0798	7.7	0.000006	0.00007	0.00011	0.000486	0.00032	*<0.001*	*<0.001*
16-Nov-18	12																						
23-Nov-18	13	0.00002	0.0011	0.395	0.00596	*<0.005*	0.00039	*<0.00005*	0.006	1.88	*<0.00002*	0.78	*<0.000025*	0.26	0.0647	6.6	0.000006	0.00014	0.00006	0.000381	0.00037	*<0.001*	*<0.001*
30-Nov-18	14																						
07-Dec-18	15	0.00001	0.0010	0.358	0.00829	*<0.005*	0.00038	*<0.00005*	*<0.0015*	1.78	*<0.00002*	0.81	*<0.000025*	0.20	0.0564	5.5	*<0.0000025*	0.00013	*<0.000025*	0.000268	0.00027	*<0.001*	*<0.001*
14-Dec-18	16																						
21-Dec-18	17	*<0.000005*	0.0008	0.322	0.00824	*<0.005*	0.00037	*<0.00005*	*<0.0015*	1.49	*<0.00002*	0.64	*<0.000025*	0.40	0.0544	5.9	*<0.0000025*	0.00006	0.00007	0.000305	0.00022	*<0.001*	*<0.001*
28-Dec-18	18																						
04-Jan-19	19	*<0.000005*	0.0009	0.369	0.00900	*<0.005*	0.00078	*<0.00005*	*<0.0015*	1.57	*<0.00002*	0.57	*<0.000025*	0.21	0.0555	8.0	*<0.0000025*	0.00006	0.00009	0.000243	0.00019	*<0.001*	*<0.001*
11-Jan-19	20																						
18-Jan-19	21	0.00003	0.0010	0.367	0.00820	*<0.005*	0.00036	*<0.00005*	*<0.0015*	1.50	*<0.00002*	0.62	*<0.000025*	0.26	0.0544	6.6	*<0.0000025*	0.00018	*<0.000025*	0.000258	0.00021	*<0.001*	*<0.001*
25-Jan-19	22																						
01-Feb-19	23	*<0.000005*	0.0016	0.339	0.00768	*<0.005*	0.00164	*<0.00005*	*<0.0015*	1.14	*<0.00002*	0.57	*<0.000025*	0.21	0.0487	6.5	*<0.0000025*	0.00010	*<0.000025*	0.000271	0.00019	*<0.001*	*<0.001*
08-Feb-19	24																						
15-Feb-19	25	*<0.000005*	0.0008	0.310	0.00902	*<0.005*	0.00032	*<0.00005*	*<0.0015*	1.36	*<0.00002*	0.55	*<0.000025*	0.25	0.0424	7.5	*<0.0000025*	*<0.00005*	0.00005	0.000196	0.00016	*<0.001*	*<0.001*
22-Feb-19	26																						
01-Mar-19	27	0.00003	0.0010	0.282	0.00858	*<0.005*	0.00040	0.0001	*<0.0015*	1.17	*<0.00002*	0.53	*<0.000025*	0.23	0.0405	5.1	*<0.0000025*	*<0.00003*	0.00333	0.000186	0.00014	*<0.001*	*<0.001*
08-Mar-19	28																						
15-Mar-19	29	*<0.000005*	0.0008	0.267	0.00857	*<0.005*	0.00032	*<0.00005*	*<0.0015*	1.14	0.00006	0.51	*<0.000025*	0.10	0.0385	5.7	*<0.0000025*	*<0.00003*	*<0.000025*	0.000188	0.00016	*<0.001*	*<0.001*
22-Mar-19	30																						
29-Mar-19	31	*<0.000005*	0.0011	0.283	0.00826	*<0.005*	0.00031	*<0.00005*	*<0.0015*	1.11	*<0.00002*	0.52	*<0.000025*	0.16	0.0384	6.5	*<0.0000025*	*<0.00003*	*<0.000025*	0.000163	0.00014	*<0.001*	*<0.001*
05-Apr-19	32																						
12-Apr-19	33	0.00027	0.0009	0.263	0.00749	*<0.005*	0.00066	*<0.00005*	*<0.0015*	1.02	*<0.00002*	0.50	*<0.000025*	0.10	0.0418	4.5	0.000006	0.00171	0.00005	0.000301	0.00011	*<0.001*	*<0.001*
19-Apr-19	34																						
26-Apr-19	35	*<0.000005*	0.0009	0.273	0.00537	*<0.005*	0.00056	*<0.00005*	*<0.0015*	1.10	*<0.00002*	0.46	*<0.000025*	0.17	0.0384	7.1	*<0.0000025*	0.00007	0.00006	0.000169	0.00011	*<0.001*	*<0.001*
03-May-19	36																						
10-May-19	37	0.00003	0.0008	0.248	0.00493	*<0.005*	0.00033	0.0001	0.003	1.03	*<0.00002*	0.50	*<0.000025*	0.14	0.0350	6.7	*<0.0000025*	*<0.00003*	*<0.000025*	0.000175	0.00012	*<0.001*	*<0.001*
17-May-19	38	*<0.000005*	0.0009	0.234	0.00344	*<0.005*	0.00028	*<0.00005*	*<0.0015*	0.994	*<0.00002*	0.47	*<0.000025*	0.13	0.0367	6.2	0.000005	0.00007	*<0.000025*	0.000129	0.00010	*<0.001*	*<0.001*
24-May-19	39	*<0.000005*	0.0010	0.270	0.00299	*<0.005*	0.00030	*<0.00005*	*<0.0015*	1.05	*<0.00002*	0.46	*<0.000025*	0.13	0.0372	6.6	*<0.0000025*	*<0.00003*	*<0.000025*	0.000119	0.00009	*<0.001*	*<0.001*
31-May-19	40																						
07-Jun-19	41																						
14-Jun-19	42																						
21-Jun-19	43	0.00002	0.0007	0.242	0.00195	*<0.005*	0.00052	0.0005	*<0.0015*	0.995	*<0.00002*	0.40	*<0.000025*	0.14	0.0349	6.5	0.000005	0.00020	*<0.000025*	0.000253	0.00008	*<0.001*	*<0.001*
28-Jun-19	44																						
05-Jul-19	45																						
12-Jul-19	46																						
19-Jul-19	47	0.00002	0.0009	0.245	0.00116	*<0.005*	0.00060	0.0001	*<0.0015*	1.05	*<0.00002*	0.37	*<0.000025*	0.10	0.0334	9.0	0.000005	*<0.00003*	0.00008	0.000119	0.00006	*<0.001*	*<0.001*
26-Jul-19	48																						
02-Aug-19	49																						
09-Aug-19	50																						

Jun 07/19. Change in analytical schedule.

Appendix 4-6: Kinetic Test Results
HC 2

Date	Cycle No.	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
		mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Loads	**mg/kg**																						
24-Aug-18	0	0.00008625	0.002415	0.70725	0.026496	0.00345	0.0004002	0.001104	0.01449	6.072	0.00007935	0.3933	0.00001725	2.96355	0.14904	4.1745	0.00009039	0.0010143	0.00003105	0.00016491	0.00008625	0.000345	0.000345
31-Aug-18	1	0.0000091	0.001729	0.64155	0.008281	0.002275	0.00051415	0.000182	0.00364	4.8685	0.0000819	0.61425	0.000011375	2.80735	0.134225	5.642	0.000004095	0.00054145	0.000011375	0.000222495	0.0002548	0.000455	0.000455
07-Sep-18	2	0.0000285	0.0009975	0.3268	0.00457425	0.002375	0.00040375	0.000095	0.0007125	3.192	0.000057	0.68875	0.000011875	1.33	0.065075	3.895	0.00000285	0.0003705	0.00019475	0.000133	0.0003135	0.000475	0.000475
14-Sep-18	3	0.0000186	0.000651	0.185535	0.0033015	0.0093	0.00028365	0.0000465	0.0006975	1.81815	0.00006045	0.5115	0.000011625	0.5673	0.041106	1.953	0.000002325	0.0002232	0.00003255	0.000099045	0.00031155	0.000465	0.000465
21-Sep-18	4																						
28-Sep-18	5	0.00001305	0.000609	0.153555	0.00277965	0.002175	0.00016965	0.000174	0.0006525	1.3659	0.0000261	0.51765	0.000010875	0.3219	0.0289275	1.4355	1.0875E-06	0.0001218	0.0000957	0.00007569	0.000348	0.000435	0.000435
05-Oct-18	6																						
12-Oct-18	7	0.0000172	0.000559	0.15652	0.003225	0.00215	0.0001376	0.000086	0.000645	1.1438	0.0000172	0.4472	0.00001075	0.2064	0.027262	1.677	0.000001075	0.0000817	0.00001075	0.00010922	0.0002666	0.00043	0.00043
19-Oct-18	8																						
26-Oct-18	9	0.000009	0.00072	0.24885	0.004491	0.018	0.0002655	0.00009	0.000675	1.386	0.000063	0.351	0.00001125	0.2745	0.03825	3.915	0.000001125	0.0000855	0.000423	0.0002592	0.0002295	0.00045	0.00045
02-Nov-18	10																						
09-Nov-18	11	0.000009	0.000585	0.21015	0.0034785	0.00225	0.000135	0.000045	0.000675	0.9405	0.000009	0.3465	0.00001125	0.135	0.03591	3.465	0.0000027	0.0000315	0.0000495	0.0002187	0.000144	0.00045	0.00045
16-Nov-18	12																						
23-Nov-18	13	0.000009	0.000495	0.17775	0.002682	0.00225	0.0001755	0.0000225	0.0027	0.846	0.000009	0.351	0.00001125	0.117	0.029115	2.97	0.0000027	0.000063	0.000027	0.00017145	0.0001665	0.00045	0.00045
30-Nov-18	14																						
07-Dec-18	15	0.0000044	0.00044	0.15752	0.0036476	0.0022	0.0001672	0.000022	0.00066	0.7832	0.0000088	0.3564	0.000011	0.088	0.024816	2.42	0.0000011	0.0000572	0.000011	0.00011792	0.0001188	0.00044	0.00044
14-Dec-18	16																						
21-Dec-18	17	0.0000022	0.000352	0.14168	0.0036256	0.0022	0.0001628	0.000022	0.00066	0.6556	0.0000088	0.2816	0.000011	0.176	0.023936	2.596	0.0000011	0.0000264	0.0000308	0.0001342	0.0000968	0.00044	0.00044
28-Dec-18	18																						
04-Jan-19	19	0.000002225	0.0004005	0.164205	0.004005	0.002225	0.0003471	0.00002225	0.0006675	0.69865	0.0000089	0.25365	0.000011125	0.09345	0.0246975	3.56	1.1125E-06	0.0000267	0.00004005	0.000108135	0.00008455	0.000445	0.000445
11-Jan-19	20																						
18-Jan-19	21	0.0000132	0.00044	0.16148	0.003608	0.0022	0.0001584	0.000022	0.00066	0.66	0.0000088	0.2728	0.000011	0.1144	0.023936	2.904	0.0000011	0.0000792	0.000011	0.00011352	0.0000924	0.00044	0.00044
25-Jan-19	22																						
01-Feb-19	23	0.000002225	0.000712	0.150855	0.0034176	0.002225	0.0007298	0.00002225	0.0006675	0.5073	0.0000089	0.25365	0.000011125	0.09345	0.0216715	2.8925	1.1125E-06	0.0000445	0.000011125	0.000120595	0.00008455	0.000445	0.000445
08-Feb-19	24																						
15-Feb-19	25	0.000002225	0.000356	0.13795	0.0040139	0.002225	0.0001424	0.00002225	0.0006675	0.6052	0.0000089	0.24475	0.000011125	0.11125	0.018868	3.3375	1.1125E-06	0.00002225	0.00002225	0.00008722	0.0000712	0.000445	0.000445
22-Feb-19	26																						
01-Mar-19	27	0.00001335	0.000445	0.12549	0.0038181	0.002225	0.000178	0.0000445	0.0006675	0.52065	0.0000089	0.23585	0.000011125	0.10235	0.0180225	2.2695	1.1125E-06	0.00001335	0.00148185	0.00008277	0.0000623	0.000445	0.000445
08-Mar-19	28																						
15-Mar-19	29	0.000002275	0.000364	0.121485	0.00389935	0.002275	0.0001456	0.00002275	0.0006825	0.5187	0.0000273	0.23205	0.000011375	0.0455	0.0175175	2.5935	1.1375E-06	0.00001365	0.000011375	0.00008554	0.0000728	0.000455	0.000455
22-Mar-19	30																						
29-Mar-19	31	0.000002225	0.0004895	0.125935	0.0036757	0.002225	0.00013795	0.00002225	0.0006675	0.49395	0.0000089	0.2314	0.000011125	0.0712	0.017088	2.8925	1.1125E-06	0.00001335	0.000011125	0.000072535	0.0000623	0.000445	0.000445
05-Apr-19	32																						
12-Apr-19	33	0.00013095	0.0004365	0.127555	0.00363265	0.002425	0.0003201	0.00002425	0.0007275	0.4947	0.0000097	0.2425	0.000012125	0.0485	0.020273	2.1825	0.00000291	0.00082935	0.00002425	0.000145985	0.00005335	0.000485	0.000485
19-Apr-19	34																						
26-Apr-19	35	0.000002275	0.0004095	0.124215	0.00244335	0.002275	0.0002548	0.00002275	0.0006825	0.5005	0.0000091	0.2093	0.000011375	0.07735	0.017472	3.2305	1.1375E-06	0.00003185	0.0000273	0.000076895	0.00005005	0.000455	0.000455
03-May-19	36																						
10-May-19	37	0.00001395	0.000372	0.11532	0.00229245	0.002325	0.00015345	0.0000465	0.001395	0.47895	0.0000093	0.2325	0.000011625	0.0651	0.016275	3.1155	1.1625E-06	0.00001395	0.000011625	0.000081375	0.0000558	0.000465	0.000465
17-May-19	38	0.00000225	0.000405	0.1053	0.001548	0.00225	0.000126	0.0000225	0.000675	0.4473	0.000009	0.2115	0.00001125	0.0585	0.016515	2.79	0.00000225	0.0000315	0.00001125	0.00005805	0.000045	0.00045	0.00045
24-May-19	39	0.000002275	0.000455	0.12285	0.00136045	0.002275	0.0001365	0.00002275	0.0006825	0.47775	0.0000091	0.2093	0.000011375	0.05915	0.016926	3.003	1.1375E-06	0.00001365	0.000011375	0.000054145	0.00004095	0.000455	0.000455
31-May-19	40																						
07-Jun-19	41																						
14-Jun-19	42																						
21-Jun-19	43	0.0000088	0.000308	0.10648	0.000858	0.0022	0.0002288	0.00022	0.00066	0.4378	0.0000088	0.176	0.000011	0.0616	0.015356	2.86	0.0000022	0.000088	0.000011	0.00011132	0.0000352	0.00044	0.00044
28-Jun-19	44																						
05-Jul-19	45																						
12-Jul-19	46																						
19-Jul-19	47	0.000009	0.000405	0.11025	0.000522	0.00225	0.00027	0.000045	0.000675	0.4725	0.000009	0.1665	0.00001125	0.045	0.01503	4.05	0.00000225	0.0000135	0.000036	0.00005355	0.000027	0.00045	0.00045
26-Jul-19	48																						
02-Aug-19	49																						

Appendix 4-6: Kinetic Test Results
HC 3

Date	**Cycle**	**Volume mL**		**pH**	**Cond.**	**Acidity**	**Acidity**	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output			(pH 4.5)	(pH 8.3)					CaCO3												
					umhos/cm	mgCaCO3/L	mgCaCO3/L	mgCaCO3/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
24-Aug-18	0	500	355	7.95	189	#N/A	3.3	30.0	11	10	0.09	58.6	0.095	0.0010	0.327	0.00241	0.000027	0.000026	0.008	0.000036	22.0	0.00006	0.000063	0.00047
31-Aug-18	1	500	450	7.89	136	#N/A	2.9	16.9	16	8	0.07	43.6	0.157	0.0010	0.213	0.00161	*<0.0000035*	*<0.0000035*	0.010	0.000029	16.0	*<0.000015*	0.000012	0.00032
07-Sep-18	2	500	440	7.82	103	#N/A	2.4	20.1	19	4	0.06	33.3	0.258	0.0009	0.163	0.00120	*<0.0000035*	*<0.0000035*	0.022	0.000003	12.3	*<0.000015*	0.000015	0.00004
14-Sep-18	3	500	445	7.83	76	#N/A	1.5	15.1	12	2	*<0.03*	22.6	0.164	0.0007	0.127	0.00074	0.000007	*<0.0000035*	0.008	*<0.0000015*	8.32	0.00018	0.000012	0.00052
21-Sep-18	4	500	435	7.84	67	#N/A	2.2	15.3	10															
28-Sep-18	5	500	440	7.95	62	#N/A	1.1	21.7	10	*<0.5*	*<0.03*	23.8	0.184	0.0005	0.103	0.00081	*<0.0000035*	*<0.0000035*	0.005	*<0.0000015*	8.77	0.00003	0.000009	0.00048
05-Oct-18	6	500	450	7.71	61	#N/A	1.8	15.1	8															
12-Oct-18	7	500	455	7.88	78	#N/A	3.5	20.5	14	*<0.5*	*<0.03*	30.1	0.190	0.0004	0.0833	0.00095	*<0.0000035*	*<0.0000035*	0.005	*<0.0000015*	11.1	0.00014	0.000014	0.00021
19-Oct-18	8	500	440	7.81	83	#N/A	1.5	15.2	19															
26-Oct-18	9	500	450	7.76	83	#N/A	1.2	14.1	21	*<0.5*	*<0.03*	35.5	0.154	0.0003	0.0491	0.00115	*<0.0000035*	*<0.0000035*	0.003	*<0.0000015*	13.2	0.00004	0.000008	0.00112
02-Nov-18	10	500	435	7.93	87	#N/A	0.9	15.4	20															
09-Nov-18	11	500	450	7.78	88	#N/A	2.2	15.0	21	*<0.5*	*<0.03*	31.5	0.134	0.0003	0.0639	0.00093	*<0.0000035*	*<0.0000035*	0.004	0.000003	11.7	0.00004	0.000004	0.00071
16-Nov-18	12	500	415	7.69	94	#N/A	1.1	12.6	22															
23-Nov-18	13	500	445	7.73	101	#N/A	1.9	12.5	25	*<0.5*	*<0.03*	38.0	0.124	*<0.0001*	0.0548	0.00103	*<0.0000035*	*<0.0000035*	0.002	0.000003	14.2	*<0.000015*	*<0.000002*	0.00017
30-Nov-18	14	500	445	7.70	100	#N/A	1.7	12.2	27															
07-Dec-18	15	500	440	7.60	96	#N/A	3.7	13.6	27	*<0.5*	*<0.03*	39.5	0.116	*<0.0001*	0.0503	0.00097	*<0.0000035*	*<0.0000035*	0.003	*<0.0000015*	14.9	*<0.000015*	*<0.000002*	0.00096
14-Dec-18	16	500	450	7.65	92	#N/A	2.9	13.7	23															
21-Dec-18	17	500	445	7.69	97	#N/A	3.4	14.7	24	*<0.5*	*<0.03*	38.2	0.113	*<0.0001*	0.0527	0.00116	*<0.0000035*	*<0.0000035*	0.003	0.000006	14.5	*<0.000015*	0.000018	0.00141
28-Dec-18	18	500	445	7.69	88	#N/A	1.6	12.9	23															
04-Jan-19	19	500	465	7.75	83	#N/A	2.9	13.1	21	*<0.5*	*<0.03*	36.3	0.124	*<0.0001*	0.0518	0.00094	*<0.0000035*	*<0.0000035*	0.002	*<0.0000015*	13.8	0.00006	0.000028	0.00046
11-Jan-19	20	500	445	7.43	77	#N/A	2.2	12.4	22															
18-Jan-19	21	500	440	7.58	72	#N/A	1.4	11.8	21	*<0.5*	*<0.03*	32.9	0.113	*<0.0001*	0.0473	0.00086	*<0.0000035*	*<0.0000035*	0.003	0.000051	12.5	*<0.000015*	*<0.000002*	0.00015
25-Jan-19	22	500	440	7.65	77	#N/A	1.5	10.4	18															
01-Feb-19	23	500	450	7.56	78	#N/A	2.8	12.7	18	*<0.5*	*<0.03*	29.6	0.086	*<0.0001*	0.0427	0.00080	*<0.0000035*	*<0.0000035*	0.003	*<0.0000015*	11.2	*<0.000015*	0.000005	0.00056
08-Feb-19	24	500	445	7.64	76	#N/A	2.7	11.4	18															
15-Feb-19	25	500	450	7.54	78	#N/A	1.5	11.1	19	*<0.5*	*<0.03*	33.6	0.088	*<0.0001*	0.0414	0.00083	*<0.0000035*	*<0.0000035*	0.007	*<0.0000015*	12.8	*<0.000015*	*<0.000002*	0.00044
22-Feb-19	26	500	425	7.75	88	#N/A	2.8	13.2	24															
01-Mar-19	27	500	435	7.47	84	#N/A	2.3	13.8	19	*<0.5*	*<0.03*	35.8	0.100	*<0.00045*	0.0434	0.00084	*<0.0000035*	*<0.0000035*	0.002	*<0.0000015*	13.7	*<0.00004*	*<0.000002*	0.0005
08-Mar-19	28	500	430	7.69	88	#N/A	2.7	14.4	23															
15-Mar-19	29	500	450	7.64	81	#N/A	2.1	13.0	24	*<0.5*	*<0.03*	35.8	0.106	*<0.00045*	0.0497	0.00082	*<0.0000035*	*<0.0000035*	0.003	0.000010	13.7	*<0.00004*	*<0.000002*	0.0036
22-Mar-19	30	500	440	7.84	81	#N/A	2.6	14.4	20															
29-Mar-19	31	500	420	7.49	79	#N/A	2.4	13.3	20	*<0.5*	*<0.03*	33.3	0.105	*<0.00045*	0.0439	0.00082	*<0.0000035*	*<0.0000035*	0.003	*<0.0000015*	12.7	*<0.00004*	*<0.000002*	0.0002
05-Apr-19	32	500	440	7.82	76	#N/A	5.1	18.8	19															
12-Apr-19	33	500	485	7.57	77	#N/A	1.9	20.8	19	*<0.5*	*<0.03*	30.9	0.084	*<0.00045*	0.0395	0.00073	*<0.0000035*	*<0.0000035*	*<0.001*	*<0.0000015*	11.9	*<0.00004*	0.000019	0.0006
19-Apr-19	34	500	430	7.73	68	#N/A	1.7	13.5	16															
26-Apr-19	35	500	435	7.77	76	#N/A	2.3	12.8	20	*<0.5*	*<0.03*	34.0	0.107	*<0.00045*	0.0424	0.00087	*<0.0000035*	*<0.0000035*	0.003	0.000005	13.1	*<0.00004*	0.000015	0.0006
03-May-19	36	500	440	7.97	77	#N/A	2.3	11.1	20															
10-May-19	37	500	445	7.61	80	#N/A	1.5	11.0	21	*<0.5*	*<0.03*	34.8	0.087	*<0.00045*	0.0380	0.00083	*<0.0000035*	*<0.0000035*	0.002	*<0.0000015*	13.4	*<0.00004*	0.000025	0.0011
17-May-19	38	500	445	7.61	77	#N/A	2.1	11.4	20	*<0.5*	*<0.03*	32.2	0.092	*<0.00045*	0.0385	0.00080	*<0.0000035*	*<0.0000035*	*<0.001*	0.000004	12.4	*<0.00004*	0.000027	0.0005
24-May-19	39	500	445	7.56	75	#N/A	2.8	12.3	20	*<0.5*	*<0.03*	31.2	0.097	*<0.00045*	0.0340	0.00081	*<0.0000035*	*<0.0000035*	0.002	0.000014	12.0	*<0.00004*	0.000019	0.0006
Cell Terminated																								
Loads	**mg/kg**																							
24-Aug-18	0			7.95					3.905	3.55	0.03195	20.803	0.033725	0.000355	0.116085	0.00085555	0.000009585	0.00000923	0.00284	0.00001278	7.81	0.0000213	0.000022365	0.00016685
31-Aug-18	1			7.89					7.2	3.6	0.0315	19.62	0.07065	0.00045	0.09585	0.0007245	0.000001575	0.000001575	0.0045	0.00001305	7.2	0.00000675	0.0000054	0.000144
07-Sep-18	2			7.82					8.36	1.76	0.0264	14.652	0.11352	0.000396	0.07172	0.000528	0.00000154	0.00000154	0.00968	0.00000132	5.412	0.0000066	0.0000066	0.0000176
14-Sep-18	3			7.83					5.34	0.89	0.01335	10.057	0.07298	0.0003115	0.056515	0.0003293	0.000003115	1.5575E-06	0.00356	6.675E-07	3.7024	0.0000801	0.00000534	0.0002314
21-Sep-18	4			7.84					4.35															
28-Sep-18	5			7.95					4.4	0.22	0.0132	10.472	0.08096	0.00022	0.04532	0.0003564	0.00000154	0.00000154	0.0022	0.00000066	3.8588	0.0000132	0.00000396	0.0002112
05-Oct-18	6			7.71					3.6															
12-Oct-18	7			7.88					6.37	0.2275	0.01365	13.6955	0.08645	0.000182	0.0379015	0.00043225	1.5925E-06	1.5925E-06	0.002275	6.825E-07	5.0505	0.0000637	0.00000637	0.00009555
19-Oct-18	8			7.81					8.36															
26-Oct-18	9			7.76					9.45	0.225	0.0135	15.975	0.0693	0.000135	0.022095	0.0005175	0.000001575	0.000001575	0.00135	0.000000675	5.94	0.000018	0.0000036	0.000504
02-Nov-18	10			7.93					8.7															
09-Nov-18	11			7.78					9.45	0.225	0.0135	14.175	0.0603	0.000135	0.028755	0.0004185	0.000001575	0.000001575	0.0018	0.00000135	5.265	0.000018	0.0000018	0.0003195
16-Nov-18	12			7.69					9.13															
23-Nov-18	13			7.73					11.125	0.2225	0.01335	16.91	0.05518	0.0000445	0.024386	0.00045835	1.5575E-06	1.5575E-06	0.00089	0.000001335	6.319	0.000006675	0.00000089	0.00007565
30-Nov-18	14			7.70					12.015															
07-Dec-18	15			7.60					11.88	0.22	0.0132	17.38	0.05104	0.000044	0.022132	0.0004268	0.00000154	0.00000154	0.00132	0.00000066	6.556	0.0000066	0.00000088	0.0004224
14-Dec-18	16			7.65					10.35															
21-Dec-18	17			7.69					10.68	0.2225	0.01335	16.999	0.050285	0.0000445	0.0234515	0.0005162	1.5575E-06	1.5575E-06	0.001335	0.00000267	6.4525	0.000006675	0.00000801	0.00062745
28-Dec-18	18			7.69					10.235															
04-Jan-19	19			7.75					9.765	0.2325	0.01395	16.8795	0.05766	0.0000465	0.024087	0.0004371	1.6275E-06	1.6275E-06	0.00093	6.975E-07	6.417	0.0000279	0.00001302	0.0002139
11-Jan-19	20			7.43					9.79															
18-Jan-19	21			7.58					9.24	0.22	0.0132	14.476	0.04972	0.000044	0.020812	0.0003784	0.00000154	0.00000154	0.00132	0.00002244	5.5	0.0000066	0.00000088	0.000066
25-Jan-19	22			7.65					7.92															
01-Feb-19	23			7.56					8.1	0.225	0.0135	13.32	0.0387	0.000045	0.019215	0.00036	0.000001575	0.000001575	0.00135	0.000000675	5.04	0.00000675	0.00000225	0.000252
08-Feb-19	24			7.64					8.01															
15-Feb-19	25			7.54					8.55	0.225	0.0135	15.12	0.0396	0.000045	0.01863	0.0003735	0.000001575	0.000001575	0.00315	0.000000675	5.76	0.00000675	0.0000009	0.000198
22-Feb-19	26			7.75					10.2															
01-Mar-19	27			7.47					8.265	0.2175	0.01305	15.573	0.0435	0.00019575	0.018879	0.0003654	1.5225E-06	1.5225E-06	0.00087	6.525E-07	5.9595	0.0000174	0.00000087	0.0002175
08-Mar-19	28			7.69					9.89															
15-Mar-19	29			7.64					10.8	0.225	0.0135	16.11	0.0477	0.0002025	0.022365	0.000369	0.000001575	0.000001575	0.00135	0.0000045	6.165	0.000018	0.0000009	0.00162
22-Mar-19	30			7.84					8.8															
29-Mar-19	31			7.49					8.4	0.21	0.0126	13.986	0.0441	0.000189	0.018438	0.0003444	0.00000147	0.00000147	0.00126	0.00000063	5.334	0.0000168	0.00000084	0.000084
05-Apr-19	32			7.82					8.36															
12-Apr-19	33			7.57					9.215	0.2425	0.01455	14.9865	0.04074	0.00021825	0.0191575	0.00035405	1.6975E-06	1.6975E-06	0.000485	7.275E-07	5.7715	0.0000194	0.000009215	0.000291
19-Apr-19	34			7.73					6.88															
26-Apr-19	35			7.77					8.7	0.2175	0.01305	14.79	0.046545	0.00019575	0.018444	0.00037845	1.5225E-06	1.5225E-06	0.001305	0.000002175	5.6985	0.0000174	0.000006525	0.000261
03-May-19	36			7.97					8.8															
10-May-19	37			7.61					9.345	0.2225	0.01335	15.486	0.038715	0.00020025	0.01691	0.00036935	1.5575E-06	1.5575E-06	0.00089	6.675E-07	5.963	0.0000178	0.000011125	0.0004895
17-May-19	38			7.61					8.9	0.2225	0.01335	14.329	0.04094	0.00020025	0.0171325	0.000356	1.5575E-06	1.5575E-06	0.000445	0.00000178	5.518	0.0000178	0.000012015	0.0002225
24-May-19	39			7.56					8.9	0.2225	0.01335	13.884	0.043165	0.00020025	0.01513	0.00036045	1.5575E-06	1.5575E-06	0.00089	0.00000623	5.34	0.0000178	0.000008455	0.000267

Appendix 4-6: Kinetic Test Results
HC 3

Date	Cycle No.	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
		mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
24-Aug-18	0	0.012	0.00003	0.0049	0.882	0.0699	*<0.005*	0.00045	0.0045	0.031	8.68	0.00009	1.44	*<0.000025*	6.49	0.0457	5.0	0.000027	0.00174	0.00021	0.000156	0.00096	*<0.001*	*<0.001*
31-Aug-18	1	*<0.0035*	*<0.000005*	0.0037	0.861	0.0183	*<0.005*	0.00173	0.0006	0.005	6.25	0.00006	1.36	*<0.000025*	5.60	0.0366	7.3	*<0.0000025*	0.00086	*<0.000025*	0.000636	0.00106	*<0.001*	*<0.001*
07-Sep-18	2	0.013	0.00007	0.0027	0.642	0.0130	*<0.005*	0.00253	0.0003	*<0.0015*	5.44	0.00005	1.46	*<0.000025*	3.91	0.0319	7.9	*<0.0000025*	0.00063	0.00051	0.000521	0.00121	*<0.001*	*<0.001*
14-Sep-18	3	0.007	0.00003	0.0019	0.436	0.0122	0.02	0.00139	0.0001	*<0.0015*	3.39	0.00007	1.07	*<0.000025*	1.98	0.0224	3.7	*<0.0000025*	0.00038	0.00012	0.000458	0.00092	*<0.001*	*<0.001*
21-Sep-18	4																							
28-Sep-18	5	0.021	0.00003	0.0021	0.450	0.0153	0.02	0.00056	0.0004	*<0.0015*	3.03	*<0.00002*	1.13	*<0.000025*	1.17	0.0208	3.9	*<0.0000025*	0.00029	0.00013	0.000648	0.00106	*<0.001*	*<0.001*
05-Oct-18	6																							
12-Oct-18	7	*<0.0035*	0.00011	0.0021	0.540	0.00310	*<0.005*	0.00027	*<0.00005*	*<0.0015*	2.89	*<0.00002*	1.14	*<0.000025*	0.78	0.0241	5.6	*<0.0000025*	0.00019	*<0.000025*	0.000843	0.00084	*<0.001*	*<0.001*
19-Oct-18	8																							
26-Oct-18	9	0.008	*<0.000005*	0.0016	0.605	0.00204	*<0.005*	0.00031	0.0001	*<0.0015*	3.24	0.00011	0.79	*<0.000025*	0.65	0.0240	7.5	*<0.0000025*	0.00016	0.00028	0.000950	0.00072	*<0.001*	*<0.001*
02-Nov-18	10																							
09-Nov-18	11	*<0.0035*	0.00002	0.0018	0.555	0.00219	*<0.005*	0.00030	0.0001	*<0.0015*	2.22	*<0.00002*	0.87	*<0.000025*	0.44	0.0252	7.1	*<0.0000025*	0.00009	0.00006	0.00104	0.00055	*<0.001*	*<0.001*
16-Nov-18	12																							
23-Nov-18	13	*<0.0035*	*<0.000005*	0.0016	0.599	0.00230	*<0.005*	0.00034	*<0.00005*	*<0.0015*	2.19	*<0.00002*	0.87	*<0.000025*	0.38	0.0267	9.2	*<0.0000025*	0.00014	*<0.000025*	0.00107	0.00046	*<0.001*	*<0.001*
30-Nov-18	14																							
07-Dec-18	15	*<0.0035*	*<0.000005*	0.0013	0.546	0.00535	*<0.005*	0.00023	*<0.00005*	*<0.0015*	2.05	*<0.00002*	0.85	*<0.000025*	0.27	0.0265	9.0	*<0.0000025*	0.00012	0.00015	0.000701	0.00037	*<0.001*	*<0.001*
14-Dec-18	16																							
21-Dec-18	17	*<0.0035*	0.00003	0.0014	0.474	0.00465	*<0.005*	0.00024	*<0.00005*	*<0.0015*	1.71	*<0.00002*	0.82	*<0.000025*	0.25	0.0251	8.8	*<0.0000025*	0.00009	0.00005	0.000852	0.00035	*<0.001*	*<0.001*
28-Dec-18	18																							
04-Jan-19	19	*<0.0035*	*<0.000005*	0.0011	0.448	0.00437	*<0.005*	0.00041	*<0.00005*	*<0.0015*	1.78	*<0.00002*	0.70	*<0.000025*	0.26	0.0223	9.9	*<0.0000025*	0.00006	0.00007	0.000538	0.00033	*<0.001*	*<0.001*
11-Jan-19	20																							
18-Jan-19	21	*<0.0035*	*<0.000005*	0.0012	0.434	0.00427	*<0.005*	0.00163	*<0.00005*	*<0.0015*	1.53	*<0.00002*	0.64	*<0.000025*	0.28	0.0207	7.2	*<0.0000025*	0.00008	*<0.000025*	0.000545	0.00030	*<0.001*	*<0.001*
25-Jan-19	22																							
01-Feb-19	23	*<0.0035*	*<0.000005*	0.0011	0.408	0.00432	*<0.005*	0.00084	*<0.00005*	*<0.0015*	1.24	*<0.00002*	0.68	*<0.000025*	0.24	0.0200	7.8	*<0.0000025*	0.00006	0.00010	0.000540	0.00024	*<0.001*	*<0.001*
08-Feb-19	24																							
15-Feb-19	25	*<0.0035*	*<0.000005*	0.0009	0.399	0.00465	*<0.005*	0.00016	*<0.00005*	*<0.0015*	1.48	*<0.00002*	0.66	*<0.000025*	0.28	0.0181	9.3	*<0.0000025*	*<0.00005*	0.00008	0.000455	0.00024	*<0.001*	*<0.001*
22-Feb-19	26																							
01-Mar-19	27	*<0.0035*	0.00001	0.0011	0.401	0.00680	*<0.005*	0.00024	*<0.00005*	0.004	1.40	*<0.00002*	0.64	*<0.000025*	0.27	0.0200	8.1	*<0.0000025*	0.00008	0.00013	0.000396	0.00021	*<0.001*	*<0.001*
08-Mar-19	28																							
15-Mar-19	29	*<0.0035*	*<0.000005*	0.0009	0.377	0.00471	*<0.005*	0.00015	*<0.00005*	*<0.0015*	1.44	*<0.00002*	0.66	*<0.000025*	0.16	0.0202	8.9	*<0.0000025*	*<0.00003*	*<0.000025*	0.000392	0.00027	*<0.001*	*<0.001*
22-Mar-19	30																							
29-Mar-19	31	*<0.0035*	*<0.000005*	0.0012	0.371	0.00428	*<0.005*	0.00017	*<0.00005*	*<0.0015*	1.38	*<0.00002*	0.63	*<0.000025*	0.23	0.0185	9.4	*<0.0000025*	*<0.00003*	*<0.000025*	0.000297	0.00024	*<0.001*	*<0.001*
05-Apr-19	32																							
12-Apr-19	33	*<0.0035*	*<0.000005*	0.0009	0.318	0.00337	*<0.005*	0.00032	*<0.00005*	*<0.0015*	1.19	*<0.00002*	0.63	*<0.000025*	0.15	0.0183	4.9	*<0.0000025*	0.00010	0.00006	0.000518	0.00019	*<0.001*	*<0.001*
19-Apr-19	34																							
26-Apr-19	35	*<0.0035*	0.00001	0.0010	0.341	0.00449	*<0.005*	0.00030	*<0.00005*	*<0.0015*	1.36	*<0.00002*	0.62	*<0.000025*	0.23	0.0188	8.6	0.000005	0.00008	0.00008	0.000356	0.00022	*<0.001*	*<0.001*
03-May-19	36																							
10-May-19	37	0.013	*<0.000005*	0.0009	0.340	0.00520	*<0.005*	0.00014	*<0.00005*	*<0.0015*	1.30	*<0.00002*	0.62	*<0.000025*	0.20	0.0184	9.1	*<0.0000025*	0.00010	0.00011	0.000316	0.00019	*<0.001*	*<0.001*
17-May-19	38	*<0.0035*	*<0.000005*	0.0009	0.308	0.00474	*<0.005*	0.00010	*<0.00005*	*<0.0015*	1.25	*<0.00002*	0.61	*<0.000025*	0.18	0.0172	7.3	*<0.0000025*	0.00007	*<0.000025*	0.000235	0.00019	*<0.001*	*<0.001*
24-May-19	39	*<0.0035*	0.00003	0.0011	0.311	0.00436	*<0.005*	0.00010	*<0.00005*	*<0.0015*	1.24	*<0.00002*	0.59	*<0.000025*	0.18	0.0170	6.4	*<0.0000025*	*<0.00003*	*<0.000025*	0.000217	0.00019	*<0.001*	*<0.001*
Cell Terminated																								
Loads	**mg/kg**																							
24-Aug-18	0	0.00426	0.00001065	0.0017395	0.31311	0.0248145	0.001775	0.00015975	0.0015975	0.011005	3.0814	0.00003195	0.5112	0.000008875	2.30395	0.0162235	1.775	0.000009585	0.0006177	0.00007455	0.00005538	0.0003408	0.000355	0.000355
31-Aug-18	1	0.001575	0.00000225	0.001665	0.38745	0.008235	0.00225	0.0007785	0.00027	0.00225	2.8125	0.000027	0.612	0.00001125	2.52	0.01647	3.285	0.000001125	0.000387	0.00001125	0.0002862	0.000477	0.00045	0.00045
07-Sep-18	2	0.00572	0.0000308	0.001188	0.28248	0.00572	0.0022	0.0011132	0.000132	0.00066	2.3936	0.000022	0.6424	0.000011	1.7204	0.014036	3.476	0.0000011	0.0002772	0.0002244	0.00022924	0.0005324	0.00044	0.00044
14-Sep-18	3	0.003115	0.00001335	0.0008455	0.19402	0.005429	0.0089	0.00061855	0.0000445	0.0006675	1.50855	0.00003115	0.47615	0.000011125	0.8811	0.009968	1.6465	1.1125E-06	0.0001691	0.0000534	0.00020381	0.0004094	0.000445	0.000445
21-Sep-18	4																							
28-Sep-18	5	0.00924	0.0000132	0.000924	0.198	0.006732	0.0088	0.0002464	0.000176	0.00066	1.3332	0.0000088	0.4972	0.000011	0.5148	0.009152	1.716	0.0000011	0.0001276	0.0000572	0.00028512	0.0004664	0.00044	0.00044
05-Oct-18	6																							
12-Oct-18	7	0.0015925	0.00005005	0.0009555	0.2457	0.0014105	0.002275	0.00012285	0.00002275	0.0006825	1.31495	0.0000091	0.5187	0.000011375	0.3549	0.0109655	2.548	1.1375E-06	0.00008645	0.000011375	0.000383565	0.0003822	0.000455	0.000455
19-Oct-18	8																							
26-Oct-18	9	0.0036	0.00000225	0.00072	0.27225	0.000918	0.00225	0.0001395	0.000045	0.000675	1.458	0.0000495	0.3555	0.00001125	0.2925	0.0108	3.375	0.000001125	0.000072	0.000126	0.0004275	0.000324	0.00045	0.00045
02-Nov-18	10																							
09-Nov-18	11	0.001575	0.000009	0.00081	0.24975	0.0009855	0.00225	0.000135	0.000045	0.000675	0.999	0.000009	0.3915	0.00001125	0.198	0.01134	3.195	0.000001125	0.0000405	0.000027	0.000468	0.0002475	0.00045	0.00045
16-Nov-18	12																							
23-Nov-18	13	0.0015575	0.000002225	0.000712	0.266555	0.0010235	0.002225	0.0001513	0.00002225	0.0006675	0.97455	0.0000089	0.38715	0.000011125	0.1691	0.0118815	4.094	1.1125E-06	0.0000623	0.000011125	0.00047615	0.0002047	0.000445	0.000445
30-Nov-18	14																							
07-Dec-18	15	0.00154	0.0000022	0.000572	0.24024	0.002354	0.0022	0.0001012	0.000022	0.00066	0.902	0.0000088	0.374	0.000011	0.1188	0.01166	3.96	0.0000011	0.0000528	0.000066	0.00030844	0.0001628	0.00044	0.00044
14-Dec-18	16																							
21-Dec-18	17	0.0015575	0.00001335	0.000623	0.21093	0.00206925	0.002225	0.0001068	0.00002225	0.0006675	0.76095	0.0000089	0.3649	0.000011125	0.11125	0.0111695	3.916	1.1125E-06	0.00004005	0.00002225	0.00037914	0.00015575	0.000445	0.000445
28-Dec-18	18																							
04-Jan-19	19	0.0016275	0.000002325	0.0005115	0.20832	0.00203205	0.002325	0.00019065	0.00002325	0.0006975	0.8277	0.0000093	0.3255	0.000011625	0.1209	0.0103695	4.6035	1.1625E-06	0.0000279	0.00003255	0.00025017	0.00015345	0.000465	0.000465
11-Jan-19	20																							
18-Jan-19	21	0.00154	0.0000022	0.000528	0.19096	0.0018788	0.0022	0.0007172	0.000022	0.00066	0.6732	0.0000088	0.2816	0.000011	0.1232	0.009108	3.168	0.0000011	0.0000352	0.000011	0.0002398	0.000132	0.00044	0.00044
25-Jan-19	22																							
01-Feb-19	23	0.001575	0.00000225	0.000495	0.1836	0.001944	0.00225	0.000378	0.0000225	0.000675	0.558	0.000009	0.306	0.00001125	0.108	0.009	3.51	0.000001125	0.000027	0.000045	0.000243	0.000108	0.00045	0.00045
08-Feb-19	24																							
15-Feb-19	25	0.001575	0.00000225	0.000405	0.17955	0.0020925	0.00225	0.000072	0.0000225	0.000675	0.666	0.000009	0.297	0.00001125	0.126	0.008145	4.185	0.000001125	0.0000225	0.000036	0.00020475	0.000108	0.00045	0.00045
22-Feb-19	26																							
01-Mar-19	27	0.0015225	0.00000435	0.0004785	0.174435	0.002958	0.002175	0.0001044	0.00002175	0.00174	0.609	0.0000087	0.2784	0.000010875	0.11745	0.0087	3.5235	1.0875E-06	0.0000348	0.00005655	0.00017226	0.00009135	0.000435	0.000435
08-Mar-19	28																							
15-Mar-19	29	0.001575	0.00000225	0.000405	0.16965	0.0021195	0.00225	0.0000675	0.0000225	0.000675	0.648	0.000009	0.297	0.00001125	0.072	0.00909	4.005	0.000001125	0.0000135	0.00001125	0.0001764	0.0001215	0.00045	0.00045
22-Mar-19	30																							
29-Mar-19	31	0.00147	0.0000021	0.000504	0.15582	0.0017976	0.0021	0.0000714	0.000021	0.00063	0.5796	0.0000084	0.2646	0.0000105	0.0966	0.00777	3.948	0.00000105	0.0000126	0.0000105	0.00012474	0.0001008	0.00042	0.00042
05-Apr-19	32																							
12-Apr-19	33	0.0016975	0.000002425	0.0004365	0.15423	0.00163445	0.002425	0.0001552	0.00002425	0.0007275	0.57715	0.0000097	0.30555	0.000012125	0.07275	0.0088755	2.3765	1.2125E-06	0.0000485	0.0000291	0.00025123	0.00009215	0.000485	0.000485
19-Apr-19	34																							
26-Apr-19	35	0.0015225	0.00000435	0.000435	0.148335	0.00195315	0.002175	0.0001305	0.00002175	0.0006525	0.5916	0.0000087	0.2697	0.000010875	0.10005	0.008178	3.741	0.000002175	0.0000348	0.0000348	0.00015486	0.0000957	0.000435	0.000435
03-May-19	36																							
10-May-19	37	0.005785	0.000002225	0.0004005	0.1513	0.002314	0.002225	0.0000623	0.00002225	0.0006675	0.5785	0.0000089	0.2759	0.000011125	0.089	0.008188	4.0495	1.1125E-06	0.0000445	0.00004895	0.00014062	0.00008455	0.000445	0.000445
17-May-19	38	0.0015575	0.000002225	0.0004005	0.13706	0.0021093	0.002225	0.0000445	0.00002225	0.0006675	0.55625	0.0000089	0.27145	0.000011125	0.0801	0.007654	3.2485	1.1125E-06	0.00003115	0.000011125	0.000104575	0.00008455	0.000445	0.000445
24-May-19	39	0.0015575	0.00001335	0.0004895	0.138395	0.0019402	0.002225	0.0000445	0.00002225	0.0006675	0.5518	0.0000089	0.26255	0.000011125	0.0801	0.007565	2.848	1.1125E-06	0.00001335	0.000011125	0.000096565	0.00008455	0.000445	0.000445

Appendix 4-6: Kinetic Test Results
HC 4

Date	Cycle	Volume mL		pH	Cond.	Acidity	Acidity	Alkalinity	Sulphate	Chloride	Fluoride	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu	Fe
	No.	Input	Output			(pH 4.5)	(pH 8.3)					CaCO3													
					umhos/cm	mgCaCO3/L	mgCaCO3/L	mgCaCO3/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
24-Aug-18	0	500	380	7.72	327	#N/A	3.9	28.7	8	48	0.09	111	0.040	0.0005	0.192	0.00516	0.000050	0.000049	0.010	0.000058	41.0	0.00007	0.000225	0.00067	0.026
31-Aug-18	1	500	450	7.89	136	#N/A	2.9	16.9	11	34	0.07	72.1	0.090	0.0007	0.175	0.00342	<0.0000035	<0.0000035	0.012	0.000004	26.0	<0.000015	0.000025	0.00048	<0.0035
07-Sep-18	2	500	440	7.76	115	#N/A	2.5	18.0	9	11	0.06	38.5	0.144	0.0007	0.154	0.00181	<0.0000035	<0.0000035	0.016	<0.0000015	13.9	<0.000015	0.000017	0.00023	<0.0035
14-Sep-18	3	500	440	7.88	77	#N/A	1.5	17.0	7	3	<0.03	25.5	0.118	0.0005	0.127	0.00114	<0.0000035	<0.0000035	0.004	0.000004	9.27	0.00013	0.000020	0.00015	<0.0035
21-Sep-18	4	500	450	7.82	64	#N/A	2.2	17.9	7																
28-Sep-18	5	500	435	7.92	59	#N/A	1.0	24.0	5	<0.5	<0.03	25.6	0.173	0.0004	0.103	0.00102	<0.0000035	<0.0000035	0.004	0.000003	9.42	<0.000015	0.000011	0.00035	<0.0035
05-Oct-18	6	500	445	7.77	58	#N/A	1.7	17.1	4																
12-Oct-18	7	500	435	7.97	59	#N/A	3.3	21.7	5	<0.5	<0.03	23.7	0.158	0.0003	0.0801	0.00098	<0.0000035	<0.0000035	0.003	0.000003	8.72	0.00017	0.000130	0.00022	0.017
19-Oct-18	8	500	435	8.04	59	#N/A	0.7	16.7	7																
26-Oct-18	9	500	435	7.96	65	#N/A	0.6	16.1	11	<0.5	<0.03	30.9	0.159	0.0002	0.0397	0.00129	<0.0000035	<0.0000035	0.003	0.000005	11.5	<0.000015	0.000024	0.00317	0.010
02-Nov-18	10	500	435	7.99	80	#N/A	0.9	16.0	18																
09-Nov-18	11	500	445	7.91	95	#N/A	1.7	15.3	22	<0.5	<0.03	34.6	0.111	<0.0001	0.0350	0.00157	<0.0000035	<0.0000035	0.002	0.000004	12.9	0.00007	0.000025	0.00063	<0.0035
16-Nov-18	12	500	425	7.74	110	#N/A	1.0	13.9	27																
23-Nov-18	13	500	440	7.89	90	#N/A	1.8	14.2	18	<0.5	<0.03	34.7	0.125	<0.0001	0.0296	0.00156	<0.0000035	<0.0000035	<0.001	0.000008	13.1	<0.000015	0.000017	0.00027	<0.0035
30-Nov-18	14	500	440	7.86	90	#N/A	1.3	14.0	20																
07-Dec-18	15	500	435	7.71	90	#N/A	3.4	15.7	19	<0.5	<0.03	36.2	0.109	<0.0001	0.0262	0.00143	<0.0000035	<0.0000035	0.002	0.000003	13.7	<0.000015	0.000020	0.00086	<0.0035
14-Dec-18	16	500	445	7.94	85	#N/A	2.5	15.7	18																
21-Dec-18	17	500	440	7.74	92	#N/A	3.0	14.6	22	<0.5	<0.03	36.5	0.090	<0.0001	0.0205	0.00143	<0.0000035	<0.0000035	<0.001	0.000010	14.0	<0.000015	<0.000002	0.00040	<0.0035
28-Dec-18	18	500	440	7.81	86	#N/A	1.5	14.3	20																
04-Jan-19	19	500	450	7.81	83	#N/A	2.9	14.1	21	<0.5	<0.03	37.1	0.110	<0.0001	0.0199	0.00149	<0.0000035	<0.0000035	<0.001	<0.0000015	14.2	0.00004	0.000047	0.00047	<0.0035
11-Jan-19	20	500	440	7.61	84	#N/A	2.1	12.9	25																
18-Jan-19	21	500	435	7.70	85	#N/A	1.3	13.8	20	<0.5	<0.03	34.1	0.111	<0.0001	0.0187	0.00135	<0.0000035	<0.0000035	0.003	0.000005	13.1	<0.000015	0.000022	0.00011	<0.0035
25-Jan-19	22	500	435	7.75	87	#N/A	1.5	11.9	20																
01-Feb-19	23	500	440	7.66	87	#N/A	2.7	14.5	19	<0.5	<0.03	33.9	0.102	<0.0001	0.0166	0.00131	<0.0000035	<0.0000035	0.002	0.000010	13.0	<0.000015	0.000081	0.00055	0.008
08-Feb-19	24	500	430	7.83	80	#N/A	2.4	14.0	17																
15-Feb-19	25	500	440	7.75	77	#N/A	1.4	13.7	17	<0.5	<0.03	33.8	0.104	<0.0001	0.0150	0.00121	<0.0000035	<0.0000035	0.007	0.000003	13.0	<0.000015	0.000020	0.00041	<0.0035
22-Feb-19	26	500	430	7.89	77	#N/A	2.6	15.4	17																
01-Mar-19	27	500	440	7.73	71	#N/A	2.0	17.4	11	<0.5	<0.03	30.7	0.105	<0.00045	0.0137	0.00116	<0.0000035	<0.0000035	<0.001	0.000003	11.8	<0.00004	0.000022	0.0004	<0.0035
08-Mar-19	28	500	440	7.81	70	#N/A	2.4	13.8	15																
15-Mar-19	29	500	445	7.70	63	#N/A	1.7	13.6	14	<0.5	<0.03	28.5	0.087	<0.00045	0.0121	0.00110	<0.0000035	<0.0000035	<0.001	0.000011	10.9	<0.00004	0.000007	0.0048	<0.0035
22-Mar-19	30	500	445	7.93	71	#N/A	2.4	13.8	15																
29-Mar-19	31	500	445	7.60	74	#N/A	2.0	13.7	17	<0.5	<0.03	32.2	0.087	<0.00045	0.0120	0.00114	<0.0000035	<0.0000035	0.003	<0.0000015	12.5	<0.00004	0.000011	0.0003	<0.0035
05-Apr-19	32	500	450	7.87	65	#N/A	4.0	22.1	12																
12-Apr-19	33	500	485	7.67	92	#N/A	1.6	23.3	22	<0.5	<0.03	37.2	0.083	<0.00045	0.0130	0.00116	<0.0000035	<0.0000035	<0.001	0.000006	14.5	<0.00004	0.000029	0.0006	<0.0035
19-Apr-19	34	500	430	7.97	67	#N/A	1.6	14.6	14																
26-Apr-19	35	500	440	7.81	58	#N/A	2.2	13.0	12	<0.5	<0.03	26.7	0.090	<0.00045	0.0111	0.00104	<0.0000035	<0.0000035	0.002	<0.0000015	10.3	<0.00004	0.000020	0.0014	<0.0035
03-May-19	36	500	445	7.91	58	#N/A	2.1	12.6	11																
10-May-19	37	500	445	7.74	71	#N/A	1.3	13.6	15	<0.5	<0.03	31.9	0.101	<0.00045	0.0134	0.00118	<0.0000035	<0.0000035	<0.001	<0.0000015	12.4	<0.00004	0.000025	0.0008	0.010
17-May-19	38	500	445	7.78	68	#N/A	1.9	13.8	13	<0.5	<0.03	28.9	0.101	<0.00045	0.0132	0.00101	<0.0000035	<0.0000035	<0.001	0.000004	11.2	<0.00004	0.000036	0.0023	<0.0035
24-May-19	39	500	440	7.74	56	#N/A	2.8	13.4	10	<0.5	<0.03	24.7	0.092	<0.00045	0.0097	0.00103	<0.0000035	<0.0000035	0.002	0.000003	9.54	<0.00004	0.000024	0.0006	<0.0035
Cell Terminated																									
Loads	**mg/kg**																								
24-Aug-18	0			7.72					3.04	18.24	0.0342	42.18	0.0152	0.00019	0.07296	0.0019608	0.000019	0.00001862	0.0038	0.00002204	15.58	0.0000266	0.0000855	0.0002546	0.00988
31-Aug-18	1			7.89					4.95	15.3	0.0315	32.445	0.0405	0.000315	0.07875	0.001539	0.000001575	0.000001575	0.0054	0.0000018	11.7	0.00000675	0.00001125	0.000216	0.001575
07-Sep-18	2			7.76					3.96	4.84	0.0264	16.94	0.06336	0.000308	0.06776	0.0007964	0.00000154	0.00000154	0.00704	0.00000066	6.116	0.0000066	0.00000748	0.0001012	0.00154
14-Sep-18	3			7.88					3.08	1.32	0.0132	11.22	0.05192	0.00022	0.05588	0.0005016	0.00000154	0.00000154	0.00176	0.00000176	4.0788	0.0000572	0.0000088	0.000066	0.00154
21-Sep-18	4			7.82					3.15																
28-Sep-18	5			7.92					2.175	0.2175	0.01305	11.136	0.075255	0.000174	0.044805	0.0004437	1.5225E-06	1.5225E-06	0.00174	0.000001305	4.0977	0.000006525	0.000004785	0.00015225	0.0015225
05-Oct-18	6			7.77					1.78																
12-Oct-18	7			7.97					2.175	0.2175	0.01305	10.3095	0.06873	0.0001305	0.0348435	0.0004263	1.5225E-06	1.5225E-06	0.001305	0.000001305	3.7932	0.00007395	0.00005655	0.0000957	0.007395
19-Oct-18	8			8.04					3.045																
26-Oct-18	9			7.96					4.785	0.2175	0.01305	13.4415	0.069165	0.000087	0.0172695	0.00056115	1.5225E-06	1.5225E-06	0.001305	0.000002175	5.0025	0.000006525	0.00001044	0.00137895	0.00435
02-Nov-18	10			7.99					7.83																
09-Nov-18	11			7.91					9.79	0.2225	0.01335	15.397	0.049395	0.0000445	0.015575	0.00069865	1.5575E-06	1.5575E-06	0.00089	0.00000178	5.7405	0.00003115	0.000011125	0.00028035	0.0015575
16-Nov-18	12			7.74					11.475																
23-Nov-18	13			7.89					7.92	0.22	0.0132	15.268	0.055	0.000044	0.013024	0.0006864	0.00000154	0.00000154	0.00044	0.00000352	5.764	0.0000066	0.00000748	0.0001188	0.00154
30-Nov-18	14			7.86					8.8																
07-Dec-18	15			7.71					8.265	0.2175	0.01305	15.747	0.047415	0.0000435	0.011397	0.00062205	1.5225E-06	1.5225E-06	0.00087	0.000001305	5.9595	0.000006525	0.0000087	0.0003741	0.0015225
14-Dec-18	16			7.94					8.01																
21-Dec-18	17			7.74					9.68	0.22	0.0132	16.06	0.0396	0.000044	0.00902	0.0006292	0.00000154	0.00000154	0.00044	0.0000044	6.16	0.0000066	0.00000088	0.000176	0.00154
28-Dec-18	18			7.81					8.8																
04-Jan-19	19			7.81					9.45	0.225	0.0135	16.695	0.0495	0.000045	0.008955	0.0006705	0.000001575	0.000001575	0.00045	0.000000675	6.39	0.000018	0.00002115	0.0002115	0.001575
11-Jan-19	20			7.61					11																
18-Jan-19	21			7.70					8.7	0.2175	0.01305	14.8335	0.048285	0.0000435	0.0081345	0.00058725	1.5225E-06	1.5225E-06	0.001305	0.000002175	5.6985	0.000006525	0.00000957	0.00004785	0.0015225
25-Jan-19	22			7.75					8.7																
01-Feb-19	23			7.66					8.36	0.22	0.0132	14.916	0.04488	0.000044	0.007304	0.0005764	0.00000154	0.00000154	0.00088	0.0000044	5.72	0.0000066	0.00003564	0.000242	0.00352
08-Feb-19	24			7.83					7.31																
15-Feb-19	25			7.75					7.48	0.22	0.0132	14.872	0.04576	0.000044	0.0066	0.0005324	0.00000154	0.00000154	0.00308	0.00000132	5.72	0.0000066	0.0000088	0.0001804	0.00154
22-Feb-19	26			7.89					7.31																
01-Mar-19	27			7.73					4.84	0.22	0.0132	13.508	0.0462	0.000198	0.006028	0.0005104	0.00000154	0.00000154	0.00044	0.00000132	5.192	0.0000176	0.00000968	0.000176	0.00154
08-Mar-19	28			7.81					6.6																
15-Mar-19	29			7.70					6.23	0.2225	0.01335	12.6825	0.038715	0.00020025	0.0053845	0.0004895	1.5575E-06	1.5575E-06	0.000445	0.000004895	4.8505	0.0000178	0.000003115	0.002136	0.0015575
22-Mar-19	30			7.93					6.675																
29-Mar-19	31			7.60					7.565	0.2225	0.01335	14.329	0.038715	0.00020025	0.00534	0.0005073	1.5575E-06	1.5575E-06	0.001335	6.675E-07	5.5625	0.0000178	0.000004895	0.0001335	0.0015575
05-Apr-19	32			7.87					5.4																
12-Apr-19	33			7.67					10.67	0.2425	0.01455	18.042	0.040255	0.00021825	0.006305	0.0005626	1.6975E-06	1.6975E-06	0.000485	0.00000291	7.0325	0.0000194	0.000014065	0.000291	0.0016975
19-Apr-19	34			7.97					6.02																
26-Apr-19	35			7.81					5.28	0.22	0.0132	11.748	0.0396	0.000198	0.004884	0.0004576	0.00000154	0.00000154	0.00088	0.00000066	4.532	0.0000176	0.0000088	0.000616	0.00154
03-May-19	36			7.91					4.895																
10-May-19	37			7.74					6.675	0.2225	0.01335	14.1955	0.044945	0.00020025	0.005963	0.0005251	1.5575E-06	1.5575E-06	0.000445	6.675E-07	5.518	0.0000178	0.000011125	0.000356	0.00445
17-May-19	38			7.78					5.785	0.2225	0.01335	12.8605	0.044945	0.00020025	0.005874	0.00044945	1.5575E-06	1.5575E-06	0.000445	0.00000178	4.984	0.0000178	0.00001602	0.0010235	0.0015575
24-May-19	39			7.74					4.4	0.22	0.0132	10.868	0.04048	0.000198	0.004268	0.0004532	0.00000154	0.00000154	0.00088	0.00000132	4.1976	0.0000176	0.00001056	0.000264	0.00154

Appendix 4-6: Kinetic Test Results
HC 4

Date	**Cycle** No.	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
		mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
24-Aug-18	0	0.00005	0.0068	2.05	0.159	*<0.005*	0.00048	0.0139	0.037	9.08	0.00011	1.17	0.00006	7.95	0.191	3.7	0.000063	0.00178	0.00011	0.000169	0.00039	*<0.001*	*<0.001*
31-Aug-18	1	0.00003	0.0046	1.77	0.0453	*<0.005*	0.00109	0.0024	*<0.0015*	6.42	0.00005	1.28	*<0.000025*	6.16	0.135	5.4	0.000010	0.00121	*<0.000025*	0.000611	0.00073	*<0.001*	*<0.001*
07-Sep-18	2	0.00004	0.0028	0.945	0.0348	0.02	0.00123	0.0009	*<0.0015*	3.94	0.00004	1.21	*<0.000025*	3.28	0.0670	4.3	0.000006	0.00069	0.00010	0.000599	0.00084	*<0.001*	*<0.001*
14-Sep-18	3	0.00002	0.0018	0.571	0.0329	0.03	0.00079	0.0005	*<0.0015*	2.42	0.00004	0.89	*<0.000025*	1.48	0.0452	1.8	0.000005	0.00039	0.00006	0.000563	0.00078	*<0.001*	*<0.001*
21-Sep-18	4																						
28-Sep-18	5	0.00004	0.0020	0.517	0.0396	*<0.005*	0.00033	0.0008	*<0.0015*	2.15	*<0.00002*	0.94	*<0.000025*	0.84	0.0382	2.4	*<0.0000025*	0.00022	0.00010	0.000686	0.00090	*<0.001*	*<0.001*
05-Oct-18	6																						
12-Oct-18	7	0.00003	0.0018	0.469	0.0363	*<0.005*	0.00016	0.0005	*<0.0015*	1.86	*<0.00002*	0.89	*<0.000025*	0.56	0.0338	2.7	*<0.0000025*	0.00012	0.00025	0.000774	0.00075	*<0.001*	*<0.001*
19-Oct-18	8																						
26-Oct-18	9	0.00001	0.0015	0.522	0.0452	*<0.005*	0.00019	0.0003	*<0.0015*	2.27	*<0.00002*	0.63	*<0.000025*	0.54	0.0349	4.1	*<0.0000025*	0.00013	0.00039	0.000939	0.00077	*<0.001*	*<0.001*
02-Nov-18	10																						
09-Nov-18	11	0.00001	0.0019	0.586	0.0438	*<0.005*	0.00010	0.0004	*<0.0015*	1.92	*<0.00002*	0.64	*<0.000025*	0.45	0.0488	7.3	0.000006	0.00006	0.00015	0.00148	0.00035	*<0.001*	*<0.001*
16-Nov-18	12																						
23-Nov-18	13	*<0.000005*	0.0016	0.487	0.0380	*<0.005*	0.00014	0.0002	*<0.0015*	1.89	*<0.00002*	0.67	*<0.000025*	0.31	0.0420	6.9	0.000005	0.00019	*<0.000025*	0.00126	0.00036	*<0.001*	*<0.001*
30-Nov-18	14																						
07-Dec-18	15	*<0.000005*	0.0014	0.461	0.0439	*<0.005*	0.00012	0.0002	*<0.0015*	1.93	*<0.00002*	0.71	*<0.000025*	0.24	0.0417	7.2	*<0.0000025*	0.00006	*<0.000025*	0.00110	0.00029	*<0.001*	*<0.001*
14-Dec-18	16																						
21-Dec-18	17	0.00001	0.0011	0.357	0.0367	*<0.005*	0.00008	*<0.00005*	*<0.0015*	1.53	*<0.00002*	0.56	*<0.000025*	0.19	0.0397	8.1	*<0.0000025*	0.00007	*<0.000025*	0.00104	0.00025	*<0.001*	*<0.001*
28-Dec-18	18																						
04-Jan-19	19	*<0.000005*	0.0011	0.377	0.0397	*<0.005*	0.00019	0.0002	*<0.0015*	1.66	*<0.00002*	0.50	*<0.000025*	0.21	0.0360	9.4	*<0.0000025*	0.00004	*<0.000025*	0.000846	0.00028	*<0.001*	*<0.001*
11-Jan-19	20																						
18-Jan-19	21	0.00001	0.0013	0.347	0.0363	*<0.005*	0.00616	0.0001	*<0.0015*	1.47	*<0.00002*	0.56	*<0.000025*	0.20	0.0326	6.6	*<0.0000025*	0.00006	*<0.000025*	0.000947	0.00028	*<0.001*	*<0.001*
25-Jan-19	22																						
01-Feb-19	23	0.00070	0.0019	0.363	0.0356	*<0.005*	0.00025	0.0003	*<0.0015*	1.30	*<0.00002*	0.56	*<0.000025*	0.22	0.0348	8.6	*<0.0000025*	0.00013	*<0.000025*	0.000848	0.00021	0.002	*<0.001*
08-Feb-19	24																						
15-Feb-19	25	*<0.000005*	0.0009	0.317	0.0360	*<0.005*	0.00009	*<0.00005*	*<0.0015*	1.44	*<0.00002*	0.62	*<0.000025*	0.25	0.0265	7.8	*<0.0000025*	*<0.00005*	0.00005	0.000614	0.00022	*<0.001*	*<0.001*
22-Feb-19	26																						
01-Mar-19	27	0.00001	0.0011	0.284	0.0453	*<0.005*	0.00027	0.0002	*<0.0015*	1.24	0.00010	0.49	*<0.000025*	0.24	0.0253	5.4	*<0.0000025*	*<0.00003*	0.00005	0.000557	0.00019	*<0.001*	*<0.001*
08-Mar-19	28																						
15-Mar-19	29	0.00006	0.0008	0.277	0.0370	*<0.005*	0.00010	0.0001	*<0.0015*	1.20	*<0.00002*	0.46	*<0.000025*	0.12	0.0226	5.7	*<0.0000025*	0.00007	0.00031	0.000543	0.00017	*<0.001*	*<0.001*
22-Mar-19	30																						
29-Mar-19	31	*<0.000005*	0.0010	0.256	0.03301	*<0.005*	0.00007	*<0.00005*	*<0.0015*	1.18	*<0.00002*	0.49	*<0.000025*	0.15	0.0252	8.7	*<0.0000025*	*<0.00003*	*<0.000025*	0.000439	0.00019	*<0.001*	*<0.001*
05-Apr-19	32																						
12-Apr-19	33	*<0.000005*	0.0008	0.252	0.0330	*<0.005*	0.00018	*<0.00005*	*<0.0015*	1.11	*<0.00002*	0.54	*<0.000025*	0.11	0.0301	6.4	0.000006	0.00015	*<0.000025*	0.000803	0.00018	*<0.001*	*<0.001*
19-Apr-19	34																						
26-Apr-19	35	0.00004	0.0009	0.244	0.0300	*<0.005*	0.00019	*<0.00005*	*<0.0015*	1.16	*<0.00002*	0.46	*<0.000025*	0.15	0.0214	5.7	0.000005	0.00008	*<0.000025*	0.000552	0.00016	*<0.001*	*<0.001*
03-May-19	36																						
10-May-19	37	0.00002	0.0008	0.258	0.0273	*<0.005*	0.00007	0.0001	*<0.0015*	1.16	*<0.00002*	0.53	*<0.000025*	0.15	0.0239	7.0	0.000005	*<0.00003*	*<0.000025*	0.000498	0.00020	*<0.001*	*<0.001*
17-May-19	38	0.00005	0.0008	0.229	0.0517	*<0.005*	0.00006	*<0.00005*	*<0.0015*	1.12	*<0.00002*	0.54	*<0.000025*	0.13	0.0225	5.4	*<0.0000025*	0.00010	0.00005	0.000389	0.00019	*<0.001*	*<0.001*
24-May-19	39	0.00002	0.0008	0.205	0.0342	*<0.005*	0.00006	*<0.00005*	*<0.0015*	0.980	*<0.00002*	0.47	*<0.000025*	0.13	0.0190	3.4	*<0.0000025*	*<0.00003*	0.00006	0.000329	0.00016	*<0.001*	*<0.001*
Cell Terminated																							
Loads	**mg/kg**																						
24-Aug-18	0	0.000019	0.002584	0.779	0.06042	0.0019	0.0001824	0.005282	0.01406	3.4504	0.0000418	0.4446	0.0000228	3.021	0.07258	1.406	0.00002394	0.0006764	0.0000418	0.00006422	0.0001482	0.00038	0.00038
31-Aug-18	1	0.0000135	0.00207	0.7965	0.020385	0.00225	0.0004905	0.00108	0.000675	2.889	0.0000225	0.576	0.00001125	2.772	0.06075	2.43	0.0000045	0.0005445	0.00001125	0.00027495	0.0003285	0.00045	0.00045
07-Sep-18	2	0.0000176	0.001232	0.4158	0.015312	0.0088	0.0005412	0.000396	0.00066	1.7336	0.0000176	0.5324	0.000011	1.4432	0.02948	1.892	0.00000264	0.0003036	0.000044	0.00026356	0.0003696	0.00044	0.00044
14-Sep-18	3	0.0000088	0.000792	0.25124	0.014476	0.0132	0.0003476	0.00022	0.00066	1.0648	0.0000176	0.3916	0.000011	0.6512	0.019888	0.792	0.0000022	0.0001716	0.0000264	0.00024772	0.0003432	0.00044	0.00044
21-Sep-18	4																						
28-Sep-18	5	0.0000174	0.00087	0.224895	0.017226	0.002175	0.00014355	0.000348	0.0006525	0.93525	0.0000087	0.4089	0.000010875	0.3654	0.016617	1.044	1.0875E-06	0.0000957	0.0000435	0.00029841	0.0003915	0.000435	0.000435
05-Oct-18	6																						
12-Oct-18	7	0.00001305	0.000783	0.204015	0.0157905	0.002175	0.0000696	0.0002175	0.0006525	0.8091	0.0000087	0.38715	0.000010875	0.2436	0.014703	1.1745	1.0875E-06	0.0000522	0.00010875	0.00033669	0.00032625	0.000435	0.000435
19-Oct-18	8																						
26-Oct-18	9	0.00000435	0.0006525	0.22707	0.019662	0.002175	0.00008265	0.0001305	0.0006525	0.98745	0.0000087	0.27405	0.000010875	0.2349	0.0151815	1.7835	1.0875E-06	0.00005655	0.00016965	0.000408465	0.00033495	0.000435	0.000435
02-Nov-18	10																						
09-Nov-18	11	0.00000445	0.0008455	0.26077	0.019491	0.002225	0.0000445	0.000178	0.0006675	0.8544	0.0000089	0.2848	0.000011125	0.20025	0.021716	3.2485	0.00000267	0.0000267	0.00006675	0.0006586	0.00015575	0.000445	0.000445
16-Nov-18	12																						
23-Nov-18	13	0.0000022	0.000704	0.21428	0.01672	0.0022	0.0000616	0.000088	0.00066	0.8316	0.0000088	0.2948	0.000011	0.1364	0.01848	3.036	0.0000022	0.0000836	0.000011	0.0005544	0.0001584	0.00044	0.00044
30-Nov-18	14																						
07-Dec-18	15	0.000002175	0.000609	0.200535	0.0190965	0.002175	0.0000522	0.000087	0.0006525	0.83955	0.0000087	0.30885	0.000010875	0.1044	0.0181395	3.132	1.0875E-06	0.0000261	0.000010875	0.0004785	0.00012615	0.000435	0.000435
14-Dec-18	16																						
21-Dec-18	17	0.0000044	0.000484	0.15708	0.016148	0.0022	0.0000352	0.000022	0.00066	0.6732	0.0000088	0.2464	0.000011	0.0836	0.017468	3.564	0.0000011	0.0000308	0.000011	0.0004576	0.00011	0.00044	0.00044
28-Dec-18	18																						
04-Jan-19	19	0.00000225	0.000495	0.16965	0.017865	0.00225	0.0000855	0.00009	0.000675	0.747	0.000009	0.225	0.00001125	0.0945	0.0162	4.23	0.000001125	0.000018	0.00001125	0.0003807	0.000126	0.00045	0.00045
11-Jan-19	20																						
18-Jan-19	21	0.00000435	0.0005655	0.150945	0.0157905	0.002175	0.0026796	0.0000435	0.0006525	0.63945	0.0000087	0.2436	0.000010875	0.087	0.014181	2.871	1.0875E-06	0.0000261	0.000010875	0.000411945	0.0001218	0.000435	0.000435
25-Jan-19	22																						
01-Feb-19	23	0.000308	0.000836	0.15972	0.015664	0.0022	0.00011	0.000132	0.00066	0.572	0.0000088	0.2464	0.000011	0.0968	0.015312	3.784	0.0000011	0.0000572	0.000011	0.00037312	0.0000924	0.00088	0.00044
08-Feb-19	24																						
15-Feb-19	25	0.0000022	0.000396	0.13948	0.01584	0.0022	0.0000396	0.000022	0.00066	0.6336	0.0000088	0.2728	0.000011	0.11	0.01166	3.432	0.0000011	0.000022	0.000022	0.00027016	0.0000968	0.00044	0.00044
22-Feb-19	26																						
01-Mar-19	27	0.0000044	0.000484	0.12496	0.019932	0.0022	0.0001188	0.000088	0.00066	0.5456	0.000044	0.2156	0.000011	0.1056	0.011132	2.376	0.0000011	0.0000132	0.000022	0.00024508	0.0000836	0.00044	0.00044
08-Mar-19	28																						
15-Mar-19	29	0.0000267	0.000356	0.123265	0.016465	0.002225	0.0000445	0.0000445	0.0006675	0.534	0.0000089	0.2047	0.000011125	0.0534	0.010057	2.5365	1.1125E-06	0.00003115	0.00013795	0.000241635	0.00007565	0.000445	0.000445
22-Mar-19	30																						
29-Mar-19	31	0.000002225	0.000445	0.11392	0.01468945	0.002225	0.00003115	0.00002225	0.0006675	0.5251	0.0000089	0.21805	0.000011125	0.06675	0.011214	3.8715	1.1125E-06	0.00001335	0.000011125	0.000195355	0.00008455	0.000445	0.000445
05-Apr-19	32																						
12-Apr-19	33	0.000002425	0.000388	0.12222	0.016005	0.002425	0.0000873	0.00002425	0.0007275	0.53835	0.0000097	0.2619	0.000012125	0.05335	0.0145985	3.104	0.00000291	0.00007275	0.000012125	0.000389455	0.0000873	0.000485	0.000485
19-Apr-19	34																						
26-Apr-19	35	0.0000176	0.000396	0.10736	0.0132	0.0022	0.0000836	0.000022	0.00066	0.5104	0.0000088	0.2024	0.000011	0.066	0.009416	2.508	0.0000022	0.0000352	0.000011	0.00024288	0.0000704	0.00044	0.00044
03-May-19	36																						
10-May-19	37	0.0000089	0.000356	0.11481	0.0121485	0.002225	0.00003115	0.0000445	0.0006675	0.5162	0.0000089	0.23585	0.000011125	0.06675	0.0106355	3.115	0.000002225	0.00001335	0.000011125	0.00022161	0.000089	0.000445	0.000445
17-May-19	38	0.00002225	0.000356	0.101905	0.0230065	0.002225	0.0000267	0.00002225	0.0006675	0.4984	0.0000089	0.2403	0.000011125	0.05785	0.0100125	2.403	1.1125E-06	0.0000445	0.00002225	0.000173105	0.00008455	0.000445	0.000445
24-May-19	39	0.0000088	0.000352	0.0902	0.015048	0.0022	0.0000264	0.000022	0.00066	0.4312	0.0000088	0.2068	0.000011	0.0572	0.00836	1.496	0.0000011	0.0000132	0.0000264	0.00014476	0.0000704	0.00044	0.00044

Appendix 4-6: Kinetic Test Results
HC 5

Date	**Cycle**	**Volume mL**		**pH**	**Cond.**	**Acidity**	**Acidity**	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output			(pH 4.5)	(pH 8.3)					CaCO3												
					umhos/cm	mgCaCO3/L	mgCaCO3/L	mgCaCO3/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
24-Aug-18	0	500	385	7.86	438	#N/A	4.1	40.3	73	32	0.12	165	0.026	0.0002	0.0123	0.00764	*<0.0000035*	*<0.0000035*	0.018	0.000024	61.4	*<0.000015*	0.000821	0.00037
31-Aug-18	1	500	450	7.65	269	#N/A	3.3	14.4	54	26	0.11	98.0	0.134	0.0003	0.0217	0.00366	*<0.0000035*	*<0.0000035*	0.016	0.000003	36.0	*<0.000015*	0.000028	0.00042
07-Sep-18	2	500	430	7.69	147	#N/A	2.9	15.7	33	7	0.09	54.2	0.212	0.0003	0.0186	0.00190	*<0.0000035*	*<0.0000035*	0.017	*<0.0000015*	19.9	*<0.000015*	0.000019	0.00009
14-Sep-18	3	500	440	7.72	104	#N/A	1.7	14.8	25	3	0.07	34.7	0.143	0.0002	0.0158	0.00116	*<0.0000035*	*<0.0000035*	0.008	0.000008	12.8	0.00011	0.000019	0.00017
21-Sep-18	4	500	435	7.74	89	#N/A	2.4	14.7	21															
28-Sep-18	5	500	450	7.87	81	#N/A	1.3	20.1	17	1	*<0.03*	34.2	0.169	0.0002	0.0163	0.00102	*<0.0000035*	*<0.0000035*	0.008	*<0.0000015*	12.6	*<0.000015*	0.000016	0.00034
05-Oct-18	6	500	435	7.69	75	#N/A	1.9	14.3	14															
12-Oct-18	7	500	415	7.79	83	#N/A	4.2	15.9	18	*<0.5*	*<0.03*	32.4	0.158	*<0.0001*	0.0142	0.00104	*<0.0000035*	*<0.0000035*	0.006	*<0.0000015*	12.1	0.00021	0.000099	0.00150
19-Oct-18	8	500	440	7.72	69	#N/A	1.6	13.5	14															
26-Oct-18	9	500	445	7.74	69	#N/A	1.3	13.6	16	*<0.5*	*<0.03*	31.0	0.151	*<0.0001*	0.0096	0.00089	*<0.0000035*	*<0.0000035*	0.005	*<0.0000015*	11.6	*<0.000015*	0.000024	0.00191
02-Nov-18	10	500	440	7.78	68	#N/A	1.5	13.4	15															
09-Nov-18	11	500	450	7.78	66	#N/A	2.2	13.1	14	*<0.5*	*<0.03*	24.4	0.119	*<0.0001*	0.0110	0.00074	*<0.0000035*	*<0.0000035*	0.004	0.000005	9.09	0.00004	0.000014	0.00032
16-Nov-18	12	500	425	7.63	76	#N/A	1.1	12.5	16															
23-Nov-18	13	500	440	7.91	77	#N/A	1.7	14.0	14	*<0.5*	*<0.03*	29.1	0.161	*<0.0001*	0.0114	0.00077	*<0.0000035*	*<0.0000035*	0.003	*<0.0000015*	10.9	*<0.000015*	0.000007	0.00026
30-Nov-18	14	500	430	7.85	77	#N/A	1.5	15.3	15															
07-Dec-18	15	500	440	7.72	79	#N/A	3.3	15.7	16	*<0.5*	*<0.03*	31.9	0.149	*<0.0001*	0.0115	0.00085	*<0.0000035*	*<0.0000035*	0.004	0.000005	12.0	*<0.000015*	0.000005	0.0168
14-Dec-18	16	500	440	7.92	84	#N/A	2.6	15.6	19															
21-Dec-18	17	500	435	7.72	101	#N/A	3.3	14.2	26	*<0.5*	*<0.03*	38.9	0.100	*<0.0001*	0.0219	0.00105	*<0.0000035*	*<0.0000035*	*<0.001*	*<0.0000015*	14.8	*<0.000015*	*<0.000002*	0.00045
28-Dec-18	18	500	440	7.61	108	#N/A	1.7	11.3	31															
04-Jan-19	19	500	440	7.74	101	#N/A	3.0	12.9	29	*<0.5*	*<0.03*	43.7	0.114	*<0.0001*	0.0447	0.00130	*<0.0000035*	*<0.0000035*	0.003	*<0.0000015*	16.7	0.00003	0.000041	0.00042
11-Jan-19	20	500	435	7.46	99	#N/A	2.7	12.9	33															
18-Jan-19	21	500	435	7.57	89	#N/A	1.5	12.1	32	*<0.5*	*<0.03*	42.7	0.112	*<0.0001*	0.0503	0.00105	*<0.0000035*	*<0.0000035*	0.003	*<0.0000015*	16.3	*<0.000015*	0.000014	0.00012
25-Jan-19	22	500	440	7.65	104	#N/A	1.6	11.3	29															
01-Feb-19	23	500	440	7.61	103	#N/A	2.7	12.9	28	*<0.5*	*<0.03*	39.8	0.093	*<0.0001*	0.0426	0.00098	*<0.0000035*	*<0.0000035*	0.003	*<0.0000015*	15.2	*<0.000015*	0.000019	0.00062
08-Feb-19	24	500	440	7.67	103	#N/A	2.6	12.4	29															
15-Feb-19	25	500	440	7.56	101	#N/A	1.8	11.8	30	*<0.5*	*<0.03*	43.0	0.090	*<0.0001*	0.0394	0.00113	*<0.0000035*	*<0.0000035*	0.008	0.000025	16.5	0.00007	0.000028	0.00029
22-Feb-19	26	500	425	7.74	117	#N/A	3.0	14.2	36															
01-Mar-19	27	500	435	7.48	113	#N/A	2.4	14.1	34	*<0.5*	*<0.03*	46.9	0.066	*<0.00045*	0.0231	0.00107	*<0.0000035*	*<0.0000035*	0.003	*<0.0000015*	18.1	*<0.00004*	0.000087	0.0004
08-Mar-19	28	500	435	7.64	107	#N/A	2.8	12.2	36															
15-Mar-19	29	500	450	7.57	99	#N/A	2.0	12.1	35	*<0.5*	*<0.03*	44.1	0.065	*<0.00045*	0.0182	0.00102	*<0.0000035*	*<0.0000035*	0.003	0.000007	17.0	*<0.00004*	0.000040	0.0023
22-Mar-19	30	500	435	7.76	109	#N/A	2.7	13.0	35															
29-Mar-19	31	500	435	7.43	108	#N/A	2.4	13.8	33	*<0.5*	*<0.03*	47.1	0.063	*<0.00045*	0.0140	0.00104	*<0.0000035*	*<0.0000035*	0.003	0.000017	18.2	*<0.00004*	0.000087	0.0008
05-Apr-19	32	500	430	7.75	108	#N/A	5.3	16.5	34															
12-Apr-19	33	500	480	7.51	115	#N/A	1.6	16.5	37	*<0.5*	*<0.03*	46.0	0.080	*<0.00045*	0.0181	0.00096	*<0.0000035*	*<0.0000035*	0.002	*<0.0000015*	17.8	*<0.00004*	0.000017	0.0006
19-Apr-19	34	500	430	7.52	106	#N/A	2.2	12.3	36															
26-Apr-19	35	500	430	7.64	103	#N/A	2.5	11.7	34	*<0.5*	*<0.03*	46.4	0.059	*<0.00045*	0.0094	0.00115	*<0.0000035*	*<0.0000035*	0.003	0.000003	18.0	*<0.00004*	0.000135	0.0006
03-May-19	36	500	440	7.91	97	#N/A	2.3	10.2	33															
10-May-19	37	500	430	7.52	97	#N/A	1.7	10.2	30	*<0.5*	*<0.03*	42.1	0.059	*<0.00045*	0.0120	0.00103	*<0.0000035*	*<0.0000035*	0.003	0.000005	16.3	*<0.00004*	0.000080	0.0008
17-May-19	38	500	435	7.49	96	#N/A	2.5	10.8	29	*<0.5*	*<0.03*	39.5	0.063	*<0.00045*	0.0135	0.00090	*<0.0000035*	*<0.0000035*	*<0.001*	0.000006	15.3	*<0.00004*	0.000060	0.0004
24-May-19	39	500	435	7.53	90	#N/A	3.1	11.1	29	*<0.5*	*<0.03*	37.5	0.054	*<0.00045*	0.0093	0.00089	*<0.0000035*	*<0.0000035*	0.003	*<0.0000015*	14.5	*<0.00004*	0.000111	0.0008
Cell Terminated																								
Loads	**mg/kg**																							
24-Aug-18	0			7.86					28.105	12.32	0.0462	63.525	0.01001	0.000077	0.0047355	0.0029414	1.3475E-06	1.3475E-06	0.00693	0.00000924	23.639	0.000005775	0.000316085	0.00014245
31-Aug-18	1			7.65					24.3	11.7	0.0495	44.1	0.0603	0.000135	0.009765	0.001647	0.000001575	0.000001575	0.0072	0.00000135	16.2	0.00000675	0.0000126	0.000189
07-Sep-18	2			7.69					14.19	3.01	0.0387	23.306	0.09116	0.000129	0.007998	0.000817	0.000001505	0.000001505	0.00731	0.000000645	8.557	0.00000645	0.00000817	0.0000387
14-Sep-18	3			7.72					11	1.32	0.0308	15.268	0.06292	0.000088	0.006952	0.0005104	0.00000154	0.00000154	0.00352	0.00000352	5.632	0.0000484	0.00000836	0.0000748
21-Sep-18	4			7.74					9.135															
28-Sep-18	5			7.87					7.65	0.45	0.0135	15.39	0.07605	0.00009	0.007335	0.000459	0.000001575	0.000001575	0.0036	0.000000675	5.67	0.00000675	0.0000072	0.000153
05-Oct-18	6			7.69					6.09															
12-Oct-18	7			7.79					7.47	0.2075	0.01245	13.446	0.06557	0.0000415	0.005893	0.0004316	1.4525E-06	1.4525E-06	0.00249	6.225E-07	5.0215	0.00008715	0.000041085	0.0006225
19-Oct-18	8			7.72					6.16															
26-Oct-18	9			7.74					7.12	0.2225	0.01335	13.795	0.067195	0.0000445	0.004272	0.00039605	1.5575E-06	1.5575E-06	0.002225	6.675E-07	5.162	0.000006675	0.00001068	0.00084995
02-Nov-18	10			7.78					6.6															
09-Nov-18	11			7.78					6.3	0.225	0.0135	10.98	0.05355	0.000045	0.00495	0.000333	0.000001575	0.000001575	0.0018	0.00000225	4.0905	0.000018	0.0000063	0.000144
16-Nov-18	12			7.63					6.8															
23-Nov-18	13			7.91					6.16	0.22	0.0132	12.804	0.07084	0.000044	0.005016	0.0003388	0.00000154	0.00000154	0.00132	0.00000066	4.796	0.0000066	0.00000308	0.0001144
30-Nov-18	14			7.85					6.45															
07-Dec-18	15			7.72					7.04	0.22	0.0132	14.036	0.06556	0.000044	0.00506	0.000374	0.00000154	0.00000154	0.00176	0.0000022	5.28	0.0000066	0.0000022	0.007392
14-Dec-18	16			7.92					8.36															
21-Dec-18	17			7.72					11.31	0.2175	0.01305	16.9215	0.0435	0.0000435	0.0095265	0.00045675	1.5225E-06	1.5225E-06	0.000435	6.525E-07	6.438	0.000006525	0.00000087	0.00019575
28-Dec-18	18			7.61					13.64															
04-Jan-19	19			7.74					12.76	0.22	0.0132	19.228	0.05016	0.000044	0.019668	0.000572	0.00000154	0.00000154	0.00132	0.00000066	7.348	0.0000132	0.00001804	0.0001848
11-Jan-19	20			7.46					14.355															
18-Jan-19	21			7.57					13.92	0.2175	0.01305	18.5745	0.04872	0.0000435	0.0218805	0.00045675	1.5225E-06	1.5225E-06	0.001305	6.525E-07	7.0905	0.000006525	0.00000609	0.0000522
25-Jan-19	22			7.65					12.76															
01-Feb-19	23			7.61					12.32	0.22	0.0132	17.512	0.04092	0.000044	0.018744	0.0004312	0.00000154	0.00000154	0.00132	0.00000066	6.688	0.0000066	0.00000836	0.0002728
08-Feb-19	24			7.67					12.76															
15-Feb-19	25			7.56					13.2	0.22	0.0132	18.92	0.0396	0.000044	0.017336	0.0004972	0.00000154	0.00000154	0.00352	0.000011	7.26	0.0000308	0.00001232	0.0001276
22-Feb-19	26			7.74					15.3															
01-Mar-19	27			7.48					14.79	0.2175	0.01305	20.4015	0.02871	0.00019575	0.0100485	0.00046545	1.5225E-06	1.5225E-06	0.001305	6.525E-07	7.8735	0.0000174	0.000037845	0.000174
08-Mar-19	28			7.64					15.66															
15-Mar-19	29			7.57					15.75	0.225	0.0135	19.845	0.02925	0.0002025	0.00819	0.000459	0.000001575	0.000001575	0.00135	0.00000315	7.65	0.000018	0.000018	0.001035
22-Mar-19	30			7.76					15.225															
29-Mar-19	31			7.43					14.355	0.2175	0.01305	20.4885	0.027405	0.00019575	0.00609	0.0004524	1.5225E-06	1.5225E-06	0.001305	0.000007395	7.917	0.0000174	0.000037845	0.000348
05-Apr-19	32			7.75					14.62															
12-Apr-19	33			7.51					17.76	0.24	0.0144	22.08	0.0384	0.000216	0.008688	0.0004608	0.00000168	0.00000168	0.00096	0.00000072	8.544	0.0000192	0.00000816	0.000288
19-Apr-19	34			7.52					15.48															
26-Apr-19	35			7.64					14.62	0.215	0.0129	19.952	0.02537	0.0001935	0.004042	0.0004945	0.000001505	0.000001505	0.00129	0.00000129	7.74	0.0000172	0.00005805	0.000258
03-May-19	36			7.91					14.52															
10-May-19	37			7.52					12.9	0.215	0.0129	18.103	0.02537	0.0001935	0.00516	0.0004429	0.000001505	0.000001505	0.00129	0.00000215	7.009	0.0000172	0.0000344	0.000344
17-May-19	38			7.49					12.615	0.2175	0.01305	17.1825	0.027405	0.00019575	0.0058725	0.0003915	1.5225E-06	1.5225E-06	0.000435	0.00000261	6.6555	0.0000174	0.0000261	0.000174
24-May-19	39			7.53					12.615	0.2175	0.01305	16.3125	0.02349	0.00019575	0.0040455	0.00038715	1.5225E-06	1.5225E-06	0.001305	6.525E-07	6.3075	0.0000174	0.000048285	0.000348

Appendix 4-6: Kinetic Test Results
HC 5

Date	Cycle No.	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
		mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
24-Aug-18	0	<0.0035	<0.000005	0.0098	2.97	0.245	<0.005	0.00023	0.0131	0.006	13.8	0.00020	1.06	<0.000025	7.82	0.447	31.0	0.000019	0.00192	<0.000025	0.000590	0.00005	<0.001	<0.001
31-Aug-18	1	<0.0035	<0.000005	0.0055	1.99	0.0355	<0.005	0.00153	0.0006	0.006	8.27	0.00024	1.19	<0.000025	5.82	0.290	22.8	0.000006	0.00123	<0.000025	0.000400	0.00034	<0.001	<0.001
07-Sep-18	2	<0.0035	0.00006	0.0033	1.08	0.0197	<0.005	0.00121	0.0003	<0.0015	5.79	0.00017	1.25	<0.000025	2.94	0.150	14.1	<0.0000025	0.00064	0.00027	0.000287	0.00045	<0.001	<0.001
14-Sep-18	3	<0.0035	0.00002	0.0022	0.673	0.0183	0.03	0.00071	0.0002	<0.0015	3.39	0.00013	0.91	<0.000025	1.40	0.102	7.5	<0.0000025	0.00031	0.00005	0.000198	0.00050	<0.001	<0.001
21-Sep-18	4																							
28-Sep-18	5	<0.0035	0.00006	0.0024	0.645	0.0215	<0.005	0.00031	0.0004	<0.0015	2.83	0.00010	1.08	<0.000025	0.84	0.0857	6.3	<0.0000025	0.00020	0.00015	0.000286	0.00059	<0.001	<0.001
05-Oct-18	6																							
12-Oct-18	7	0.016	0.00005	0.0021	0.535	0.0224	<0.005	0.00015	0.0003	<0.0015	2.28	0.00008	0.97	<0.000025	0.54	0.0774	5.9	<0.0000025	0.00014	0.00020	0.000248	0.00049	<0.001	<0.001
19-Oct-18	8																							
26-Oct-18	9	0.011	0.00003	0.0016	0.495	0.0237	<0.005	0.00023	0.0002	<0.0015	2.36	0.00009	0.71	<0.000025	0.40	0.0549	5.8	<0.0000025	0.00014	0.00047	0.000196	0.00056	<0.001	<0.001
02-Nov-18	10																							
09-Nov-18	11	<0.0035	0.00002	0.0016	0.415	0.0205	<0.005	0.00008	0.0002	<0.0015	1.53	0.00005	0.69	<0.000025	0.30	0.0517	4.6	<0.0000025	0.00005	<0.000025	0.000219	0.00039	<0.001	<0.001
16-Nov-18	12																							
23-Nov-18	13	0.009	0.00002	0.0016	0.432	0.0196	<0.005	0.00011	<0.00005	0.004	1.57	0.00007	0.78	<0.000025	0.34	0.0526	5.8	0.000005	0.00007	0.00035	0.000262	0.00044	<0.001	<0.001
30-Nov-18	14																							
07-Dec-18	15	<0.0035	<0.000005	0.0016	0.442	0.0135	<0.005	0.00008	0.0002	<0.0015	1.74	0.00006	0.86	<0.000025	0.25	0.0558	6.2	<0.0000025	0.00018	<0.000025	0.000296	0.00035	<0.001	<0.001
14-Dec-18	16																							
21-Dec-18	17	<0.0035	<0.000005	0.0014	0.469	0.00694	<0.005	0.00016	0.0001	<0.0015	1.61	<0.00002	0.62	<0.000025	0.20	0.0657	9.8	<0.0000025	0.00006	<0.000025	0.000400	0.00024	<0.001	<0.001
28-Dec-18	18																							
04-Jan-19	19	<0.0035	<0.000005	0.0015	0.504	0.00808	<0.005	0.00026	0.0003	<0.0015	1.80	<0.00002	0.58	<0.000025	0.24	0.0629	12.5	<0.0000025	0.00003	0.00006	0.000329	0.00028	<0.001	<0.001
11-Jan-19	20																							
18-Jan-19	21	<0.0035	0.00004	0.0017	0.477	0.00726	<0.005	0.00021	0.0001	<0.0015	1.62	0.00005	0.62	<0.000025	0.25	0.0572	10.1	<0.0000025	0.00005	0.00008	0.000350	0.00026	<0.001	<0.001
25-Jan-19	22																							
01-Feb-19	23	<0.0035	<0.000005	0.0022	0.467	0.00842	<0.005	0.00097	0.0002	<0.0015	1.31	0.00004	0.59	<0.000025	0.23	0.0550	11.7	<0.0000025	0.00004	0.00017	0.000364	0.00019	<0.001	<0.001
08-Feb-19	24																							
15-Feb-19	25	<0.0035	<0.000005	0.0014	0.426	0.0109	<0.005	0.00011	0.0003	<0.0015	1.50	<0.00002	0.59	<0.000025	0.26	0.0460	12.6	<0.0000025	<0.00005	0.00004	0.000218	0.00018	<0.001	<0.001
22-Feb-19	26																							
01-Mar-19	27	<0.0035	<0.000005	0.0014	0.420	0.0277	<0.005	0.00094	0.0009	<0.0015	1.41	0.00004	0.57	<0.000025	0.24	0.0518	12.0	<0.0000025	<0.00003	<0.000025	0.000228	0.00007	<0.001	<0.001
08-Mar-19	28																							
15-Mar-19	29	<0.0035	<0.000005	0.0013	0.379	0.0246	<0.005	0.00007	0.0005	<0.0015	1.33	0.00005	0.51	<0.000025	0.13	0.0444	12.7	<0.0000025	<0.00003	<0.000025	0.000194	0.00010	<0.001	<0.001
22-Mar-19	30																							
29-Mar-19	31	0.014	0.00011	0.0016	0.391	0.03195	<0.005	0.00005	0.0008	<0.0015	1.40	0.00004	0.51	<0.000025	0.15	0.0447	14.5	<0.0000025	0.00011	<0.000025	0.000164	0.00005	<0.001	<0.001
05-Apr-19	32																							
12-Apr-19	33	<0.0035	<0.000005	0.0011	0.358	0.0103	<0.005	0.00014	0.0002	<0.0015	1.22	<0.00002	0.51	<0.000025	0.13	0.0435	10.8	0.000006	0.00007	<0.000025	0.000244	0.00010	<0.001	<0.001
19-Apr-19	34																							
26-Apr-19	35	<0.0035	<0.000005	0.0014	0.367	0.0357	<0.005	0.00019	0.0011	<0.0015	1.42	0.00005	0.51	<0.000025	0.17	0.0409	13.5	0.000005	0.00007	<0.000025	0.000148	0.00005	<0.001	<0.001
03-May-19	36																							
10-May-19	37	0.007	<0.000005	0.0011	0.327	0.0205	<0.005	0.00005	0.0007	<0.0015	1.28	0.00004	0.46	<0.000025	0.17	0.0337	11.7	0.000006	<0.00003	<0.000025	0.000111	0.00005	<0.001	<0.001
17-May-19	38	<0.0035	<0.000005	0.0011	0.301	0.0154	<0.005	0.00005	0.0004	<0.0015	1.26	0.00006	0.47	<0.000025	0.15	0.0319	10.5	0.000005	0.00007	<0.000025	0.000093	0.00005	<0.001	<0.001
24-May-19	39	<0.0035	0.00002	0.0013	0.315	0.0224	<0.005	0.00007	0.0009	<0.0015	1.24	0.00005	0.47	<0.000025	0.16	0.0299	9.8	<0.0000025	<0.00003	<0.000025	0.000089	0.00003	<0.001	<0.001
Cell Terminated																								
Loads	**mg/kg**																							
24-Aug-18	0	0.0013475	0.000001925	0.003773	1.14345	0.094325	0.001925	0.00008855	0.0050435	0.00231	5.313	0.000077	0.4081	0.000009625	3.0107	0.172095	11.935	0.000007315	0.0007392	0.000009625	0.00022715	0.00001925	0.000385	0.000385
31-Aug-18	1	0.001575	0.00000225	0.002475	0.8955	0.015975	0.00225	0.0006885	0.00027	0.0027	3.7215	0.000108	0.5355	0.00001125	2.619	0.1305	10.26	0.0000027	0.0005535	0.00001125	0.00018	0.000153	0.00045	0.00045
07-Sep-18	2	0.001505	0.0000258	0.001419	0.4644	0.008471	0.00215	0.0005203	0.000129	0.000645	2.4897	0.0000731	0.5375	0.00001075	1.2642	0.0645	6.063	0.000001075	0.0002752	0.0001161	0.00012341	0.0001935	0.00043	0.00043
14-Sep-18	3	0.00154	0.0000088	0.000968	0.29612	0.008052	0.0132	0.0003124	0.000088	0.00066	1.4916	0.0000572	0.4004	0.000011	0.616	0.04488	3.3	0.0000011	0.0001364	0.000022	0.00008712	0.00022	0.00044	0.00044
21-Sep-18	4																							
28-Sep-18	5	0.001575	0.000027	0.00108	0.29025	0.009675	0.00225	0.0001395	0.00018	0.000675	1.2735	0.000045	0.486	0.00001125	0.378	0.038565	2.835	0.000001125	0.00009	0.0000675	0.0001287	0.0002655	0.00045	0.00045
05-Oct-18	6																							
12-Oct-18	7	0.00664	0.00002075	0.0008715	0.222025	0.009296	0.002075	0.00006225	0.0001245	0.0006225	0.9462	0.0000332	0.40255	0.000010375	0.2241	0.032121	2.4485	1.0375E-06	0.0000581	0.000083	0.00010292	0.00020335	0.000415	0.000415
19-Oct-18	8																							
26-Oct-18	9	0.004895	0.00001335	0.000712	0.220275	0.0105465	0.002225	0.00010235	0.000089	0.0006675	1.0502	0.00004005	0.31595	0.000011125	0.178	0.0244305	2.581	1.1125E-06	0.0000623	0.00020915	0.00008722	0.0002492	0.000445	0.000445
02-Nov-18	10																							
09-Nov-18	11	0.001575	0.000009	0.00072	0.18675	0.009225	0.00225	0.000036	0.00009	0.000675	0.6885	0.0000225	0.3105	0.00001125	0.135	0.023265	2.07	0.000001125	0.0000225	0.00001125	0.00009855	0.0001755	0.00045	0.00045
16-Nov-18	12																							
23-Nov-18	13	0.00396	0.0000088	0.000704	0.19008	0.008624	0.0022	0.0000484	0.000022	0.00176	0.6908	0.0000308	0.3432	0.000011	0.1496	0.023144	2.552	0.0000022	0.0000308	0.000154	0.00011528	0.0001936	0.00044	0.00044
30-Nov-18	14																							
07-Dec-18	15	0.00154	0.0000022	0.000704	0.19448	0.00594	0.0022	0.0000352	0.000088	0.00066	0.7656	0.0000264	0.3784	0.000011	0.11	0.024552	2.728	0.0000011	0.0000792	0.000011	0.00013024	0.000154	0.00044	0.00044
14-Dec-18	16																							
21-Dec-18	17	0.0015225	0.000002175	0.000609	0.204015	0.0030189	0.002175	0.0000696	0.0000435	0.0006525	0.70035	0.0000087	0.2697	0.000010875	0.087	0.0285795	4.263	1.0875E-06	0.0000261	0.000010875	0.000174	0.0001044	0.000435	0.000435
28-Dec-18	18																							
04-Jan-19	19	0.00154	0.0000022	0.00066	0.22176	0.0035552	0.0022	0.0001144	0.000132	0.00066	0.792	0.0000088	0.2552	0.000011	0.1056	0.027676	5.5	0.0000011	0.0000132	0.0000264	0.00014476	0.0001232	0.00044	0.00044
11-Jan-19	20																							
18-Jan-19	21	0.0015225	0.0000174	0.0007395	0.207495	0.0031581	0.002175	0.00009135	0.0000435	0.0006525	0.7047	0.00002175	0.2697	0.000010875	0.10875	0.024882	4.3935	1.0875E-06	0.00002175	0.0000348	0.00015225	0.0001131	0.000435	0.000435
25-Jan-19	22																							
01-Feb-19	23	0.00154	0.0000022	0.000968	0.20548	0.0037048	0.0022	0.0004268	0.000088	0.00066	0.5764	0.0000176	0.2596	0.000011	0.1012	0.0242	5.148	0.0000011	0.0000176	0.0000748	0.00016016	0.0000836	0.00044	0.00044
08-Feb-19	24																							
15-Feb-19	25	0.00154	0.0000022	0.000616	0.18744	0.004796	0.0022	0.0000484	0.000132	0.00066	0.66	0.0000088	0.2596	0.000011	0.1144	0.02024	5.544	0.0000011	0.000022	0.0000176	0.00009592	0.0000792	0.00044	0.00044
22-Feb-19	26																							
01-Mar-19	27	0.0015225	0.000002175	0.000609	0.1827	0.0120495	0.002175	0.0004089	0.0003915	0.0006525	0.61335	0.0000174	0.24795	0.000010875	0.1044	0.022533	5.22	1.0875E-06	0.00001305	0.000010875	0.00009918	0.00003045	0.000435	0.000435
08-Mar-19	28																							
15-Mar-19	29	0.001575	0.00000225	0.000585	0.17055	0.01107	0.00225	0.0000315	0.000225	0.000675	0.5985	0.0000225	0.2295	0.00001125	0.0585	0.01998	5.715	0.000001125	0.0000135	0.00001125	0.0000873	0.000045	0.00045	0.00045
22-Mar-19	30																							
29-Mar-19	31	0.00609	0.00004785	0.000696	0.170085	0.01389825	0.002175	0.00002175	0.000348	0.0006525	0.609	0.0000174	0.22185	0.000010875	0.06525	0.0194445	6.3075	1.0875E-06	0.00004785	0.000010875	0.00007134	0.00002175	0.000435	0.000435
05-Apr-19	32																							
12-Apr-19	33	0.00168	0.0000024	0.000528	0.17184	0.004944	0.0024	0.0000672	0.000096	0.00072	0.5856	0.0000096	0.2448	0.000012	0.0624	0.02088	5.184	0.00000288	0.0000336	0.000012	0.00011712	0.000048	0.00048	0.00048
19-Apr-19	34																							
26-Apr-19	35	0.001505	0.00000215	0.000602	0.15781	0.015351	0.00215	0.0000817	0.000473	0.000645	0.6106	0.0000215	0.2193	0.00001075	0.0731	0.017587	5.805	0.00000215	0.0000301	0.00001075	0.00006364	0.0000215	0.00043	0.00043
03-May-19	36																							
10-May-19	37	0.00301	0.00000215	0.000473	0.14061	0.008815	0.00215	0.0000215	0.000301	0.000645	0.5504	0.0000172	0.1978	0.00001075	0.0731	0.014491	5.031	0.00000258	0.0000129	0.00001075	0.00004773	0.0000215	0.00043	0.00043
17-May-19	38	0.0015225	0.000002175	0.0004785	0.130935	0.006699	0.002175	0.00002175	0.000174	0.0006525	0.5481	0.0000261	0.20445	0.000010875	0.06525	0.0138765	4.5675	0.000002175	0.00003045	0.000010875	0.000040455	0.00002175	0.000435	0.000435
24-May-19	39	0.0015225	0.0000087	0.0005655	0.137025	0.009744	0.002175	0.00003045	0.0003915	0.0006525	0.5394	0.00002175	0.20445	0.000010875	0.0696	0.0130065	4.263	1.0875E-06	0.00001305	0.000010875	0.000038715	0.00001305	0.000435	0.000435

Appendix 4-7:
Field Bin Leachate Results

Atlantic Gold

Appendix 4-7: Field Bin Leachate Results

Parameter	Units	CCME WQG		FB3							
		Short Term	Long Term	2018-09-27 12:30:00 PM	2018-10-24 2:07:00 PM	2019-03-29 11:53:00 AM	2019-04-18 1:30:00 PM	2019-04-29 2:00:00 PM	2019-05-29 10:10:00 AM	2019-06-12 12:00:00 AM	2019-07-03 2:10:00 PM
Calculated Parameters											
Anion Sum	me/L	-	-	10.1	3.48	1.04	1.18	1.32	2.35	1.7	2.26
Bicarb. Alkalinity (calc. as $CaCO_3$)	mg/L	-	-	56	29	13	22	27	28	26	21
Calculated TDS	mg/L	-	-	630	210	65	72	79	150	110	150
Carb. Alkalinity (calc. as $CaCO_3$)	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Cation Sum	me/L	-	-	9.97	3.3	1.03	1.16	1.27	2.39	1.6	2.22
Hardness ($CaCO_3$)	mg/L	-	-	450	150	49	52	58	110	75	110
Ion Balance (% Difference)	%	-	-	0.8	2.65	0.48	0.85	1.93	0.84	3.03	0.89
Langelier Index (@ 20C)	N/A	-	-	-0.14	-1.01	-1.88	-1.32	-0.83	-0.746	-1.38	-1.08
Langelier Index (@ 4C)	N/A	-	-	-0.388	-1.26	-2.13	-1.57	-1.08	-0.996	-1.63	-1.33
Saturation pH (@ 20C)	N/A	-	-	7.53	8.19	8.93	8.7	8.56	8.29	8.48	8.45
Saturation pH (@ 4C)	N/A	-	-	7.78	8.44	9.18	8.95	8.81	8.54	8.73	8.70
Inorganics											
Acidity	mg/L	-	-	6.2	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Total Alkalinity (Total as $CaCO_3$)	mg/L	-	-	56	29	13	22	27	28	26	21
Dissolved Chloride (Cl-)	mg/L	640	120	130	56	4.5	5.5	4.6	5.5	3.3	3.9
Colour	TCU	-	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Dissolved Fluoride (F-)	mg/L	-	0.12	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Nitrate (N)	mg/L	-	-	0.54	0.056	<0.05	<0.05	0.1	0.075	<0.05	0.088
Nitrate + Nitrite (N)	mg/L	-	-	0.6	0.073	<0.05	<0.05	0.1	0.075	0.063	0.13
Nitrite (N)	mg/L	-	-	0.058	0.018	<0.01	<0.01	<0.01	<0.01	0.015	0.042
Nitrogen (Ammonia Nitrogen)	mg/L	-	-	0.067	0.065	<0.05	<0.05	0.081	0.1	<0.05	0.061
Total Organic Carbon (C)	mg/L	-	-	1.6	1.6	0.63	0.71	0.76	1.2	1.3	0.74
Orthophosphate (P)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
pH	pH	6.5-9.0	-	7.39	7.18	7.05	7.38	7.73	7.55	7.1	7.37
Reactive Silica (SiO_2)	mg/L	-	-	3.2	2.1	0.61	1.1	1.4	2.1	2	2.1
Dissolved Sulphate (SO_4)	mg/L	-	-	250	63	31	29	31	78	52	83
Turbidity	NTU	-	-	820	4.1	1.2	5.4	29	2.2	1.3	0.69
Conductivity	µS/cm	-	-	990	360	110	120	150	230	170	210
Bromide (Br-)	mg/L	-	-	18	1.6	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nutritional Parameters											
Total Nitrogen (N)	mg/L			1.43	0.225	0.13		0.278	0.385	0.36	0.356
Metals											
Dissolved Aluminum (Al)[a]	µg/L	-	100	6.5	17	<5.0	11	11	130	14	11
Dissolved Antimony (Sb)	µg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1
Dissolved Arsenic (As)	µg/L	-	5	6.4	3.2	1.6	2.2	3.4	3.5	3.9	2.4
Dissolved Barium (Ba)	µg/L	-	-	22	5.3	1	1.5	1.7	3.1	2.4	3.1
Dissolved Beryllium (Be)	µg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dissolved Bismuth (Bi)	µg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Dissolved Boron (B)	µg/L	29000	1500	<50	<50	<50	<50	<50	<50	<50	<50
Dissolved Cadmium (Cd)	µg/L	1	0.09	0.088	0.015	<0.01	<0.01	<0.01	0.043	<0.01	0.015
Dissolved Calcium (Ca)	µg/L	-	-	160000	54000	19000	19000	21000	42000	28000	40000
Dissolved Chromium (Cr)	µg/L	-	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dissolved Cobalt (Co)	µg/L	-	-	40	5.2	0.92	1.3	1.1	2.3	1.4	2.3
Dissolved Copper (Cu)[b]	µg/L	-	2	<2.0	<2.0	<0.50	0.84	<0.50	0.89	0.63	0.74
Dissolved Iron (Fe)	µg/L	-	300	<50	<50	<50	<50	<50	<50	<50	57
Dissolved Lead (Pb)[b]	µg/L	-	1	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Dissolved Magnesium (Mg)	µg/L	-	-	11000	3500	530	890	1000	2000	1300	1600
Dissolved Manganese (Mn)	µg/L	-	-	1400	220	45	70	52	110	57	110
Dissolved Molybdenum (Mo)	µg/L	-	73	<2.0	<2.0	<2.0	2.8	<2.0	<2.0	<2.0	<2.0
Dissolved Nickel (Ni)[b]	µg/L	-	25	230	38	6.6	9.2	9.6	19	14	23
Dissolved Phosphorus (P)	µg/L	-	-	<100	<100	<100	<100	<100	<100	<100	<100
Dissolved Potassium (K)	µg/L	-	-	13000	3600	650	1200	1500	2400	1800	2200
Dissolved Selenium (Se)	µg/L	-	1	<1.0	<1.0	<1.0	<1.0	<1.0	<0.50	<0.50	<0.50
Dissolved Silver (Ag)	µg/L	-	0.25	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Dissolved Sodium (Na)	µg/L	-	-	13000	4900	790	1900	1700	1700	1100	1100
Dissolved Strontium (Sr)	µg/L	-	-	1400	510	140	160	170	340	220	290
Dissolved Thallium (Tl)	µg/L	-	0.8	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Dissolved Tin (Sn)	µg/L	-	-	14	3.2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Dissolved Titanium (Ti)	µg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Dissolved Uranium (U)	µg/L	33	15	1.5	0.87	0.17	0.47	0.52	1.2	0.65	0.57
Dissolved Vanadium (V)	µg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Dissolved Zinc (Zn)	µg/L	37	7	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0

Notes:

Values shaded in light grey are above the long-term CCME guideline; no values are above the short-term CCME guidelines

[a] Aluminum guideline is based on pH > 6.5

[b] Hardness dependent guidelines are based on a hardness of 10 mg/L

CCME – Canadian Council for Ministers of the Environment; WQG – Water quality guideline for the protection of aquatic life

Appendix 4-8:
Tailings Static Test Results

Atlantic Gold

Appendix 4-8: Tailings Static Test Results

Sample ID	**Paste**	**TIC**	**CaNP**	**S(T)**	**$S(SO_4)$**	**$S(S^{-2})$**	**Insoluble S**	**TAP**	**SAP**	**Modified NP**	**Net Modified**	**NPR**	**Fizz Test**
	pH	*%*	*kg $CaCO_3$/t*	*%*	*%*	*%*	*%*	*kg $CaCO_3$/t*	*kg $CaCO_3$/t*	*kg $CaCO_3$/t*	*NP*	*ModNP/TAP*	
Method Code	Sobek	CSB02V	Calc.	CSA06V	CSA07V	CSA08D	Calc.	Calc.	Calc.	Modified	Calc.	Calc.	Sobek
LOD	0.20	0.01	#N/A	0.005	0.01	0.01	N/A	N/A	N/A	0.5	N/A	N/A	N/A
FMS 2017 Tailings - Test 8	8.28	0.13	10.8	0.213	<0.01	0.02	0.19	6.66	0.6	13.9	13.3	2.1	Slight
FMS 2017 Tailings - Test 42	8.33	0.15	12.5	0.085	<0.01	0.01	0.08	2.66	0.3	14.9	14.6	5.6	Slight
FMS 2018 Tailings - Test 6	8.09	0.13	10.8	0.249	<0.01	0.25	N/A	7.8	7.8	12.1	4.3	0.55502008	None
FMS 2018 Tailings - Test 10	8.23	0.13	10.8	0.195	<0.01	0.20	N/A	6.1	6.1	12.2	6.1	1.002051282	None
Duplicates													
FMS 2017 Tailings - Test 8					<0.01								
FMS 2018 Tailings - Test 6				0.25									
FMS 2018 Tailings - Test 10		0.14											
QC													
GTS-2A				0.326									
RTS-3A					1.06	2.31							
SY4		0.91											
NBM-1										40.9			Slight
Expected Values		0.91		0.341	0.98	2.46				40.4			Slight
Tolerance +/-		0.07		0.01	0.12	0.25				2.2			

Note:

AP = Acid potential in tonnes CaCO3 equivalent per 1000 tonnes of material. TAP is determined from the total S content; SAP is determined from the measured sulphide sulphur content.

NP = Neutralization potential in tonnes CaCO3 equivalent per 1000 tonnes of material.

NET Modified NP = Modified NP - AP

Carbonate NP is calculated from TIC originating from carbonate minerals and is expressed in kg CaCO3/tonne.

Sulphate Sulphur determined by 25% HCl Leach with S by ICP Finish.

2017 samples: Sulphide Sulphur determined by Sobek 1:7 Nitric Acid Leach with S by ICP Finish.

Insoluble S is acid insoluble S (Total S - (Sulphate S + Sulphide S)).

2018 samples: Sulphide Sulphur calculated as (Total S - Sulphate S)

Appendix 4-8: Tailings Static Test Results

Sample ID	**Ag**	**Al**	**As**	**Ba**	**Be**	**Bi**	**Ca**	**Cd**	**Ce**	**Co**	**Cr**	**Cs**	**Cu**	**Fe**	**Ga**	**Ge**	**Hf**
	ppm	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
Method Code	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B
LOD	0.01	0.01	1	5	0.1	0.02	0.01	0.01	0.05	0.1	1	0.05	0.5	0.01	0.1	0.1	0.05
FMS 2017 Tailings - Test 8	0.03	2.31	176	48	0.6	0.18	0.5	0.07	57.4	7.9	50	3.42	4.2	4.53	6.7	0.1	0.39
FMS 2017 Tailings - Test 42	0.01	2.33	43	46	0.7	0.15	0.55	0.04	56.3	6	50	3.1	3.6	4.43	6.7	0.1	0.4
FMS 2018 Tailings - Test 6	0.03	2.35	335	41	0.4	0.17	0.61	0.05	62.57	12.7	49	2.47	5.4	4.51	6.8	0.2	0.3
FMS 2018 Tailings - Test 10	0.03	2.18	225	128	0.7	0.09	0.48	0.52	35.13	4.6	52	4.09	9.6	3.4	7.7	0.1	0.16
QC																	
CH4	2.09	1.89	10	279	0.1	0.45	0.57	1.18	27	23.6	108	2.53	1900	4.86	8.7	0.2	0.38
Certified Values	2.10	1.85	8.14	293	0.108	0.51	0.61	1.17	28.18	23.56	103.8	2.6	2000	4.79	9.139	0.213	0.292
Tolerance (%)	28.57	11.35	40.72	14.3	241.3	19.7	14.1	12.1	16.1	11.1	12.4	14.8	10.1	10.52	12.9	127.4	52.8
AUCCA	0.0530	8.15	4.80	628	2.10	0.16	2.57	0.09	63.0	17.3	92	4.9	28.0	3.92	17.50	1.40	5.30

Sample ID	**Hg**	**In**	**K**	**La**	**Li**	**Lu**	**Mg**	**Mn**	**Mo**	**Na**	**Nb**	**Ni**	**P**	**Pb**	**Rb**	**S**	**Sb**
	ppm	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**%**	**ppm**
Method Code	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B
LOD	0.01	0.02	0.01	0.1	1	0.01	0.01	2	0.05	0.01	0.05	0.5	0.005	0.2	0.2	0.01	0.05
FMS 2017 Tailings - Test 8	<0.01	<0.02	0.43	26.8	42	0.17	1.3	587	0.73	0.02	0.38	25.2	0.04	6.4	27.9	0.22	0.13
FMS 2017 Tailings - Test 42	<0.01	<0.02	0.4	27.2	45	0.17	1.32	621	0.69	0.02	0.35	20.2	0.04	4.7	25.3	0.08	0.05
FMS 2018 Tailings - Test 6	0.01	<0.02	0.34	29.4	42	0.15	1.23	556	1.73	0.02	0.35	38.9	0.05	4.4	22.8	0.26	0.36
FMS 2018 Tailings - Test 10	0.02	0.02	1.04	16.5	42	0.05	1.07	369	0.88	0.04	1.08	15.9	0.04	29.2	67.6	0.15	0.35
QC																	
CH4	0.03	0.1	1.39	13.4	12	0.06	1.22	322	3.42	0.06	0.37	49.5	0.06	8.7	68.1	0.67	0.44
Certified Values	#N/A	0.096	1.43	14	12.6	0.07	1.18	324.4	3.05	0.062	0.346	49.57	0.072	8.24	67.039	0.63	0.335
Tolerance (%)	#N/A	62.1	11.74	11.8	29.84	45.71	12.3	11.5	26.07	50.3	75	12.52	27.4	16.1	10.75	28.57	47.3
AUCCA	0.050	0.056	2.32	31.0	24.0	0.31	1.50	775	1.10	2.43	12	47.0	0.066	17.0	84.0	0.062	0.40

Sample ID	**Sc**	**Se**	**Sn**	**Sr**	**Ta**	**Tb**	**Te**	**Th**	**Ti**	**Tl**	**U**	**V**	**W**	**Y**	**Yb**	**Zn**	**Zr**
	ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Method Code	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B
LOD	0.1	1	0.3	0.5	0.05	0.02	0.05	0.1	0.01	0.02	0.05	1	0.1	0.05	0.1	1	0.5
FMS 2017 Tailings - Test 8	3.4	<1	0.6	10.7	<0.05	0.77	<0.05	8.7	0.06	0.21	0.89	29	0.2	18.9	1.4	90	14.4
FMS 2017 Tailings - Test 42	3.3	<1	0.7	11.6	<0.05	0.78	<0.05	8.7	0.06	0.18	0.94	28	0.1	19.1	1.4	88	14.6
FMS 2018 Tailings - Test 6	3	<1	0.8	11.1	<0.05	0.76	0.06	8.6	0.05	0.17	0.82	29	0.2	17.91	1.3	96	9.9
FMS 2018 Tailings - Test 10	6.1	<1	1.3	12.4	<0.05	0.36	<0.05	4.9	0.16	0.41	0.7	56	0.3	5.62	0.4	209	5.4
QC																	
CH4	8.2	2	1	9.6	<0.05	0.28	0.43	2	0.22	0.39	0.29	84	2	5.85	0.5	197	16.1
Certified Values	8.53	1.57	0.6	9.38	<0.05	0.272	0.422	2.239	0.21	0.398	0.291	79.27	2.15	5.66	0.5	200	13.95
Tolerance (%)	13.1	169.6	134.5	23.3	250	28.4	39.6	21.2	23.3	22.6	52.9	13.2	49.28	12.2	60	11.3	18.96
AUCCA	14.000	0.090	2.10	320	1	0.9	-	11	0.384	0.900	2.70	97	1.90	21	2.0	67.0	193.0

Notes:
AUCCA = average upper continental crust abundance (Rudnick and Gao, 2014);
Values greater than 3x the AUCCC are shaded in light grey; values greater than 10x the AUCCC are shaded in dark grey.

Appendix 4-8: Tailings Static Test Results

Sample ID			**CCME WQG**		**FMS 2017 Tailings**	**FMS 2017 Tailings**	**FMS 2018 Tailings**	**FMS 2018 Tailings**
			Short Term	**Long Term**	**Test 8**	**Test 42**	**Test 6**	**Test 10**
Parameter	**Method**	**Units**						
Volume Nanopure Water		mL	-	-	750	750	750	750
Sample Weight		g	-	-	250	250	250	250
pH	meter	-	6.5-9	-	8.09	8.15	7.95	7.93
Redox	meter	mV	-	-	336	346	322	317
Conductivity	meter	µS/cm	-	-	134	123	157	178
Acidity (to pH 4.5)	titration	mg CaCO$_3$/L	-	-	#N/A	#N/A	#N/A	#N/A
Total Acidity (to pH 8.3)	titration	mg CaCO$_3$/L	-	-	1.5	1.2	6.3	5.8
Alkalinity	titration	mg CaCO$_3$/L	-	-	35.5	30.4	50.6	55.5
Chloride	Colour	mg/L	640	120	2	2	2	3
Fluoride	IC	mg/L	-	0.12	0.11	0.10	0.16	0.17
Sulphate	Turbidity	mg/L	-	-	18	16	29	30
Ion Balance								
Major Anions	Calc	meq/L	-	-	1.15	1.01	1.68	1.83
Major Cations	Calc	meq/L	-	-	1.11	1.00	1.58	1.76
Difference	Calc	meq/L	-	-	0.04	0.00	0.10	0.07
Balance (%)	Calc	%	-	-	1.7%	0.0%	3.0%	2.0%
Dissolved Metals								
Hardness CaCO$_3$		mg/L	-	-	46.8	39.8	61.9	62.9
Aluminum Al[a]	ICP-MS	mg/L	-	0.1	0.150	0.226	0.126	0.128
Antimony Sb	ICP-MS	mg/L	-	-	0.0005	0.0004	< 0.0009	< 0.0009
Arsenic As	ICP-MS	mg/L	-	0.005	0.0131	0.0189	0.0126	0.0066
Barium Ba	ICP-MS	mg/L	-	-	0.00130	0.00099	0.00377	0.00424
Beryllium Be	ICP-MS	mg/L	-	-	< 0.000007	0.000007	< 0.000007	< 0.000007
Bismuth Bi	ICP-MS	mg/L	-	-	< 0.000007	< 0.000007	< 0.000007	< 0.000007
Boron B	ICP-MS	mg/L	29	1.5	0.008	0.007	0.012	0.015
Cadmium Cd	ICP-MS	mg/L	0.001	0.00009	< 0.000003	< 0.000003	0.000005	0.000005
Calcium Ca	ICP-MS	mg/L	-	-	17.9	15.4	21.7	22.1
Chromium Cr	ICP-MS	mg/L	-	0.001	0.00019	0.00077	0.00015	0.00013
Cobalt Co	ICP-MS	mg/L	-	-	0.000036	0.000044	0.000032	0.000023
Copper Cu[b]	ICP-MS	mg/L	-	0.002	0.00045	0.00038	0.0007	0.0014
Iron Fe	ICP-MS	mg/L	-	0.3	0.039	0.061	0.020	0.050
Lead Pb[b]	ICP-MS	mg/L	-	0.001	0.00005	0.00005	0.00003	0.00002
Lithium Li	ICP-MS	mg/L	-	-	0.0036	0.0024	0.0022	0.0024
Magnesium Mg	ICP-MS	mg/L	-	-	0.546	0.349	1.88	1.88
Manganese Mn	ICP-MS	mg/L	-	-	0.00589	0.00164	0.0121	0.0108
Mercury Hg	ICP-MS	µg/L	-	0.026	< 0.01	< 0.01	< 0.01	0.02
Molybdenum Mo	ICP-MS	mg/L	-	0.073	0.00251	0.00187	0.00571	0.0135
Nickel Ni[b]	ICP-MS	mg/L	-	0.025	0.0003	0.0002	0.0004	0.0005
Phosphorus P	ICP-MS	mg/L	-	-	0.022	0.020	< 0.003	< 0.003
Potassium K	ICP-MS	mg/L	-	-	3.66	3.78	8.74	13.6
Selenium Se	ICP-MS	mg/L	-	0.001	0.00018	0.00021	0.00033	0.00013
Silicon Si	ICP-MS	mg/L	-	-	1.33	1.46	1.78	1.55
Silver Ag	ICP-MS	mg/L	-	0.00025	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Sodium Na	ICP-MS	mg/L	-	-	1.45	1.97	2.45	3.04
Strontium Sr	ICP-MS	mg/L	-	-	0.0591	0.0452	0.0840	0.100
Sulphur (S)	ICP-MS	mg/L	-	-	6.6	6.2	12.1	12.0
Thallium Tl	ICP-MS	mg/L	-	0.0008	0.000007	0.000006	0.000005	< 0.000005
Tin Sn	ICP-MS	mg/L	-	-	0.00005	0.00004	0.00011	0.00024
Titanium Ti	ICP-MS	mg/L	-	-	0.00059	0.00094	0.00052	0.00066
Uranium U	ICP-MS	mg/L	0.033	0.015	0.000349	0.000332	0.000250	0.000226
Vanadium V	ICP-MS	mg/L	-	-	0.00028	0.00051	0.00018	0.00015
Zinc Zn	ICP-MS	mg/L	0.037	0.007	< 0.002	< 0.002	< 0.002	< 0.002
Zirconium Zr	ICP-MS	mg/L	-	-	< 0.002	< 0.002	< 0.002	< 0.002

Notes:

Values shaded in light grey are above the long-term CCME guideline; no values are above the short-term CCME guidelines

[a] Aluminum guideline is based on pH > 6.5

[b] Hardness dependent guidelines are based on a hardness of 10 mg/L

CCME – Canadian Council for Ministers of the Environment; WQG – Water quality guideline for the protection of aquatic life

Appendix 4-9:
Saturated Column Leachate Results

Atlantic Gold

Appendix 4-9: Saturated Column Leachate Results

		mL	mL	pH	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Collect Date/Time**	**Vol-Leachate-LE**	**Vol-Eff-LE**	**pH-LE**	**Cond-LE**	**T-Alk-LE**	**NH3**	**NO2-N**	**NO3-N**	**TD-P**	**DOC**	**SO4**	**D-Br**	**D-Cl**
INFLUENT	2019-02-06 10:40	100		7.95	314	79	0.352	0.0048	0.0480	*<0.0020*	11.4	47.1	*<0.050*	15.0
FMS_TEST10	2019-03-07 10:50	165		8.06	480	119	0.0518	*<0.0010*	*<0.0050*	0.0061	4.56	95.9	*<0.050*	16.2
FMS_TEST10	2019-03-21 14:05	189	7	8.07	440	135	0.128	*<0.0010*	*<0.0050*	0.0043	6.32	75.3	*<0.050*	16.2
FMS_TEST10	2019-04-04 15:45	203	13	8.05	417	126	0.192	*<0.0010*	*<0.0050*	0.0041	11.8	61.9	*<0.050*	15.8
FMS_TEST10	2019-04-17 14:00	214		8.15	410	145	0.202	0.0012	*<0.0050*	0.0035	11.7	56.7	*<0.050*	16.3
FMS_TEST10	2019-05-02 14:30	225		8.05	401	142	0.206	0.0020	*<0.0050*	0.0041	10.5	49.3	*<0.050*	15.6
FMS_TEST10	2019-05-16 14:30	216	3	8.06	387	149	0.226	0.0024	*<0.0050*	0.0046	7.81	47.8	*<0.050*	16.1
FMS_TEST10	2019-06-13 15:30	221		8.13	397	154	0.230	*<0.0010*	*<0.0050*	0.0031	6.35	46.8	*<0.050*	15.9
FMS_TEST10	2019-07-11 15:00	235		8.31	411	161	0.239	*<0.0010*	*<0.0050*	0.0021	4.38	49.6	*<0.050*	15.8

		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Collect Date/Time**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**	**D-Cs**
INFLUENT	2019-02-06 10:40	0.284	*<0.0000050*	0.0944	0.0119	0.021	0.00664	*<0.000010*	*<0.0000050*	24.7	*<0.0000050*	0.0000094	*<0.00010*	0.000216
FMS_TEST10	2019-03-07 10:50	0.442	*<0.0000050*	0.0260	0.0134	0.054	0.0149	*<0.000010*	*<0.0000050*	37.9	*<0.000030*	0.0000839	*<0.00010*	0.000356
FMS_TEST10	2019-03-21 14:05	0.511	*<0.0000050*	0.0199	0.0155	0.058	0.0128	*<0.000010*	*<0.0000050*	39.1	*<0.000015*	0.0000077	*<0.00010*	0.000286
FMS_TEST10	2019-04-04 15:45	0.544	*<0.0000050*	0.0176	0.0196	0.054	0.0116	*<0.000010*	*<0.0000050*	34.6	*<0.000025*	0.0000085	*<0.00010*	0.000287
FMS_TEST10	2019-04-17 14:00	0.625	*<0.0000050*	0.0147	0.0226	0.058	0.0126	*<0.000010*	*<0.0000050*	35.5	*<0.0000050*	0.0000091	*<0.00010*	0.000308
FMS_TEST10	2019-05-02 14:30	0.619	*<0.0000050*	0.0133	0.0247	0.053	0.0103	*<0.000010*	*<0.0000050*	29.6	*<0.000015*	0.0000091	*<0.00010*	0.000275
FMS_TEST10	2019-05-16 14:30	0.670	*<0.0000050*	0.0135	0.0278	0.052	0.00969	*<0.000010*	*<0.0000050*	27.9	*<0.000020*	0.0000124	*<0.00010*	0.000270
FMS_TEST10	2019-06-13 15:30	0.650	*<0.0000050*	0.0125	0.0309	0.059	0.0108	*<0.000010*	*<0.0000050*	29.0	*<0.000020*	0.0000360	*<0.00010*	0.000294
FMS_TEST10	2019-07-11 15:00	0.724	*<0.0000050*	0.0103	0.0349	0.062	0.0113	*<0.000010*	*<0.0000050*	32.2	*<0.000050*	0.0000481	*<0.00010*	0.000280

		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Collect Date/Time**	**D-Cu**	**D-Fe**	**D-Hg**	**D-K**	**D-Li**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-S**
INFLUENT	2019-02-06 10:40	*<0.00010*	*<0.0010*	*<0.0000050*	32.0	0.00587	3.47	0.0182	0.0160	11.2	0.000762	*<0.050*	*<0.0000050*	0.0218	20.3
FMS_TEST10	2019-03-07 10:50	0.00016	*<0.0010*	*<0.0000050*	46.1	0.00705	5.99	0.0498	0.0598	18.1	0.00202	*<0.050*	0.0000085	0.0237	34.7
FMS_TEST10	2019-03-21 14:05	*<0.00010*	*<0.0010*	*<0.0000050*	44.0	0.00950	5.87	0.0611	0.0564	19.1	0.000792	*<0.050*	*<0.0000050*	0.0240	28.9
FMS_TEST10	2019-04-04 15:45	*<0.00010*	0.0021	*<0.0000050*	41.4	0.0119	5.17	0.0665	0.0585	19.3	0.000401	*<0.050*	*<0.0000050*	0.0228	26.5
FMS_TEST10	2019-04-17 14:00	*<0.00010*	0.0042	*<0.0000050*	41.6	0.0127	4.96	0.0761	0.0633	19.7	0.000327	*<0.050*	*<0.0000050*	0.0245	21.4
FMS_TEST10	2019-05-02 14:30	*<0.00010*	0.0044	*<0.0000050*	38.7	0.0134	4.33	0.0799	0.0629	19.8	0.000293	*<0.050*	*<0.0000050*	0.0219	21.0
FMS_TEST10	2019-05-16 14:30	*<0.00010*	0.0082	*<0.0000050*	38.5	0.0142	4.20	0.0807	0.0567	20.8	0.000277	*<0.050*	*<0.0000050*	0.0217	19.6
FMS_TEST10	2019-06-13 15:30	*<0.00010*	0.0050	*<0.0000050*	40.0	0.0167	4.13	0.0918	0.0548	22.3	0.000834	*<0.050*	*<0.0000050*	0.0238	17.6
FMS_TEST10	2019-07-11 15:00	*<0.00010*	0.0022	*<0.0000050*	40.6	0.0164	3.99	0.114	0.0526	22.5	0.000620	*<0.050*	*<0.0000050*	0.0233	19.2

		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Collect Date/Time**	**D-Sb**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
INFLUENT	2019-02-06 10:40	0.000305	0.000276	1.66	0.000563	0.160	*<0.00020*	*<0.00010*	*<0.00030*	0.0000061	0.000157	0.000109	0.00031	0.0101	*<0.000060*
FMS_TEST10	2019-03-07 10:50	0.000572	0.000229	2.91	0.000345	0.319	*<0.00020*	*<0.00010*	*<0.00030*	0.0000085	0.00104	0.000082	0.00016	0.0016	*<0.000060*
FMS_TEST10	2019-03-21 14:05	0.000357	0.000342	3.44	0.000276	0.302	*<0.00020*	*<0.00010*	*<0.00030*	*<0.0000020*	0.000610	0.000099	0.00015	*<0.0010*	*<0.000060*
FMS_TEST10	2019-04-04 15:45	0.000317	0.000255	3.63	0.000277	0.258	*<0.00020*	*<0.00010*	*<0.00030*	*<0.0000020*	0.000368	0.000086	0.00018	*<0.0010*	*<0.000060*
FMS_TEST10	2019-04-17 14:00	0.000270	0.000142	3.71	0.000283	0.281	*<0.00020*	*<0.00010*	*<0.00030*	*<0.0000020*	0.000349	0.000074	0.00019	*<0.0010*	*<0.000060*
FMS_TEST10	2019-05-02 14:30	0.000246	0.000183	4.18	0.000267	0.242	*<0.00020*	*<0.00010*	*<0.00030*	*<0.0000020*	0.000258	0.000058	0.00018	*<0.0010*	*<0.000060*
FMS_TEST10	2019-05-16 14:30	0.000221	0.000135	4.38	0.000228	0.216	*<0.00020*	*<0.00010*	*<0.00030*	*<0.0000020*	0.000228	*<0.000050*	0.00017	*<0.0010*	*<0.000060*
FMS_TEST10	2019-06-13 15:30	0.000186	0.000115	4.86	0.000190	0.215	*<0.00020*	*<0.00010*	*<0.00030*	*<0.0000020*	0.000276	0.000071	0.00016	*<0.0010*	*<0.00020*
FMS_TEST10	2019-07-11 15:00	0.000174	0.000068	4.71	0.000155	0.218	*<0.00020*	*<0.00010*	*<0.00030*	*<0.0000020*	0.000280	0.000074	0.00013	*<0.0010*	*<0.00020*

Notes:
Values in blue italics are below detection limit.