Atlantic Gold

Appendix E.2

Beaver Dam Project - ML/ARD Assessment Report – Dec. 20, 2018 as
Completed for the Updated 2021 Beaver Dam Mine EIS

Beaver Dam Project –
ML/ARD Assessment Report

Prepared for:
Atlantic Gold Corporation
Suite 3083, 595 Burrard St.
Vancouver, BC, V7X 1L3

Prepared by:
Lorax Environmental Services Ltd.
2289 Burrard St.
Vancouver, BC, V6J 3H9

Project No. A458-3

20 December 2018

Table of Contents

ATLANTIC GOLD

Table of Contents

APPENDICES

LIST OF FIGURES

LIST OF TABLES

1. Introduction

1 Introduction

The Beaver Dam project is a proposed gold mine owned by Atlantic Mining Nova Scotia Corporation (AMNS) who is preparing a revised 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, tailings and overburden. This study considers material properties that may change water quality attributed to metal leaching and acid rock drainage (ML/ARD). The geochemical characterization of Beaver Dam samples will also support the development of geochemical source terms for water quality modelling.

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 background 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

ATLANTIC GOLD

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 Beaver Dam 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 > 5,600m 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 Beaver Dam 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 site of the Beaver Dam project is within the northeast trending Moose River-Beaver Dam Anticline. The metamorphic facies in this region are amphibolite to staurolite facies. The main unit at the project site is the Moose River Member of the Goldenville Formation which 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

ATLANTIC GOLD

3 Samples and Analytical Methods

3.1 Sample Selection and Collection

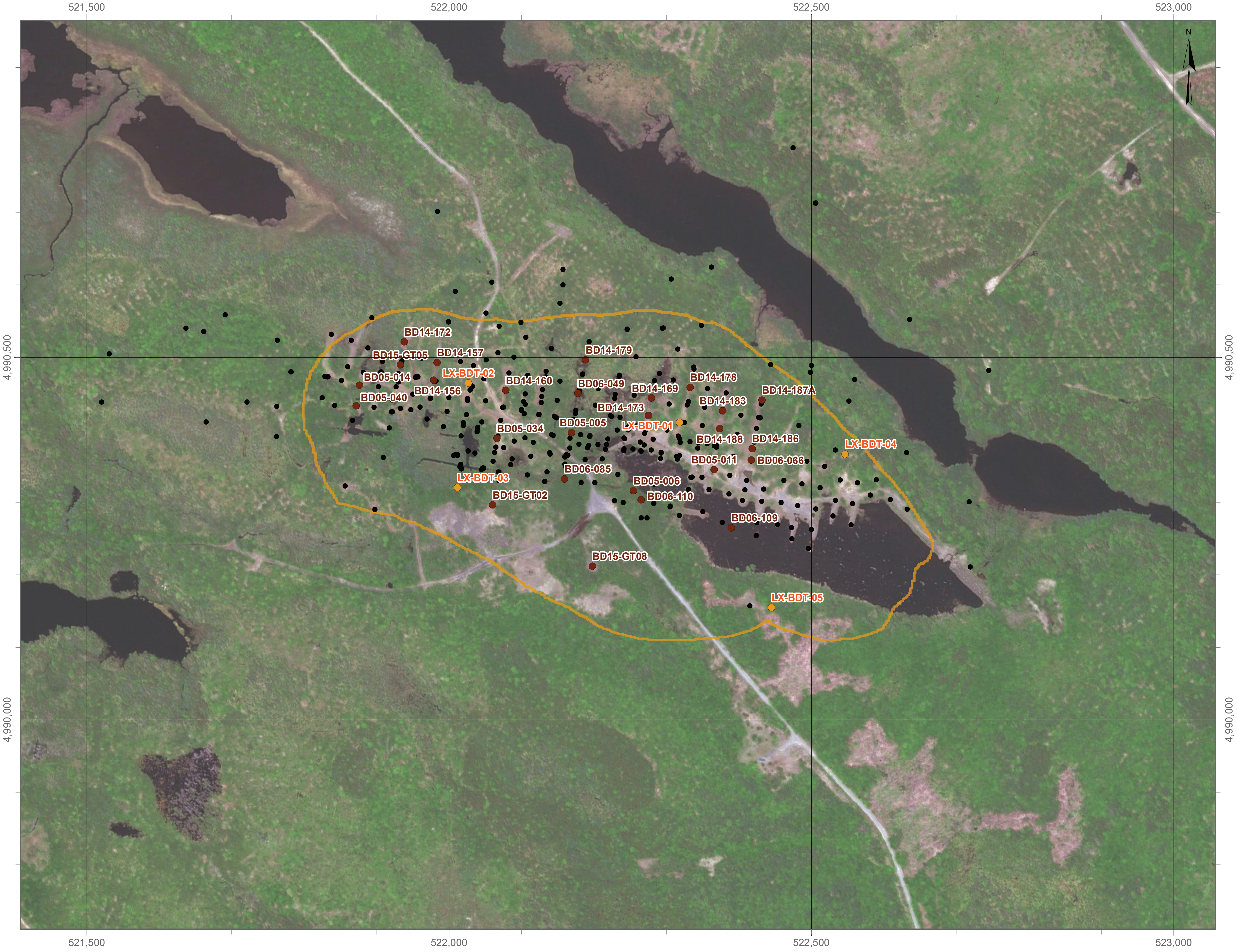
3.1.1 Mine Rock Samples

A total of 30 Beaver Dam drill core samples were collected by Lorax in November 2017 to supplement the existing mine rock geochemical data set based on 40 drill core samples previously collected by Atlantic Gold in support of the 2017 EIS submission. Static test analyses were carried out on all samples; however, the initial 40 samples were only evaluated for acid base accounting (ABA) characteristics. All Lorax samples were analyzed for ABA and solid phase elements, and based on these results, a subset of samples was selected for kinetic testwork. The kinetic test subsamples were additionally assessed for mineralogy and particle size distribution. The Beaver Dam 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. Eight of the samples collected for the EIS submission could not be classified by lithology as the corresponding logs were not made available. The results from these samples are not included in the report. The location of the sampled drill holes is provided in Figure 3-1.

Eight humidity cells (HC1 through HC8) were initiated using crushed drill core material covering median and high sulphur content ranges for each of the four lithologies, as summarized in Table 3-2. The objective of the program is to provide sulphide oxidation and metal leaching rates for a range of sulphide contents under varying pH conditions to be used as input for the geochemical source term model.

Table 3-1:
Beaver Dam Geologic Units and Sample Descriptions

Geologic Unit	Description	Code	No. Samples
Argillite	argillite with < 5% greywacke interbeds	AR	10
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
Quartz Vein	quartz vein	QTZV	3
Unknown	Core logs were not available	-	8



LEGEND

- ● Overburden Sample
- ● Drill Hole Location (sampled)
- ● Drill Hole Location (unsampled)
- ▭ Pit Outline

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

1:5,000

0 100 200
Meters

DATE SAVED:	Nov 08, 2018
DRAWN BY:	GM
REVIEWED:	JO
VERSION:	1

CLIENT:

ATLANTICGOLD

LORAX ENVIRONMENTAL

PROJECT:

Beaver Dam Phase II Geochemical Assessment

TITLE:

Beaver Dam Drill Hole and Overburden Sample Locations.

PROJECT #: A458-2 FIGURE: 3-1

P:\@Drafting\Touquoy\Drafting Figures\MXD\Sample Selection\BD Pit Sample Locations.mxd

**Table 3-2:
Summary of humidity cell testwork**

HC ID	Lithology	Rational	Hole ID	Interval (m)		Sample ID
				From	*To*	
HC1	Argillite	Median sulphur	BD14-178	7	7.9	LX17-12
HC2	Argillite	High sulphur	BD14-188	22	23	LX17-24
			BD15-GT05	57	58	LX17-22
HC3	Argillite-Greywacke	Median sulphur	BD14-172	140	141	LX17-10
			BD15-GT02	15	16	LX17-02
HC4	Argillite-Greywacke	High sulphur	BD15-GT02	26	27	LX17-03
			BD15-GT02	31	32	LX17-04
HC5	Greywacke-Argillite	Median sulphur	BD14-188	10	11	LX17-23
			BD15-GT02	10	11	LX17-01
HC6	Greywacke-Argillite	High sulphur	BD14-178	161	162	LX17-17
			BD15-GT05	15	16	LX17-19
HC7	Greywacke	Median sulphur	BD14-178	49	50	LX17-16
HC8	Greywacke	High sulphur	BD15-GT05	25	26	LX17-20
			BD15-GT05	41	42	LX17-21

3.1.2 Overburden Samples

Five overburden samples were collected in September 2018 from within the Beaver Dam pit footprint (Figure 3-1). The samples were collected from shallow (30-45 cm) test pits dug by hand using a shovel. In general, the overburden was silty sand with minor gravel and varying amounts of cobbles (Table 3-3). Cobbles greater than approximately 5 cm in diameter were removed from the sample submitted to the lab. The analyses for these samples included ABA, solid phase elements and shake flask extractions (SFE).

**Table 3-3:
Summary of overburden samples**

Sample ID	Test Pit Depth (cm)	Sample Description
LX-BDT-01	30	Silty sand with some clay, minor gravel and cobbles
LX-BDT-02	36	Silty sand, minor gravel
LX-BDT-03	43	High organic content, silty with some cobbles
LX-BDT-04	33	Silty sand with gravel and several cobbles
LX-BDT-05	34	Silty sand with gravel and cobbles

3.1.3 Haul Road Samples

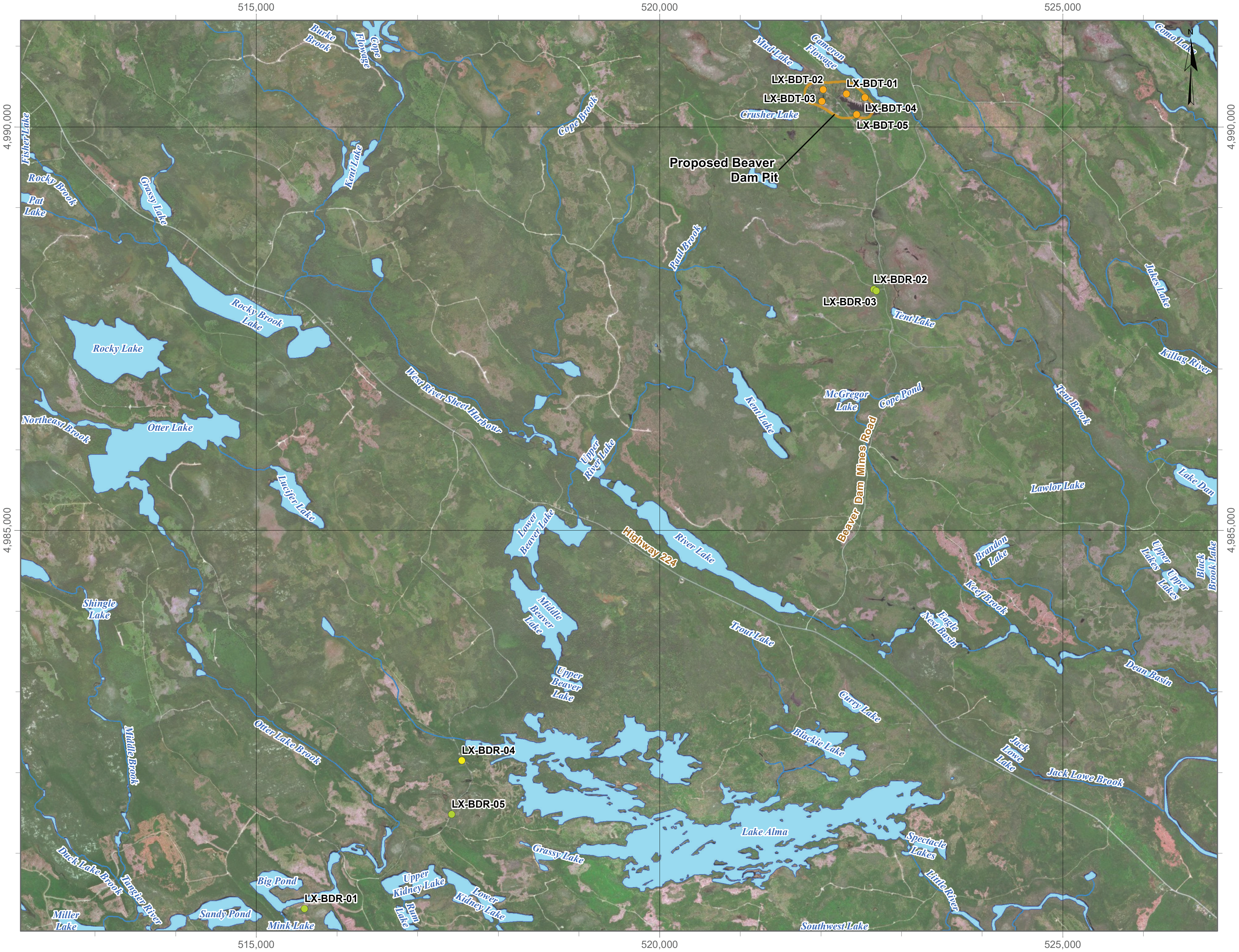
Five rock samples were collected along the Beaver Dam haul road in September 2018 (Figure 3-2 Table 3-4). The geology along the haul road was fairly consistent and all samples collected were greywacke. Samples were collected from outcrops and blasted rock fragments by breaking off rock chips using a rock hammer. These samples were analyzed for ABA and solid phase elements.

3.2 Static Test Methods

Static tests carried out to characterize rock and overburden samples include acid base accounting (ABA), aqua-regia digestible elemental abundance, mineralogical investigations, and shake flask extraction (SFE). The SFE tests were only conducted on the five overburden samples. The following sections provide a brief overview of these methods. Static testing was conducted at ALS Laboratories. All analytical procedures were conducted following standard protocols.

3.2.1 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 modified neutralization potential (NP) is used to represent the NP of the materials for this site. It is a bulk NP measurement that considers NP from other minerals (*e.g.,* the aluminosilicates) in addition to carbonates. The carbonate NP (CaNP) is calculated using the assumption that the total inorganic carbon (TIC) content is present as calcium carbonate. 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 value greater than 2 are designated as NAG.



LEGEND

- ● Bedrock Sample
- ● Blasted Rock Sample
- ● Overburden Sample
- ▭ Pit Outline

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

1:45,000

0 1 2 Km

DATE SAVED:	Nov 08, 2018
DRAWN BY:	GM
REVIEWED:	JO
VERSION:	1

CLIENT:

ATLANTIC GOLD

LORAX ENVIRONMENTAL

PROJECT:

Beaver Dam Phase II Geochemical Assessment

TITLE:

Beaver Dam Haul
Road Sample Locations

PROJECT #: A458-2 FIGURE: 3-2

P:\@Drafting\Touquoy\Drafting Figures\MXD\Sample Selection\Haul Road Rock Samples.mxd

**Table 3-4:
Summary of haul road samples**

Sample ID	Lithology	Sample Type
LX-BDR-01	Greywacke	Bedrock from outcrop
LX-BDR-02	Greywacke	Bedrock from existing quarry
LX-BDR-03	Greywacke	Bedrock from existing quarry
LX-BDR-04	Greywacke	Blasted rock from old quarry
LX-BDR-05	Greywacke	Bedrock from outcrop

3.2.2 Aqua-Regia Digestible Elemental Abundance

Solid phase elemental abundance analyses are conducted on pulverized samples by digesting a sample in aqua regia. The extract is then diluted and analyzed for metals by inductively coupled plasma mass spectrometry (ICP-MS). The data are used to characterize materials and to identify elements of potential environmental concern. The degree of enrichment as compared to average upper continental crust concentrations (AUCCC, 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. The solid phase elemental results are also considered when selecting humidity cell samples in order to ensure that representative material is selected to represent the material being characterized by the humidity cell test.

3.2.3 Shake Flask Extractions

Metal contents measured in shake flask extractions (SFE) provide a measure of the mass of readily soluble metals which will be immediately available for leaching upon exposure to infiltrating water. The procedure consists of agitating a representative sample in water, typically at a water to solids ratio of 3:1, for 24 hours. The leachate chemistry can be used as a cursory tool in determining the potential leachate chemistry of water in contact with disturbed rock.

3.3 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 eight humidity cell subsamples were submitted to the Electron Microbeam & X-Ray Diffraction Facility at the University of British Columbia for mineralogical assessment. Thin sections of the same samples were also investigated by petrographic microscopy using a Nikon Optiphot polarizing microscope with transmitted and reflected light capabilities. Photomicrographs were taken using a Nikon EOS 70D camera.

3.4 Particle Size Distribution

Particle size distribution (PSD) analyses were carried out 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.

3.5 Kinetic Test Methods

Kinetic 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. Laboratory-based humidity cells are typically composed of a plexiglass cylinder filled with approximately 1 kg of sample crushed to 80% passing <6.4 mm. Beaver Dam materials used for kinetic testing had already been crushed to 80% passing < 2 mm, such that this reduced particle size was used for this test program. 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. Humidity cell tests are usually run for a minimum of 20 cycles (weeks), but it is usually more desirable to continue testing until the rates of sulphate generation and metal leaching have stabilized, which can take up to 120 weeks or more (Lapakko, 2003). 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 on a weekly basis. As well, after geochemical modeling and careful consideration, these data may be used to estimate drainage chemistry.

4. Results

4 Results

The Beaver Dam geochemical test results are herein presented for three different sets of samples: 1) mine rock; 2) overburden; and 3) haul road material. Static test analyses were carried out on all samples to determine the geochemical characteristics of materials to be disturbed during development of the proposed Beaver Dam Mine. Kinetic tests were carried out on a subset of mine rock samples to predict geochemical behaviour as weathering proceeds. The geochemical results presented have been used to develop source terms for a site-wide water quality model, which is presented under separate cover (Lorax, 2018).

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 the identity of 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, plagioclase, illite-muscovite, biotite and chlorite with lesser amounts of calcite, pyrite and ilmenite. It is noteworthy that pyrite is the only sulphide phase detected in the Beaver Dam samples by XRD analysis and only detected in 6 of the 8 samples. Calcite is the dominant carbonate mineral in Beaver Dam mine rock, comprising up to 1.9 %. Additional neutralization capacity may be afforded by silicate phases, including plagioclase, chlorite, and biotite, which are present in all samples.

Petrographic analysis of the same eight humidity cell subsamples sheds light on textural relationships within Beaver Dam waste rock and allows the identification of trace minerals that may fall below the detection limit of XRD analysis. Since 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 length or 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. Note that a threshold grain size of 0.07 mm also roughly corresponds with the transition from the silt to sand particle size.

An overview of the petrographic results is shown in Table 4-2 and illustrates that samples HC3 and HC7 have the highest relative proportions of argillite and greywacke clasts, respectively. This breakdown also illustrates that the geologic unit assigned to the eight subsamples may not coincide with the relative greywacke to argillite proportions observed on a thin section scale. In the following, textural relationships will be discussed across the various subsamples specific 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, argillite-rich HC subsamples generally contain higher relative amounts of muscovite/illite and chlorite, while showing smaller 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.

Greywacke fragments are moderately- to well-sorted and primarily composed of rounded quartz and feldspar grains making up >70% of the volume of most fragments. The groundmass (matrix) is typically composed of fine grained sericite, clay, and chlorite filling interstices (Figure 4-1A). Biotite commonly occurs as a medium- to coarse-grained (0.1 – 0.5 mm) hydrothermal alteration phase that may be anhedral or subhedral, although the anhedral variety of biotite is more common in greywacke material. Generally, when present as anhedral patches, biotite typically shows irregular grain boundaries. Grain orientation/foliation is noticeable in the moderately-sorted greywacke clasts (Figure 4-1B) and minor or absent in the coarser-grained well-sorted occurrences (Figure 4-1A). Individual quartz and feldspar grains typically make up a range in grain sized from 0.75 to 0.2 mm, however individual monomineralic grain fragments can reach > 0.5 mm in length.

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 observed degree of foliation is generally observed in argillite fragments (Figure 4-1C), although more randomly-oriented textures are present as well. In some HC subsamples, most notably in HC6, clasts with strongly foliated clay-rich layers (Figure 4-1D) are observed while lacking the typical mica-chlorite matrix replacement pattern typically seen in other argillite fragments. This suggests that portions of the argillite may have undergone less intense hydrothermal alteration than others since the originally deposited clay-rich groundmass is unaltered. Another common textural feature is the retrograde clay-alteration of argillite clasts giving the particle surface a turbid appearance that apparently overprints any prograde mica-alteration patterns. Biotite in argillite samples is commonly distinctly larger-grained than the surrounding groundmass (Figure 4-1C) and forms tabular grains that seem to have grown independently of the sedimentary orientation of within the matrix. Distinct clusters of biotite grains in many are associated with and seem to emanate from secondary ilmenite and magnetite (±rutile,

±hematite) grains (Figure 4-2 A,B) which make up a significant portion (>50%) of the opaque mineral inventory in most samples and generally display spongy texture.

Sulphides are primarily represented by pyrrhotite (>90%) with minor arsenopyrite, pyrite, and chalcopyrite being observed as accessory sulphide phases. Pyrrhotite occurs as dispersed an- to subhedral grains that may be elongated along the foliation of argillite clasts or as randomly-oriented replacement phases of primary minerals and matrix (Figure 4-2C). Discrete arsenopyrite was only identified in HC8 where, in one instance, it formed a coarse (1.2 mm) subhedral crystal (Figure 4-2D). Chalcopyrite was exclusively identified as minute exsolution blebs in contact with pyrrhotite. Minor pyrite appears to occur primarily as vein fill with only few occurrences as dispersed grain in the argillite groundmass. Both pyrite and pyrrhotite commonly exhibit minor weathering rims along grain boundaries and cracks, however, overall, the degree of oxidation can be described as minor. 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 alteration rims. Notably, two relatively coarse (0.25 mm) pyrite grains observed in HC1 were largely (>50%) weathered by a dark-red, semi-opaque mineral that is identified as goethite.

Carbonate phases were identified in subsamples HC5 and HC7 where they may form large euhedral aggregates (Figure 4-2F) or as anhedral hydrothermal replacement phases, preferentially within the matrix of greywacke clasts (Figure 4-2E). Where observed, carbonate tend to be locally concentrated which may have direct effects on its capacity to buffer acid generated by sulphides.

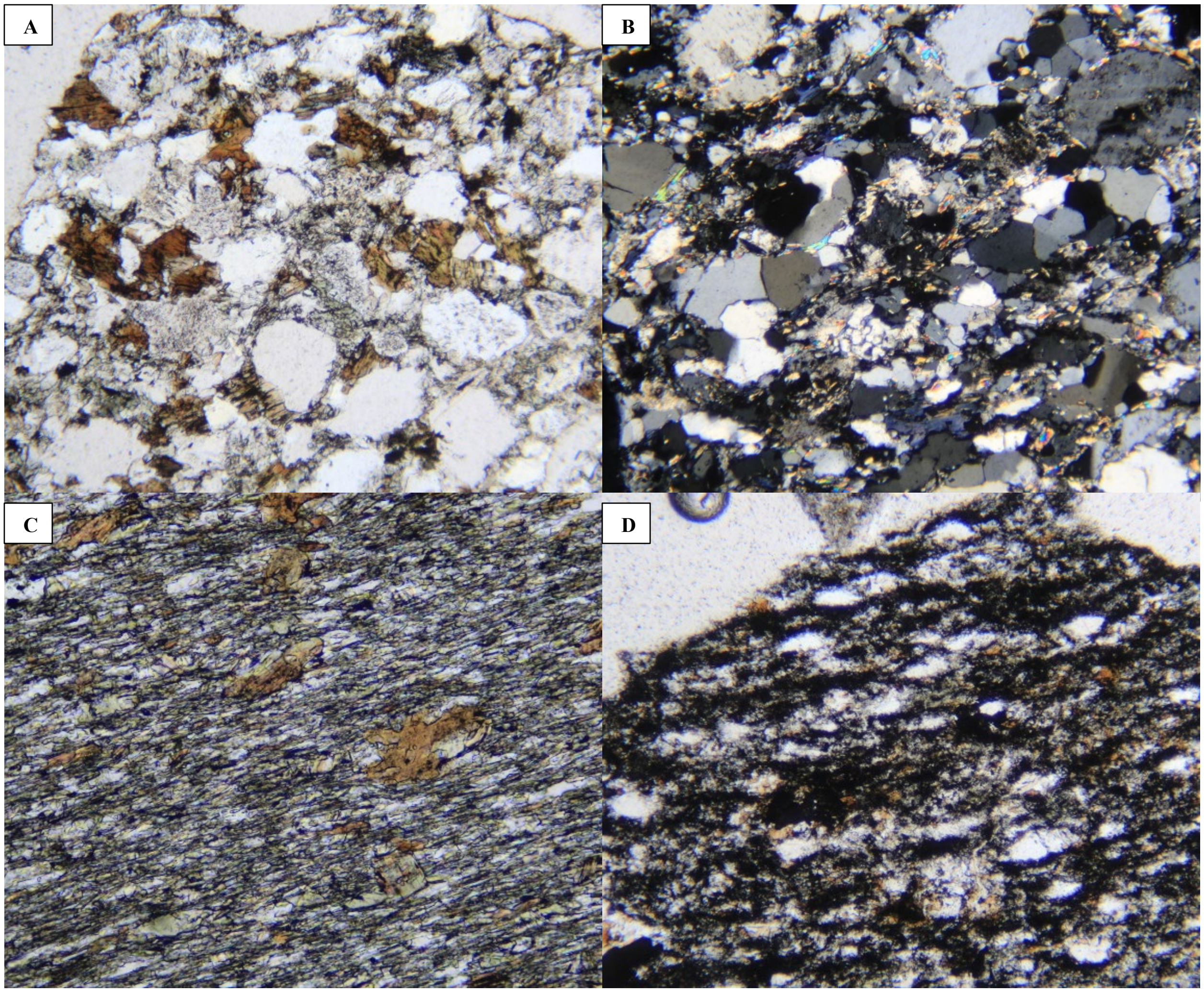


Figure 4-1: Photomicrographs from thin sections of Beaver Dam material. (A) Typical examples of a moderately-sorted greywacke clast (plane-polarized light = PPL). Biotite (brown) and muscovite/sericite fill interstices between rounded feldspar and quartz grains (colourless). Minor chlorite is observed as matrix replacement phase (pale green); FOV = 1.5 mm. (B) Greywacke clast (crossed polars = XPL) that shows minor grain orientation; FOV = 0.65 mm. (C) Typical example of a strongly oriented/foliated argillite clast containing hydrothermal biotite; FOV = 0.65 mm. (D) Argillite clast with very fine-grained clay-minerals (instead of muscovite and chlorite) making up the matrix in between quartz and feldspar grains; FOV = 1.5 mm.

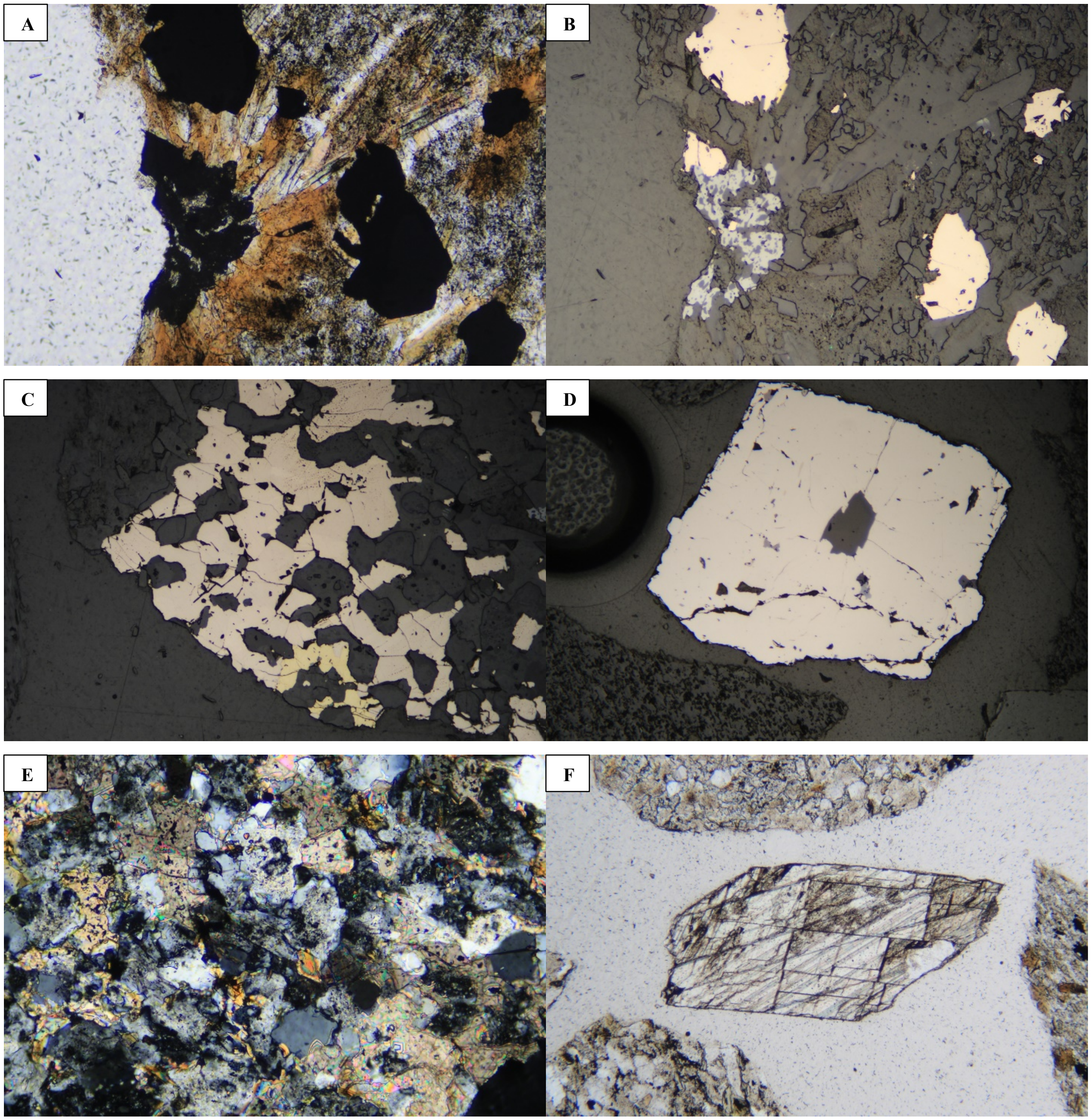


Figure 4-2: **Photomicrographs from thin sections of Beaver Dam material. (A) Spongy ilmenite ± magnetite (opaque, center left) and pyrrhotite (other opaque phases) associated with cluster of coarse hydrothermal biotite (brown sheaves) under PPL; FOV = 0.74 mm. (B) same as (A) but under reflected light. (C) Cluster of twinned, anhedral pyrrhotite aggregates (light brown) and associated chalcopyrite (bright yellow) filling interstices between quartz and feldspar; FOV = 0.74 mm. (D) Subhedral, fresh arsenopyrite grain observed in HC8; FOV = 1.8 mm. (E) Greywacke clast displaying pervasive carbonate (XPL; brown grains with high interference colours) weathering; FOV = 0.74 mm. (F) Individual, euhedral carbonate grain, likely isolated from vein material; FOV = 1.8 mm.**

Table 4-1:
X-Ray Diffraction Results of Subsamples from the Humidity Cell Test Material

Mineral Phase	**Ideal Formula**	**Argillite**		**Argillite-Greywacke**		**Greywacke**		**Greywacke-Argillite**	
		HC 1	**HC 2**	**HC 3**	**HC 4**	**HC 5**	**HC 6**	**HC 7**	**HC 8**
		Median S	High S	Median S	High S	Median S	High S	Median S	High S
Quartz low	SiO_2	31	35	27	33	34	37	51	35
Plagioclase	$NaAlSi_3O_8 – CaAl_2Si_2O_8$	21	27	18	19	37	19	29	21
Illite/Muscovite 2M1	$K_{0.65}Al_{2.0}Al_{0.65}Si_{3.35}O_{10}(OH)_2/KAl_2(AlSi_3O_{10})(OH)_2$	29	22	33	29	17	29	11	27
Biotite 1M	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$	9.9	8.8	8.4	11	5.7	6.8	1.2	9.4
Chamosite	(Fe,Al,Mg)6(Si,Al)4O10(OH)8	8.2	6.1	12	7.8	4.0	7.6	5.5	7.0
Calcite	$CaCO_3$	-	0.28	0.81	0.25	1.7	-	1.9	0.30
Pyrite[a]	FeS_2	0.14	0.19	0.098	0.48	0.22	0.29	-	-
Ilmenite	$Fe^{2+}TiO_3$	0.20	0.51	0.45	-	0.22	0.37	-	0.60

Notes: A hyphen indicates the phase was not detected
[a] Although pyrite was identified by XRD, the petrographic observations show that pyrrhotite is the more common sulphide mineral

Table 4-2:
Subsample Summary of Petrographic Observations from the Humidity Cell Test Samples

Sample ID	**Description**	**Greywacke clasts**	**Argillite clasts**	**Sulphides**			**Carbonates**
				Abundance	**Type (by abundance)**	**Weathering**	N/A
HC 1	AR - median S	43%	57%	trace (<1%)	Subhedral pyrite (0.05 - 0.25 mm)	Partially replace HFO (>50%), some grains unweathered	N/A
HC 2	AR - high S	50%	50%	trace (<1%)	Anhedral pyrrhotite & pyrite (0.1 - 0.3 mm)	Commonly clay and HFO-weathered rims	N/A
HC 3	AG - median S	20%	80%	1-2%	Anhedral pyrrhotite & pyrite (0.1 - 1 mm)	Mostly unweathered, some grains partially weathered to clay, HFO	N/A
HC 4	AG - high S	42%	58%	2-3%	Anhedral pyrrhotite (0.05 - 0.7 mm) & chalcopyrite	Mostly unweathered, some grains partially weathered to clay, HFO	N/A
HC 5	GA - median S	75%	25%	trace (<1%)	Anhedral pyrrhotite (0.05 - 0.15 mm) & chalcopyrite	Commonly clay and HFO-weathered rims	Matrix replacement patches
HC 6	GA - high S	30%	70%	trace (<1%)	Anhedral pyrrhotite & chalcopyrite (0.1 - 0.2 mm)	Mostly unweathered, some grains partially weathered to clay, HFO	N/A
HC 7	GW - median S	100%	0%	trace (<1%)	Anhedral pyrite (0.02 - 0.05 mm) & chalcopyrite	Mostly unweathered, some grains partially weathered to clay, HFO	Matrix replacement patches, large detached grains
HC 8	GW - high S	50%	50%	trace (<1%)	Anhedral pyrrhotite (0.05 - 0.3 mm), subhedral arsenopyrite (0.2 - 1.1 mm) & chalcopyrite	Mostly unweathered, some grains partially weathered to clay, HFO	N/A

4.1.1.2 Acid Base Accounting Results

The main purpose of ABA characterization is to identify acid-producing and acid-neutralizing phases. 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. If reactive neutralizing minerals are present, they will not stop the oxidation reactions but may buffer the pH to prevent the development of ARD. While many mineral dissolution reactions can be thought of as acid buffering, the minerals most typically responsible for acid neutralization are fast dissolving carbonates such as calcite and dolomite. At a pH < 6.3, the sulphide 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 the all samples range from 7.9 to 9.5, indicating that these samples are not currently acid generating. The GA samples show the widest range of pH values, ranging between 7.9 and 9.5, with a median pH value of 9.0 (Table 4-3).

Table 4-3:
Summary of acid-base accounting results for mine rock lithologies

Sample ID	**Paste pH**	**Total S**	**Sulphate S**	**Sulphide S**	**Total C**	**CaNP**	**Modified NP**	**NPR**
		%	*%*	*%*	*%*	*kg $CaCO_3$/t*	*kg $CaCO_3$/t*	*ModNP/AP*
ARGILLITE (AR) n = 10								
Min	8.2	0.020	0.010	0.020	*<0.05*	*<4.5*	6.0	0.27
Median	9.0	0.44	0.020	0.44	*<0.05*	*<4.5*	8.5	0.64
Max	9.5	1.0	0.060	0.94	*<0.05*	*<4.5*	37	17
ARGILLITE-GREYWACKE (AG) n =11								
Min	7.9	0.010	*<0.01*	0.010	*<0.05*	*<4.5*	7.0	0.23
Median	9.1	0.12	0.020	0.12	*<0.05*	*<4.5*	8.0	8.0
Max	9.5	1.1	0.060	1.1	0.17	14	177	47
GREYWACKE-ARGILLITE (GA) n = 14								
Min	7.9	0.010	0.010	0.010	*<0.05*	*<4.5*	5.0	0.40
Median	9.0	0.16	0.020	0.14	0.11	9.1	9.0	2.5
Max	9.5	1.7	0.060	1.5	0.57	48	58	46
GREYWACKE (GW) n = 24								
Min	8.9	*<0.01*	*<0.01*	*<0.01*	*<0.05*	*<4.5*	6.0	0.16
Median	9.2	0.025	0.020	0.030	0.10	9.1	14	22
Max	9.5	1.2	0.060	1.2	0.60	50	160	512
QUARTZ VEIN (QTZV) n = 3								
BD157-070	9.2	0.160	0.020	0.140	-	-	145	33
BD156-108	9.3	0.060	0.010	0.050	-	-	10	6.4
BD160-089	8.9	0.040	0.010	0.040	-	-	30	24

Notes: n = number of samples used in statistical distribution
A hyphen indicates the parameter was not analyzed.
Values in grey italics are 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 sulphur (% non-sulphate sulphur x 31.25);
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.

Table 4-4:
Summary of acid-base accounting results for humidity cell subsamples

HC ID	Description	Paste pH	Total S	Sulphate S	Sulphide S	Total C	CaNP	Modified NP	NPR
			%	%	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	ModNP/AP
ARGILLITE (AR)									
HC1	Median-S	8.9	0.02	0.02	0.02	*<0.05*	*<4.5*	6	9.6
HC2[a]	High-S	8.7	0.25	0.015	0.25	*<0.05*	*<4.5*	7.5	1.1
ARGILLITE-GREYWACKE (AG)									
HC3[a]	Median-S	8.7	0.20	0.02	0.18	0.11	9.1	15	5.6
HC4[a]	High-S	8.2	0.77	0.015	0.76	*<0.05*	4.5	8.0	0.45
GREYWACKE-ARGILLITE (GA)									
HC5[a]	Median-S	8.5	0.21	0.015	0.19	0.18	15	22	11
HC6[a]	High-S	8.6	0.39	0.015	0.39	*<0.05*	*<4.5*	5.5	0.47
GREYWACKE (GW)									
HC7	Median-S	9.1	0.03	*<0.01*	0.03	0.2	15.9	23	25
HC8[a]	High-S	9.3	0.36	0.03	0.35	0.05	4.5	8.0	0.74

Notes:

[a] Humidity cell is made up of two samples. An average value is presented and a 1:1 mixture is assumed.

Values in grey italics are 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 sulphur (% non-sulphate sulphur x 31.25);

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

4.1.1.2.2 Sulphur Species and Acid Potential

The total sulphur (T-S) contents of the Beaver Dam samples vary from below detection (0.01%) to 1.7% (Table 4-3). Of the four main rock types, the AR samples have the highest total median sulphur content (0.44%) and the GW samples have the lowest (0.025%). The three quartz vein samples analysed had low sulphur contents with a mean value of 0.087%. The sulphate S contents are generally low in most samples and typically fall below detection (0.01%) but can reach up to 0.06%. The sulphide S contents are strongly correlated with T-S (Figure 4-3) and indicate that most of the sulphur present in samples is in the form of sulphide. The sulphide S contents range from less than detection level values (0.01%) up to a maximum value of 1.5%, as measured in a GA sample (Figure 4-3). The AR samples have the highest median sulphide S contents (0.44%), whereas the GW samples have the lowest median sulphide S contents (0.030%).

The mineralogy results indicate that the sulphide S is primarily in the form of pyrrhotite, which is 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 and high S contents for the different lithologies; however, it is noted that the HC1 and HC2 have low sulphide S contents as compared to the median AR value (0.44%). These cells also have low NP contents and were specifically composited to generate acidic leachates in a timely manner.

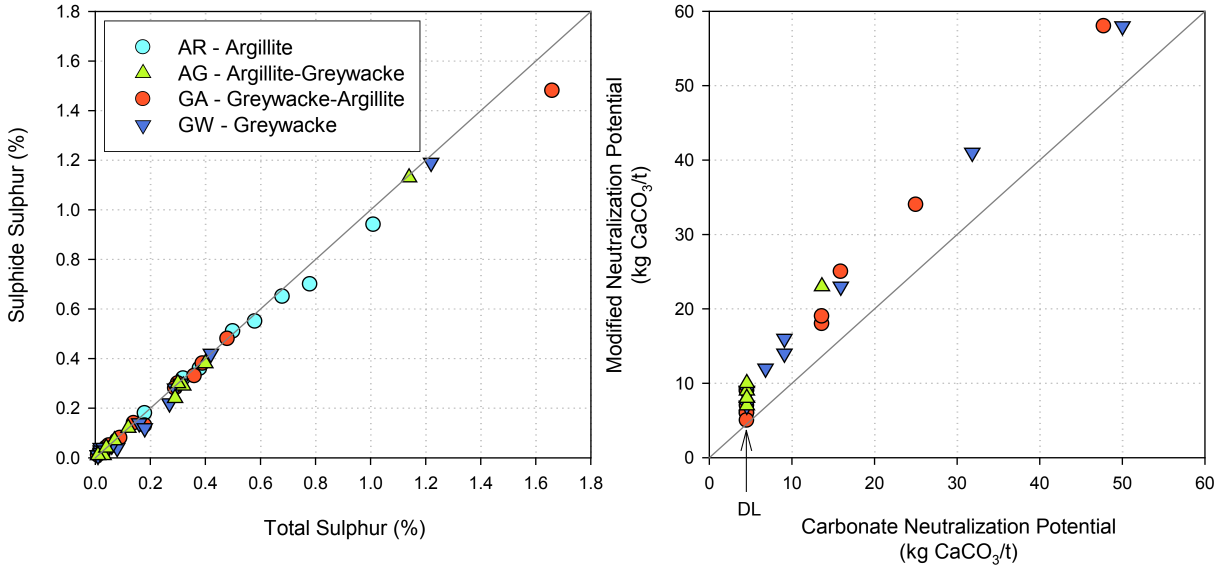


Figure 4-3: Plots showing total sulphur *versus* sulphide sulphur and carbonate neutralization potential *versus* modified neutralization potential for the Beaver Dam mine rock samples.

4.1.1.2.3 Neutralization Potential

The total inorganic carbon (TIC) content of Beaver Dam samples ranges from detection level values (<0.05%) up to 0.60%, with the highest median values measured in the GW and GA samples (0.10 % and 0.11%, respectively; 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 CaNP values of Beaver Dam samples range from detection level values (<4.5 kg $CaCO_3$/t) up to 50 kg $CaCO_3$/t. The GW and GA samples have the highest median CaNP values at 9.1 kg $CaCO_3$/t, while the AR samples have the lowest median CaNP values (< 4.5 kg $CaCO_3$/t; Table 4-3).

The CaNP values are generally comparable to the modified NP values (Figure 4-3), although the modified NP values are consistently higher suggesting that minerals other than carbonate (*i.e.*, aluminosilicates) are available for acid-neutralization. This NP is not as readily available as the carbonate NP; however, when sulphide values are low, as is the case at Beaver Dam, the NP from the dissolution of non-carbonate minerals will contribute to the to the neutralization of the low rates of acid production. Silicate minerals that act as neutralizing agents may include plagioclase, 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.

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 ModNP (Table 4-3; Figure 4-4). 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. In accordance with guidelines set out in Price (2009), a value >2 is considered to be NAG, whereas a value <2 is considered to be PAG. Based on the results, a significant number of samples covering all four major lithologies are PAG (Table 4-5).

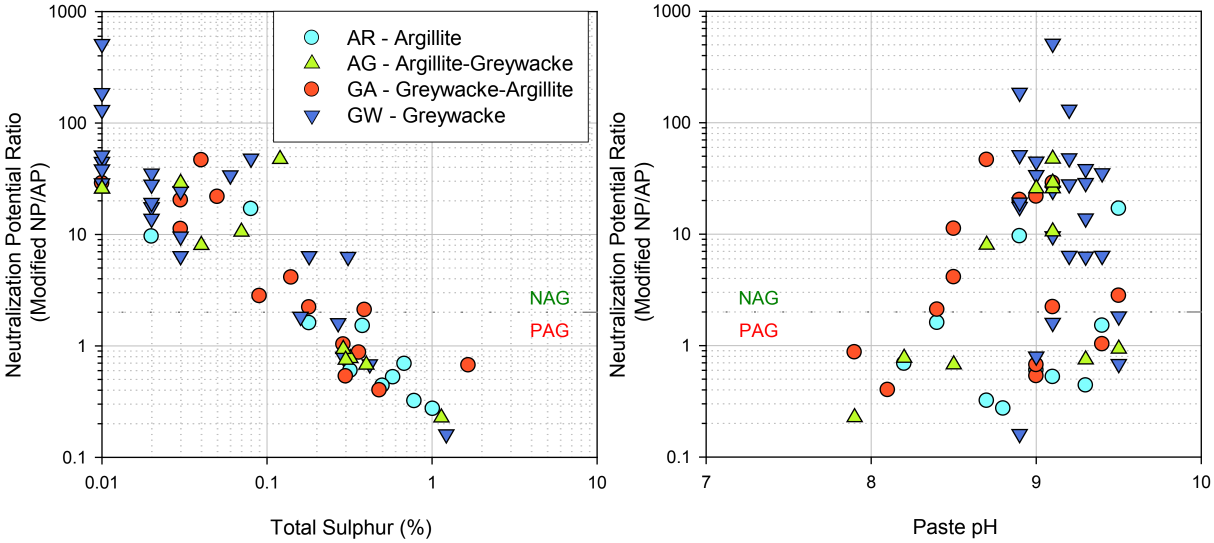


Figure 4-4: **Plots showing neutralization potential ratio (NPR) *versus* total sulphur for the Beaver Dam mine rock samples, showing the potentially acid generating (PAG) boundaries (dark grey dashed line). Plot (A) presents NPR values as modified neutralization potential (NP) versus total sulphur. Plot (B) presents NPR values as Modified NP versus paste pH. Lithology codes defined in Table 3-1.**

Table 4-5:
PAG Proportions for the Beaver Dam mine rock

Lithology	**% PAG**	**% NAG**
Argillite (AR)	80	20
Argillite-Greywacke (AG)	45.5	54.5
Greywacke-Argillite (GA)	35.7	64.3
Greywacke (GW)	20.8	79.2
Total	*39.0*	*61.0*

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 3× their respective AUCCC values (Rudnick and Gao, 2014) and greater than 2x the detection limit are listed in Table 4-6 and include Ag, As, Cu, Mn, and Pb. Solid phase concentrations of Ag, As, Mn, and Pb are enriched by a factor greater than 10 above the AUCCC in one or more samples. It is noteworthy that the elevated As concentrations (>10× AUCCC) occur in all Beaver Dam lithologies. Elevated Mn values (>10× AUCCC) occur in three of the 4 lithologies, whereas elevated Ag and Pb (>10× AUCCC) are limited to the AG samples. The AUCCC for Ag (0.053 ppm) is considerably lower that the analytical detection limit of 0.2 ppm so any values above or equal to the detection limit are flagged by the 3x the AUCCC screening criteria. Only two samples in the dataset have Ag values above 2x the detection limit.

A summary of the humidity cell total solid phase elemental results is included in Table 4-7. The concentrations of key metals of potential concern (As and Mn) in humidity cell subsamples are presented as compared to the range for each of the major rock types (Figure 4-5). Arsenic specifically is highest in HC 6 and HC 8.

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 in contact with the rocks. Kinetic test results provide a better indication of the leaching potential.

Table 4-6:
Summary of solid phase element results for Beaver Dam mine rock samples.

AUCCC	*0.053*	*8.2*	*4.8*	*2.1*	*2.6*	*17*	*92*	*28*	*3.9*	*2.3*	*1.5*	*77*	*2.4*	*47*	*17*	*0.38*	*97*	*67*
Sample ID	**Ag**	**Al**	**As**	**Be**	**Ca**	**Co**	**Cr**	**Cu**	**Fe**	**K**	**Mg**	**Mn**	**Na**	**Ni**	**Pb**	**Ti**	**V**	**Zn**
	ppm	*%*	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*ppm*	*%*	*%*	*%*	*ppm*	*%*	*ppm*	*ppm*	*%*	*ppm*	*ppm*
ARGILLITE (AR) n = 3																		
LX17-12	*<0.2*	2.7	17	0.50	0.20	20	41	28	4.6	1.1	1.4	534	0.030	44	11	0.17	44	89
LX17-22	*<0.2*	1.2	116	*<0.5*	0.15	9.0	36	18	2.5	0.64	0.75	312	0.050	15	20	0.13	40	57
LX17-24	*<0.2*	2.9	22	0.70	0.36	19	41	44	4.9	1.0	1.6	621	0.030	42	6.0	0.15	45	120
ARGILLITE-GREYWACKE (AG) n = 8																		
Min	*<0.2*	2.6	8.0	*<0.5*	0.20	19	37	4.0	4.5	0.63	1.3	601	0.020	37	*<2.0*	0.090	42	89
Median	*<0.2*	2.9	16	*<0.5*	0.25	21	47	41	5.2	0.88	1.7	679	0.035	44	6.0	0.15	52	103
Max	6.6	3.2	157	0.80	0.85	29	62	155	6.2	1.1	1.9	774	0.050	59	179	0.18	72	143
GREYWACKE-ARGILLITE (GA) n = 10																		
Min	*<0.2*	0.69	9.0	*<0.5*	0.12	4.0	21	6.0	1.5	0.16	0.40	274	0.020	6.0	2.0	0.030	20	43
Median	*<0.2*	2.1	16	0.50	0.54	14	41	23	3.8	0.77	1.1	545	0.045	32	7.5	0.14	49	68
Max	0.5	3.3	2800	0.90	2.3	25	60	67	5.7	1.2	1.6	800	0.11	48	54	0.20	76	111
GREYWACKE (GW) n = 9																		
Min	*<0.2*	1.1	7.0	*<0.5*	0.16	7.0	24	9.0	2.1	0.15	0.58	310	0.020	15	2.0	0.020	23	25
Median	*<0.2*	1.6	11	*<0.5*	0.57	15	37	24	3.2	0.22	0.89	461	0.040	25	4.0	0.090	36	66
Max	0.3	2.7	1205	0.70	2.2	25	50	35	5.2	0.92	1.4	1045	0.050	38	33	0.16	57	105

Notes: Values in grey italics are below the analytical detection limit. 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 grey; values greater than 10x the AUCCC are shaded in dark grey.

Table 4-7:
Summary of solid phase element results for humidity cell subsamples

	AUCCC	*0.053*	*8.2*	*4.8*	*2.1*	*2.6*	*17*	*92*	*28*	*3.9*	*2.3*	*1.5*	*77*	*2.4*	*47*	*17*	*0.38*	*97*	*67*
HC ID	**Description**	**Ag**	**Al**	**As**	**Be**	**Ca**	**Co**	**Cr**	**Cu**	**Fe**	**K**	**Mg**	**Mn**	**Na**	**Ni**	**Pb**	**Ti**	**V**	**Zn**
		ppm	*%*	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*ppm*	*%*	*%*	*%*	*ppm*	*%*	*ppm*	*ppm*	*%*	*ppm*	ppm
ARGILLITE (AR)																			
HC1	Median-S	*<0.2*	2.74	17	0.50	0.20	20	41	28	4.6	1.1	1.43	534	0.030	44	11	0.17	44	89
HC2[a]	High-S	*<0.2*	2.09	69	0.60	0.26	14	39	31	3.7	0.82	1.19	467	0.040	29	13	0.14	43	89
ARGILLITE-GREYWACKE (AG)																			
HC3[a]	Median-S	*<0.2*	2.93	16	0.50	0.53	22	43	23	5.3	0.84	1.59	704	0.035	43	8.5	0.15	48	113
HC4[a]	High-S	3.4	2.72	84	0.55	0.26	24	44	105	5.7	1.0	1.42	638	0.035	48	95	0.15	52	123
GREYWACKE-ARGILLITE (GA)																			
HC5[a]	Median-S	0.35	1.75	17.5	0.55	0.87	13	40	36	3.2	0.71	0.93	480	0.055	29	31	0.13	46	70
HC6[a]	High-S	*<0.2*	2.34	1833	0.55	0.19	20	39	36	4.4	0.82	1.21	487	0.045	37	6.0	0.12	42	89
GREYWACKE (GW)																			
HC7	Median-S	*<0.2*	1.13	10	0.70	0.93	7.0	31	18	2.1	0.21	0.58	372	0.040	15	2.0	0.090	29	34
HC8[a]	High-S	0.25	2.15	718	*<0.5*	0.22	21	38	30	4.2	0.89	1.16	439	0.035	32	18	0.15	42	86

Notes: [a] Humidity cell is made up of two samples. An average value is presented and a 1:1 mixture is assumed.
Values in grey italics are below the analytical detection limit. 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 grey; values greater than 10x the AUCCC are shaded in dark grey.

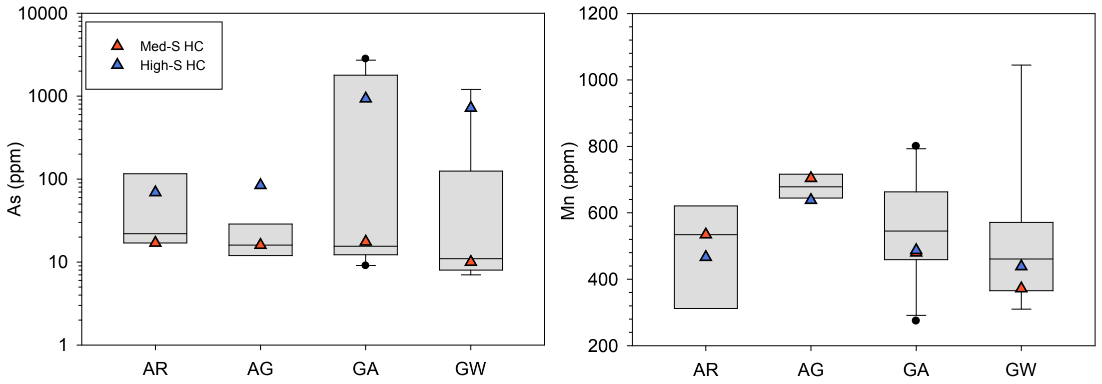


Figure 4-5: Box plots showing the range of As and Mn concentrations as compared to median and high sulphur humidity cell subsamples. Note that the box limits represent 25th and 75th percentile levels, the horizontal bar represents the median level and the whiskers represent the 5th and 95th percentile values.

4.1.1.4 Particle Size Distribution Results

The particle size distribution results for the humidity cell subsamples are presented in Appendix 4-4 and summarized in Figure 4-6. All humidity cell samples were mechanically crushed to $P_{80} < 2$ mm by the laboratory prior to placement in the humidity cells. This was done erroneously as the standard particle size to be placed into humidity cells should be $P_{80} < 6.4$ mm (Price, 2009). The finer particle size will be accounted for in the use of humidity cell data for source term development. The PSD results show that samples HC1 (AR) and HC3 (GA) have relatively higher proportions of fines as compared to other humidity cell samples.

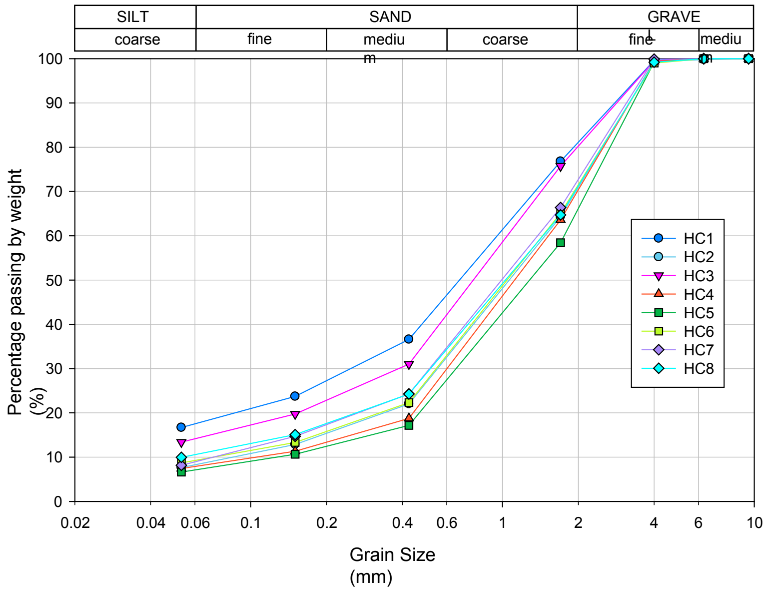


Figure 4-6: Particle Size Distribution results for humidity cell test samples presented as percent passing by weight versus grain size.

4.1.2 Kinetic Test Results

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 samples and the dissolution of stored oxidation products that may have accumulated on 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 to 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.

The kinetic test program for the Beaver Dam mine rocks consists of eight humidity cells covering the four main lithologies (AR, GA, AG and GW). Samples descriptions are provided in Table 3-2 and experimental methods are described in Section 3.5. Static characterization testwork, including mineral identification, ABA, solid phase element determination and PSD were completed on subsamples of each of the kinetic tests (presented in Section 4.1.1. Results of the static testwork show that the subsamples are considered to be representative of the respective lithologies. This report provides interim results from the ongoing humidity cell tests that were initiated in April 2018 and have been running for 24 weeks (at the time of reporting) with weekly flushing (500 mL) and sampling events. The full set of interim leachate results are presented in Appendix 4-5 and summarized in the sections below.

4.1.2.1 pH and Sulphate Loading

The leachate from all humidity cells remains circum-neutral. All pH values are between 7.1 and 8.6 (Figure 4-7). In general, when comparing the pH values for humidity cells composed of the same lithology, the median S humidity cell has a higher pH, relative to the high S humidity cell. The two AR humidity cells are an exception as the pH from HC1 (median S) is slightly lower than the pH from HC2 (high S), although the pH values from these two humidity cells are comparable. HC1 also has lower total alkalinity relative to HC2 (Figure 4-7). Overall, HC7 (median S, GW) has the highest pH values (range: 7.8 to 8.6) and HC6 (high S, GA) has the lowest pH values (range: 7.3 to 7.7). Note that the minimum pH for the dataset (7.1) was in cycle 0 in HC1.

Leachate concentrations from laboratory kinetic tests represent primary sulphate and metal release rates that do not fully account for the influence of field conditions that govern the actual sulphate and metal concentrations in mine drainage. In addition, 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 mine rock 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).

For example, the rate of sulphide oxidation in mine rock samples is estimated from sulphate loadings calculated from the humidity cell leachates. To obtain sulphide oxidation rates, weekly leachate sulphate concentrations are multiplied by the volume of leachate collected from each column and cell to obtain a mass loading which is independent of the volume of leachate collected from each humidity cell. These loadings are then normalized to the mass of sample in the humidity cell. This normalized loading calculation is an important step because it allows the direct comparison of leachate data between cycles within the same humidity cell, as well as between different humidity cells.

The majority of the humidity cells initially show high sulphate loading rates that decrease and begin to stabilize between weeks 5 and 10 (Figure 4-8). The elevated values in the first few weeks of the tests are due to dissolution and flushing of readily soluble surface oxidation products (*e.g.*, secondary sulphates). HC1 and HC7 have the lowest sulphate loading rates, with loads decreasing to less than 2 mg/kg/wk after week 5. These humidity cells also have the lowest sulphide S (0.02% and 0.03%, respectively). HC2 through HC6 have shown relatively stable or slightly decreasing sulphate loading rates in the later cycles with loading rates between approximately 10 and 20 mg/kg/wk. HC4 has the highest sulphate loading rates with values remaining above 15 mg/kg/wk. Sulphide S is also highest in this humidity cell (0.76%). HC8 initially had a lower sulphate loading rate (<15 mg/kg/wk) but has shown an increasing trend up to 18.3 mg/kg/wk in week 23. Further cycles will determine if this trend continues or if the sulphate loading rates will stabilize. The average sulphate loading rate for the last 8 cycles is plotted with sulphide S content (Figure 4-9). There is some positive correlation between the sulphate loading rate and sulphide S.

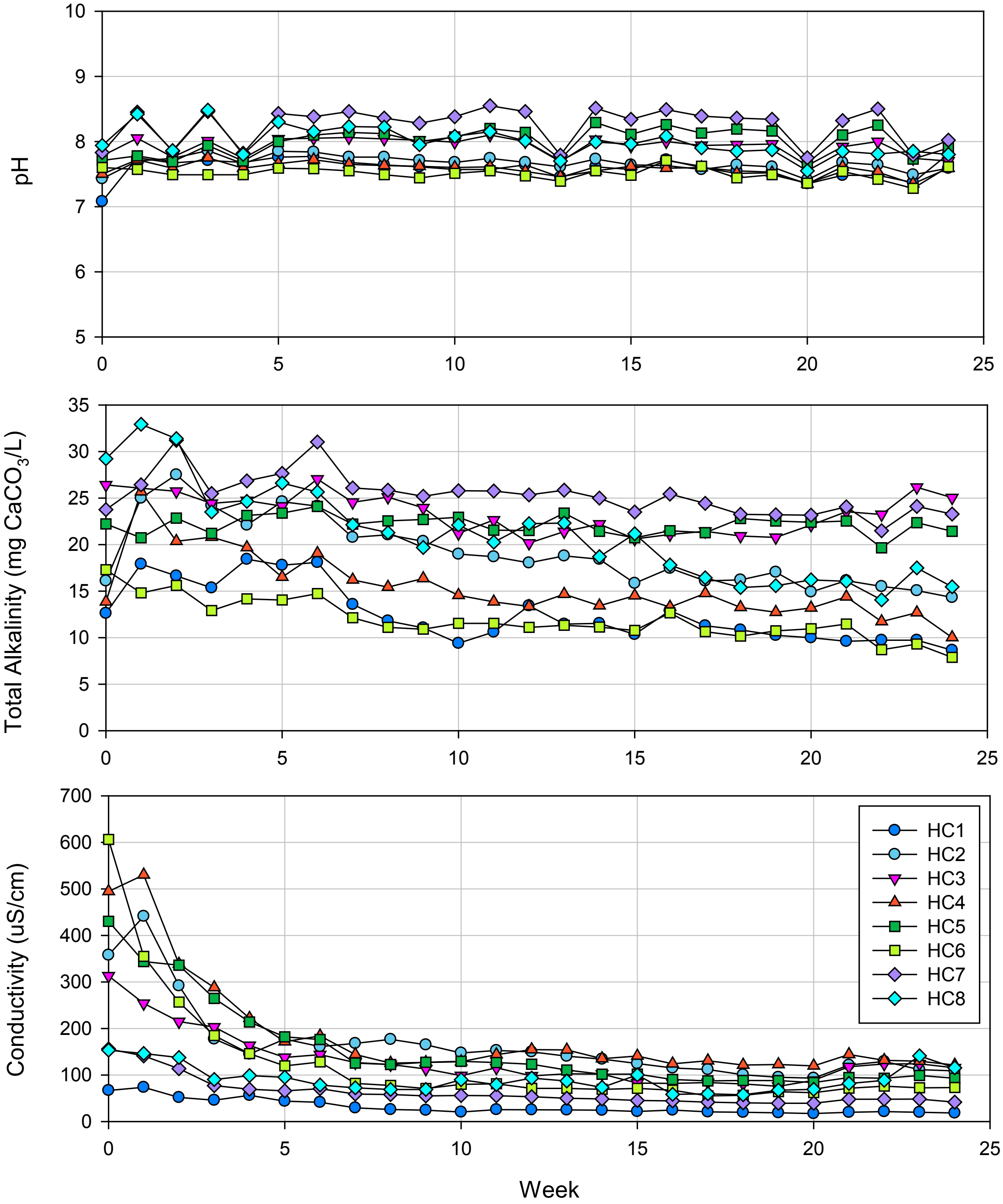


Figure 4-7: **pH, total alkalinity, conductivity and sulphate in leachates from Beaver Dam humidity cells**

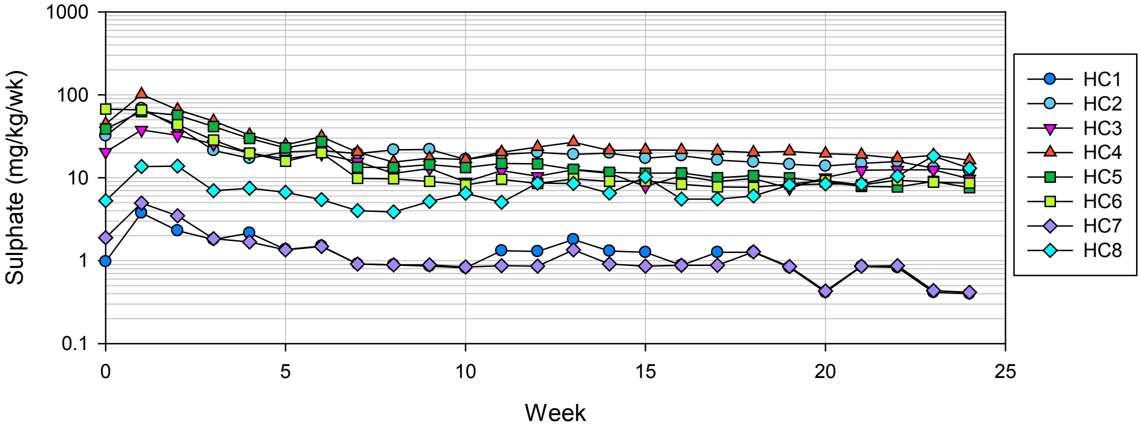


Figure 4-8: Sulphate loading rates in Beaver Dam humidity cell leachates

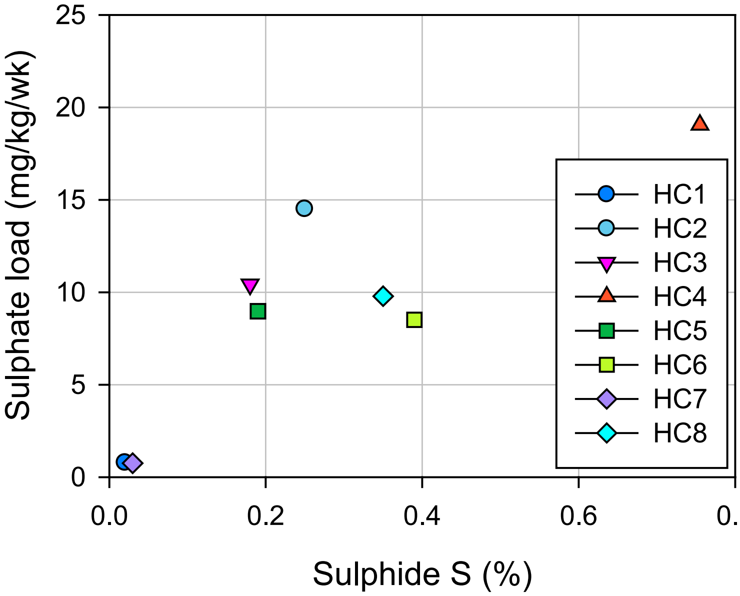


Figure 4-9: Average sulphate loading rate versus sulphide S. Sulphate load is an average from weeks 17-24.

4.1.2.2 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:

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

When reactive sulphides are present, the dominant NP consumption reaction is that of acid neutralization. In the most simplistic scenario, 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 the relationship (Mattson, 2005).

The CMR for the majority of the humidity cells is between 1 and 2 (Figure 4-10). HC1 and HC8 have slightly higher CMR values between 1 and 3. HC7 has the highest CMR values which have increased from approximately 2.5 up to 20.

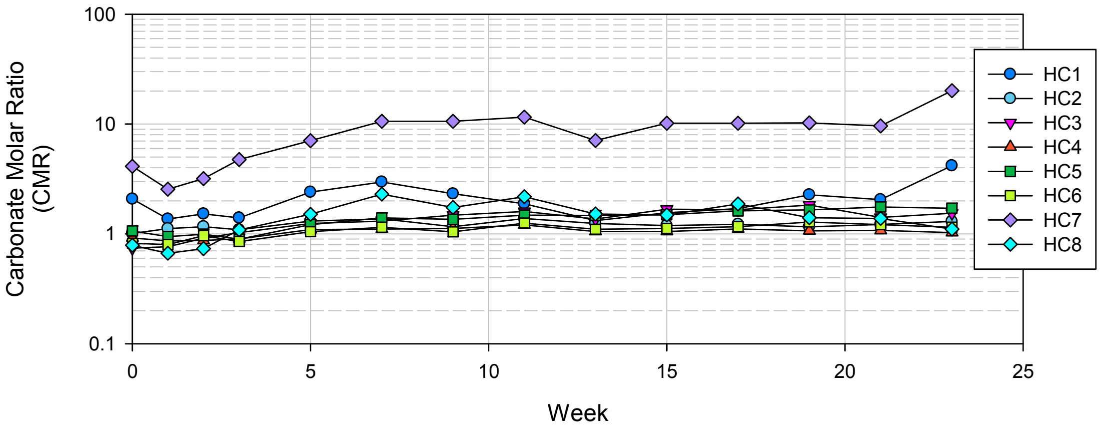


Figure 4-10: CMR values for Beaver Dam humidity cell leachate.

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. Theoretically, once carbonate is depleted and non-carbonate phases are responsible for buffering the pH, the CMR will equilibrate around a value of 1, which allows for a slower depletion of the remaining NP. For the purpose of this high-level assessment, it was conservatively assumed that the CMR and carbonate depletion rate can also be applied to all NP sources that were quantified by the ModNP method used for the Beaverdam ABA analyses. The NP depletion rate is calculated as follows:

$$\text{NP depletion rate} = \text{CMR x Sulphate loading rate (in kg } CaCO_3\text{/t/wk equivalents)}$$

For the PAG humidity cells that are expected to become acidic, the time to NP depletion theoretically corresponds to the time to onset of acid generating conditions, although the grain liberation is an important factor. 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 incorporated in the calculation. Rather the relatively stable NP depletion rates in later cycles of the tests more appropriately reflect depletion based on sulphate produced by sulphide oxidation. This will prevent underestimating the amount of available NP and the lag time to the onset of acidic conditions. The model results suggest that NP will be depleted between around 7 to 11 years for the PAG humidity cells. To provide a more realistic estimate that considers the slowing of sulphide oxidation at the Beaver Dam site in response to colder temperatures and/or freezing near-surface rock, the sulphate leaching rate was corrected by a factor of 0.3. This value is consistent with the temperature-dependent sulphide oxidation rate and sulphate release rate observed around 10°C (Dockrey and Mattson, 2016), which is somewhat higher than the mean annual temperature measured at the Beaver Dam site. Note that this approximation is only applicable for waste rock exposed to ambient air temperatures such as pit walls, since waste rock piles may have a different temperature profile. Plotting humidity cell total sulphur (S_T) contents against the respective temperature-corrected NP depletion rates shows a positive correlation (Figure 4-11a) that can be written as:

$$\text{NP depletion rate} = 0.0013 \text{ x } \ln [S_T] + 0.0064$$

This function was then applied to the PAG samples within the Beaver Dam static test population to quantify a range of lag times that can be expected until these PAG samples release net acidic drainage. The results of this exercise are shown in Figure 4-11b and show that it will take around 20 years for 10% of all PAG samples and 28 years for 50% of all PAG samples to turn acidic.

4.1.2.3 Metal Leaching Trends

The trends in leachate mass loading rates over time are provided in Figure 4-12 for selected species. These species have elevated concentrations with respect to 3x the AUCCC in the mine rocks (Section 4.1.1) and include As, Cu, Mn and Pb. Although the Ag concentrations in the total solid phase elemental analysis were above 3 times the AUCCC, Ag is not included in the discussion in this section as all Ag concentrations in the humidity cell leachates remain below the analytical detection limit.

As and Mn have the highest loading rates of the selected elements, both with rates of up to 0.06 mg/kg/wk in one or more of the humidity cells in the early weeks of the tests. The initial flush of As reaches the highest rates in leachate from HC8 (up to 0.062 mg/kg/wk), although the rate decreases over time and is comparable to the rates in the other humidity cells by Week 17 (approximately 0.01 mg/kg/wk). HC1, HC2, HC3 and HC7 show gradually increasing As loading rates until approximately week 5 and have since shown a gradual decrease to more stable rates (Figure 4-12). Arsenic loading rates in HC4 have shown a consistent decrease over time from 0.0088 to 0.00068 mg/kg/wk. The two GA humidity cells (HC5 and HC6) release relatively stable and low As loading rates (<0.01 mg/kg/wk). The As loading rates do not show a correlation with the As content in the solid phase (Figure 4-13). The humidity cell with the highest average loading rate in the last four cycles of the test (HC1; 0.021 mg/kg), had relatively low As in the solid phase (17 ppm). In contrast, HC6 is composed of two high As samples (1,915 ppm and 1,750 ppm) and has a relatively low As average loading rate throughout the duration of the test (0.0030 mg/kg). It is worth noting that sample HC8, which produces the highest initial As loading rates, is the only sample in which arsenopyrite was identified on a thin section scale. Assuming that the sample splitting was representative, these trends suggest that the As association within the different humidity cell subsamples has a strong control over the respective leaching rates.

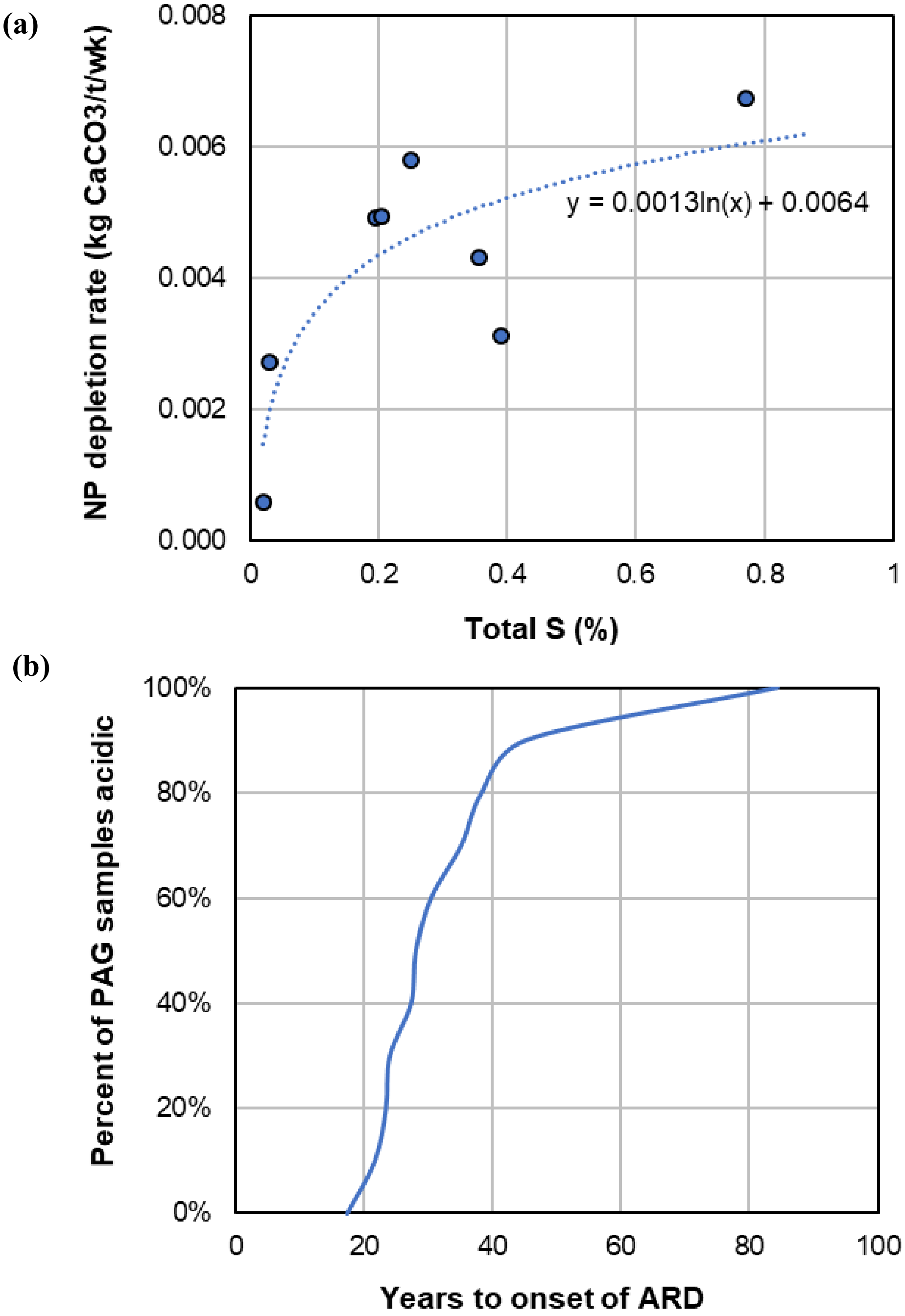


Figure 4-11: **Relationship (a) and results (b) of model to estimate the time to onset of acidic conditions in Beaver Dam PAG samples**

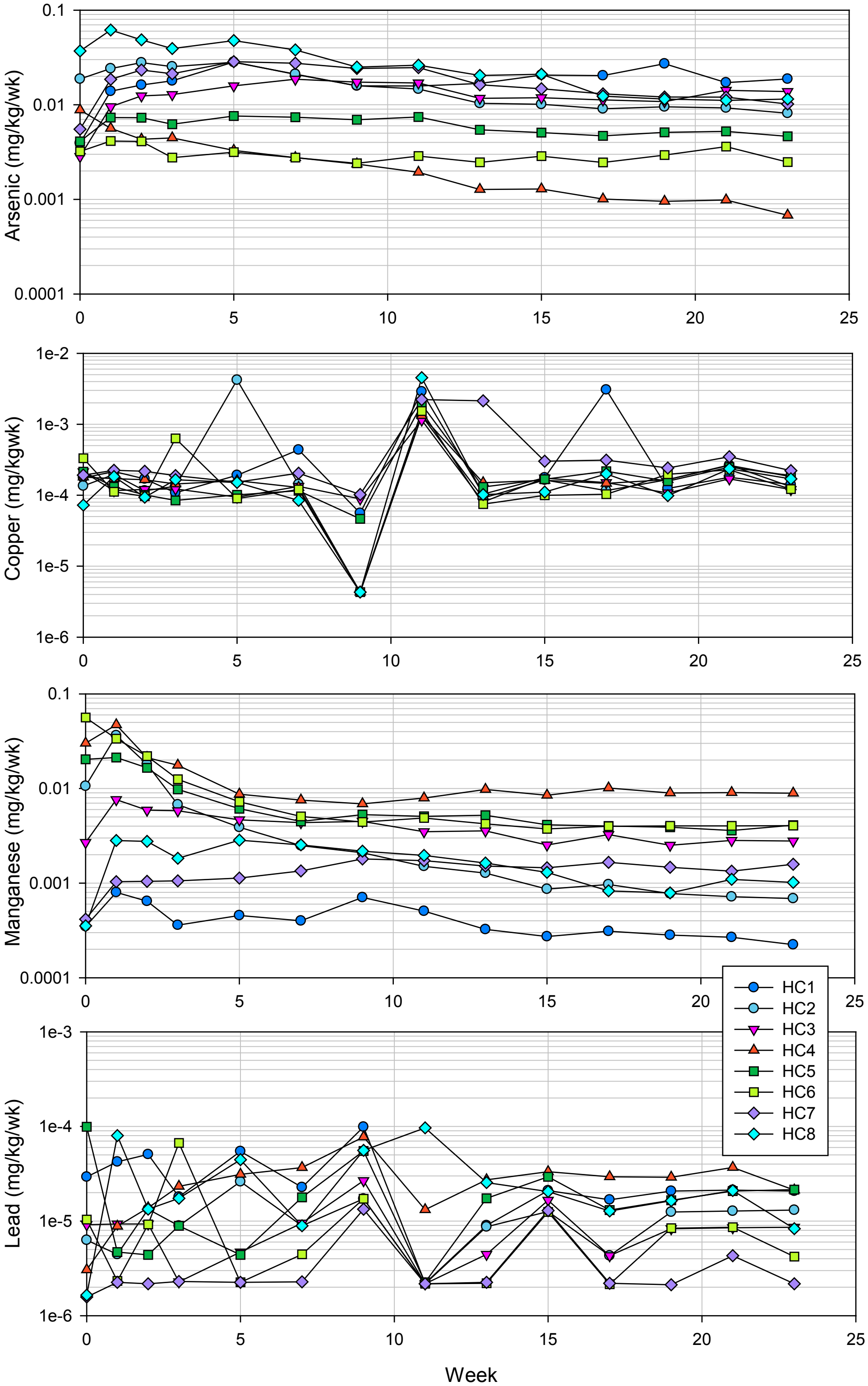


Figure 4-12: D-As, D-Cu, D-Mn and D-Pb in leachate from the Beaver Dam humidity cells

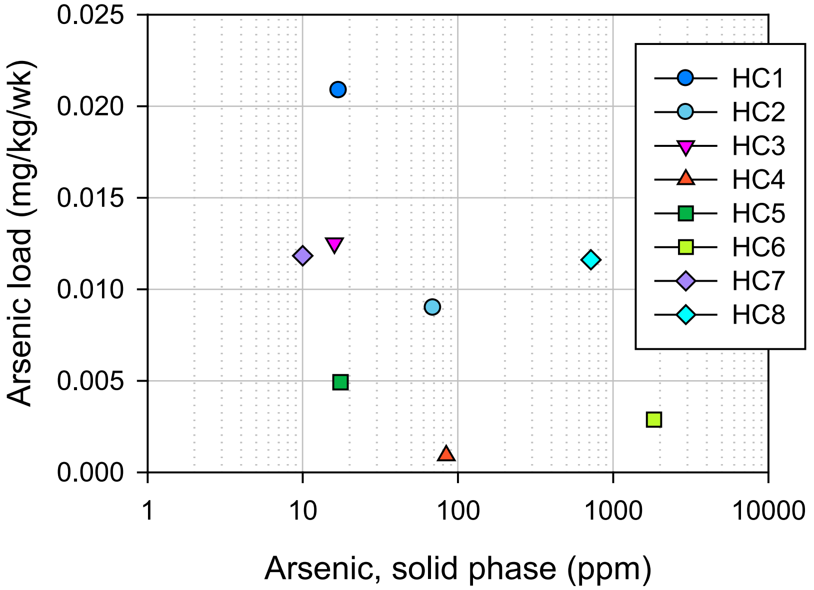


Figure 4-13: Average As loading rate vs solid phase As content. As load is an average from weeks 17-23.

Mn loading rates show an initial increase in the first few weeks in the majority of the humidity cell tests. The Mn loading rates are highest for leachate from HC2, HC4 and HC6. These are all the high S humidity cells for their respective lithologies. After Week 5, the Mn loading rates remain ≤0.01 mg/kg/wk for all humidity cells. Since Week 5, Mn loading rates for HC4 have been the highest. Mn loading rates from HC1 and HC7 remain low (<0.002 mg/kg/wk) over the course of the humidity cell tests. The loading rates for Cu and Pb are low (<0.005 mg/kg/wk) and do not display any obvious trends.

4.2 Overburden Samples

The paste pH values of the overburden samples are slightly acidic and range from pH 5.0 to pH 6.1 (Table 4-8; Appendix 4-2). One sample (LX-BDT-03) is currently acidic (pH < 5.5). The total S content of the overburden samples is low (<0.1%), with only sample LX-BDT-03 having a total S value above 0.05%. The majority of the S is present as sulphide S. This parameter is not measured but is calculated by subtracting the sulphate S, which is below the detection limit for these samples (<0.01%). There was no TIC detected in the overburden samples (<0.05%). The CaNP calculated from the TIC and the modified NP are both low, suggesting that the NP has been depleted from the overburden. Although the samples have a low NP, the risk for ARD is low due to the low sulphur content.

Table 4-8: Summary of ABA results for Beaver Dam overburden samples.

Sample ID	Paste pH	Total S	Sulphate S	Sulphide S (calc)	Total C	CaNP	Modified NP	NPR
		%	%	%	%	*kg $CaCO_3$/t*	*kg $CaCO_3$/t*	*Mod.NP/AP*
LX-BDT-01	5.6	0.02	*<0.01*	0.02	*<0.05*	*<4.5*	-4	-6.4
LX-BDT-02	5.7	0.02	*<0.01*	0.02	*<0.05*	*<4.5*	-5	-8
LX-BDT-03	5	0.08	*<0.01*	0.08	*<0.05*	*<4.5*	-5	-2
LX-BDT-04	6.1	0.02	*<0.01*	0.02	*<0.05*	*<4.5*	-4	-6.4
LX-BDT-05	5.7	0.02	*<0.01*	0.02	*<0.05*	*<4.5*	-4	-6.4

Notes: Values in grey italics are below the analytical detection limit. Values were set at the limit for calculation of NP, AP and NPR values.
Sulphate S is calculated using the HCl method.
AP (acid potential) calculated using sulphide sulphur (% non-sulphate sulphur x 31.25);
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

The results of the total solid phase elemental analysis are included in Appendix 4-3 with a summary provided in Table 4-9. Elements that are greater than 3× their respective AUCCC values (Rudnick and Gao, 2014) and greater than 2x the detection limit in at least one of the overburden samples include As and Mn (Table 4-9). Solid phase concentrations of As in 3 of the 5 samples are enriched by a factor greater than 10 above the AUCCC. The As and Mn values are also enriched in the waste rock.

Shake flask extraction (SFE) results for the five overburden samples are presented in Appendix 4-6 and summarized in Table 4-10 as compared to the CCME water quality guidelines for the protection of aquatic life (CCME, 2018). These guidelines are used for reference only to provide an indication of parameters which are of potential concern in runoff from the excavated material. 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.

Table 4-9: Summary of solid phase element results for Beaver Dam overburden samples.

AUCCC	*0.053*	*4.8*	*2.57*	*17.3*	*28*	*3.92*	*77.4*	*47*	*17*	*67*
Sample ID	**Ag**	**As**	**Ca**	**Co**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Zn**
	ppm	*ppm*	*%*	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*ppm*	*ppm*
LX-BDT-01	0.2	225	0.06	13	27	3.88	490	33	13	74
LX-BDT-02	<0.2	24	0.04	5	16	2.63	245	17	9	28
LX-BDT-03	0.2	54	0.13	5	12	1.34	162	22	10	37
LX-BDT-04	<0.2	15	0.02	2	4	0.96	112	4	7	10
LX-BDT-05	0.2	105	0.05	10	15	4.51	441	19	9	64

Notes: Values in grey italics are below the analytical detection limit. 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 grey; values greater than 10x the AUCCC are shaded in dark grey.

Table 4-10:
Summary of SFE results for Beaver Dam overburden samples.

Parameter	Units	CCME WQG		LX-BDT-01	LX-BDT-02	LX-BDT-03	LX-BDT-04	LX-BDT-05
		Short Term	Long Term					
pH	pH	6.5-9	-	5.27	5.15	4.88	4.54	5.83
Conductivity	µS/cm	-	-	12.6	15.7	89.1	36.7	19.5
Sulphate	mg/L	-	-	2.24	1.23	10.1	1.42	2.08
Leachable Metals								
Ag	mg/L	-	0.00025	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Al[a]	mg/L	-	0.1	***0.108***	***0.683***	***1.51***	***1.26***	***0.483***
As	mg/L	-	0.005	0.0012	0.0012	***0.315***	0.0038	***0.0084***
B	mg/L	29	1.5	<0.010	<0.010	0.015	<0.010	<0.010
Cd	mg/L	0.001	0.00009	<0.000050	<0.000050	***0.000217***	0.000075	<0.000050
Co	mg/L	-	-	0.00084	0.00042	0.00761	0.00054	0.00101
Cr	mg/L	-	0.001	<0.00050	0.00088	***0.00118***	***0.00126***	0.00064
Cu[b]	mg/L	-	0.002	<0.0010	<0.0010	***0.0085***	0.0014	***0.0033***
Fe	mg/L	-	0.3	<0.030	0.194	***0.425***	***0.490***	0.262
Hg	mg/L	-	0.000026	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Mn	mg/L	-	-	0.107	0.0446	0.131	0.0681	0.106
Mo	mg/L	-	0.073	<0.00010	<0.00010	0.00023	<0.00010	<0.00010
Ni[b]	mg/L	-	0.025	0.00098	0.00118	***0.0360***	0.00151	0.00179
Pb[b]	mg/L	-	0.001	<0.00010	0.00013	0.00090	***0.00129***	0.00012
Se	mg/L	-	0.001	<0.00050	0.00068	0.00079	***0.00101***	0.00085
Tl	mg/L	-	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
U	mg/L	0.033	0.015	0.000020	0.000087	0.000101	0.000073	0.000103
Zn	mg/L	0.037	0.007	<0.010	<0.010	***0.045***	***0.012***	<0.010

Notes: Values shaded in grey are above the short-term CCME guideline
Values in bold italics are above the long-term CCME guideline
[a]Aluminum guideline is based on pH > 6.5
[b]Hardness dependent guidelines are based on a hardness of 10 mg/L.

Parameters that were elevated relative to the CCME guidelines in the leachate from the samples (n=5) include Al (5 samples), As (2 samples), Cd (1 sample), Cr (2 samples), Cu (2 samples), Fe (2 samples), Pb (1 sample), Ni (1 sample), Se (1 sample) and Zn (2 samples). In addition, all samples have pH values less than 6.5 and four of the samples are acidic (pH < 5.5). Metals enriched above 10 times their respective guidelines include Al in two samples and As in one sample. Al is highly sensitive to pH and the elevated Al concentrations are likely related to the low in-situ pH of the samples. The highest As concentration in the SFE tests was measured in sample LX-BDT-03. This sample produced

As concentrations of 0.315 mg/L, while the other four overburden samples produced As concentrations ranging from 0.0012 to 0.0084 mg/L. Arsenic was identified as an element enriched in the overburden by the solid phase analysis, however, sample LX-BDT-03 does not have the highest As concentration in the solid phase. The higher As in the leachate from this sample is likely due to the low pH which would result in increased leaching from the overburden material. Given the highly weathered nature of overburden significant metal leaching potential is not expected from this unit. The cause of the elevated As concentration in LX-BDT-03 is unclear, but shows that further overburden characterization may be required.

4.3 Haul Road Samples

The samples collected along the Beaver Dam haul road have paste pH values ranging from 7.4 to 8.8 and are not currently acid generating. All total S and TIC values are below their respective detection limits for these samples (Table 4-11; Appendix 4-2). The NPR values are high due to the low acid potential, indicating that the samples are not potentially acid generating. The low total S and TIC values suggest that the samples are weathered. Fresher samples could be obtained in the future to verify these results if drilling is conducted along the road alignment.

The solid phase elements are compared to the AUCCC (Rudnick and Gao, 2014; Appendix 4-3). The only elements that are above 3x the AUCCC and greater than 2x the detection limit are As (2 samples) and Mn (4 samples) (Table 4-12). Both As and Mn were also identified as elements enriched in the mine rock. As discussed above (Section 4.1.1.3), elements enriched in the solid phase may not necessarily become a metal leaching issue as there are many factors that influence leaching rates.

Table 4-11:
Summary of ABA results for Beaver Dam haul road samples.

Sample ID	Paste pH	Total S	Sulphate S	Sulphide S (calc)	Total C	CaNP	Modified NP	NPR
		%	*%*	*%*	*%*	*kg $CaCO_3$/t*	*kg $CaCO_3$/t*	*Mod.NP/AP*
LX-BDR-01	7.4	*<0.01*	*<0.01*	*<0.01*	*<0.05*	*<4.5*	3	9.6
LX-BDR-02	8.7	*<0.01*	*<0.01*	*<0.01*	*<0.05*	*<4.5*	5	16.0
LX-BDR-03	8.7	*<0.01*	0.01	*<0.01*	*<0.05*	*<4.5*	4	12.8
LX-BDR-04	8.8	*<0.01*	0.01	*<0.01*	*<0.05*	*<4.5*	4	12.8
LX-BDR-05	7.7	*<0.01*	0.01	*<0.01*	*<0.05*	*<4.5*	8	25.6

Notes: Values in grey italics are below the analytical detection limit. Values were set at the limit for calculation of NP, AP and NPR values.
Sulphate S is calculated using the HCl method.
AP (acid potential) calculated using sulphide sulphur (% non-sulphate sulphur x 31.25);
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

**Table 4-12:
Summary of solid phase element results for Beaver Dam haul road samples.**

AUCCC	*0.053*	*4.8*	*2.57*	*17.3*	*28*	*3.92*	*77.4*	*47*	*17*	*67*
Sample ID	**Ag**	**As**	**Ca**	**Co**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Zn**
	ppm	*ppm*	*%*	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*ppm*	*ppm*
LX-BDR-01	<0.2	21	0.14	4	9	1.92	212	15	3	38
LX-BDR-02	<0.2	<2	0.14	13	20	2.87	392	31	5	62
LX-BDR-03	<0.2	2	0.17	7	17	2.08	302	18	7	45
LX-BDR-04	<0.2	<2	0.12	8	11	2.12	336	21	<2	39
LX-BDR-05	<0.2	18	0.78	13	28	3.63	625	38	7	66

Notes: Values in grey italics are below the analytical detection limit. 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 grey; values greater than 10x the AUCCC are shaded in dark grey.

4.4 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.

5. Conclusions and Recommendations

ATLANTICGOLD

5 Conclusions and Recommendations

The ML/ARD characterization of the Beaver Dam samples included static test characterization of the Beaver Dam mine rock, overburden from the proposed pit area and samples from along the Beaver Dam haul road. In addition, kinetic testing was undertaken on mine rock samples. The major conclusions and recommendations of the geochemical characterization include:

- Total S in the mine rock samples varies from below the detection limit (<0.01%) up to 1.7%. The AR unit has the highest median total S (0.44%) and the GW unit has the lowest median total S (0.025%). The GA and GW units have the highest median TIC (0.11% and 0.10%, respectively) and the highest median modified NP (9.0 and 14 kg $CaCO_3$/t, respectively), while the AR and AG units have the lowest median TIC (<0.05%) and modified NP (8.5 and 8.0 kg $CaCO_3$/t, respectively). The mine rock samples were not currently acid generating (paste pH: 7.9 to 9.5).
- All four of the main lithologies for Beaver Dam mine rock include PAG samples, however, all samples with total S less than 0.1% are NAG. The overall proportion of PAG rock identified in the static test population is 39%; AR has the highest relative proportion of PAG samples (80%) while the GW unit has the lowest (21%).
- Parameters of potential concern identified by the total solid phase elemental analysis include As, Cu, Mn and Pb. Elevated As concentrations (>10× AUCCC) occur in all Beaver Dam lithologies. Elevated Mn values (>10× AUCCC) occur in 3 of the 4 lithologies, whereas elevated Ag and Pb (>10× AUCCC) are limited to the AG samples. Cu is not above 10x the AUCCC in any of the lithologies.
- The static test results indicate that the humidity cell samples provide a good representation of the range of geochemical characteristics within each lithologic unit. However, HC1 and HC2 have low S contents as compared to the median argillite value.
- The leachate from the kinetic tests remains circumneutral for the initial 24 weeks of data available at the time of reporting. The sulphate loading rates are lowest for HC1 (AR, median S) and HC7 (GW, median S) and highest for HC4 (AG, high S). The CMR for the majority of the humidity cells is between 1 and 2 with values up to 3 in HC1 and HC8.
- As and Mn have the highest loading rates of the parameters of potential concern identified by the solid phase analysis. Arsenic loading rates are comparable in the last weeks of the available data for the AR humidity cells (HC1 and HC2), the

median S AG humidity cell (HC3), and the GW humidity cells (HC7 and HC8). Both GA humidity cells (HC5 and HC6) have lower As loading rates and As loading rates from the high S AG humidity cell (HC4) have shown a decreasing trend over the length of the test. Mn loading rates are highest for HC4 in the later weeks of the tests. Mn loading rates from HC1 and HC7 have remained low. Mn loading rates appear to be correlated with the sulphate loading rates. The loading rates for this element are typically higher for the high S pair for each lithology.

- Based on the relationship between total S content and the NP depletion rate and in consideration of Beaver Dam site climatic conditions, it is estimated that it will take at least 17 years for the Beaver Dam PAG samples to produce ARD and around 28 years for half of all PAG samples to do so. This rate may be accelerated in ARD "hotspots" within waste rock piles where increased temperatures may be attained in response to heat produced by sulphide oxidation.
- The overburden samples have low sulphur content; however, they lack any significant NP. Elements enriched in the overburden include As and Mn. The SFE tests indicate the potential for elevated Al and As in runoff, among other elements. However, significant metal leaching is not expected from this unit due to the high degree of weathering. Further characterization of the overburden material is recommended.
- Samples collected along the haul road have low total S and low NP and do not currently indicate a potential for ARD. It is assumed that these samples are surface-weathered and therefore, it is recommended that fresh, unweathered samples be collected to verify the results if drilling is conducted along the haul road. Elements of potential concern identified by the solid phase analysis include As and Mn.

6. Closure

ATLANTIC GOLD

6 Closure

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

Sincerely,

LORAX ENVIRONMENTAL SERVICES LTD.

Prepared by:	**Prepared by:**
Original Signed By:	***Original Signed and Sealed By:***
Jennifer Owen, M.Sc., GIT Environmental Scientist	**Alison Shaw, Ph.D., P.Geo** Senior Environmental Geoscientist
Reviewed by:	**Reviewed by:**
Original Signed By:	***Original Signed By:***
Timo Kirchner, M.Sc., P.Geo Environmental Geoscientist	**Bruce Mattson, M.Sc., P.Geo** Senior Environmental Geoscientist

References

ATLANTIC GOLD

References

Canadian Council of Ministers of the Environment (CCME) (2018). Canadian Environmental Quality Guidelines, water quality guidelines for the protection of aquatic life, http://ceqg-rcqe.ccme.ca/en/index.html. Accessed November 2018.

Dockrey, J. & Mattson, B (2016). Effects of pH on the Arrhenius Paradigm. In Proceedings of the International Mine Water Association (IMWA) Annual Conference, Leipzig, Germany, July 11-15, 2016.

FSSI Consultants (2015). Technical Report of the Beaver Dam Gold Project, Halifax County, Nova Scotia. Prepared by Neil Schofield of FSS International Consultants (Australia) Pty Ltd., prepared for Atlantic Gold Corporation, dated March 2, 2015.

Government of Canada (2018). Canadian Climate Normals: 1981-2010. climate.weather.gc.ca/climate_normals/index_e.html. Accessed November 6, 2018.

Jambor, J., Dutrizac, J., Raudsepp, M., and Groat, L. (2003). Effect of Peroxide on Neutralization Potential Values of Siderite and Other Carbonate Minerals. Journal of Environmental Quality 32, 2373-2378.

Lapakko, K. A. (2003). Developments in humidity cell tests and their application, in: Jambor, J. L.; Blowes, D. W.; Ritchie, A. I. M., (Eds.), Environmental aspects of mine wastes, Minerals Association of Canada 147-164.

Lorax Environmental Services Ltd. (Lorax) (2018). Beaver Dam Project - Geochemical Source Term Predictions for Waste Rock, Low-Grade Ore, Tailings and Overburden. Draft Technical Report submitted to AMNS on November 8, 2018.

Mattson, B. (2005). Evaluating Depletion of Carbonate Neutralization Potential from Laboratory Kinetic Tests. *Securing the Future 2005, International Conference on Mining and the Environment and Metals and Energy Recovery. June 27 - July 1, 2005, Skellefteå, Sweden.*

Price, W.A. (1997). Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Mine-sites in British Columbia. Reclamation Section, Energy and Minerals Division, British Columbia Ministry of Employment and Investment.

Price, W.A. (2009). MEND Report 1.20.1 – Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials, dated December 2009.

Rudnick, R.L. and S. Gao (2014). Composition of the Continental Crust. In: Holland, H. and Turekian, K. (eds). Treatise on Geochemistry 2nd Edition, Vol. 4, pp. 1-51. Oxford, UK, Elsevier Ltd.

Sapsford, D.J., Bowell, R.J., Dey, M., and Williams, K.P. (2009). Humidity cell tests for the prediction of acid rock drainage. Minerals Engineering 22, 25-36.

Appendices

ATLANTIC GOLD

Appendix 3-1:
Sample Locations and Drill Core Details

ATLANTICGOLD

Appendix 3-1 Sample Locations and Drill Core Details

Geologic Unit	Hole ID	Interval (m)		Sample ID
		From	*To*	
Argillite (AR)	BD14-178	7	7.9	LX17-12
	BD15-GT05	57	58	LX17-22
	BD14-188	22	23	LX17-24
	BD15-190	40	41	BD190-040
	BD05-005	54	55	BD005-054
	BD06-110	50	51	BD110-050
	BD15-190	43	44	BD190-043
	BD14-157	31	32	BD157-031
	BD06-085	46	47	BD085-046
	BD05-011	123	124	BD011-123
Argillite-Greywacke (AG)	BD15-GT02	15	16	LX17-02
	BD15-GT02	26	27	LX17-03
	BD15-GT02	31	32	LX17-04
	BD15-GT08	37	38	LX17-09
	BD14-172	140	141	LX17-10
	BD14-172	170	171	LX17-11
	BD14-178	15	16	LX17-13
	BD14-173	22	23	LX17-28
	BD14-160	140	141	BD160-140
	BD14-179	170	171	BD179-170
	BD14-169	136	137	BD169-136
Greywacke-Argillite (GA)	BD15-GT02	10	11	LX17-01
	BD15-GT02	46	47	LX17-05
	BD15-GT08	14	15	LX17-07
	BD14-178	30	31	LX17-14
	BD14-178	58	59	LX17-15
	BD14-178	161	162	LX17-17
	BD14-178	147	148	LX17-18
	BD15-GT05	15	16	LX17-19
	BD14-188	10	11	LX17-23
	BD14-173	37	38	LX17-29
	BD14-156	9	10	BD156-009
	BD14-187A	10	11	BD187A-010
	BD14-157	33	34	BD157-033
	BD14-169	187	188	BD169-187
Greywacke (GW)	BD15-GT08	91	10	LX17-06
	BD15-GT08	23	24	LX17-08
	BD14-178	49	50	LX17-16
	BD15-GT05	25	26	LX17-20
	BD15-GT05	41	42	LX17-21
	BD14-156	75	76	BD156-075
	BD14-160	39	40	BD160-039
	BD14-179	45	46	BD179-045
	BD14-179	149	150	BD179-149
	BD05-006	12	13	BD006-012
	BD14-169	44	45	BD169-044
	BD14-169	88	89	BD169-088
	BD05-011	15	16	BD011-015
	BD14-183	70	71	BD183-070
	BD14-183	148	149	BD183-148
	BD06-049	140	141	BD049-140
	BD14-179	43	44	BD179-043
	BD05-006	13	14	BD006-013
	BD14-183	132	133	BD183-132
	BD14-186	149	150	BD186-149
	BD14-188	38	39	LX17-25
	BD14-188	51	52	LX17-26
	BD14-173	12	13	LX17-27
	BD14-173	53	54	LX17-30
Quartz Vein (QTZV)	BD14-157	70	71	BD157-070
	BD14-156	108	109	BD156-108
	BD14-160	89	90	BD160-089

Appendix 4-1:
XRD Results

ATLANTICGOLD

QUANTITATIVE PHASE ANALYSIS OF 8 POWDER SAMPLES USING THE RIETVELD METHOD AND X-RAY POWDER DIFFRACTION DATA.

Project: 1821 Beaver Dam
PO:43079

Rik Vos - Carolyn Jones
SGS Canada Inc.
3260 Production Way
Burnaby, BC V5A 4W4

Mati Raudsepp, Ph.D.
Elisabetta Pani, Ph.D.
Edith Czech, M.Sc.
Jenny Lai, B.Sc.
Lan Kato, B.A.

Dept. of Earth & Ocean Sciences
The University of British Columbia
6339 Stores Road
Vancouver, BC V6T 1Z4

July 10, 2018

EXPERIMENTAL METHOD

The samples of **Project 1821 Beaver Dam** were reduced to the optimum grain-size range for quantitative X-ray analysis (<10 μm) by grinding under ethanol in a vibratory McCrone Micronizing Mill for 10 minutes. Continuous-scan X-ray powder-diffraction data were collected over a range 3-80°2θ with CoKα radiation on a Bruker D8 Advance Bragg-Brentano diffractometer equipped with an Fe monochromator foil, 0.6 mm (0.3°) divergence slit, incident- and diffracted-beam Soller slits and a LynxEye-XE detector. The long fine-focus Co X-ray tube was operated at 35 kV and 40 mA, using a take-off angle of 6°.

RESULTS

The X-ray diffractograms were analyzed using the International Centre for Diffraction Database PDF-4 and Search-Match software by Bruker. X-ray powder-diffraction data of the samples were refined with Rietveld program Topas 4.2 (Bruker AXS). The results of quantitative phase analysis by Rietveld refinements are given in Table 1 (separate file, ***SGS Canada Results July 10 2018 - Project 1821 Beaver Dam – PO43079 - 8 samples.xls***). These amounts represent the relative amounts of crystalline phases normalized to 100%. The Rietveld refinement plots are shown in Figures 1 - 8. The ideal formulae of the mineral phases are shown in Table 2.

Table 2.

Mineral	**Ideal Formula**
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$
Calcite	$CaCO_3$
Chamosite	$(Fe,Al,Mg)_6(Si,Al)_4O_{10}(OH)_8$
Illite/Muscovite 2M1	$K_{0.65}Al_{2.0}Al_{0.65}Si_{3.35}O_{10}(OH)_2/KAl_2(AlSi_3O_{10})(OH)_2$
Ilmenite ?	$Fe^{2+}TiO_3$
Plagioclase	$NaAlSi_3O_8$ – $CaAl_2Si_2O_8$
Pyrite	FeS_2
Quartz	SiO_2

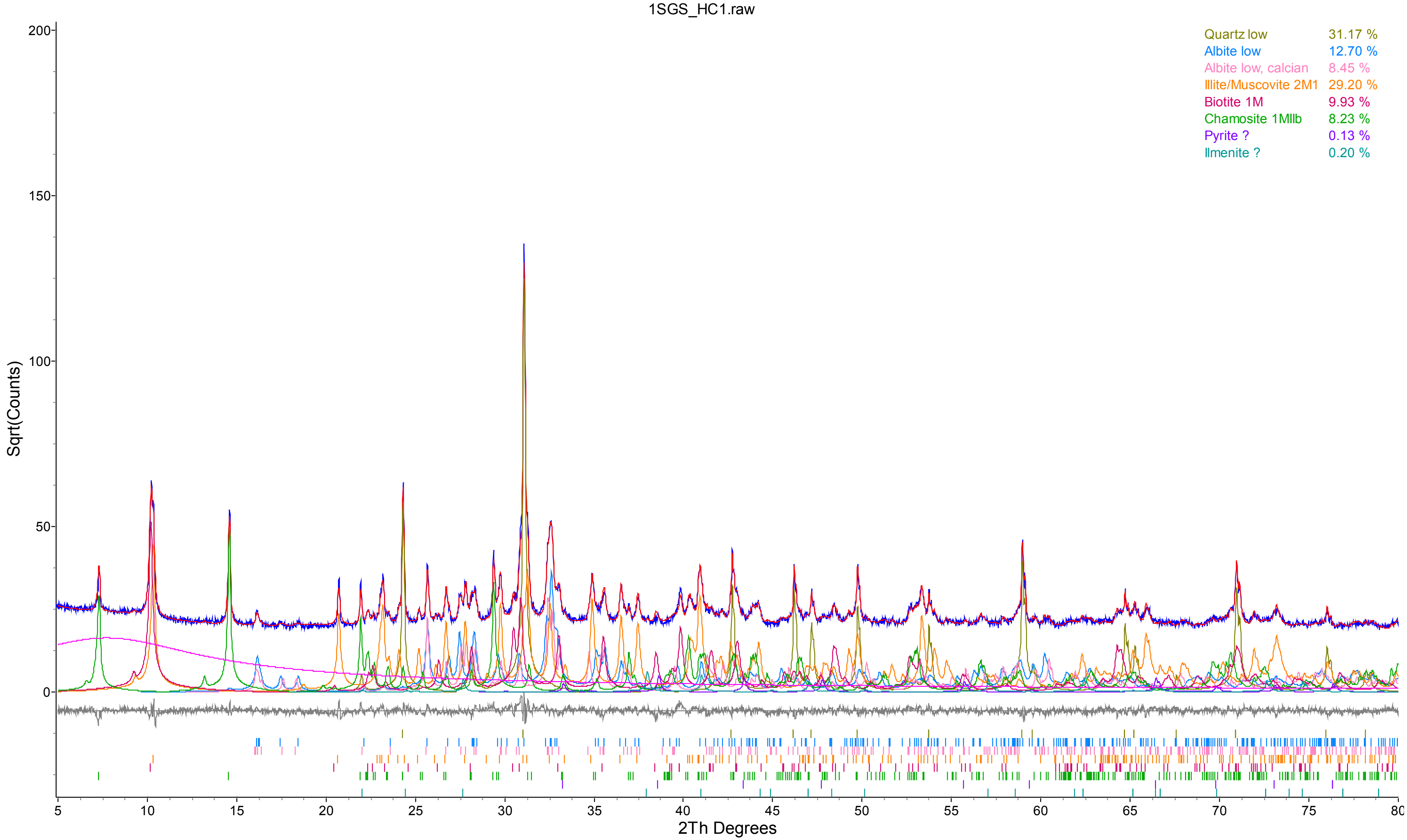


Figure 1. Rietveld refinement plot of sample **SGS CANADA HC 1** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars, positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

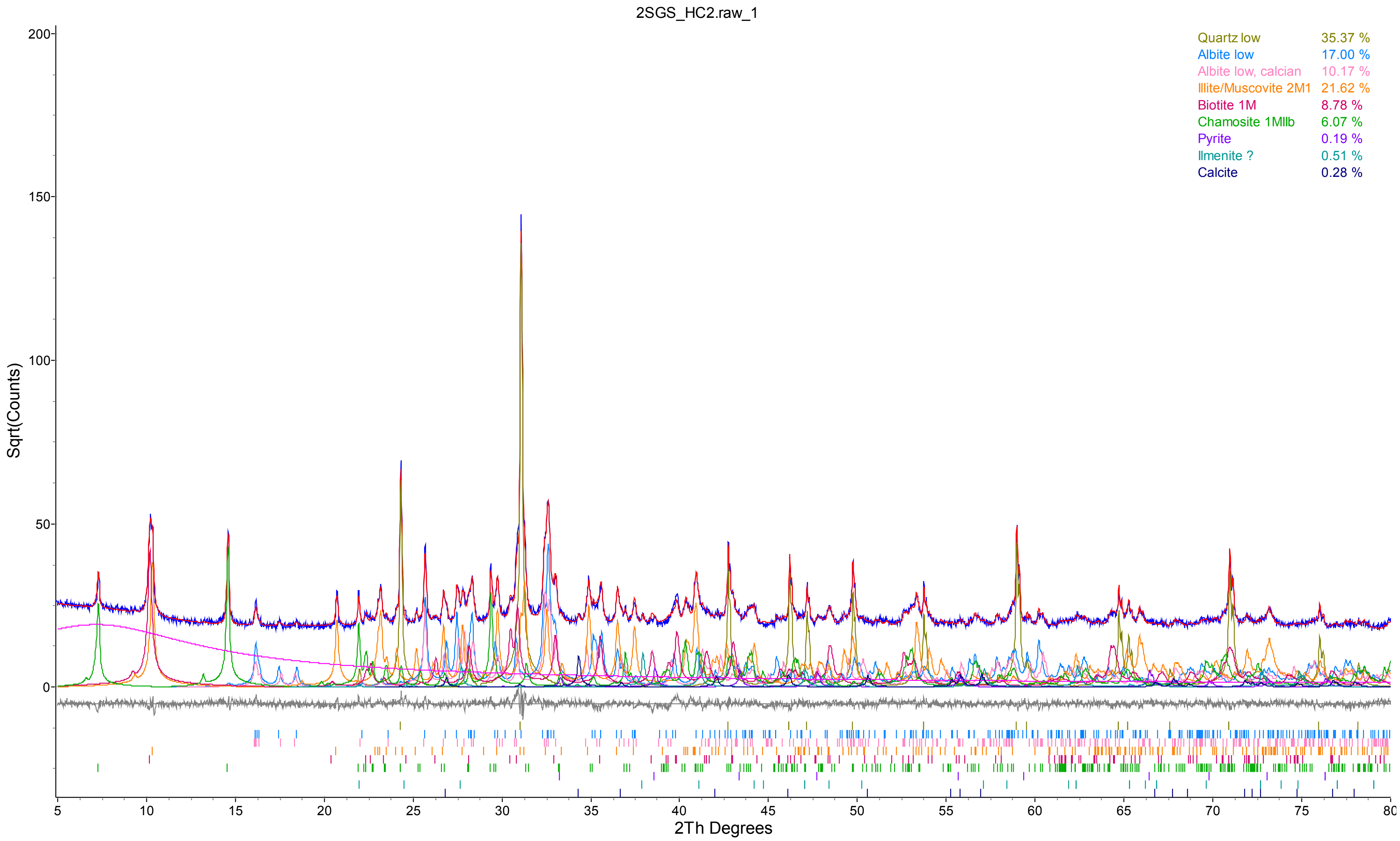


Figure 2. Rietveld refinement plot of sample **SGS CANADA HC 2** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

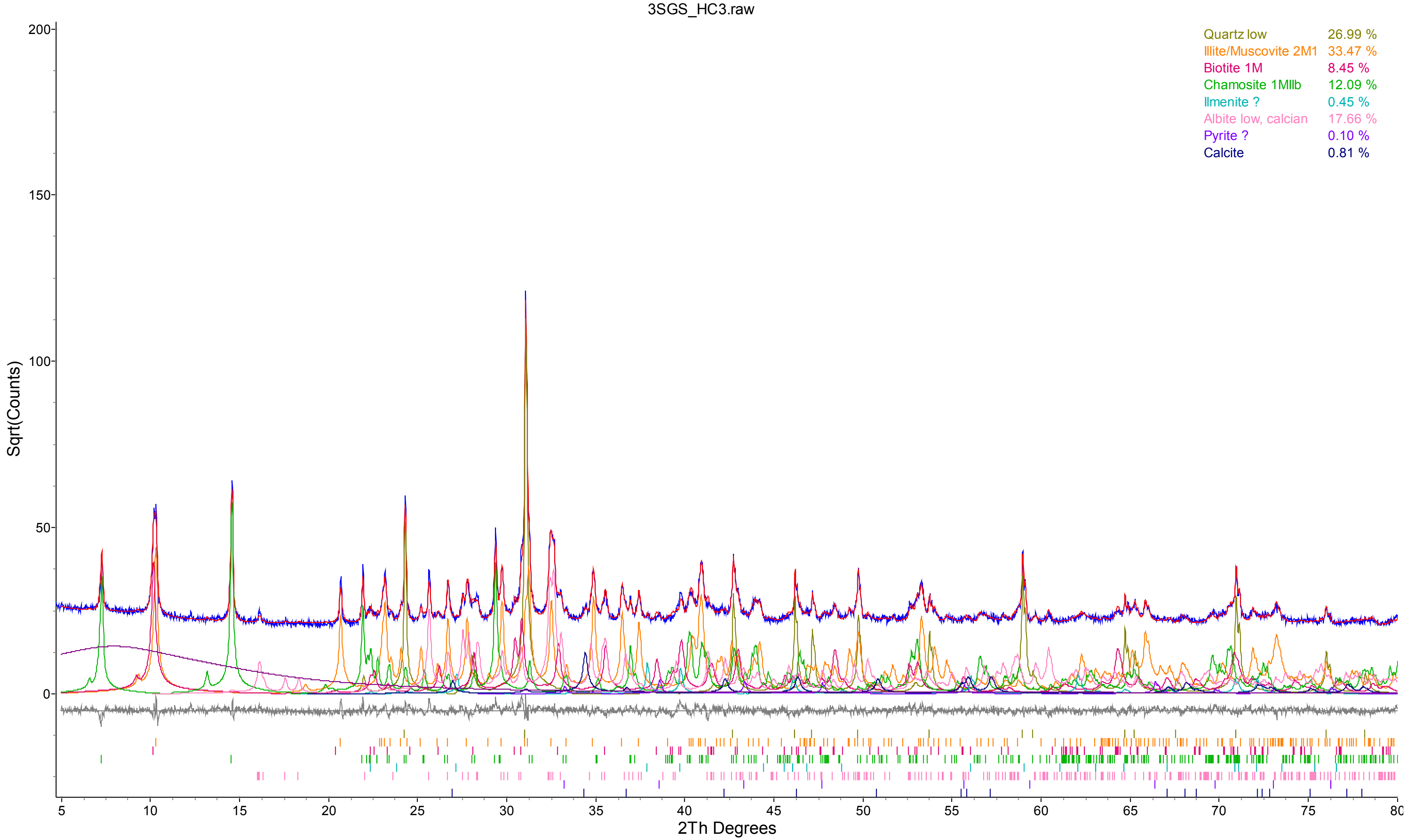


Figure 3. Rietveld refinement plot of sample **SGS CANADA HC 3** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

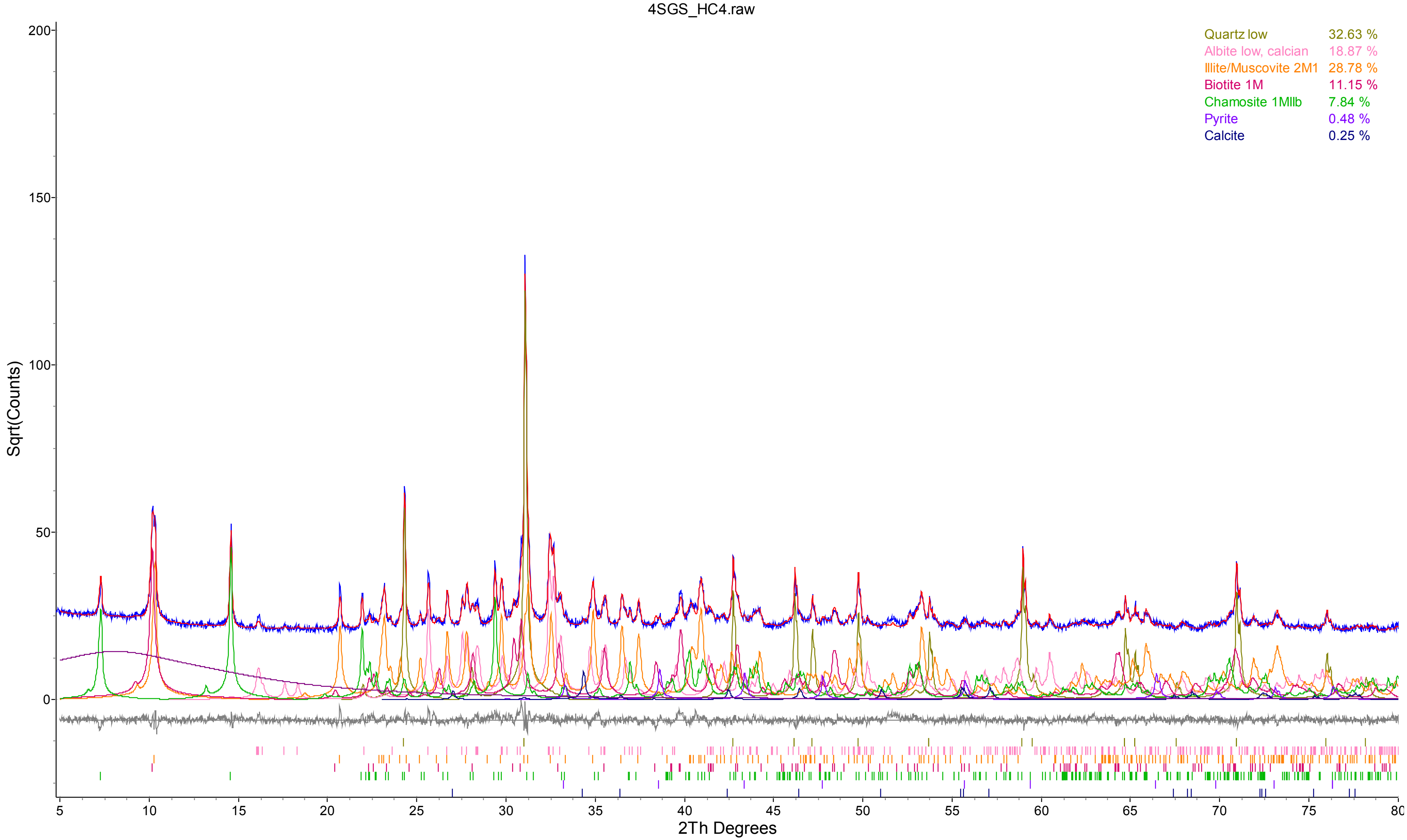


Figure 4. Rietveld refinement plot of sample **SGS CANADA HC 4** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

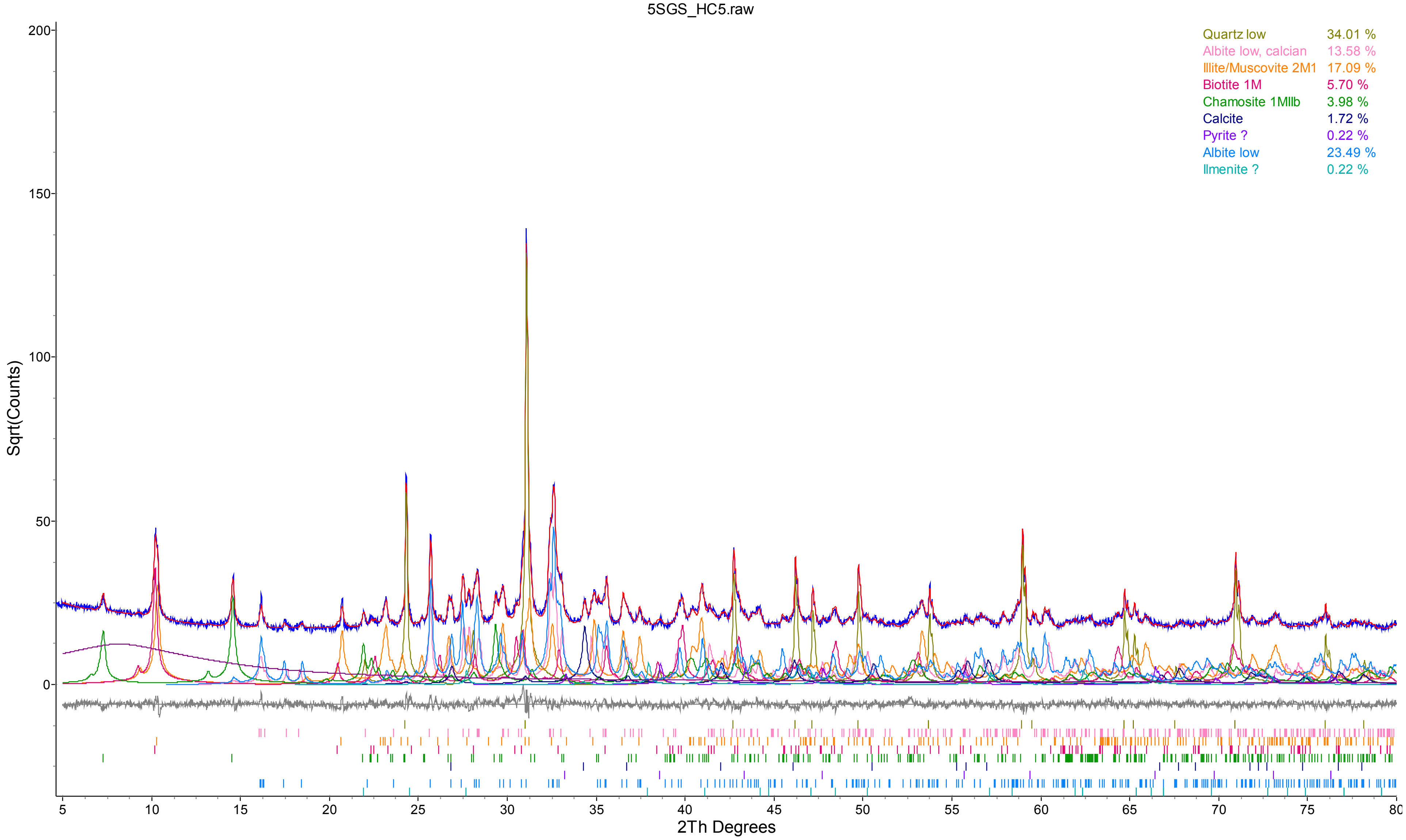


Figure 5. Rietveld refinement plot of sample **SGS CANADA HC 5** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

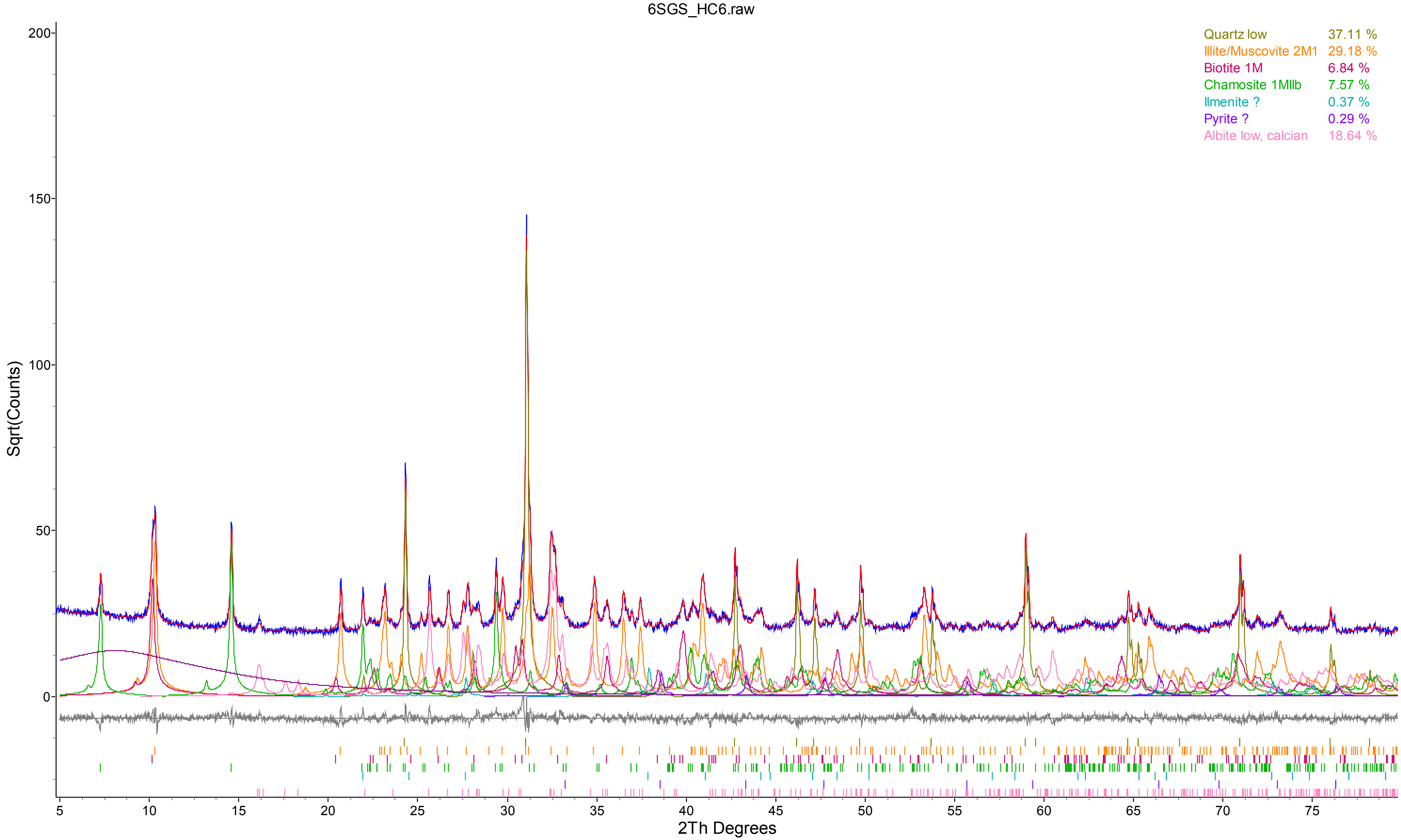


Figure 6. Rietveld refinement plot of sample **SGS CANADA HC 6** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

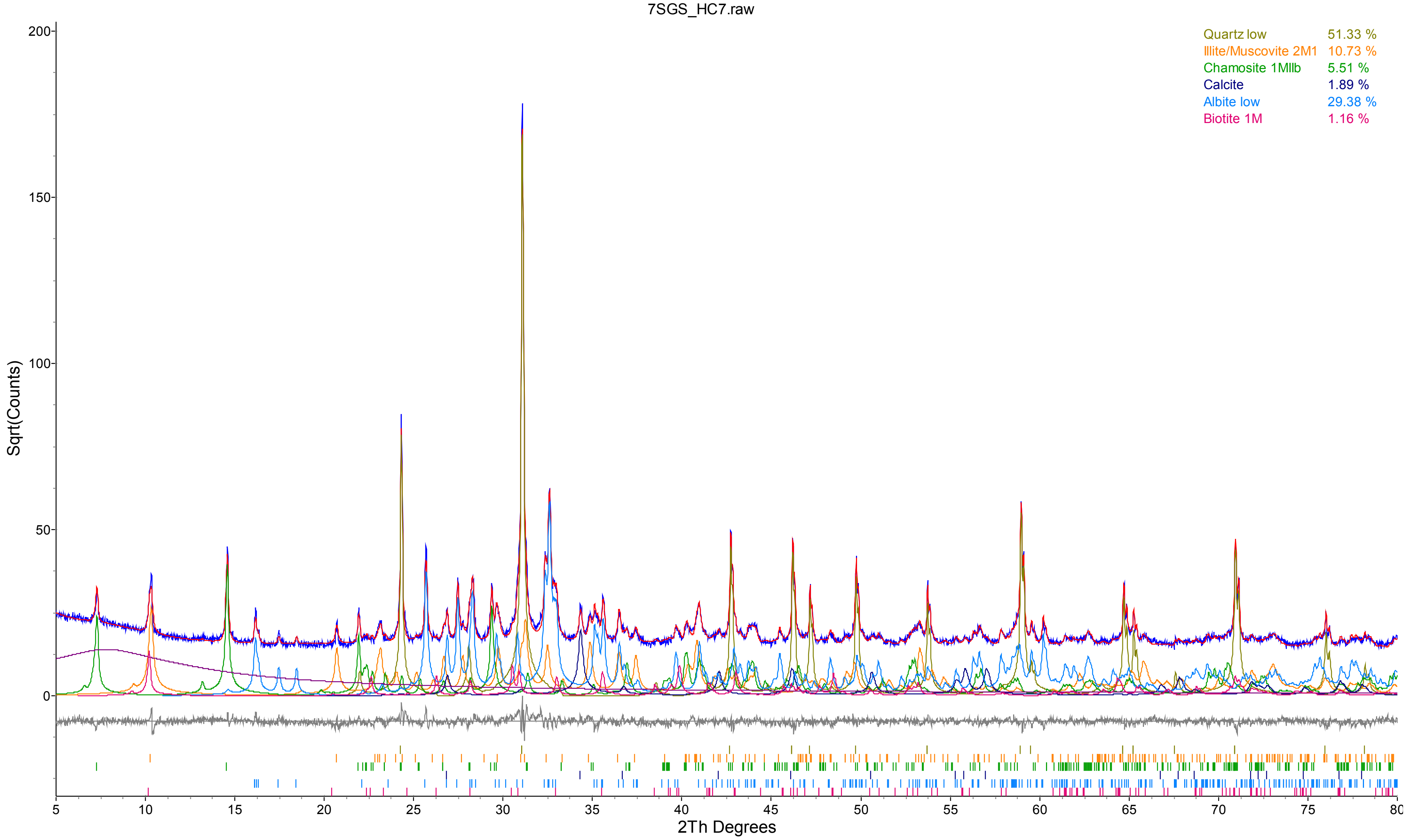


Figure 7. Rietveld refinement plot of sample **SGS CANADA HC 7** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

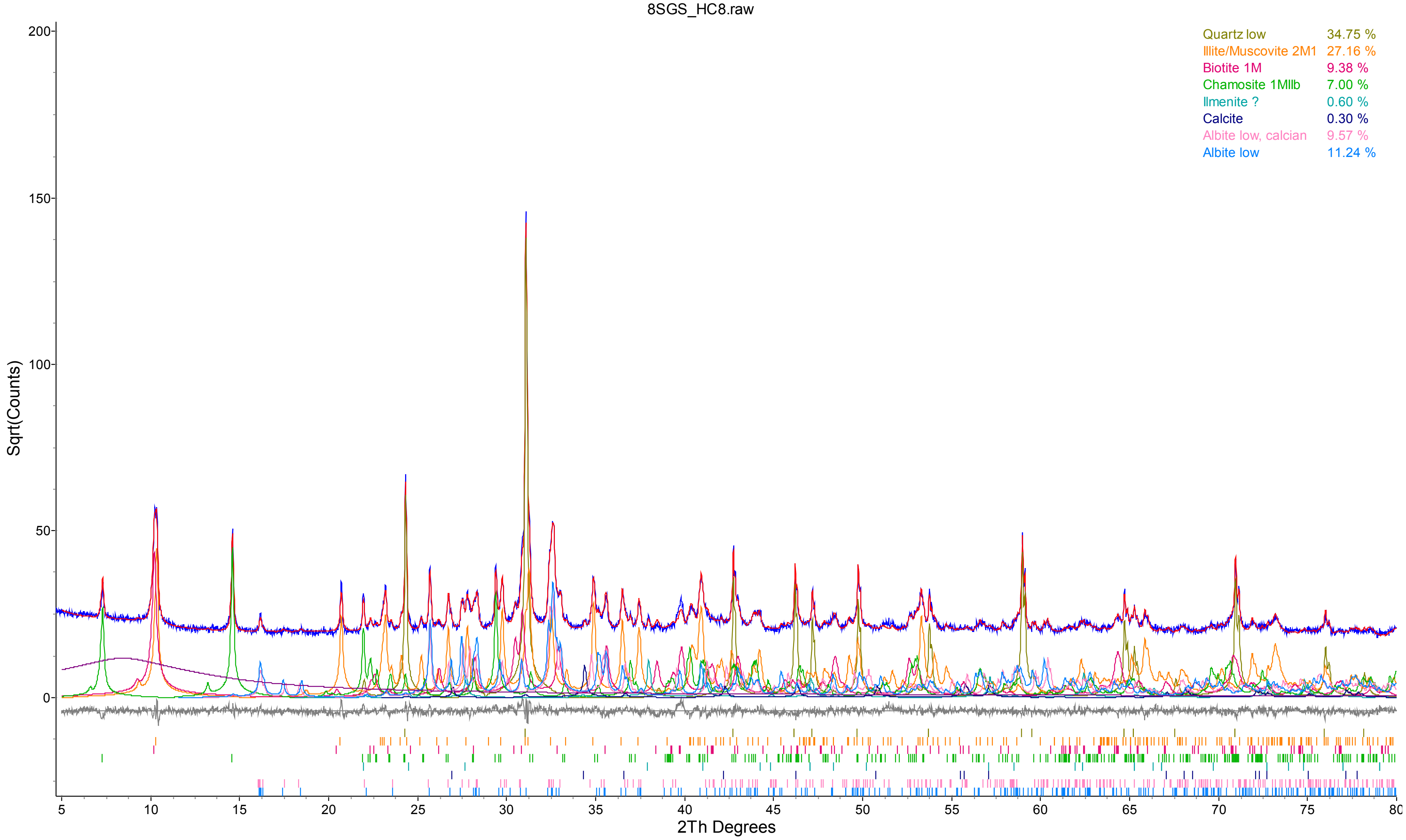


Figure 8. Rietveld refinement plot of sample **SGS CANADA HC 8** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

Appendix 4-2:
Acid-Base Accounting Results

ATLANTIC GOLD

Appendix 4-2, Table 1: Acid-Base Accounting Results - Mine Rock Samples

Sample ID	Hole ID	Interval		Paste pH	Total S	Sulphate S (CO_3)	Sulphate S (HCl)	Sulphide S (calc)	Total C	CO_2	CO_3	CaNP	Modified NP	NPR	NPR
		From	*To*		*%*	*%*	*%*	*%*	*%*	*%*	*%*	*kg $CaCO_3$/t*	*kg $CaCO_3$/t*	*CaNP/AP*	*Mod.NP/AP*
ARGILITE (AR)															
LX17-12	BD14-178	7	7.9	8.9	0.02	*<0.01*	0.02	0.02	*<0.05*	*<0.2*	*<0.2*	*<4.5*	6	*<7.3*	9.6
LX17-22	BD15-GT05	57	58	9	0.32	*<0.01*	0.01	0.32	*<0.05*	*<0.2*	*<0.2*	*<4.5*	6	*<0.5*	0.60
LX17-24	BD14-188	22	23	8.4	0.18	*<0.01*	0.02	0.18	*<0.05*	*<0.2*	*<0.2*	*<4.5*	9	*<0.8*	1.6
BD190-040	BD15-190	40	41	9.1	0.58	-	0.02	0.55	-	-	-	-	9	-	0.52
BD005-054	BD05-005	54	55	8.2	0.68	-	0.03	0.65	-	-	-	-	14	-	0.69
BD110-050	BD06-110	50	51	9.5	0.08	-	0.01	0.07	-	-	-	-	37	-	17
BD190-043	BD15-190	43	44	9.3	0.5	-	0.02	0.51	-	-	-	-	7	-	0.44
BD157-031	BD14-157	31	32	9.4	0.38	-	0.05	0.36	-	-	-	-	17	-	1.5
BD085-046	BD06-085	46	47	8.7	0.78	-	0.06	0.7	-	-	-	-	7	-	0.32
BD011-123	BD05-011	123	124	8.8	1.01	-	0.02	0.94	-	-	-	-	8	-	0.27
			Min	8.2	0.020	0.010	0.010	0.020	0.050	0.20	0.20	4.5	6.0	0.45	0.27
			Median	9.0	0.44	0.010	0.020	0.44	0.050	0.20	0.20	4.5	8.5	0.81	0.64
			Mean	8.9	0.45	0.010	0.026	0.43	0.050	0.20	0.20	4.5	12	2.8	3.2
			Max	9.5	1.0	0.010	0.060	0.94	0.050	0.20	0.20	4.5	37	7.3	17
ARGILITE-GREYWACKE (AG)															
LX17-02	BD15-GT02	15	16	8.2	0.32	0.03	0.02	0.29	*<0.05*	*<0.2*	*<0.2*	*<4.5*	7	*<0.5*	0.77
LX17-03	BD15-GT02	26	27	8.5	0.4	0.02	0.01	0.38	*<0.05*	*<0.2*	*<0.2*	*<4.5*	8	*<0.4*	0.67
LX17-04	BD15-GT02	31	32	7.9	1.14	0.01	0.02	1.13	*<0.05*	0.2	0.2	4.5	8	0.1	0.23
LX17-09	BD15-GT08	37	38	9.1	0.01	0.02	0.02	*<0.01*	*<0.05*	*<0.2*	*<0.2*	*<4.5*	8	*<14.6*	26
LX17-10	BD14-172	140	141	9.1	0.07	*<0.01*	0.02	0.07	0.17	0.6	0.8	13.6	23	6.2	11
LX17-11	BD14-172	170	171	9.1	0.03	0.02	0.03	0.01	*<0.05*	*<0.2*	*<0.2*	*<4.5*	9	*<14.6*	29
LX17-13	BD14-178	15	16	9	0.01	*<0.01*	0.01	0.01	*<0.05*	*<0.2*	*<0.2*	*<4.5*	8	*<14.6*	26
LX17-28	BD14-173	22	23	8.7	0.04	*<0.01*	0.04	0.04	*<0.05*	*<0.2*	*<0.2*	*<4.5*	10	*<3.6*	8.0
BD160-140	BD14-160	140	141	9.5	0.29	-	0.06	0.24	-	-	-	-	7	-	0.93
BD179-170	BD14-179	170	171	9.3	0.3	-	0.02	0.3	-	-	-	-	7	-	0.75
BD169-136	BD14-169	136	137	9.1	0.12	-	*<0.01*	0.12	-	-	-	-	177	-	47
			Min	7.9	0.010	0.010	0.010	0.010	0.050	0.20	0.20	4.5	7.0	0.13	0.23
			Median	9.1	0.12	0.015	0.020	0.12	0.050	0.20	0.20	4.5	8.0	4.9	8.0
			Mean	8.9	0.25	0.016	0.024	0.24	0.065	0.25	0.28	5.7	25	6.8	14
			Max	9.5	1.1	0.030	0.060	1.1	0.17	0.60	0.80	14	177	15	47
GREYWACKE-ARGILITE (GA)															
LX17-01	BD15-GT02	10	11	7.9	0.36	0.03	0.01	0.33	0.06	0.2	0.3	4.5	9	0.4	0.87
LX17-05	BD15-GT02	46	47	8.4	0.39	0.01	0.02	0.38	0.19	0.7	0.9	15.9	25	1.3	2.1
LX17-07	BD15-GT08	14	15	8.5	0.03	0.01	0.03	0.02	*<0.05*	*<0.2*	*<0.2*	*<4.5*	7	*<7.3*	11
LX17-14	BD14-178	30	31	9.1	0.01	*<0.01*	0.01	0.01	*<0.05*	*<0.2*	*<0.2*	*<4.5*	9	*<14.6*	29
LX17-15	BD14-178	58	59	8.7	0.04	*<0.01*	0.02	0.04	0.57	2.1	2.8	47.8	58	38.2	46
LX17-17	BD14-178	161	162	8.1	0.48	*<0.01*	0.01	0.48	*<0.05*	*<0.2*	*<0.2*	<4.5	6	*<0.3*	0.40
LX17-18	BD14-178	147	148	8.5	0.14	*<0.01*	0.01	0.14	0.16	0.6	0.8	13.6	18	3.1	4.1
LX17-19	BD15-GT05	15	16	9	0.3	*<0.01*	0.02	0.3	*<0.05*	*<0.2*	*<0.2*	*<4.5*	5	*<0.5*	0.53
LX17-23	BD14-188	10	11	9	0.05	*<0.01*	0.02	0.05	0.3	1.1	1.5	25.0	34	16.0	22
LX17-29	BD14-173	37	38	8.9	0.03	*<0.01*	0.02	0.03	0.16	0.6	0.8	13.6	19	14.6	20
BD156-009	BD14-156	9	10	9.4	0.29	-	0.02	0.28	-	-	-	-	9	-	1.0
BD187A-010	BD14-187A	10	11	9.1	0.18	-	0.06	0.13	-	-	-	-	9	-	2.2
BD157-033	BD14-157	33	34	9	1.66	-	0.04	1.48	-	-	-	-	31	-	0.67
BD169-187	BD14-169	187	188	9.5	0.09	-	0.02	0.08	-	-	-	-	7	-	2.8
			Min	7.9	0.010	0.010	0.010	0.010	0.050	0.20	0.20	4.5	5.0	0.30	0.40
			Median	9.0	0.16	0.010	0.020	0.14	0.11	0.40	0.55	9.1	9.0	5.2	2.5
			Mean	8.8	0.29	0.012	0.022	0.27	0.16	0.61	0.79	14	18	9.6	10
			Max	9.5	1.7	0.030	0.060	1.5	0.57	2.1	2.8	48	58	38	46

Appendix 4-2, Table 1: Acid-Base Accounting Results - Mine Rock Samples

Sample ID	**Hole ID**	**Interval**		**Paste pH**	**Total S**	**Sulphate S (CO_3)**	**Sulphate S (HCl)**	**Sulphide S (calc)**	**Total C**	**CO_2**	**CO_3**	**CaNP**	**Modified NP**	**NPR**	**NPR**
		From	***To***		***%***	***%***	***%***	***%***	***%***	***%***	***%***	***kg $CaCO_3$/t***	***kg $CaCO_3$/t***	***CaNP/AP***	***Mod.NP/AP***
GREYWACKE (GW)															
LX17-06	BD15-GT08	91	10	9	0.01	*<0.01*	0.02	0.01	0.1	0.4	0.5	9.1	14	29	45
LX17-08	BD15-GT08	23	24	8.9	*<0.01*	0.01	0.02	*<0.01*	0.12	0.4	0.6	9.1	16	29.1	51
LX17-16	BD14-178	49	50	9.1	0.03	*<0.01*	*<0.01*	0.03	0.2	0.7	1	15.9	23	17.0	25
LX17-20	BD15-GT05	25	26	9	0.29	0.01	0.03	0.28	*<0.05*	*<0.2*	*<0.2*	*<4.5*	7	*<0.5*	0.80
LX17-21	BD15-GT05	41	42	9.5	0.42	*<0.01*	0.03	0.42	0.05	0.2	0.2	4.5	9	0.3	0.69
BD156-075	BD14-156	75	76	9.4	0.02	-	0.01	0.02	-	-	-	-	22	-	35
BD160-039	BD14-160	39	40	9.5	0.16	-	0.02	0.14	-	-	-	-	8	-	1.8
BD179-045	BD14-179	45	46	9.1	0.01	-	0.01	*<0.01*	-	-	-	-	160	-	512
BD179-149	BD14-179	149	150	9.2	0.18	-	0.03	0.12	-	-	-	-	24	-	6.4
BD006-012	BD05-006	12	13	9.3	0.31	-	0.01	0.3	-	-	-	-	59	-	6.3
BD169-044	BD14-169	44	45	9.3	0.01	-	0.02	0.01	-	-	-	-	12	-	38
BD169-088	BD14-169	88	89	9.2	0.02	-	0.01	0.04	-	-	-	-	35	-	28
BD011-015	BD05-011	15	16	8.9	0.02	-	0.01	0.02	-	-	-	-	11	-	18
BD183-070	BD14-183	70	71	9.3	0.02	-	*<0.01*	0.03	-	-	-	-	13	-	14
BD183-148	BD14-183	148	149	9.2	0.08	-	0.06	0.04	-	-	-	-	60	-	48
BD049-140	BD06-049	140	141	9.4	0.03	-	*<0.01*	0.04	-	-	-	-	8	-	6.4
BD179-043	BD14-179	43	44	9.3	*<0.01*	-	0.01	*<0.01*	-	-	-	-	9	-	29
BD006-013	BD05-006	13	14	8.9	1.22	-	0.05	1.19	-	-	-	-	6	-	0.16
BD183-132	BD14-183	132	133	9	0.06	-	0.01	0.05	-	-	-	-	53	-	34
BD186-149	BD14-186	149	150	9.1	0.27	-	0.03	0.22	-	-	-	-	11	-	1.6
LX17-25	BD14-188	38	39	9.2	*<0.01*	*<0.01*	0.02	*<0.01*	0.39	1.4	1.9	31.8	41	102	131
LX17-26	BD14-188	51	52	9.1	0.03	*<0.01*	0.05	0.03	0.05	0.2	0.2	4.5	9	4.9	9.6
LX17-27	BD14-173	12	13	8.9	0.02	*<0.01*	0.02	0.02	0.09	0.3	0.4	6.8	12	10.9	19
LX17-30	BD14-173	53	54	8.9	0.01	*<0.01*	0.02	0.01	0.6	2.2	3	50.0	58	160	186
Min				8.9	0.010	0.010	0.010	0.010	0.050	0.20	0.20	4.5	6.0	0.35	0.16
Median				9.2	0.025	0.010	0.020	0.030	0.10	0.40	0.50	9.1	14	17	22
Mean				9.2	0.14	0.010	0.022	0.13	0.18	0.67	0.89	15	28	39	52
Max				9.5	1.2	0.010	0.060	1.2	0.60	2.2	3.0	50	160	160	512
QURTZ VEIN (QTZV)															
BD157-070	BD14-157	70	71	9.2	0.16	-	0.02	0.14	-	-	-	-	145	-	33
BD156-108	BD14-156	108	109	9.3	0.06	-	0.01	0.05	-	-	-	-	10	-	6.4
BD160-089	BD14-160	89	90	8.9	0.04	-	0.01	0.04	-	-	-	-	30	-	24
Min				8.9	0.040		0.010	0.040					10		6.4
Median				9.2	0.060		0.010	0.050					30		24
Mean				9.1	0.087		0.013	0.077					62		21
Max				9.3	0.16		0.020	0.14					145		33

Notes:

A hyphen indicates the parameter was not analyzed.

Values in grey italics are below the analytical detection limit. Values were set at the limit for calculation of NP, AP and NPR values.

Sulphate S is calculated using the sodium carbonate leach method (CO_3) and the HCl method (HCl).

AP (acid potential) calculated using sulfide sulfur (% non-sulfate sulfur x 31.25)

CaNP (carbonate neutralization potential) calculated using total inorganic carbon (% TIC x (100.09/12.01) x 10)

Modified NP is obtained by modified Sobek method.

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

Appendix 4-2, Table 2: Acid-Base Accounting Results - Kinetic Test Samples

Humidity Cell ID	Description	Sample ID	Hole ID	Interval		Paste pH	Total S	Sulphate S (CO_3)	Sulphate S (HCl)	Sulphide S (calc)	Total C	CO_2	CO_3	CaNP	Modified NP	NPR	NPR
				From	*To*		*%*	*%*	*%*	*%*	*%*	*%*	*%*	*kg $CaCO_3$/t*	*kg $CaCO_3$/t*	*CaNP/AP*	*Mod.NP/AP*
HC1	Median-S AR	LX17-12	BD14-178	7	7.9	8.9	0.02	*<0.01*	0.02	0.02	*<0.05*	*<0.2*	*<0.2*	*<4.5*	6	*<7.3*	9.6
HC2	High-S AR	LX17-22	BD15-GT05	57	58	9.0	0.32	*<0.01*	0.01	0.32	*<0.05*	*<0.2*	*<0.2*	*<4.5*	6	*<0.5*	0.60
		LX17-24	BD14-188	22	23	8.4	0.18	*<0.01*	0.02	0.18	*<0.05*	*<0.2*	*<0.2*	*<4.5*	9	*<0.8*	1.6
	Average					8.7	0.25	*<0.01*	0.02	0.25	*<0.05*	*<0.2*	*<0.2*	*<4.5*	8	*<0.6*	1.1
HC3	Median-S AG	LX17-02	BD15-GT02	15	16	8.2	0.32	0.03	0.02	0.29	*<0.05*	*<0.2*	*<0.2*	*<4.5*	7	*<0.5*	0.77
		LX17-10	BD14-172	140	141	9.1	0.07	*<0.01*	0.02	0.07	0.17	0.6	0.8	14	23	6.2	11
	Average					8.7	0.20	0.02	0.02	0.18	0.11	0.4	0.5	9.1	15	3.4	5.6
HC4	High-S AG	LX17-03	BD15-GT02	26	27	8.5	0.4	0.02	0.01	0.38	*<0.05*	*<0.2*	*<0.2*	*<4.5*	8	*<0.4*	0.67
		LX17-04	BD15-GT02	31	32	7.9	1.1	0.01	0.02	1.1	*<0.05*	0.2	0.2	4.5	8	0.1	0.23
	Average					8.2	0.77	0.02	0.02	0.76	*<0.05*	0.2	0.2	4.5	8	0.3	0.45
HC5	Median-S GA	LX17-01	BD15-GT02	10	11	7.9	0.36	0.03	0.01	0.33	0.06	0.2	0.3	4.5	9	0.4	0.87
		LX17-23	BD14-188	10	11	9.0	0.05	*<0.01*	0.02	0.05	0.3	1.1	1.5	25	34	16	22
	Average					8.5	0.21	0.02	0.02	0.19	0.2	0.7	0.9	15	22	8.2	11.3
HC6	High-S GA	LX17-17	BD14-178	161	162	8.1	0.48	*<0.01*	0.01	0.48	*<0.05*	*<0.2*	*<0.2*	*<4.5*	6	*<0.3*	0.40
		LX17-19	BD15-GT05	15	16	9.0	0.30	*<0.01*	0.02	0.30	*<0.05*	*<0.2*	*<0.2*	*<4.5*	5	*<0.5*	0.53
	Average					8.6	0.39	*<0.01*	0.02	0.39	*<0.05*	*<0.2*	*<0.2*	*<4.5*	6	0.4	0.47
HC7	Median-S GW	LX17-16	BD14-178	49	50	9.1	0.03	*<0.01*	*<0.01*	0.03	0.2	0.7	1.0	16	23	17	25
HC8	High-S GW	LX17-20	BD15-GT05	25	26	9.0	0.29	0.01	0.03	0.28	*<0.05*	*<0.2*	*<0.2*	*<4.5*	7	*<0.5*	0.80
		LX17-21	BD15-GT05	41	42	9.5	0.42	*<0.01*	0.03	0.42	0.05	0.2	0.2	4.5	9	0.3	0.69
	Average					9.3	0.36	0.01	0.03	0.35	0.05	0.2	0.2	4.5	8	0.4	0.74

Notes:

For humidity cells made up of two samples, a 1:1 mixture is assumed
A hyphen indicates the parameter was not analyzed.
Values in grey italics are below the analytical detection limit. Values were set at the limit for calculation of NP, AP and NPR values.
Sulphate S is calculated using the sodium carbonate leach method (CO_3) and the HCl method (HCl).
AP (acid potential) calculated using sulfide sulfur (% non-sulfate sulfur x 31.25)
CaNP (carbonate neutralization potential) calculated using total inorganic carbon (% TIC x (100.09/12.01) x 10)
Modified NP is obtained by modified Sobek method.
NPR = neutralization potential ratio; calculated as CaNP / AP and as Modified NP / AP.

Appendix 4-2, Table 3: Acid-Base Accounting Results - Overburden

Sample ID	Paste pH	Total S	Sulphate S (CO_3)	Sulphate S (HCl)	Sulphide S (calc)	Total C	CO_2	CaNP	Modified NP	NPR	NPR
		%	%	%	%	%	%	*kg $CaCO_3$/t*	*kg $CaCO_3$/t*	*CaNP/AP*	*Mod.NP/AP*
LX-BDT-01	5.6	0.02	*<0.01*	*<0.01*	0.02	*<0.05*	*<0.2*	*<4.5*	-4	7.28	-6.4
LX-BDT-02	5.7	0.02	*<0.01*	*<0.01*	0.02	*<0.05*	*<0.2*	*<4.5*	-5	7.28	-8
LX-BDT-03	5	0.08	*<0.01*	*<0.01*	0.08	*<0.05*	*<0.2*	*<4.5*	-5	1.82	-2
LX-BDT-04	6.1	0.02	*<0.01*	*<0.01*	0.02	*<0.05*	*<0.2*	*<4.5*	-4	7.28	-6.4
LX-BDT-05	5.7	0.02	*<0.01*	*<0.01*	0.02	*<0.05*	*<0.2*	*<4.5*	-4	7.28	-6.4

Notes:
Values in grey italics are below the analytical detection limit. Values were set at the limit for calculation of NP, AP and NPR values.
Sulphate S is calculated using the sodium carbonate leach method (CO_3) and the HCl method (HCl).
AP (acid potential) calculated using sulfide sulfur (% non-sulfate sulfur x 31.25)
CaNP (carbonate neutralization potential) calculated using total inorganic carbon (% TIC x (100.09/12.01) x 10)
Modified NP is obtained by modified Sobek method.
NPR = neutralization potential ratio; calculated as CaNP / AP and as Modified NP / AP.

Appendix 4-1, Table 4: Acid-Base Accounting Results - Haul Road

Sample ID	**Paste pH**	**Total S**	**Sulphate S (CO_3)**	**Sulphate S (HCl)**	**Sulphide S (calc)**	**Total C**	**CO_2**	**CaNP**	**Modified NP**	**NPR**	**NPR**
		%	**%**	**%**	**%**	**%**	**%**	***kg $CaCO_3$/t***	***kg $CaCO_3$/t***	***CaNP/AP***	***Mod.NP/AP***
LX-BDR-01	7.4	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.05*	*<0.2*	*<4.5*	3	14.6	9.6
LX-BDR-02	8.7	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.05*	*<0.2*	*<4.5*	5	14.6	16.0
LX-BDR-03	8.7	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.05*	*<0.2*	*<4.5*	4	14.6	12.8
LX-BDR-04	8.8	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.05*	*<0.2*	*<4.5*	4	14.6	12.8
LX-BDR-05	7.7	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.05*	*<0.2*	*<4.5*	8	14.6	25.6

Notes: Values in grey italics are below the analytical detection limit. Values were set at the limit for calculation of NP, AP and NPR values.
Sulphate S is calculated using the sodium carbonate leach method (CO_3) and the HCl method (HCl).
AP (acid potential) calculated using sulfide sulfur (% non-sulfate sulfur x 31.25)
CaNP (carbonate neutralization potential) calculated using total inorganic carbon (% TIC x (100.09/12.01) x 10)
Modified NP is obtained by modified Sobek method.
NPR = neutralization potential ratio; calculated as CaNP / AP and as Modified NP / AP.

Appendix 4-3:
Solid Phase Elemental Analysis Results

ATLANTIC GOLD

Appendix 4-3, Table 1: Solid Phase Elemental Analysis Results - Mine Rock

Sample ID	**Ag**	**Al**	**As**	**B**	**Ba**	**Be**	**Bi**	**Ca**	**Cd**	**Co**	**Cr**	**Cu**	**Fe**	**Hg**	**Hg**	**K**	**La**
	ppm	*%*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*%*	*ppm*
ARGILLITE (AR)																	
LX17-12	*<0.2*	2.74	17	*<10*	90	0.5	*<2*	0.2	*<0.5*	20	41	28	4.57	*<1*	*<0.005*	1.08	30
LX17-22	*<0.2*	1.24	116	*<10*	90	*<0.5*	*<2*	0.15	*<0.5*	9	36	18	2.48	*<1*	*<0.005*	0.64	10
LX17-24	*<0.2*	2.94	22	*<10*	110	0.7	*<2*	0.36	*<0.5*	19	41	44	4.85	*<1*	*<0.005*	0.99	30
ARGILLITE-GREYWACKE (AG)																	
LX17-02	*<0.2*	3.22	17	*<10*	80	0.5	*<2*	0.2	*<0.5*	24	37	42	6.22	*<1*	*<0.005*	0.83	40
LX17-03	*<0.2*	2.72	157	*<10*	110	*<0.5*	*<2*	0.26	*<0.5*	19	44	55	5.3	*<1*	*<0.005*	0.98	30
LX17-04	6.6	2.72	11	*<10*	110	0.6	26	0.25	0.5	29	43	155	6.16	*<1*	*<0.005*	1.11	30
LX17-09	*<0.2*	3.02	15	*<10*	130	*<0.5*	*<2*	0.21	*<0.5*	21	62	67	5.09	1	*<0.005*	0.9	20
LX17-10	*<0.2*	2.64	15	*<10*	120	*<0.5*	*<2*	0.85	*<0.5*	19	48	4	4.45	1	*<0.005*	0.85	20
LX17-11	*<0.2*	3.21	28	10	100	*<0.5*	*<2*	0.24	*<0.5*	25	48	13	5.4	*<1*	*<0.005*	0.84	30
LX17-13	*<0.2*	2.97	8	*<10*	140	0.5	*<2*	0.24	*<0.5*	21	51	26	4.84	*<1*	*<0.005*	1.12	30
LX17-28	*<0.2*	2.9	29	*<10*	80	0.8	*<2*	0.34	*<0.5*	21	45	39	4.85	*<1*	*<0.005*	0.63	20
Min	0.20	2.6	8.0	10	80	0.50	2.0	0.20	0.50	19	37	4.0	4.5	1.0	0.0050	0.63	20
Median	0.20	2.9	16	10	110	0.50	2.0	0.25	0.50	21	47	41	5.2	1.0	0.0050	0.88	30
Mean	1.0	2.9	35	10	109	0.55	5.0	0.32	0.50	22	47	50	5.3	1.0	0.0050	0.91	28
Max	6.6	3.2	157	10	140	0.80	26	0.85	0.50	29	62	155	6.2	1.0	0.0050	1.1	40
GREYWACKE-ARGILLITE (GA)																	
LX17-01	0.5	1.5	10	*<10*	60	0.5	*<2*	0.4	*<0.5*	13	38	47	3.06	*<1*	*<0.005*	0.43	30
LX17-05	*<0.2*	3.3	13	*<10*	150	0.6	*<2*	1.54	*<0.5*	17	52	67	4.54	*<1*	*<0.005*	0.98	30
LX17-07	*<0.2*	3.12	9	*<10*	90	*<0.5*	*<2*	0.2	*<0.5*	23	50	57	5.65	*<1*	*<0.005*	0.76	20
LX17-14	*<0.2*	2.42	14	*<10*	190	*<0.5*	*<2*	0.33	*<0.5*	16	54	17	3.81	*<1*	*<0.005*	1.24	20
LX17-15	*<0.2*	2.07	17	*<10*	90	0.5	*<2*	2.3	*<0.5*	14	60	6	3.85	*<1*	*<0.005*	0.46	30
LX17-17	*<0.2*	1.97	1915	*<10*	120	0.6	*<2*	0.26	*<0.5*	14	38	51	3.63	*<1*	*<0.005*	0.78	20
LX17-18	*<0.2*	0.69	2800	*<10*	20	*<0.5*	*<2*	0.68	*<0.5*	4	21	13	1.5	*<1*	*<0.005*	0.16	20
LX17-19	*<0.2*	2.71	1750	*<10*	90	*<0.5*	*<2*	0.12	*<0.5*	25	39	21	5.12	*<1*	*<0.005*	0.86	30
LX17-23	*<0.2*	1.99	25	*<10*	130	0.6	*<2*	1.33	*<0.5*	13	41	25	3.28	*<1*	*<0.005*	0.98	30
LX17-29	*<0.2*	2.12	14	*<10*	30	0.9	*<2*	0.73	*<0.5*	14	40	21	3.91	*<1*	*<0.005*	0.16	30
Min	0.20	0.69	9.0	10	20	0.50	2.0	0.12	0.50	4.0	21	6.0	1.5	1.0	0.0050	0.16	20
Median	0.20	2.1	16	10	90	0.50	2.0	0.54	0.50	14	41	23	3.8	1.0	0.0050	0.77	30
Mean	0.23	2.2	657	10	97	0.57	2.0	0.79	0.50	15	43	33	3.8	1.0	0.0050	0.68	26
Max	0.50	3.3	2800	10	190	0.90	2.0	2.3	0.50	25	60	67	5.7	1.0	0.0050	1.2	30
GREYWACKE (GW)																	
LX17-06	*<0.2*	2.32	11	*<10*	130	*<0.5*	*<2*	0.57	*<0.5*	18	50	25	4.05	*<1*	*<0.005*	0.74	30
LX17-08	*<0.2*	2.2	8	10	40	*<0.5*	*<2*	0.67	*<0.5*	15	48	29	3.85	*<1*	*<0.005*	0.22	20
LX17-16	*<0.2*	1.13	10	*<10*	40	0.7	*<2*	0.93	*<0.5*	7	31	18	2.12	*<1*	*<0.005*	0.21	30
LX17-20	*<0.2*	2.68	231	*<10*	80	*<0.5*	*<2*	0.16	*<0.5*	25	37	35	5.23	*<1*	*<0.005*	0.85	20
LX17-21	0.3	1.61	1205	*<10*	130	*<0.5*	*<2*	0.28	*<0.5*	16	39	24	3.24	*<1*	*<0.005*	0.92	20
LX17-25	*<0.2*	1.33	8	*<10*	90	*<0.5*	*<2*	1.53	*<0.5*	9	31	28	2.29	*<1*	*<0.005*	0.65	20
LX17-26	*<0.2*	1.24	7	*<10*	30	*<0.5*	*<2*	0.34	*<0.5*	7	24	9	2.37	*<1*	*<0.005*	0.21	20
LX17-27	*<0.2*	1.32	19	*<10*	30	0.5	*<2*	0.51	*<0.5*	7	31	24	2.53	*<1*	*<0.005*	0.15	20
LX17-30	*<0.2*	2.29	12	*<10*	20	0.5	*<2*	2.2	*<0.5*	16	41	15	4.05	*<1*	*<0.005*	0.18	30
Min	0.20	1.1	7.0	10	20	0.50	2.0	0.16	0.50	7.0	24	9.0	2.1	1.0	0.0050	0.15	20
Median	0.20	1.6	11	10	40	0.50	2.0	0.57	0.50	15	37	24	3.2	1.0	0.0050	0.22	20
Mean	0.21	1.8	168	10	66	0.52	2.0	0.80	0.50	13	37	23	3.3	1.0	0.0050	0.46	23
Max	0.30	2.7	1205	10	130	0.70	2.0	2.2	0.50	25	50	35	5.2	1.0	0.0050	0.92	30

Note: Values in grey italics are below the analytical detection limit.

Appendix 4-3, Table 1: Solid Phase Elemental Analysis Results - Mine Rock

Sample ID	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sr	Th	Ti	Tl	U	V	W	Zn
	%	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*
ARGILLITE (AR)																		
LX17-12	1.43	534	*<1*	0.03	44	610	11	0.02	*<2*	6	10	*<20*	0.17	*<10*	*<10*	44	*<10*	89
LX17-22	0.75	312	*<1*	0.05	15	210	20	0.35	*<2*	6	5	*<20*	0.13	*<10*	*<10*	40	*<10*	57
LX17-24	1.63	621	*<1*	0.03	42	650	6	0.19	*<2*	5	16	*<20*	0.15	*<10*	*<10*	45	*<10*	120
ARGILLITE-GREYWACKE (AG)																		
LX17-02	1.65	634	1	0.02	43	520	10	0.33	*<2*	4	4	*<20*	0.13	*<10*	*<10*	42	*<10*	123
LX17-03	1.33	601	*<1*	0.04	37	490	11	0.43	*<2*	7	9	*<20*	0.15	*<10*	*<10*	54	*<10*	102
LX17-04	1.51	675	1	0.03	59	360	179	1.26	*<2*	7	7	*<20*	0.15	*<10*	*<10*	50	*<10*	143
LX17-09	1.75	680	*<1*	0.04	44	660	*<2*	0.01	*<2*	10	7	*<20*	0.15	*<10*	*<10*	72	*<10*	102
LX17-10	1.52	774	*<1*	0.05	43	640	7	0.06	*<2*	7	20	*<20*	0.16	*<10*	*<10*	54	*<10*	103
LX17-11	1.85	677	*<1*	0.03	51	670	5	0.03	*<2*	6	8	*<20*	0.14	*<10*	*<10*	50	*<10*	116
LX17-13	1.67	726	*<1*	0.04	45	710	3	0.01	*<2*	7	12	*<20*	0.18	*<10*	*<10*	62	*<10*	89
LX17-28	1.74	687	*<1*	0.03	43	690	4	0.04	*<2*	6	24	*<20*	0.09	*<10*	*<10*	49	*<10*	90
Min	1.3	601	1.0	0.020	37	360	2.0	0.010	2.0	4.0	4.0	20	0.090	10	10	42	10	89
Median	1.7	679	1.0	0.035	44	650	6.0	0.050	2.0	7.0	8.5	20	0.15	10	10	52	10	103
Mean	1.6	682	1.0	0.035	46	593	28	0.27	2.0	6.8	11	20	0.14	10	10	54	10	109
Max	1.9	774	1.0	0.050	59	710	179	1.3	2.0	10	24	20	0.18	10	10	72	10	143
GREYWACKE-ARGILLITE (GA)																		
LX17-01	0.8	447	15	0.06	27	560	54	0.41	*<2*	6	8	*<20*	0.09	*<10*	*<10*	40	*<10*	63
LX17-05	1.06	732	*<1*	0.11	45	500	8	0.42	*<2*	8	62	*<20*	0.16	*<10*	*<10*	56	*<10*	80
LX17-07	1.6	640	*<1*	0.03	48	640	4	0.04	*<2*	7	9	*<20*	0.14	*<10*	*<10*	51	*<10*	111
LX17-14	1.33	578	1	0.06	36	710	3	*<0.01*	*<2*	9	24	*<20*	0.2	*<10*	*<10*	66	*<10*	69
LX17-15	1.19	800	*<1*	0.04	30	750	33	0.04	*<2*	8	35	20	0.15	*<10*	*<10*	76	*<10*	65
LX17-17	1.04	511	*<1*	0.07	27	310	8	0.54	*<2*	6	10	*<20*	0.13	*<10*	*<10*	46	*<10*	67
LX17-18	0.4	274	1	0.04	6	180	17	0.15	2	2	6	*<20*	0.03	*<10*	*<10*	20	*<10*	43
LX17-19	1.38	463	1	0.02	46	400	4	0.31	*<2*	4	5	*<20*	0.11	*<10*	*<10*	37	*<10*	110
LX17-23	1.05	512	*<1*	0.05	30	650	7	0.05	*<2*	7	20	*<20*	0.17	*<10*	*<10*	51	*<10*	76
LX17-29	1.24	594	*<1*	0.03	33	680	2	0.03	*<2*	3	13	*<20*	0.03	*<10*	*<10*	42	*<10*	64
Min	0.40	274	1.0	0.020	6.0	180	2.0	0.010	2.0	2.0	5.0	20	0.030	10	10	20	10	43
Median	1.1	545	1.0	0.045	32	600	7.5	0.10	2.0	6.5	12	20	0.14	10	10	49	10	68
Mean	1.1	555	2.4	0.051	33	538	14	0.20	2.0	6.0	19	20	0.12	10	10	49	10	75
Max	1.6	800	15	0.11	48	750	54	0.54	2.0	9.0	62	20	0.20	10	10	76	10	111
GREYWACKE (GW)																		
LX17-06	1.18	624	*<1*	0.05	36	540	5	*<0.01*	*<2*	8	13	*<20*	0.16	*<10*	*<10*	54	*<10*	79
LX17-08	1.35	512	*<1*	0.05	36	630	5	*<0.01*	*<2*	6	10	*<20*	0.09	*<10*	*<10*	57	*<10*	78
LX17-16	0.58	372	1	0.04	15	520	2	0.03	*<2*	3	15	*<20*	0.09	*<10*	*<10*	29	*<10*	34
LX17-20	1.43	518	*<1*	0.02	38	340	3	0.33	*<2*	4	4	*<20*	0.14	*<10*	*<10*	36	*<10*	105
LX17-21	0.89	359	1	0.05	25	260	33	0.45	*<2*	6	7	*<20*	0.15	*<10*	*<10*	47	*<10*	66
LX17-25	0.69	461	*<1*	0.05	18	510	8	*<0.01*	*<2*	5	19	*<20*	0.13	*<10*	*<10*	35	*<10*	50
LX17-26	0.7	310	1	0.04	15	450	2	0.02	*<2*	3	10	*<20*	0.07	*<10*	*<10*	23	*<10*	38
LX17-27	0.71	388	*<1*	0.04	16	530	3	0.02	2	3	14	*<20*	0.06	*<10*	*<10*	32	*<10*	25
LX17-30	1.4	1045	*<1*	0.03	38	770	4	*<0.01*	*<2*	4	22	*<20*	0.02	*<10*	*<10*	42	*<10*	75
Min	0.58	310	1.0	0.020	15	260	2.0	0.010	2.0	3.0	4.0	20	0.020	10	10	23	10	25
Median	0.89	461	1.0	0.040	25	520	4.0	0.020	2.0	4.0	13	20	0.090	10	10	36	10	66
Mean	0.99	510	1.0	0.041	26	506	7.2	0.099	2.0	4.7	13	20	0.10	10	10	39	10	61
Max	1.4	1045	1.0	0.050	38	770	33	0.45	2.0	8.0	22	20	0.16	10	10	57	10	105

Note: Values in grey italics are below the analytical detection limit.

Appendix 4-3, Table 2: Solid Phase Elemental Analysis Results - Humidity Cell Samples

Humidity Cell ID	**Description**	**Sample ID**	**Ag**	**Al**	**As**	**B**	**Ba**	**Be**	**Bi**	**Ca**	**Cd**	**Co**	**Cr**	**Cu**	**Fe**	**Hg**	**Hg**	**K**	**La**
			ppm	*%*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*%*	*ppm*
HC1	Median-S AR	LX17-12	*<0.2*	2.74	17	*<10*	90	0.5	*<2*	0.20	*<0.5*	20	41	28	4.57	*<1*	*<0.005*	1.08	30
HC2	High-S AR	LX17-22	*<0.2*	1.24	116	*<10*	90	*<0.5*	*<2*	0.15	*<0.5*	9	36	18	2.48	*<1*	*<0.005*	0.64	10
		LX17-24	*<0.2*	2.94	22	*<10*	110	0.7	*<2*	0.36	*<0.5*	19	41	44	4.85	*<1*	*<0.005*	0.99	30
	Average		*<0.2*	2.09	69	*<10*	100	0.6	*<2*	0.26	*<0.5*	14	39	31	3.67	*<1*	*<0.005*	0.82	20
HC3	Median-S AG	LX17-02	*<0.2*	3.22	17	*<10*	80	0.5	*<2*	0.20	*<0.5*	24	37	42	6.22	*<1*	*<0.005*	0.83	40
		LX17-10	*<0.2*	2.64	15	*<10*	120	*<0.5*	*<2*	0.85	*<0.5*	19	48	4	4.45	1	*<0.005*	0.85	20
	Average		*<0.2*	2.93	16	*<10*	100	0.5	*<2*	0.53	*<0.5*	22	43	23	5.34	1	*<0.005*	0.84	30
HC4	High-S AG	LX17-03	*<0.2*	2.72	157	*<10*	110	*<0.5*	*<2*	0.26	*<0.5*	19	44	55	5.3	*<1*	*<0.005*	0.98	30
		LX17-04	6.6	2.72	11	*<10*	110	0.6	26	0.25	0.5	29	43	155	6.16	*<1*	*<0.005*	1.11	30
	Average		3.4	2.72	84	*<10*	110	0.6	14	0.26	0.5	24	44	105	5.73	*<1*	*<0.005*	1.05	30
HC5	Median-S GA	LX17-01	0.5	1.5	10	*<10*	60	0.5	*<2*	0.40	*<0.5*	13	38	47	3.06	*<1*	*<0.005*	0.43	30
		LX17-23	*<0.2*	1.99	25	*<10*	130	0.6	*<2*	1.33	*<0.5*	13	41	25	3.28	*<1*	*<0.005*	0.98	30
	Average		0.4	1.75	18	*<10*	95	0.6	*<2*	0.87	*<0.5*	13	40	36	3.17	*<1*	*<0.005*	0.71	30
HC6	High-S GA	LX17-17	*<0.2*	1.97	1915	*<10*	120	0.6	*<2*	0.26	*<0.5*	14	38	51	3.63	*<1*	*<0.005*	0.78	20
		LX17-19	*<0.2*	2.71	1750	*<10*	90	*<0.5*	*<2*	0.12	*<0.5*	25	39	21	5.12	*<1*	*<0.005*	0.86	30
	Average		*<0.2*	2.34	1833	*<10*	105	0.6	*<2*	0.19	*<0.5*	20	39	36	4.38	*<1*	*<0.005*	0.82	25
HC7	Median-S GW	LX17-16	*<0.2*	1.13	10	*<10*	40	0.7	*<2*	0.93	*<0.5*	7	31	18	2.12	*<1*	*<0.005*	0.21	30
HC8	High-S GW	LX17-20	*<0.2*	2.68	231	*<10*	80	*<0.5*	*<2*	0.16	*<0.5*	25	37	35	5.23	*<1*	*<0.005*	0.85	20
		LX17-21	0.3	1.61	1205	*<10*	130	*<0.5*	*<2*	0.28	*<0.5*	16	39	24	3.24	*<1*	*<0.005*	0.92	20
	Average		0.3	2.15	718	*<10*	105	*<0.5*	*<2*	0.22	*<0.5*	21	38	30	4.24	*<1*	*<0.005*	0.89	20

Notes: For humidity cells made up of two samples, a 1:1 mixture is assumed
Values in grey italics are below the analytical detection limit.

Appendix 4-3, Table 2: Solid Phase Elemental Analysis Results - Humidity Cell Samples

Humidity Cell ID	**Description**	**Sample ID**	**Mg**	**Mn**	**Mo**	**Na**	**Ni**	**P**	**Pb**	**S**	**Sb**	**Sc**	**Sr**	**Th**	**Ti**	**Tl**	**U**	**V**	**W**	**Zn**
			%	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*
HC1	Median-S AR	LX17-12	1.43	534	*<1*	0.03	44	610	11	0.02	*<2*	6	10	*<20*	0.17	*<10*	*<10*	44	*<10*	89
HC2	High-S AR	LX17-22	0.75	312	*<1*	0.05	15	210	20	0.35	*<2*	6	5	*<20*	0.13	*<10*	*<10*	40	*<10*	57
		LX17-24	1.63	621	*<1*	0.03	42	650	6	0.19	*<2*	5	16	*<20*	0.15	*<10*	*<10*	45	*<10*	120
	Average		1.19	467	*<1*	0.04	29	430	13	0.27	*<2*	6	11	*<20*	0.14	*<10*	*<10*	43	*<10*	89
HC3	Median-S AG	LX17-02	1.65	634	1	0.02	43	520	10	0.33	*<2*	4	4	*<20*	0.13	*<10*	*<10*	42	*<10*	123
		LX17-10	1.52	774	*<1*	0.05	43	640	7	0.06	*<2*	7	20	*<20*	0.16	*<10*	*<10*	54	*<10*	103
	Average		1.59	704	1	0.04	43	580	9	0.20	*<2*	6	12	*<20*	0.15	*<10*	*<10*	48	*<10*	113
HC4	High-S AG	LX17-03	1.33	601	*<1*	0.04	37	490	11	0.43	*<2*	7	9	*<20*	0.15	*<10*	*<10*	54	*<10*	102
		LX17-04	1.51	675	1	0.03	59	360	179	1.26	*<2*	7	7	*<20*	0.15	*<10*	*<10*	50	*<10*	143
	Average		1.42	638	1	0.04	48	425	95	0.85	*<2*	7	8	*<20*	0.15	*<10*	*<10*	52	*<10*	123
HC5	Median-S GA	LX17-01	0.8	447	15	0.06	27	560	54	0.41	*<2*	6	8	*<20*	0.09	*<10*	*<10*	40	*<10*	63
		LX17-23	1.05	512	*<1*	0.05	30	650	7	0.05	*<2*	7	20	*<20*	0.17	*<10*	*<10*	51	*<10*	76
	Average		0.93	480	8	0.06	29	605	31	0.23	*<2*	7	14	*<20*	0.13	*<10*	*<10*	46	*<10*	70
HC6	High-S GA	LX17-17	1.04	511	*<1*	0.07	27	310	8	0.54	*<2*	6	10	*<20*	0.13	*<10*	*<10*	46	*<10*	67
		LX17-19	1.38	463	1	0.02	46	400	4	0.31	*<2*	4	5	*<20*	0.11	*<10*	*<10*	37	*<10*	110
	Average		1.21	487	1	0.05	37	355	6	0.43	*<2*	5	8	*<20*	0.12	*<10*	*<10*	42	*<10*	89
HC7	Median-S GW	LX17-16	0.58	372	1	0.04	15	520	2	0.03	*<2*	3	15	*<20*	0.09	*<10*	*<10*	29	*<10*	34
HC8	High-S GW	LX17-20	1.43	518	*<1*	0.02	38	340	3	0.33	*<2*	4	4	*<20*	0.14	*<10*	*<10*	36	*<10*	105
		LX17-21	0.89	359	1	0.05	25	260	33	0.45	*<2*	6	7	*<20*	0.15	*<10*	*<10*	47	*<10*	66
	Average		1.16	439	1	0.04	32	300	18	0.39	*<2*	5	6	*<20*	0.15	*<10*	*<10*	42	*<10*	86

Notes: For humidity cells made up of two samples, a 1:1 mixture is assumed
Values in grey italics are below the analytical detection limit.

Appendix 4-3, Table 3: Solid Phase Elemental Analysis Results - Overburden

Sample ID	**Ag**	**Al**	**As**	**B**	**Ba**	**Be**	**Bi**	**Ca**	**Cd**	**Co**	**Cr**	**Cu**
	ppm	*%*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*ppm*	*ppm*
LX-BDT-01	0.2	3.17	225	*<10*	50	0.8	*<2*	0.06	*<0.5*	13	37	27
LX-BDT-02	*<0.2*	1.5	24	*<10*	30	*<0.5*	*<2*	0.04	*<0.5*	5	21	16
LX-BDT-03	0.2	0.98	54	*<10*	50	*<0.5*	*<2*	0.13	*<0.5*	5	14	12
LX-BDT-04	*<0.2*	0.53	15	*<10*	30	*<0.5*	*<2*	0.02	*<0.5*	2	8	4
LX-BDT-05	0.2	2.39	105	*<10*	50	0.9	*<2*	0.05	*<0.5*	10	30	15
Sample ID	**Fe**	**Ga**	**Hg**	**K**	**La**	**Mg**	**Mn**	**Mo**	**Na**	**Ni**	**P**	**Pb**
	%	*ppm*	*ppm*	*%*	*ppm*	*%*	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*ppm*
LX-BDT-01	3.88	10	0.064	0.25	20	0.95	490	1	*<0.01*	33	440	13
LX-BDT-02	2.63	10	0.061	0.13	10	0.32	245	1	0.01	17	260	9
LX-BDT-03	1.34	10	0.053	0.19	30	0.32	162	1	0.01	22	220	10
LX-BDT-04	0.96	*<10*	0.038	0.1	*<10*	0.1	112	*<1*	0.01	4	110	7
LX-BDT-05	4.51	10	0.054	0.16	20	0.72	441	1	0.01	19	330	9
Sample ID	**S**	**Sb**	**Sc**	**Sr**	**Th**	**Ti**	**Tl**	**U**	**V**	**W**	**Zn**	
	%	*ppm*	*ppm*	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	
LX-BDT-01	0.01	*<2*	4	5	*<20*	0.09	*<10*	*<10*	39	*<10*	74	
LX-BDT-02	0.02	*<2*	2	8	*<20*	0.05	*<10*	*<10*	27	*<10*	28	
LX-BDT-03	0.08	*<2*	1	9	*<20*	0.04	*<10*	*<10*	13	*<10*	37	
LX-BDT-04	*<0.01*	*<2*	1	4	*<20*	0.04	*<10*	*<10*	16	*<10*	10	
LX-BDT-05	0.01	*<2*	3	6	*<20*	0.08	*<10*	*<10*	45	20	64	

Note: Values in grey italics are below the analytical detection limit.

Appendix 4-3, Table 4: Solid Phase Elemental Analysis Results - Haul Road

Sample ID	**Ag**	**Al**	**As**	**B**	**Ba**	**Be**	**Bi**	**Ca**	**Cd**	**Co**	**Cr**	**Cu**
	ppm	*%*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*ppm*	*ppm*
LX-BDR-01	*<0.2*	1.03	21	*<10*	60	*<0.5*	*<2*	0.14	*<0.5*	4	26	9
LX-BDR-02	*<0.2*	1.69	*<2*	*<10*	110	*<0.5*	*<2*	0.14	*<0.5*	13	30	20
LX-BDR-03	*<0.2*	1.1	2	*<10*	70	*<0.5*	*<2*	0.17	*<0.5*	7	26	17
LX-BDR-04	*<0.2*	1.21	*<2*	*<10*	120	*<0.5*	*<2*	0.12	*<0.5*	8	29	11
LX-BDR-05	*<0.2*	2.79	18	*<10*	190	0.5	*<2*	0.78	*<0.5*	13	52	28

Sample ID	**Fe**	**Ga**	**Hg**	**K**	**La**	**Mg**	**Mn**	**Mo**	**Na**	**Ni**	**P**	**Pb**
	%	*ppm*	*ppm*	*%*	*ppm*	*%*	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*ppm*
LX-BDR-01	1.92	*<10*	*<0.005*	0.38	10	0.5	212	1	0.02	15	380	3
LX-BDR-02	2.87	10	*<0.005*	0.92	20	0.95	392	1	0.03	31	610	5
LX-BDR-03	2.08	*<10*	*<0.005*	0.56	10	0.65	302	1	0.02	18	550	7
LX-BDR-04	2.12	*<10*	*<0.005*	0.77	10	0.6	336	*<1*	0.03	21	440	*<2*
LX-BDR-05	3.63	10	*<0.005*	1.17	30	1.13	625	*<1*	0.11	38	1130	7

Sample ID	**S**	**Sb**	**Sc**	**Sr**	**Th**	**Ti**	**Tl**	**U**	**V**	**W**	**Zn**
	%	*ppm*	*ppm*	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*
LX-BDR-01	*<0.01*	*<2*	2	12	*<20*	0.1	*<10*	*<10*	21	*<10*	38
LX-BDR-02	*<0.01*	3	3	10	*<20*	0.13	*<10*	*<10*	32	*<10*	62
LX-BDR-03	*<0.01*	*<2*	2	15	*<20*	0.11	*<10*	*<10*	25	*<10*	45
LX-BDR-04	*<0.01*	*<2*	3	7	*<20*	0.14	*<10*	*<10*	28	*<10*	39
LX-BDR-05	*<0.01*	*<2*	7	55	*<20*	0.18	*<10*	*<10*	53	*<10*	66

Note: Values in grey italics are below the analytical detection limit.

Appendix 4-4:
Particle Size Distribution Results

ATLANTIC GOLD

HC 1

Sieve	Aperture	Weight Retained		
Designation				Cumulative
	(mm)	(g)	(%)	(%)
+3/8"	9.500	0.00	0.0%	0.0%
-3/8" + 1/4"	6.300	0.00	0.0%	0.0%
-1/4" + 5	4.000	0.40	0.4%	0.4%
5 + 10	1.700	22.70	22.8%	23.2%
-10 + 35	0.425	40.00	40.2%	63.4%
-48 + 100	0.150	12.80	12.9%	76.3%
-200 + 270	0.053	7.00	7.0%	83.3%
-270	-0.053	16.60	16.7%	100.0%
TOTAL		99.50	100.0%	

HC 2

Sieve	Aperture	Weight Retained		
Designation				Cumulative
	(mm)	(g)	(%)	(%)
+3/8"	9.500	0.00	0.0%	0.0%
-3/8" + 1/4"	6.300	0.20	0.2%	0.2%
-1/4" + 5	4.000	0.50	0.5%	0.7%
5 + 10	1.700	34.80	35.0%	35.7%
-10 + 35	0.425	42.10	42.3%	78.0%
-48 + 100	0.150	9.10	9.1%	87.1%
-200 + 270	0.053	5.20	5.2%	92.4%
-270	-0.053	7.60	7.6%	100.0%
TOTAL		99.50	100.0%	

HC 3

Sieve	Aperture	Weight Retained		
Designation				Cumulative
	(mm)	(g)	(%)	(%)
+3/8"	9.500	0.00	0.0%	0.0%
-3/8" + 1/4"	6.300	0.00	0.0%	0.0%
-1/4" + 5	4.000	0.50	0.5%	0.5%
5 + 10	1.700	23.60	23.8%	24.3%
-10 + 35	0.425	44.40	44.7%	69.0%
-48 + 100	0.150	11.20	11.3%	80.3%
-200 + 270	0.053	6.30	6.3%	86.6%
-270	-0.053	13.30	13.4%	100.0%
TOTAL		99.30	100.0%	

HC 4

Sieve	Aperture	Weight Retained		
Designation				Cumulative
	(mm)	(g)	(%)	(%)
+3/8"	9.500	0.00	0.0%	0.0%
-3/8" + 1/4"	6.300	0.00	0.0%	0.0%
-1/4" + 5	4.000	0.60	0.6%	0.6%
5 + 10	1.700	35.70	35.8%	36.4%
-10 + 35	0.425	44.70	44.8%	81.2%
-48 + 100	0.150	7.40	7.4%	88.7%
-200 + 270	0.053	3.90	3.9%	92.6%
-270	-0.053	7.40	7.4%	100.0%
TOTAL		99.70	100.0%	

HC 5

Sieve	Aperture	Weight Retained		
Designation				Cumulative
	(mm)	(g)	(%)	(%)
+3/8"	9.500	0.00	0.0%	0.0%
-3/8" + 1/4"	6.300	0.00	0.0%	0.0%
-1/4" + 5	4.000	0.80	0.8%	0.8%
5 + 10	1.700	40.60	40.8%	41.6%
-10 + 35	0.425	41.10	41.3%	82.8%
-48 + 100	0.150	6.50	6.5%	89.4%
-200 + 270	0.053	4.00	4.0%	93.4%
-270	-0.053	6.60	6.6%	100.0%
TOTAL		99.60	100.0%	

HC 6

Sieve	Aperture	Weight Retained		
Designation				Cumulative
	(mm)	(g)	(%)	(%)
+3/8"	9.500	0.00	0.0%	0.0%
-3/8" + 1/4"	6.300	0.00	0.0%	0.0%
-1/4" + 5	4.000	1.00	1.0%	1.0%
5 + 10	1.700	33.60	33.9%	34.9%
-10 + 35	0.425	42.40	42.8%	77.7%
-48 + 100	0.150	8.90	9.0%	86.7%
-200 + 270	0.053	4.60	4.6%	91.3%
-270	-0.053	8.60	8.7%	100.0%
TOTAL		99.10	100.0%	

HC 7

Sieve	Aperture	Weight Retained		
Designation				Cumulative
	(mm)	(g)	(%)	(%)
+3/8"	9.500	0.00	0.0%	0.0%
-3/8" + 1/4"	6.300	0.00	0.0%	0.0%
-1/4" + 5	4.000	0.10	0.1%	0.1%
5 + 10	1.700	33.30	33.5%	33.6%
-10 + 35	0.425	41.80	42.1%	75.7%
-48 + 100	0.150	9.50	9.6%	85.3%
-200 + 270	0.053	6.50	6.5%	91.8%
-270	-0.053	8.10	8.2%	100.0%
TOTAL		99.30	100.0%	

HC 8

Sieve	Aperture	Weight Retained		
Designation				Cumulative
	(mm)	(g)	(%)	(%)
+3/8"	9.500	0.00	0.0%	0.0%
-3/8" + 1/4"	6.300	0.00	0.0%	0.0%
-1/4" + 5	4.000	0.80	0.8%	0.8%
5 + 10	1.700	34.30	34.5%	35.3%
-10 + 35	0.425	40.20	40.4%	75.8%
-48 + 100	0.150	9.10	9.2%	84.9%
-200 + 270	0.053	5.10	5.1%	90.0%
-270	-0.053	9.90	10.0%	100.0%
TOTAL		99.40	100.0%	

Appendix 4-5:
Kinetic Test Results

ATLANTIC GOLD

Appendix 4-5, Table 1: Kinetic Test Results - Cell Description

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**	**Sample Prep for Flushings**
				Inner Diameter (cm)	Length (cm)	Dry Wt. of Sample (kg)	Other Materials Used	Column Material	(mL)	(mL)	(°C)		**2018**			
HC 1	LX17-12	Waste Rock	MEND	10.00	20.00	1.00	Plexiglas perforated disk & nylon mesh	Plexiglas	500	500	20-22 °C	Weekly	**26-Apr**	Thursday	Flood Leach	None
HC 2	LX17-24 + LX17-22 Composite	Waste Rock	MEND	10.00	20.00	1.00	Plexiglas perforated disk & nylon mesh	Plexiglas	500	500	20-22 °C	Weekly	**26-Apr**	Thursday	Flood Leach	None
HC 3	LX17-10 + LX17-02 Composite	Waste Rock	MEND	10.00	20.00	1.00	Plexiglas perforated disk & nylon mesh	Plexiglas	500	500	20-22 °C	Weekly	**26-Apr**	Thursday	Flood Leach	None
HC 4	LX17-03 + LX17-04 Composite	Waste Rock	MEND	10.00	20.00	1.00	Plexiglas perforated disk & nylon mesh	Plexiglas	500	500	20-22 °C	Weekly	**26-Apr**	Thursday	Flood Leach	None
HC 5	LX17-23 + LX17-01 Composite	Waste Rock	MEND	10.00	20.00	1.00	Plexiglas perforated disk & nylon mesh	Plexiglas	500	500	20-22 °C	Weekly	**26-Apr**	Thursday	Flood Leach	None
HC 6	LX17-17 + LX17-19 Composite	Waste Rock	MEND	10.00	20.00	1.00	Plexiglas perforated disk & nylon mesh	Plexiglas	500	500	20-22 °C	Weekly	**26-Apr**	Thursday	Flood Leach	None
HC 7	LX17-16	Waste Rock	MEND	10.00	20.00	1.00	Plexiglas perforated disk & nylon mesh	Plexiglas	500	500	20-22 °C	Weekly	**26-Apr**	Thursday	Flood Leach	None
HC 8	LX17-20 + LX17-21 Composite	Waste Rock	MEND	10.00	20.00	1.00	Plexiglas perforated disk & nylon mesh	Plexiglas	500	500	20-22 °C	Weekly	**26-Apr**	Thursday	Flood Leach	None

Appendix 4-5, Table 2: Kinetic Test Results - HC1

Mass	**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**	**Fe**
	No.	**Input**	**Output**			**(pH 4.5)**	**(pH 8.3)**					**$CaCO_3$**													
					umhos/cm	$mgCaCO_3/L$	$mgCaCO_3/L$	$mgCaCO_3/L$	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
26-Apr-18	0	500	325	7.08	67	#N/A	3.2	12.6	3	3	0.17	6.5	0.247	<0.0001	0.0121	0.00090	<3.5E-06	0.000008	0.008	0.000003	2.20	0.00011	0.000015	0.00054	0.040
3-May-18	1	500	470	7.75	74	#N/A	1.8	17.9	8	3	0.17	11.4	0.278	0.0004	0.0296	0.00119	<3.5E-06	0.000007	0.012	0.000003	3.86	0.00010	0.000013	0.00046	0.039
10-May-18	2	500	460	7.67	52	#N/A	2.6	16.6	5	1	0.17	7.9	0.310	0.0004	0.0352	0.00102	<3.5E-06	0.000009	0.011	0.000006	2.62	0.00013	0.000042	0.00037	0.046
17-May-18	3	500	450	7.71	46	#N/A	2.1	15.4	4	<0.5	0.16	5.8	0.179	0.0003	0.0398	0.00062	<3.5E-06	<3.5E-06	0.017	0.000016	1.92	0.00004	0.000014	0.00024	0.007
24-May-18	4	500	430	7.68	56	#N/A	3.4	18.4	5																
31-May-18	5	500	455	7.76	44	#N/A	2.3	17.8	3	<0.5	0.16	7.5	0.225	0.0004	0.0622	0.00106	<3.5E-06	0.000009	0.010	<1.5E-06	2.46	0.00006	0.000045	0.00042	0.045
7-Jun-18	6	500	500	7.77	41	#N/A	2.9	18.1	3																
14-Jun-18	7	500	455	7.68	29	#N/A	3.4	13.6	2	<0.5	0.08	6.2	0.161	0.0002	0.0460	0.00057	<3.5E-06	<3.5E-06	0.007	<1.5E-06	2.01	0.00004	0.000023	0.00096	0.014
21-Jun-18	8	500	445	7.64	26	#N/A	4.0	11.8	2																
28-Jun-18	9	500	430	7.61	24	#N/A	4.5	11.1	2	<0.5	0.07	4.8	0.191	<0.0001	0.0368	0.00088	<3.5E-06	0.000012	0.006	0.000019	1.53	0.00010	0.000069	0.00013	0.070
5-Jul-18	10	500	410	7.57	21	#N/A	4.7	9.4	2																
12-Jul-18	11	500	440	7.57	26	#N/A	1.4	10.6	3	<0.5	<0.03	5.89	0.101	<0.0001	0.0359	0.00070	<3.5E-06	<3.5E-06	0.007	<1.5E-06	1.95	0.00004	0.000049	0.00655	0.009
19-Jul-18	12	500	430	7.64	25	#N/A	1.3	13.4	3																
26-Jul-18	13	500	450	7.45	25	#N/A	2.2	11.5	4	<0.5	0.06	5.5	0.094	<0.0001	0.0373	0.00052	<3.5E-06	<3.5E-06	0.004	0.000003	1.75	<0.000015	0.000028	0.00023	0.010
2-Aug-18	14	500	435	7.61	24	#N/A	1.5	11.5	3																
9-Aug-18	15	500	420	7.57	22	#N/A	1.8	10.4	3	<0.5	0.06	4.9	0.101	<0.0001	0.0490	0.00051	<3.5E-06	<3.5E-06	0.005	<1.5E-06	1.54	0.00004	0.000021	0.00042	0.010
16-Aug-18	16	500	440	7.72	25	#N/A	3.0	12.9	2																
23-Aug-18	17	500	420	7.60	21	#N/A	3.7	11.3	3	<0.5	<0.03	5.31	0.092	<0.0001	0.0485	0.00046	<3.5E-06	<3.5E-06	0.008	<1.5E-06	1.68	0.00005	0.000027	0.00728	0.015
30-Aug-18	18	500	420	7.55	20	#N/A	2.5	10.8	3																
6-Sep-18	19	500	415	7.53	19	#N/A	3.6	10.3	2	<0.5	<0.03	4.7	0.110	<0.0001	0.0655	0.00064	<3.5E-06	<3.5E-06	0.007	0.000008	1.47	0.00005	0.000039	0.00030	0.016
13-Sep-18	20	500	415	7.35	17	#N/A	3.9	10.0	<1																
20-Sep-18	21	500	425	7.48	20	#N/A	2.5	9.6	2	<0.5	<0.03	4.3	0.064	<0.0001	0.0404	0.00042	0.000007	<3.5E-06	0.004	<1.5E-06	1.31	0.00004	0.000027	0.00042	0.017
27-Sep-18	22	500	415	7.48	21	#N/A	3.1	9.7	2																
4-Oct-18	23	500	415	7.37	20	#N/A	4.1	9.7	<1	<0.5	<0.03	4.4	0.073	<0.0001	0.0452	0.00057	<3.5E-06	<3.5E-06	0.004	<1.5E-06	1.34	0.00007	0.000026	0.00034	0.015
11-Oct-18	24	500	400	7.81	18	#N/A	3.0	8.7	<1																

Loads	**mg/kg**								mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
26-Apr-18	0			7.08					0.975	0.975	0.05525	2.1125	0.080275	0.0000325	0.0039325	0.0002925	1.1375E-06	0.0000026	0.0026	9.75E-07	0.715	3.575E-05	4.875E-06	0.0001755	0.013
3-May-18	1			7.75					3.76	1.41	0.0799	5.358	0.13066	0.000188	0.013912	0.0005593	1.645E-06	3.29E-06	0.00564	1.41E-06	1.8142	0.000047	6.11E-06	0.0002162	0.01833
10-May-18	2			7.67					2.3	0.46	0.0782	3.634	0.1426	0.000184	0.016192	0.0004692	0.00000161	4.14E-06	0.00506	2.76E-06	1.2052	0.0000598	1.932E-05	0.0001702	0.02116
17-May-18	3			7.71					1.8	0.225	0.072	2.61	0.08055	0.000135	0.01791	0.000279	1.575E-06	1.575E-06	0.00765	0.0000072	0.864	0.000018	0.0000063	0.000108	0.00315
24-May-18	4			7.68					2.15																
31-May-18	5			7.76					1.365	0.2275	0.0728	3.4125	0.102375	0.000182	0.028301	0.0004823	1.5925E-06	4.095E-06	0.00455	6.825E-07	1.1193	0.0000273	2.048E-05	0.0001911	0.020475
7-Jun-18	6			7.77					1.5																
14-Jun-18	7			7.68					0.91	0.2275	0.0364	2.821	0.073255	0.000091	0.02093	0.0002594	1.5925E-06	1.593E-06	0.003185	6.825E-07	0.91455	0.0000182	1.047E-05	0.0004368	0.00637
21-Jun-18	8			7.64					0.89																
28-Jun-18	9			7.61					0.86	0.215	0.0301	2.064	0.08213	0.000043	0.015824	0.0003784	1.505E-06	5.16E-06	0.00258	8.17E-06	0.6579	0.000043	2.967E-05	0.0000559	0.0301
5-Jul-18	10			7.57					0.82																
12-Jul-18	11			7.57					1.32	0.22	0.0132	2.5916	0.04444	0.000044	0.015796	0.000308	0.00000154	1.54E-06	0.00308	6.6E-07	0.858	0.0000176	2.156E-05	0.002882	0.00396
19-Jul-18	12			7.64					1.29																
26-Jul-18	13			7.45					1.8	0.225	0.027	2.475	0.0423	0.000045	0.016785	0.000234	1.575E-06	1.575E-06	0.0018	1.35E-06	0.7875	6.75E-06	0.0000126	0.0001035	0.0045
2-Aug-18	14			7.61					1.305																
9-Aug-18	15			7.57					1.26	0.21	0.0252	2.058	0.04242	0.000042	0.02058	0.0002142	0.00000147	1.47E-06	0.0021	6.3E-07	0.6468	0.0000168	8.82E-06	0.0001764	0.0042
16-Aug-18	16			7.72					0.88																
23-Aug-18	17			7.60					1.26	0.21	0.0126	2.2302	0.03864	0.000042	0.02037	0.0001932	0.00000147	1.47E-06	0.00336	6.3E-07	0.7056	0.000021	1.134E-05	0.0030576	0.0063
30-Aug-18	18			7.55					1.26																
6-Sep-18	19			7.53					0.83	0.2075	0.01245	1.9505	0.04565	0.0000415	0.0271825	0.0002656	1.4525E-06	1.453E-06	0.002905	3.32E-06	0.61005	2.075E-05	1.619E-05	0.0001245	0.00664
13-Sep-18	20			7.35					0.415																
20-Sep-18	21			7.48					0.85	0.2125	0.01275	1.8275	0.0272	0.0000425	0.01717	0.0001785	2.975E-06	1.488E-06	0.0017	6.375E-07	0.55675	0.000017	1.148E-05	0.0001785	0.007225
27-Sep-18	22			7.48					0.83																
4-Oct-18	23			7.37					0.415	0.2075	0.01245	1.826	0.030295	0.0000415	0.018758	0.0002366	1.4525E-06	1.453E-06	0.00166	6.225E-07	0.5561	2.905E-05	1.079E-05	0.0001411	0.006225
11-Oct-18	24			7.81					0.4																

Appendix 4-5, Table 2: Kinetic Test Results - HC1

Mass	**1**																								
Date	**Cycle**	**Volume mL**		**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
	No.	**Input**	**Output**																						
				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
26-Apr-18	0	500	325	0.00009	0.0046	0.247	0.00107	*<0.005*	0.00681	0.0002	0.018	5.40	0.00034	1.03	*<0.000025*	4.67	0.00435	1.1	0.000012	0.00030	0.00214	0.000013	0.00078	*<0.001*	*<0.001*
3-May-18	1	500	470	0.00009	0.0057	0.427	0.0017	*<0.005*	0.0133	0.0001	0.007	5.51	0.00054	1.48	*<0.000025*	6.35	0.00773	2.5	*<2.5E-06*	0.00014	0.00240	0.000160	0.00157	*<0.001*	*<0.001*
10-May-18	2	500	460	0.00011	0.0040	0.338	0.0014	*<0.005*	0.00926	0.0002	0.014	4.77	0.00036	1.53	*<0.000025*	4.61	0.00530	2.2	0.000016	0.00023	0.00299	0.000199	0.00193	*<0.001*	*<0.001*
17-May-18	3	500	450	0.00004	0.0035	0.251	0.0008	*<0.005*	0.00608	*<0.00005*	0.008	3.55	0.00040	1.35	*<0.000025*	4.22	0.00447	2.5	*<2.5E-06*	0.00010	0.00040	0.000341	0.00191	*<0.001*	*<0.001*
24-May-18	4	500	430																						
31-May-18	5	500	455	0.00012	0.0026	0.331	0.00100	*<0.005*	0.00221	0.0001	0.011	4.66	0.00025	2.00	*<0.000025*	2.92	0.00508	0.6	*<2.5E-06*	0.00004	0.00208	0.000668	0.00287	*<0.001*	*<0.001*
7-Jun-18	6	500	500																						
14-Jun-18	7	500	455	0.00005	0.0020	0.286	0.00088	*<0.005*	0.00125	*<0.00005*	*<0.0015*	3.32	0.00023	1.74	*<0.000025*	1.53	0.00411	0.9	*<2.5E-06*	0.00003	0.00074	0.000673	0.00226	*<0.001*	*<0.001*
21-Jun-18	8	500	445																						
28-Jun-18	9	500	430	0.00023	0.0018	0.247	0.00164	*<0.005*	0.00072	0.0002	*<0.0015*	3.03	0.00011	1.52	*<0.000025*	1.07	0.00331	1.0	*<2.5E-06*	0.00007	0.00289	0.000341	0.00196	*<0.001*	*<0.001*
5-Jul-18	10	500	410																						
12-Jul-18	11	500	440	*<0.000005*	0.0016	0.246	0.00115	*<0.005*	0.00057	*<0.00005*	*<0.0015*	2.70	0.00009	1.26	*<0.000025*	1.10	0.00350	0.7	*<2.5E-06*	0.00008	0.00049	0.000363	0.00199	*<0.001*	*<0.001*
19-Jul-18	12	500	430																						
26-Jul-18	13	500	450	0.00002	0.0017	0.278	0.00072	*<0.005*	0.00045	*<0.00005*	*<0.0015*	3.03	0.00009	1.75	*<0.000025*	1.02	0.00360	*<0.05*	*<2.5E-06*	0.00003	0.00040	0.000371	0.00250	*<0.001*	*<0.001*
2-Aug-18	14	500	435																						
9-Aug-18	15	500	420	0.00005	0.0017	0.248	0.00065	*<0.005*	0.00037	*<0.00005*	*<0.0015*	2.86	0.00010	2.02	*<0.000025*	0.87	0.00323	0.5	*<2.5E-06*	0.00004	0.00065	0.000235	0.00322	*<0.001*	*<0.001*
16-Aug-18	16	500	440																						
23-Aug-18	17	500	420	0.00004	0.0015	0.273	0.00074	*<0.005*	0.00162	*<0.00005*	*<0.0015*	3.04	0.00011	4.46	*<0.000025*	0.84	0.00359	*<0.05*	*<2.5E-06*	0.00037	0.00072	0.000236	0.00354	*<0.001*	*<0.001*
30-Aug-18	18	500	420																						
6-Sep-18	19	500	415	0.00005	0.0018	0.259	0.00068	*<0.005*	0.00030	*<0.00005*	*<0.0015*	2.91	0.00011	2.77	*<0.000025*	0.67	0.00317	*<0.05*	*<2.5E-06*	*<0.000005*	0.00085	0.000137	0.00466	*<0.001*	*<0.001*
13-Sep-18	20	500	415																						
20-Sep-18	21	500	425	0.00005	0.0014	0.242	0.00063	0.03	0.00027	*<0.00005*	*<0.0015*	2.34	0.00006	2.20	*<0.000025*	0.40	0.00297	3.2	*<2.5E-06*	0.00004	0.00071	0.000090	0.00286	*<0.001*	*<0.001*
27-Sep-18	22	500	415																						
4-Oct-18	23	500	415	0.00005	0.0017	0.245	0.00054	*<0.005*	0.00020	0.0002	*<0.0015*	2.40	0.00006	2.72	*<0.000025*	0.45	0.00277	0.9	*<2.5E-06*	0.00005	0.00083	0.000089	0.00348	*<0.001*	*<0.001*
11-Oct-18	24	500	400																						

Loads	**mg/kg**			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
26-Apr-18	0			2.925E-05	0.001495	0.080275	0.0003478	0.001625	0.0022133	0.000065	0.00585	1.755	0.0001105	0.33475	8.125E-06	1.51775	0.0014138	0.3575	0.0000039	0.0000975	0.0006955	4.225E-06	0.0002535	0.000325	0.000325
3-May-18	1			0.0000423	0.002679	0.20069	0.000799	0.00235	0.006251	0.000047	0.00329	2.5897	0.0002538	0.6956	1.175E-05	2.9845	0.0036331	1.175	1.175E-06	0.0000658	0.001128	0.0000752	0.0007379	0.00047	0.00047
10-May-18	2			0.0000506	0.00184	0.15548	0.000644	0.0023	0.0042596	0.000092	0.00644	2.1942	0.0001656	0.7038	0.0000115	2.1206	0.002438	1.012	7.36E-06	0.0001058	0.0013754	9.154E-05	0.0008878	0.00046	0.00046
17-May-18	3			0.000018	0.001575	0.11295	0.00036	0.00225	0.002736	0.0000225	0.0036	1.5975	0.00018	0.6075	1.125E-05	1.899	0.0020115	1.125	1.125E-06	0.000045	0.00018	0.0001535	0.0008595	0.00045	0.00045
24-May-18	4																								
31-May-18	5			0.0000546	0.001183	0.150605	0.000455	0.002275	0.0010056	0.0000455	0.005005	2.1203	0.0001138	0.91	1.138E-05	1.3286	0.0023114	0.273	1.138E-06	0.0000182	0.0009464	0.0003039	0.0013059	0.000455	0.000455
7-Jun-18	6																								
14-Jun-18	7			2.275E-05	0.00091	0.13013	0.0004004	0.002275	0.0005688	2.275E-05	0.0006825	1.5106	0.0001047	0.7917	1.138E-05	0.69615	0.0018701	0.4095	1.138E-06	1.365E-05	0.0003367	0.0003062	0.0010283	0.000455	0.000455
21-Jun-18	8																								
28-Jun-18	9			0.0000989	0.000774	0.10621	0.0007052	0.00215	0.0003096	0.000086	0.000645	1.3029	0.0000473	0.6536	1.075E-05	0.4601	0.0014233	0.43	1.075E-06	0.0000301	0.0012427	0.0001466	0.0008428	0.00043	0.00043
5-Jul-18	10																								
12-Jul-18	11			0.0000022	0.000704	0.10824	0.000506	0.0022	0.0002508	0.000022	0.00066	1.188	0.0000396	0.5544	0.000011	0.484	0.00154	0.308	0.0000011	0.0000352	0.0002156	0.0001597	0.0008756	0.00044	0.00044
19-Jul-18	12																								
26-Jul-18	13			0.000009	0.000765	0.1251	0.000324	0.00225	0.0002025	0.0000225	0.000675	1.3635	0.0000405	0.7875	1.125E-05	0.459	0.00162	0.0225	1.125E-06	0.0000135	0.00018	0.000167	0.001125	0.00045	0.00045
2-Aug-18	14																								
9-Aug-18	15			0.000021	0.000714	0.10416	0.000273	0.0021	0.0001554	0.000021	0.00063	1.2012	0.000042	0.8484	0.0000105	0.3654	0.0013566	0.21	1.05E-06	0.0000168	0.000273	0.0000987	0.0013524	0.00042	0.00042
16-Aug-18	16																								
23-Aug-18	17			0.0000168	0.00063	0.11466	0.0003108	0.0021	0.0006804	0.000021	0.00063	1.2768	0.0000462	1.8732	0.0000105	0.3528	0.0015078	0.021	1.05E-06	0.0001554	0.0003024	9.912E-05	0.0014868	0.00042	0.00042
30-Aug-18	18																								
6-Sep-18	19			2.075E-05	0.000747	0.107485	0.0002822	0.002075	0.0001245	2.075E-05	0.0006225	1.20765	4.565E-05	1.14955	1.038E-05	0.27805	0.0013156	0.02075	1.038E-06	2.075E-06	0.0003528	5.686E-05	0.0019339	0.000415	0.000415
13-Sep-18	20																								
20-Sep-18	21			2.125E-05	0.000595	0.10285	0.0002678	0.01275	0.0001148	2.125E-05	0.0006375	0.9945	0.0000255	0.935	1.063E-05	0.17	0.0012623	1.36	1.063E-06	0.000017	0.0003018	3.825E-05	0.0012155	0.000425	0.000425
27-Sep-18	22																								
4-Oct-18	23			2.075E-05	0.0007055	0.101675	0.0002241	0.002075	0.000083	0.000083	0.0006225	0.996	0.0000249	1.1288	1.038E-05	0.18675	0.0011496	0.3735	1.038E-06	2.075E-05	0.0003445	3.694E-05	0.0014442	0.000415	0.000415
11-Oct-18	24																								

Appendix 4-5, Table 3: Kinetic Test Results - HC2

Mass	**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**	**Fe**
	No.	**Input**	**Output**			**(pH 4.5)**	**(pH 8.3)**					**CaCO$_3$**													
					umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/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
26-Apr-18	0	500	315	7.43	358	#N/A	3.9	16.1	102	10	0.11	107	0.099	<0.0001	0.0594	0.00647	<3.5E-06	<3.5E-06	0.015	0.000005	36.9	0.00010	0.000275	0.00043	<0.0035
3-May-18	1	500	445	7.70	441	#N/A	2.7	25.0	154	9	0.13	179	0.098	0.0005	0.0543	0.0113	<3.5E-06	<3.5E-06	0.030	0.000019	62.0	<0.000015	0.000509	0.00044	<0.0035
10-May-18	2	500	445	7.74	292	#N/A	3.1	27.5	92	3	0.17	112	0.124	0.0006	0.0626	0.00680	<3.5E-06	<3.5E-06	0.027	0.000014	37.4	0.00004	0.000222	0.00026	<0.0035
17-May-18	3	500	445	7.86	177	#N/A	2.3	24.2	48	1	0.13	54.7	0.125	0.0004	0.0568	0.00393	<3.5E-06	<3.5E-06	0.023	0.000017	18.4	<0.000015	0.000092	0.00030	<0.0035
24-May-18	4	500	420	7.66	145	#N/A	4.0	22.1	41																
31-May-18	5	500	435	7.85	177	#N/A	2.7	24.6	47	<0.5	0.12	63.9	0.122	0.0004	0.0646	0.00376	<3.5E-06	<3.5E-06	0.015	0.000006	22.0	0.00003	0.000114	0.00966	0.009
7-Jun-18	6	500	495	7.84	161	#N/A	3.4	24.1	43																
14-Jun-18	7	500	445	7.76	168	#N/A	4.1	20.8	44	<0.5	0.08	62.9	0.103	0.0003	0.0474	0.00339	<3.5E-06	<3.5E-06	0.011	0.000007	21.3	<0.000015	0.000121	0.00032	<0.0035
21-Jun-18	8	500	425	7.76	177	#N/A	4.5	21.1	51																
28-Jun-18	9	500	430	7.71	165	#N/A	5.3	20.4	51	<0.5	0.06	62.0	0.095	0.0002	0.0370	0.00341	<3.5E-06	<3.5E-06	0.008	0.000031	21.2	0.00005	0.000120	<0.00001	<0.0035
5-Jul-18	10	500	415	7.68	147	#N/A	5.1	19.0	40																
12-Jul-18	11	500	435	7.74	153	#N/A	1.8	18.7	44	<0.5	<0.03	63.3	0.093	<0.0001	0.0337	0.00338	<3.5E-06	<3.5E-06	0.008	<0.0000015	21.3	<0.000015	0.000150	0.00302	<0.0035
19-Jul-18	12	500	430	7.68	150	#N/A	1.3	18.0	47																
26-Jul-18	13	500	435	7.61	140	#N/A	2.4	18.8	44	<0.5	<0.03	57.3	0.077	<0.0001	0.0238	0.00296	<3.5E-06	<3.5E-06	0.008	0.000003	19.4	<0.000015	0.000127	0.00021	<0.0035
2-Aug-18	14	500	430	7.73	134	#N/A	1.8	18.4	46																
9-Aug-18	15	500	420	7.64	125	#N/A	2.0	15.9	41	<0.5	<0.03	50.9	0.085	<0.0001	0.0241	0.00267	<3.5E-06	<3.5E-06	0.005	0.000008	17.4	<0.000015	0.000112	0.00039	<0.0035
16-Aug-18	16	500	440	7.63	115	#N/A	3.4	17.5	42																
23-Aug-18	17	500	430	7.57	112	#N/A	4.0	16.1	38	<0.5	<0.03	48.5	0.071	<0.0001	0.0211	0.00255	<3.5E-06	<3.5E-06	0.006	0.000006	16.9	<0.000015	0.000127	0.00027	<0.0035
30-Aug-18	18	500	430	7.64	100	#N/A	2.7	16.2	36																
6-Sep-18	19	500	415	7.61	95	#N/A	3.8	17.0	35	<0.5	<0.03	42.4	0.080	<0.0001	0.0229	0.00241	<3.5E-06	<3.5E-06	0.007	0.000006	14.7	0.00004	0.000094	0.00040	<0.0035
13-Sep-18	20	500	420	7.41	93	#N/A	4.1	14.9	33																
20-Sep-18	21	500	425	7.68	121	#N/A	2.6	16.1	35	<0.5	<0.03	44.6	0.062	<0.0001	0.0218	0.00218	0.000007	<3.5E-06	0.005	0.000008	15.5	0.00004	0.000110	0.00062	0.007
27-Sep-18	22	500	425	7.64	129	#N/A	3.8	15.5	37																
4-Oct-18	23	500	435	7.49	112	#N/A	4.0	15.1	30	<0.5	<0.03	40.5	0.062	<0.0001	0.0187	0.00215	<3.5E-06	<3.5E-06	0.005	0.000004	14.3	0.00004	0.000100	0.00042	<0.0035
11-Oct-18	24	500	405	7.59	109	#N/A	4.9	14.3	30																

Loads	**mg/kg**								mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
26-Apr-18	0			7.43					32.13	3.15	0.03465	33.705	0.031185	0.0000315	0.018711	0.0020381	1.103E-06	1.103E-06	0.004725	0.000001575	11.6235	0.0000315	0.000086625	0.0001355	0.0011025
3-May-18	1			7.70					68.53	4.005	0.05785	79.655	0.04361	0.0002225	0.0241635	0.0050285	1.558E-06	1.558E-06	0.01335	0.000008455	27.59	6.675E-06	0.000226505	0.0001958	0.0015575
10-May-18	2			7.74					40.94	1.335	0.07565	49.84	0.05518	0.000267	0.027857	0.003026	1.558E-06	1.558E-06	0.012015	0.00000623	16.643	0.0000178	0.00009879	0.0001157	0.0015575
17-May-18	3			7.86					21.36	0.445	0.05785	24.3415	0.055625	0.000178	0.025276	0.0017489	1.558E-06	1.558E-06	0.010235	0.000007565	8.188	6.675E-06	0.00004094	0.0001335	0.0015575
24-May-18	4			7.66					17.22																
31-May-18	5			7.85					20.445	0.2175	0.0522	27.7965	0.05307	0.000174	0.028101	0.0016356	1.523E-06	1.523E-06	0.006525	0.00000261	9.57	1.305E-05	0.00004959	0.0042021	0.003915
7-Jun-18	6			7.84					21.285																
14-Jun-18	7			7.76					19.58	0.2225	0.0356	27.9905	0.045835	0.0001335	0.021093	0.0015086	1.558E-06	1.558E-06	0.004895	0.000003115	9.4785	6.675E-06	0.000053845	0.0001424	0.0015575
21-Jun-18	8			7.76					21.675																
28-Jun-18	9			7.71					21.93	0.215	0.0258	26.66	0.04085	0.000086	0.01591	0.0014663	1.505E-06	1.505E-06	0.00344	0.00001333	9.116	0.0000215	0.0000516	0.0000043	0.001505
5-Jul-18	10			7.68					16.6																
12-Jul-18	11			7.74					19.14	0.2175	0.01305	27.5355	0.040455	0.0000435	0.0146595	0.0014703	1.523E-06	1.523E-06	0.00348	6.525E-07	9.2655	6.525E-06	0.00006525	0.0013137	0.0015225
19-Jul-18	12			7.68					20.21																
26-Jul-18	13			7.61					19.14	0.2175	0.01305	24.9255	0.033495	0.0000435	0.010353	0.0012876	1.523E-06	1.523E-06	0.00348	0.000001305	8.439	6.525E-06	0.000055245	9.135E-05	0.0015225
2-Aug-18	14			7.73					19.78																
9-Aug-18	15			7.64					17.22	0.21	0.0126	21.378	0.0357	0.000042	0.010122	0.0011214	1.47E-06	1.47E-06	0.0021	0.00000336	7.308	0.0000063	0.00004704	0.0001638	0.00147
16-Aug-18	16			7.63					18.48																
23-Aug-18	17			7.57					16.34	0.215	0.0129	20.855	0.03053	0.000043	0.009073	0.0010965	1.505E-06	1.505E-06	0.00258	0.00000258	7.267	6.45E-06	0.00005461	0.0001161	0.001505
30-Aug-18	18			7.64					15.48																
6-Sep-18	19			7.61					14.525	0.2075	0.01245	17.596	0.0332	0.0000415	0.0095035	0.0010002	1.453E-06	1.453E-06	0.002905	0.00000249	6.1005	0.0000166	0.00003901	0.000166	0.0014525
13-Sep-18	20			7.41					13.86																
20-Sep-18	21			7.68					14.875	0.2125	0.01275	18.955	0.02635	0.0000425	0.009265	0.0009265	2.975E-06	1.488E-06	0.002125	0.0000034	6.5875	0.000017	0.00004675	0.0002635	0.002975
27-Sep-18	22			7.64					15.725																
4-Oct-18	23			7.49					13.05	0.2175	0.01305	17.6175	0.02697	0.0000435	0.0081345	0.0009353	1.523E-06	1.523E-06	0.002175	0.00000174	6.2205	0.0000174	0.0000435	0.0001827	0.0015225
11-Oct-18	24			7.59					12.15																

Appendix 4-5, Table 3: Kinetic Test Results - HC2

Mass	**1**																									
Date	**Cycle**	**Volume mL**		**pH**	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
	No.	**Input**	**Output**																							
					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
26-Apr-18	0	500	315	7.43	0.00002	0.0135	3.70	0.0337	0.03	0.00237	0.0061	0.011	11.7	0.00060	1.48	*<0.000025*	8.75	0.283	37.1	0.000034	0.00020	0.00008	0.00140	0.00051	*<0.001*	*<0.001*
3-May-18	1	500	445	7.70	0.00001	0.0177	5.90	0.0818	*<0.005*	0.0199	0.0055	0.003	12.0	0.00090	2.05	*<0.000025*	12.3	0.496	51.5	0.000038	0.00014	0.00009	0.00453	0.00090	*<0.001*	*<0.001*
10-May-18	2	500	445	7.74	0.00003	0.0140	4.41	0.0406	*<0.005*	0.0180	0.0017	0.007	10.6	0.00053	2.48	*<0.000025*	7.64	0.284	32.0	0.000032	0.00017	0.00037	0.00312	0.00114	*<0.001*	*<0.001*
17-May-18	3	500	445	7.86	0.00002	0.0087	2.12	0.0152	0.01	0.00838	0.0005	*<0.0015*	6.21	0.00030	1.88	*<0.000025*	3.94	0.155	15.6	0.000024	0.00018	0.00016	0.00194	0.00090	*<0.001*	*<0.001*
24-May-18	4	500	420	7.66																						
31-May-18	5	500	435	7.85	0.00006	0.0071	2.20	0.00895	*<0.005*	0.00531	0.0005	*<0.0015*	7.98	0.00024	2.49	*<0.000025*	2.22	0.154	17.9	0.000021	0.00009	0.00032	0.00164	0.00124	*<0.001*	*<0.001*
7-Jun-18	6	500	495	7.84																						
14-Jun-18	7	500	445	7.76	0.00002	0.0067	2.38	0.00560	*<0.005*	0.00304	0.0005	*<0.0015*	6.45	0.00036	2.13	*<0.000025*	1.28	0.141	18.4	0.000021	0.00004	0.00015	0.00201	0.00091	*<0.001*	*<0.001*
21-Jun-18	8	500	425	7.76																						
28-Jun-18	9	500	430	7.71	0.00004	0.0058	2.19	0.00487	*<0.005*	0.00185	0.0005	*<0.0015*	6.31	0.00015	2.07	*<0.000025*	0.82	0.140	19.7	0.000021	0.00004	0.00017	0.001636	0.00082	*<0.001*	*<0.001*
5-Jul-18	10	500	415	7.68																						
12-Jul-18	11	500	435	7.74	*<0.000005*	0.0053	2.46	0.00346	*<0.005*	0.00155	0.0004	*<0.0015*	4.91	0.00012	1.71	*<0.000025*	0.68	0.125	15.6	0.000019	0.00012	0.00016	0.00153	0.00081	*<0.001*	*<0.001*
19-Jul-18	12	500	430	7.68																						
26-Jul-18	13	500	435	7.61	0.00002	0.0046	2.12	0.00293	*<0.005*	0.00117	0.0003	*<0.0015*	4.86	0.00014	1.71	*<0.000025*	0.58	0.118	12.6	0.000021	0.00003	0.00017	0.00143	0.00066	*<0.001*	*<0.001*
2-Aug-18	14	500	430	7.73																						
9-Aug-18	15	500	420	7.64	0.00003	0.0042	1.82	0.00206	*<0.005*	0.00120	0.0003	*<0.0015*	4.59	0.00014	1.61	*<0.000025*	0.56	0.103	13.8	0.000019	0.00003	0.00022	0.000950	0.00069	*<0.001*	*<0.001*
16-Aug-18	16	500	440	7.63																						
23-Aug-18	17	500	430	7.57	0.00001	0.0033	1.51	0.00225	*<0.005*	0.00104	0.0003	*<0.0015*	4.28	0.00007	1.64	*<0.000025*	0.51	0.0989	14.1	0.000018	0.00004	0.00014	0.000857	0.00063	*<0.001*	*<0.001*
30-Aug-18	18	500	430	7.64																						
6-Sep-18	19	500	415	7.61	0.00003	0.0035	1.38	0.00187	*<0.005*	0.00090	0.0002	*<0.0015*	3.58	0.00006	1.61	*<0.000025*	0.46	0.0831	11.2	0.000019	*<0.000005*	0.00025	0.000771	0.00064	*<0.001*	*<0.001*
13-Sep-18	20	500	420	7.41																						
20-Sep-18	21	500	425	7.68	0.00003	0.0030	1.41	0.00169	0.04	0.00103	0.0003	*<0.0015*	3.71	0.00009	1.46	*<0.000025*	0.36	0.0918	12.6	0.000019	0.00004	0.00016	0.000760	0.00058	*<0.001*	*<0.001*
27-Sep-18	22	500	425	7.64																						
4-Oct-18	23	500	435	7.49	0.00003	0.0033	1.18	0.00158	*<0.005*	0.00070	0.0002	*<0.0015*	3.00	0.00005	1.44	*<0.000025*	0.35	0.0756	9.8	0.000015	0.00003	*<0.000025*	0.000679	0.00056	*<0.001*	*<0.001*
11-Oct-18	24	500	405	7.59																						

Loads	**mg/kg**				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
26-Apr-18	0			7.43	0.0000063	0.0042525	1.1655	0.0106155	0.00945	0.0007466	0.0019215	0.003465	3.6855	0.000189	0.4662	7.875E-06	2.75625	0.089145	11.6865	0.00001071	0.000063	0.0000252	0.000441	0.0001607	0.000315	0.000315
3-May-18	1			7.70	4.45E-06	0.0078765	2.6255	0.036401	0.002225	0.0088555	0.0024475	0.001335	5.34	0.0004005	0.91225	1.113E-05	5.4735	0.22072	22.9175	0.00001691	0.0000623	4.005E-05	0.0020159	0.0004005	0.000445	0.000445
10-May-18	2			7.74	1.335E-05	0.00623	1.96245	0.018067	0.002225	0.00801	0.0007565	0.003115	4.717	0.0002359	1.1036	1.113E-05	3.3998	0.12638	14.24	0.00001424	7.565E-05	0.0001647	0.0013884	0.0005073	0.000445	0.000445
17-May-18	3			7.86	0.0000089	0.0038715	0.9434	0.006764	0.00445	0.0037291	0.0002225	0.0006675	2.76345	0.0001335	0.8366	1.113E-05	1.7533	0.068975	6.942	0.00001068	0.0000801	0.0000712	0.0008633	0.0004005	0.000445	0.000445
24-May-18	4			7.66																						
31-May-18	5			7.85	0.0000261	0.0030885	0.957	0.0038933	0.002175	0.0023099	0.0002175	0.0006525	3.4713	0.0001044	1.08315	1.088E-05	0.9657	0.06699	7.7865	0.000009135	3.915E-05	0.0001392	0.0007134	0.0005394	0.000435	0.000435
7-Jun-18	6			7.84																						
14-Jun-18	7			7.76	0.0000089	0.0029815	1.0591	0.002492	0.002225	0.0013528	0.0002225	0.0006675	2.87025	0.0001602	0.94785	1.113E-05	0.5696	0.062745	8.188	0.000009345	0.0000178	6.675E-05	0.0008945	0.000405	0.000445	0.000445
21-Jun-18	8			7.76																						
28-Jun-18	9			7.71	0.0000172	0.002494	0.9417	0.0020941	0.00215	0.0007955	0.000215	0.000645	2.7133	0.0000645	0.8901	1.075E-05	0.3526	0.0602	8.471	0.00000903	0.0000172	0.0000731	0.0007035	0.0003526	0.00043	0.00043
5-Jul-18	10			7.68																						
12-Jul-18	11			7.74	2.175E-06	0.0023055	1.0701	0.0015051	0.002175	0.0006743	0.000174	0.0006525	2.13585	0.0000522	0.74385	1.088E-05	0.2958	0.054375	6.786	0.000008265	0.0000522	0.0000696	0.0006656	0.0003524	0.000435	0.000435
19-Jul-18	12			7.68																						
26-Jul-18	13			7.61	0.0000087	0.002001	0.9222	0.0012746	0.002175	0.000509	0.0001305	0.0006525	2.1141	0.0000609	0.74385	1.088E-05	0.2523	0.05133	5.481	0.000009135	1.305E-05	7.395E-05	0.0006221	0.0002871	0.000435	0.000435
2-Aug-18	14			7.73																						
9-Aug-18	15			7.64	0.0000126	0.001764	0.7644	0.0008652	0.0021	0.000504	0.000126	0.00063	1.9278	0.0000588	0.6762	0.0000105	0.2352	0.04326	5.796	0.00000798	0.0000126	0.0000924	0.000399	0.0002898	0.00042	0.00042
16-Aug-18	16			7.63																						
23-Aug-18	17			7.57	0.0000043	0.001419	0.6493	0.0009675	0.00215	0.0004472	0.000129	0.000645	1.8404	0.0000301	0.7052	1.075E-05	0.2193	0.042527	6.063	0.00000774	0.0000172	0.0000602	0.0003685	0.0002709	0.00043	0.00043
30-Aug-18	18			7.64																						
6-Sep-18	19			7.61	1.245E-05	0.0014525	0.5727	0.0007761	0.002075	0.0003735	0.000083	0.0006225	1.4857	0.0000249	0.66815	1.038E-05	0.1909	0.0344865	4.648	0.000007885	2.075E-06	0.0001038	0.00032	0.0002656	0.000415	0.000415
13-Sep-18	20			7.41																						
20-Sep-18	21			7.68	1.275E-05	0.001275	0.59925	0.0007183	0.017	0.0004378	0.0001275	0.0006375	1.57675	3.825E-05	0.6205	1.063E-05	0.153	0.039015	5.355	0.000008075	0.000017	0.000068	0.000323	0.0002465	0.000425	0.000425
27-Sep-18	22			7.64																						
4-Oct-18	23			7.49	1.305E-05	0.0014355	0.5133	0.0006873	0.002175	0.0003045	0.000087	0.0006525	1.305	2.175E-05	0.6264	1.088E-05	0.15225	0.032886	4.263	0.000006525	1.305E-05	1.088E-05	0.0002954	0.0002436	0.000435	0.000435
11-Oct-18	24			7.59																						

Appendix 4-5, Table 4: Kinetic Test Results - HC3

Mass	**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**	**Fe**
	No.	**Input**	**Output**			**(pH 4.5)**	**(pH 8.3)**					**CaCO$_3$**													
					umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/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
26-Apr-18	0	500	305	7.78	313	#N/A	3.8	26.4	67	9	0.25	51.7	0.196	<0.0001	0.0093	0.00340	<0.0000035	<0.0000035	0.015	<0.0000015	16.7	0.00012	0.000024	0.00070	0.007
3-May-18	1	500	465	8.05	254	#N/A	1.3	26.1	81	4	0.16	64.5	0.292	0.0003	0.0205	0.00371	<0.0000035	<0.0000035	0.024	<0.0000015	20.6	0.00005	0.000029	0.00025	0.016
10-May-18	2	500	465	7.76	215	#N/A	2.7	25.7	70	2	0.15	66.7	0.281	0.0004	0.0267	0.00294	<0.0000035	<0.0000035	0.018	<0.0000015	20.9	0.00004	0.000070	0.00026	0.008
17-May-18	3	500	455	8.01	203	#N/A	1.9	24.4	56	1	0.12	59.7	0.209	0.0003	0.0282	0.00270	<0.0000035	<0.0000035	0.021	0.000012	19.1	<0.000015	0.000056	0.00027	<0.0035
24-May-18	4	500	440	7.74	164	#N/A	3.3	24.7	45																
31-May-18	5	500	470	8.04	138	#N/A	2.1	24.1	36	<0.5	0.13	46.8	0.234	0.0002	0.0337	0.00153	<0.0000035	<0.0000035	0.010	<0.0000015	15.5	<0.000015	0.000078	0.00020	0.008
7-Jun-18	6	500	485	8.05	144	#N/A	2.7	27.0	40																
14-Jun-18	7	500	475	8.06	127	#N/A	2.8	24.6	33	1	0.13	45.2	0.214	0.0003	0.0392	0.00142	<0.0000035	<0.0000035	0.012	0.000003	15.0	<0.000015	0.000072	0.00028	<0.0035
21-Jun-18	8	500	435	8.04	122	#N/A	3.2	25.1	26																
28-Jun-18	9	500	445	8.02	113	#N/A	3.6	24.0	29	<0.5	0.07	45.0	0.227	<0.0001	0.0390	0.00143	<0.0000035	<0.0000035	0.008	0.000022	15.1	0.00003	0.000109	0.00020	0.016
5-Jul-18	10	500	405	7.99	99	#N/A	3.7	21.2	22																
12-Jul-18	11	500	435	8.10	116	#N/A	1.0	22.6	28	<0.5	<0.03	46.6	0.217	<0.0001	0.0391	0.00153	<0.0000035	<0.0000035	0.008	<0.0000015	15.9	<0.000015	0.000189	0.00263	<0.0035
19-Jul-18	12	500	435	8.00	98	#N/A	0.8	20.2	24																
26-Jul-18	13	500	445	7.69	102	#N/A	2.2	21.4	28	<0.5	<0.03	39.9	0.169	<0.0001	0.0263	0.00128	<0.0000035	<0.0000035	0.002	<0.0000015	13.7	<0.000015	0.000084	0.00018	<0.0035
2-Aug-18	14	500	435	8.03	102	#N/A	1.2	22.2	26																
9-Aug-18	15	500	415	7.93	83	#N/A	1.5	20.6	19	<0.5	<0.03	33.2	0.200	<0.0001	0.0286	0.00119	<0.0000035	<0.0000035	0.004	0.000006	11.7	<0.000015	0.000072	0.00042	0.008
16-Aug-18	16	500	440	8.00	82	#N/A	2.8	21.1	24																
23-Aug-18	17	500	430	7.94	84	#N/A	3.2	21.4	21	<0.5	<0.03	36.4	0.153	<0.0001	0.0262	0.00129	<0.0000035	<0.0000035	0.006	<0.0000015	12.7	<0.000015	0.000100	0.00035	0.007
30-Aug-18	18	500	425	7.95	81	#N/A	2.0	20.9	23																
6-Sep-18	19	500	415	7.96	76	#N/A	2.7	20.8	18	<0.5	<0.03	34.3	0.164	<0.0001	0.0260	0.00122	<0.0000035	<0.0000035	0.006	<0.0000015	12.2	<0.000015	0.000078	0.00026	0.007
13-Sep-18	20	500	420	7.63	89	#N/A	3.9	22.1	24																
20-Sep-18	21	500	425	7.92	118	#N/A	2.5	23.5	29	<0.5	<0.03	42.7	0.138	<0.0001	0.0334	0.00144	0.000008	<0.0000035	0.007	<0.0000015	15.2	0.00004	0.000102	0.00040	0.008
27-Sep-18	22	500	430	8.00	124	#N/A	2.8	23.2	29																
4-Oct-18	23	500	430	7.74	124	#N/A	3.9	26.2	29	<0.5	<0.03	46.6	0.152	<0.0001	0.0321	0.00151	<0.0000035	<0.0000035	0.005	<0.0000015	16.7	0.00004	0.000124	0.00028	<0.0035
11-Oct-18	24	500	405	7.70	115	#N/A	3.3	25.0	24																

Loads	**mg/kg**								mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
26-Apr-18	0			7.78					20.435	2.745	0.07625	15.7685	0.05978	0.0000305	0.0028365	0.001037	1.0675E-06	1.0675E-06	0.004575	4.575E-07	5.0935	0.0000366	7.32E-06	0.0002135	0.002135
3-May-18	1			8.05					37.665	1.86	0.0744	29.9925	0.13578	0.0001395	0.0095325	0.0017252	1.6275E-06	1.6275E-06	0.01116	6.975E-07	9.579	2.325E-05	1.349E-05	0.0001163	0.00744
10-May-18	2			7.76					32.55	0.93	0.06975	31.0155	0.130665	0.000186	0.0124155	0.0013671	1.6275E-06	1.6275E-06	0.00837	6.975E-07	9.7185	0.0000186	3.255E-05	0.0001209	0.00372
17-May-18	3			8.01					25.48	0.455	0.0546	27.1635	0.095095	0.0001365	0.012831	0.0012285	1.5925E-06	1.5925E-06	0.009555	0.00000546	8.6905	6.825E-06	2.548E-05	0.0001229	0.0015925
24-May-18	4			7.74					19.8																
31-May-18	5			8.04					16.92	0.235	0.0611	21.996	0.10998	0.000094	0.015839	0.0007191	0.000001645	0.000001645	0.0047	0.000000705	7.285	7.05E-06	3.666E-05	0.000094	0.00376
7-Jun-18	6			8.05					19.4																
14-Jun-18	7			8.06					15.675	0.475	0.06175	21.47	0.10165	0.0001425	0.01862	0.0006745	1.6625E-06	1.6625E-06	0.0057	0.000001425	7.125	7.125E-06	0.0000342	0.000133	0.0016625
21-Jun-18	8			8.04					11.31																
28-Jun-18	9			8.02					12.905	0.2225	0.03115	20.025	0.101015	0.0000445	0.017355	0.0006364	1.5575E-06	1.5575E-06	0.00356	0.00000979	6.7195	1.335E-05	4.851E-05	0.000089	0.00712
5-Jul-18	10			7.99					8.91																
12-Jul-18	11			8.10					12.18	0.2175	0.01305	20.271	0.094395	0.0000435	0.0170085	0.0006656	1.5225E-06	1.5225E-06	0.00348	6.525E-07	6.9165	6.525E-06	8.222E-05	0.0011441	0.0015225
19-Jul-18	12			8.00					10.44																
26-Jul-18	13			7.69					12.46	0.2225	0.01335	17.7555	0.075205	0.0000445	0.0117035	0.0005696	1.5575E-06	1.5575E-06	0.00089	6.675E-07	6.0965	6.675E-06	3.738E-05	0.0000801	0.0015575
2-Aug-18	14			8.03					11.31																
9-Aug-18	15			7.93					7.885	0.2075	0.01245	13.778	0.083	0.0000415	0.011869	0.0004939	1.4525E-06	1.4525E-06	0.00166	0.00000249	4.8555	6.225E-06	2.988E-05	0.0001743	0.00332
16-Aug-18	16			8.00					10.56																
23-Aug-18	17			7.94					9.03	0.215	0.0129	15.652	0.06579	0.000043	0.011266	0.0005547	0.000001505	0.000001505	0.00258	0.000000645	5.461	6.45E-06	0.000043	0.0001505	0.00301
30-Aug-18	18			7.95					9.775																
6-Sep-18	19			7.96					7.47	0.2075	0.01245	14.2345	0.06806	0.0000415	0.01079	0.0005063	1.4525E-06	1.4525E-06	0.00249	6.225E-07	5.063	6.225E-06	3.237E-05	0.0001079	0.002905
13-Sep-18	20			7.63					10.08																
20-Sep-18	21			7.92					12.325	0.2125	0.01275	18.1475	0.05865	0.0000425	0.014195	0.000612	0.0000034	1.4875E-06	0.002975	6.375E-07	6.46	0.000017	4.335E-05	0.00017	0.0034
27-Sep-18	22			8.00					12.47																
4-Oct-18	23			7.74					12.47	0.215	0.0129	20.038	0.06536	0.000043	0.013803	0.0006493	0.000001505	0.000001505	0.00215	0.000000645	7.181	0.0000172	5.332E-05	0.0001204	0.001505
11-Oct-18	24			7.70					9.72																

Appendix 4-5, Table 4: Kinetic Test Results - HC3

Mass	**1**																									
Date	**Cycle**	**Volume mL**		**pH**	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
	No.	**Input**	**Output**																							
					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
26-Apr-18	0	500	305	7.78	0.00003	0.0070	2.45	0.00883	0.04	0.00100	0.0010	0.013	26.6	0.00041	1.00	*<0.000025*	10.6	0.0677	27.1	0.000053	0.00045	0.00032	0.000281	0.00049	*<0.001*	*<0.001*
3-May-18	1	500	465	8.05	0.00002	0.0075	3.17	0.0164	*<0.005*	0.00452	0.0004	*<0.0015*	20.8	0.00041	1.32	*<0.000025*	9.00	0.0884	27.4	0.000042	0.00022	0.00083	0.00113	0.00097	*<0.001*	*<0.001*
10-May-18	2	500	465	7.76	0.00002	0.0072	3.52	0.0127	*<0.005*	0.00233	0.0003	*<0.0015*	16.0	0.00025	1.41	*<0.000025*	5.08	0.0795	24.5	0.000045	0.00011	0.00056	0.00115	0.00098	*<0.001*	*<0.001*
17-May-18	3	500	455	8.01	*<0.000005*	0.0065	2.95	0.0128	0.02	0.00164	0.0002	*<0.0015*	12.1	0.00014	1.27	*<0.000025*	3.34	0.0751	21.2	0.000034	0.00016	0.00011	0.00126	0.00086	*<0.001*	*<0.001*
24-May-18	4	500	440	7.74																						
31-May-18	5	500	470	8.04	0.00001	0.0040	1.96	0.00992	0.01	0.00087	0.0003	*<0.0015*	7.85	0.00007	1.54	*<0.000025*	1.34	0.0451	13.1	0.000022	0.00004	0.00032	0.000565	0.00107	*<0.001*	*<0.001*
7-Jun-18	6	500	485	8.05																						
14-Jun-18	7	500	475	8.06	0.00002	0.0045	1.85	0.00918	*<0.005*	0.00072	0.0001	*<0.0015*	6.19	0.00008	1.46	*<0.000025*	0.94	0.0405	11.7	0.000022	0.00006	0.00010	0.000772	0.00119	*<0.001*	*<0.001*
21-Jun-18	8	500	435	8.04																						
28-Jun-18	9	500	445	8.02	0.00006	0.0037	1.73	0.0101	*<0.005*	0.00045	0.0002	*<0.0015*	6.02	0.00007	1.48	*<0.000025*	0.70	0.03854	11.5	0.000018	0.00006	0.00094	0.000583	0.00130	*<0.001*	*<0.001*
5-Jul-18	10	500	405	7.99																						
12-Jul-18	11	500	435	8.10	*<0.000005*	0.0036	1.69	0.00803	*<0.005*	0.00037	0.0001	*<0.0015*	4.43	0.00007	1.37	*<0.000025*	0.80	0.0350	9.3	0.000016	0.00008	0.00021	0.000711	0.00127	*<0.001*	*<0.001*
19-Jul-18	12	500	435	8.00																						
26-Jul-18	13	500	445	7.69	0.00001	0.0033	1.36	0.00802	*<0.005*	0.00029	*<0.00005*	*<0.0015*	4.17	0.00004	1.24	*<0.000025*	0.47	0.0313	7.6	0.000018	0.00002	0.00011	0.000690	0.00101	*<0.001*	*<0.001*
2-Aug-18	14	500	435	8.03																						
9-Aug-18	15	500	415	7.93	0.00004	0.0027	0.977	0.00610	0.02	0.00024	0.0001	*<0.0015*	3.34	*<0.00002*	1.25	*<0.000025*	0.41	0.0254	6.2	0.000015	0.00004	0.00050	0.000415	0.00108	*<0.001*	*<0.001*
16-Aug-18	16	500	440	8.00																						
23-Aug-18	17	500	430	7.94	0.00001	0.0025	1.14	0.00758	*<0.005*	0.00035	*<0.00005*	*<0.0015*	3.71	0.00006	1.29	*<0.000025*	0.48	0.0270	7.5	0.000014	0.00006	0.00030	0.000482	0.00097	*<0.001*	*<0.001*
30-Aug-18	18	500	425	7.95																						
6-Sep-18	19	500	415	7.96	0.00002	0.0025	0.954	0.00605	*<0.005*	0.00024	*<0.00005*	*<0.0015*	3.25	*<0.00002*	1.10	*<0.000025*	0.37	0.0245	6.5	0.000016	*<0.000005*	0.00033	0.000461	0.00098	*<0.001*	*<0.001*
13-Sep-18	20	500	420	7.63																						
20-Sep-18	21	500	425	7.92	0.00002	0.0029	1.17	0.00666	*<0.005*	0.00030	*<0.00005*	*<0.0015*	3.95	0.00010	1.36	*<0.000025*	0.33	0.0343	9.5	0.000017	0.00009	0.00025	0.000635	0.00107	*<0.001*	*<0.001*
27-Sep-18	22	500	430	8.00																						
4-Oct-18	23	500	430	7.74	0.00002	0.0036	1.18	0.00648	*<0.005*	0.00018	*<0.00005*	*<0.0015*	3.90	*<0.00002*	1.48	*<0.000025*	0.35	0.0342	8.5	0.000018	0.00004	0.00019	0.000726	0.00120	*<0.001*	*<0.001*
11-Oct-18	24	500	405	7.70																						

Loads	**mg/kg**				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
26-Apr-18	0			7.78	9.15E-06	0.002135	0.74725	0.0026932	0.0122	0.000305	0.000305	0.003965	8.113	0.0001251	0.305	0.000007625	3.233	0.0206485	8.2655	1.617E-05	0.0001373	0.0000976	8.571E-05	0.0001495	0.000305	0.000305
3-May-18	1			8.05	0.0000093	0.0034875	1.47405	0.007626	0.002325	0.0021018	0.000186	0.0006975	9.672	0.0001907	0.6138	0.000011625	4.185	0.041106	12.741	1.953E-05	0.0001023	0.000386	0.0005255	0.0004511	0.000465	0.000465
10-May-18	2			7.76	0.0000093	0.003348	1.6368	0.0059055	0.002325	0.0010835	0.0001395	0.0006975	7.44	0.0001163	0.65565	0.000011625	2.3622	0.0369675	11.3925	2.093E-05	5.115E-05	0.0002604	0.0005348	0.0004557	0.000465	0.000465
17-May-18	3			8.01	2.275E-06	0.0029575	1.34225	0.005824	0.0091	0.0007462	0.000091	0.0006825	5.5055	0.0000637	0.57785	0.000011375	1.5197	0.0341705	9.646	1.547E-05	0.0000728	5.005E-05	0.0005733	0.0003913	0.000455	0.000455
24-May-18	4			7.74																						
31-May-18	5			8.04	0.0000047	0.00188	0.9212	0.0046624	0.0047	0.0004089	0.000141	0.000705	3.6895	0.0000329	0.7238	0.00001175	0.6298	0.021197	6.157	1.034E-05	0.0000188	0.0001504	0.0002656	0.0005029	0.00047	0.00047
7-Jun-18	6			8.05																						
14-Jun-18	7			8.06	0.0000095	0.0021375	0.87875	0.0043605	0.002375	0.000342	0.0000475	0.0007125	2.94025	0.000038	0.6935	0.000011875	0.4465	0.0192375	5.5575	1.045E-05	0.0000285	0.0000475	0.0003667	0.0005653	0.000475	0.000475
21-Jun-18	8			8.04																						
28-Jun-18	9			8.02	0.0000267	0.0016465	0.76985	0.0044945	0.002225	0.0002003	0.000089	0.0006675	2.6789	3.115E-05	0.6586	0.000011125	0.3115	0.0171503	5.1175	8.01E-06	0.0000267	0.0004183	0.0002594	0.0005785	0.000445	0.000445
5-Jul-18	10			7.99																						
12-Jul-18	11			8.10	2.175E-06	0.001566	0.73515	0.0034931	0.002175	0.000161	0.0000435	0.0006525	1.92705	3.045E-05	0.59595	0.000010875	0.348	0.015225	4.0455	6.96E-06	0.0000348	9.135E-05	0.0003093	0.0005525	0.000435	0.000435
19-Jul-18	12			8.00																						
26-Jul-18	13			7.69	4.45E-06	0.0014685	0.6052	0.0035689	0.002225	0.0001291	2.225E-05	0.0006675	1.85565	0.0000178	0.5518	0.000011125	0.20915	0.0139285	3.382	8.01E-06	0.0000089	4.895E-05	0.0003071	0.0004495	0.000445	0.000445
2-Aug-18	14			8.03																						
9-Aug-18	15			7.93	0.0000166	0.0011205	0.405455	0.0025315	0.0083	0.0000996	0.0000415	0.0006225	1.3861	0.0000083	0.51875	0.000010375	0.17015	0.010541	2.573	6.225E-06	0.0000166	0.0002075	0.0001722	0.0004482	0.000415	0.000415
16-Aug-18	16			8.00																						
23-Aug-18	17			7.94	0.0000043	0.001075	0.4902	0.0032594	0.00215	0.0001505	0.0000215	0.000645	1.5953	0.0000258	0.5547	0.00001075	0.2064	0.01161	3.225	6.02E-06	0.0000258	0.000129	0.0002073	0.0004171	0.00043	0.00043
30-Aug-18	18			7.95																						
6-Sep-18	19			7.96	0.0000083	0.0010375	0.39591	0.0025108	0.002075	0.0000996	2.075E-05	0.0006225	1.34875	0.0000083	0.4565	0.000010375	0.15355	0.0101675	2.6975	6.64E-06	2.075E-06	0.000137	0.0001913	0.0004067	0.000415	0.000415
13-Sep-18	20			7.63																						
20-Sep-18	21			7.92	0.0000085	0.0012325	0.49725	0.0028305	0.002125	0.0001275	2.125E-05	0.0006375	1.67875	0.0000425	0.578	0.000010625	0.14025	0.0145775	4.0375	7.225E-06	3.825E-05	0.0001063	0.0002699	0.0004548	0.000425	0.000425
27-Sep-18	22			8.00																						
4-Oct-18	23			7.74	0.0000086	0.001548	0.5074	0.0027864	0.00215	0.0000774	0.0000215	0.000645	1.677	0.0000086	0.6364	0.00001075	0.1505	0.014706	3.655	7.74E-06	0.0000172	0.0000817	0.0003122	0.000516	0.00043	0.00043
11-Oct-18	24			7.70																						

Appendix 4-5, Table 5: Kinetic Test Results - HC4

Mass	**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**	**Fe**
	No.	**Input**	**Output**			**(pH 4.5)**	**(pH 8.3)**					**CaCO$_3$**													
					umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/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
26-Apr-18	0	500	305	7.50	494	#N/A	4.8	13.8	146	8	0.11	140	0.087	*<0.0001*	0.0289	0.00729	*<3.5E-06*	*<0.0000035*	0.015	0.000003	46.2	0.00007	0.000656	0.00059	*<0.0035*
3-May-18	1	500	440	7.72	530	#N/A	3.0	25.7	230	7	0.15	207	0.114	0.0005	0.0128	0.00969	*<3.5E-06*	*<0.0000035*	0.031	0.000011	66.9	*<0.000015*	0.000398	0.00039	*<0.0035*
10-May-18	2	500	460	7.59	338	#N/A	3.2	20.4	144	1	0.15	131	0.150	0.0005	0.0094	0.00466	*<3.5E-06*	*<0.0000035*	0.024	0.000007	42.0	0.00003	0.000164	0.00036	*<0.0035*
17-May-18	3	500	465	7.75	288	#N/A	2.6	20.8	104	1	0.15	97.7	0.126	0.0005	0.0096	0.00432	*<3.5E-06*	0.000007	0.027	0.000015	32.1	*<0.000015*	0.000140	0.00031	*<0.0035*
24-May-18	4	500	420	7.59	222	#N/A	3.8	19.7	78																
31-May-18	5	500	445	7.66	171	#N/A	2.7	16.5	56	*<0.5*	0.10	63.9	0.153	0.0003	0.0074	0.00183	*<3.5E-06*	0.000012	0.012	0.000007	22.1	*<0.000015*	0.000067	0.00036	0.007
7-Jun-18	6	500	495	7.72	184	#N/A	3.4	19.1	63																
14-Jun-18	7	500	460	7.65	144	#N/A	3.7	16.2	44	1	0.08	50.6	0.136	0.0003	0.0060	0.00146	*<3.5E-06*	0.000009	0.011	0.000008	17.8	*<0.000015*	0.000057	0.00028	*<0.0035*
21-Jun-18	8	500	430	7.63	126	#N/A	4.5	15.4	36																
28-Jun-18	9	500	430	7.62	127	#N/A	5.3	16.4	40	*<0.5*	0.07	46.6	0.134	0.0002	0.0055	0.00193	*<3.5E-06*	0.000016	0.008	0.000012	16.6	*<0.000015*	0.000070	*<0.00001*	0.014
5-Jul-18	10	500	415	7.60	129	#N/A	5.1	14.6	40																
12-Jul-18	11	500	440	7.61	144	#N/A	1.6	13.9	46	*<0.5*	0.06	57.7	0.128	*<0.0001*	0.0044	0.00159	*<3.5E-06*	0.000009	0.009	*<1.5E-06*	20.9	*<0.000015*	0.000090	0.00301	*<0.0035*
19-Jul-18	12	500	435	7.54	155	#N/A	1.6	13.4	54																
26-Jul-18	13	500	455	7.46	154	#N/A	2.2	14.7	59	*<0.5*	*<0.03*	64.9	0.089	*<0.0001*	0.0028	0.00183	*<3.5E-06*	0.000009	0.003	0.000011	23.8	*<0.000015*	0.000098	0.00033	*<0.0035*
2-Aug-18	14	500	445	7.55	135	#N/A	1.9	13.4	48																
9-Aug-18	15	500	415	7.62	141	#N/A	2.0	14.5	52	*<0.5*	*<0.03*	57.2	0.101	*<0.0001*	0.0031	0.00172	*<3.5E-06*	0.000009	0.006	0.000032	20.8	*<0.000015*	0.000108	0.00039	*<0.0035*
16-Aug-18	16	500	430	7.59	124	#N/A	3.5	13.3	50																
23-Aug-18	17	500	420	7.60	131	#N/A	4.0	14.8	50	*<0.5*	*<0.03*	58.0	0.075	*<0.0001*	0.0024	0.00180	*<3.5E-06*	*<0.0000035*	0.007	0.000011	21.3	*<0.000015*	0.000118	0.00035	*<0.0035*
30-Aug-18	18	500	420	7.51	121	#N/A	2.9	13.3	48																
6-Sep-18	19	500	415	7.52	123	#N/A	3.5	12.7	50	*<0.5*	*<0.03*	55.6	0.077	*<0.0001*	0.0023	0.00176	*<3.5E-06*	0.000007	0.006	0.000015	20.5	*<0.000015*	0.000116	0.00040	*<0.0035*
13-Sep-18	20	500	415	7.35	120	#N/A	4.3	13.2	47																
20-Sep-18	21	500	410	7.61	144	#N/A	2.6	14.4	46	*<0.5*	*<0.03*	51.6	0.069	*<0.0001*	0.0024	0.00162	0.000007	0.000008	0.006	0.000008	19.1	*<0.000015*	0.000117	0.00065	0.007
27-Sep-18	22	500	420	7.53	132	#N/A	3.9	11.7	41																
4-Oct-18	23	500	425	7.35	130	#N/A	3.7	12.7	44	*<0.5*	*<0.03*	47.2	0.064	*<0.0001*	0.0016	0.00135	*<3.5E-06*	0.000008	0.005	0.000010	17.6	*<0.000015*	0.000104	0.00031	*<0.0035*
11-Oct-18	24	500	405	7.59	121	#N/A	3.8	10.0	40																

Loads	**mg/kg**								mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
26-Apr-18	0			7.50					44.53	2.44	0.03355	42.7	0.026535	0.0000305	0.0088145	0.00222345	1.0675E-06	1.0675E-06	0.004575	9.15E-07	14.091	0.00002135	0.00020008	0.00017995	0.0010675
3-May-18	1			7.72					101.2	3.08	0.066	91.08	0.05016	0.00022	0.005632	0.0042636	0.00000154	0.00000154	0.01364	0.00000484	29.436	0.0000066	0.00017512	0.0001716	0.00154
10-May-18	2			7.59					66.24	0.46	0.069	60.26	0.069	0.00023	0.004324	0.0021436	0.00000161	0.00000161	0.01104	0.00000322	19.32	0.0000138	0.00007544	0.0001656	0.00161
17-May-18	3			7.75					48.36	0.465	0.06975	45.4305	0.05859	0.0002325	0.004464	0.0020088	1.6275E-06	0.000003255	0.012555	6.975E-06	14.9265	6.975E-06	0.0000651	0.00014415	0.0016275
24-May-18	4			7.59					32.76																
31-May-18	5			7.66					24.92	0.2225	0.0445	28.4355	0.068085	0.0001335	0.003293	0.00081435	1.5575E-06	0.00000534	0.00534	3.115E-06	9.8345	6.675E-06	2.9815E-05	0.0001602	0.003115
7-Jun-18	6			7.72					31.185																
14-Jun-18	7			7.65					20.24	0.46	0.0368	23.276	0.06256	0.000138	0.00276	0.0006716	0.00000161	0.00000414	0.00506	0.00000368	8.188	0.0000069	0.00002622	0.0001288	0.00161
21-Jun-18	8			7.63					15.48																
28-Jun-18	9			7.62					17.2	0.215	0.0301	20.038	0.05762	0.000086	0.002365	0.0008299	1.505E-06	0.00000688	0.00344	0.00000516	7.138	0.00000645	0.0000301	0.0000043	0.00602
5-Jul-18	10			7.60					16.6																
12-Jul-18	11			7.61					20.24	0.22	0.0264	25.388	0.05632	0.000044	0.001936	0.0006996	0.00000154	0.00000396	0.00396	0.00000066	9.196	0.0000066	0.0000396	0.0013244	0.00154
19-Jul-18	12			7.54					23.49																
26-Jul-18	13			7.46					26.845	0.2275	0.01365	29.5295	0.040495	0.0000455	0.001274	0.00083265	1.5925E-06	0.000004095	0.001365	5.005E-06	10.829	6.825E-06	0.00004459	0.00015015	0.0015925
2-Aug-18	14			7.55					21.36																
9-Aug-18	15			7.62					21.58	0.2075	0.01245	23.738	0.041915	0.0000415	0.0012865	0.0007138	1.4525E-06	0.000003735	0.00249	0.00001328	8.632	6.225E-06	0.00004482	0.00016185	0.0014525
16-Aug-18	16			7.59					21.5																
23-Aug-18	17			7.60					21	0.21	0.0126	24.36	0.0315	0.000042	0.001008	0.000756	0.00000147	0.00000147	0.00294	0.00000462	8.946	0.0000063	0.00004956	0.000147	0.00147
30-Aug-18	18			7.51					20.16																
6-Sep-18	19			7.52					20.75	0.2075	0.01245	23.074	0.031955	0.0000415	0.0009545	0.0007304	1.4525E-06	0.000002905	0.00249	6.225E-06	8.5075	6.225E-06	0.00004814	0.000166	0.0014525
13-Sep-18	20			7.35					19.505																
20-Sep-18	21			7.61					18.86	0.205	0.0123	21.156	0.02829	0.000041	0.000984	0.0006642	0.00000287	0.00000328	0.00246	0.00000328	7.831	0.00000615	0.00004797	0.0002665	0.00287
27-Sep-18	22			7.53					17.22																
4-Oct-18	23			7.35					18.7	0.2125	0.01275	20.06	0.0272	0.0000425	0.00068	0.00057375	1.4875E-06	0.0000034	0.002125	0.00000425	7.48	6.375E-06	0.0000442	0.00013175	0.0014875
11-Oct-18	24			7.59					16.2																

Appendix 4-5, Table 5: Kinetic Test Results - HC4

Mass	**1**																									
Date	**Cycle**	**Volume mL**		**pH**	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
	No.	**Input**	**Output**																							
					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
26-Apr-18	0	500	305	7.50	0.00001	0.0170	6.01	0.0986	*<0.005*	0.00048	0.0132	*<0.0015*	25.3	0.00061	0.83	*<0.000025*	6.36	0.150	57.9	0.000035	0.00025	*<0.000025*	0.000486	0.00009	*<0.001*	*<0.001*
3-May-18	1	500	440	7.72	0.00002	0.0183	9.57	0.107	0.02	0.00898	0.0046	*<0.0015*	29.4	0.00105	1.50	*<0.000025*	9.68	0.221	81.3	0.000031	0.00009	*<0.000025*	0.00138	0.00021	*<0.001*	*<0.001*
10-May-18	2	500	460	7.59	0.00003	0.0114	6.29	0.0461	*<0.005*	0.00855	0.0011	*<0.0015*	18.3	0.00067	1.52	*<0.000025*	4.24	0.125	48.8	0.000024	0.00008	*<0.000025*	0.000711	0.00023	*<0.001*	*<0.001*
17-May-18	3	500	465	7.75	0.00005	0.0095	4.28	0.0379	*<0.005*	0.00637	0.0005	0.003	13.3	0.00049	1.35	*<0.000025*	2.82	0.0972	35.8	0.000028	0.00009	*<0.000025*	0.000786	0.00024	*<0.001*	*<0.001*
24-May-18	4	500	420	7.59																						
31-May-18	5	500	445	7.66	0.00007	0.0046	2.10	0.0196	0.02	0.00315	0.0002	*<0.0015*	7.83	0.00023	1.34	*<0.000025*	0.94	0.0489	21.5	0.000017	0.00008	0.00024	0.000305	0.00029	*<0.001*	*<0.001*
7-Jun-18	6	500	495	7.72																						
14-Jun-18	7	500	460	7.65	0.00008	0.0040	1.53	0.0164	*<0.005*	0.00217	0.0002	*<0.0015*	5.48	0.00021	1.31	*<0.000025*	0.69	0.0354	16.5	0.000016	0.00003	0.00024	0.000338	0.00030	*<0.001*	*<0.001*
21-Jun-18	8	500	430	7.63																						
28-Jun-18	9	500	430	7.62	0.00018	0.0034	1.27	0.0160	*<0.005*	0.00147	0.0002	*<0.0015*	4.89	0.00015	1.26	*<0.000025*	0.44	0.03087	15.3	0.000015	0.00006	0.00065	0.000247	0.00032	*<0.001*	*<0.001*
5-Jul-18	10	500	415	7.60																						
12-Jul-18	11	500	440	7.61	0.00003	0.0033	1.38	0.0180	0.01	0.00097	0.0002	*<0.0015*	4.03	0.00017	1.07	*<0.000025*	0.36	0.0320	15.6	0.000016	0.00007	0.00014	0.000309	0.00028	*<0.001*	*<0.001*
19-Jul-18	12	500	435	7.54																						
26-Jul-18	13	500	455	7.46	0.00006	0.0034	1.32	0.0215	*<0.005*	0.00075	0.0001	*<0.0015*	4.59	0.00014	1.18	*<0.000025*	0.48	0.0369	16.2	0.000019	0.00002	0.00008	0.000360	0.00023	*<0.001*	*<0.001*
2-Aug-18	14	500	445	7.55																						
9-Aug-18	15	500	415	7.62	0.00008	0.0034	1.27	0.02042	0.06	0.00071	0.0002	*<0.0015*	4.57	0.00014	1.23	*<0.000025*	0.50	0.0317	17.0	0.000020	0.00003	0.00018	0.000274	0.00027	*<0.001*	*<0.001*
16-Aug-18	16	500	430	7.59																						
23-Aug-18	17	500	420	7.60	0.00007	0.0029	1.15	0.0241	*<0.005*	0.00073	0.0002	*<0.0015*	4.48	0.00014	1.34	*<0.000025*	0.50	0.0311	18.6	0.000020	0.00009	0.00013	0.000258	0.00022	*<0.001*	*<0.001*
30-Aug-18	18	500	420	7.51																						
6-Sep-18	19	500	415	7.52	0.00007	0.0028	1.05	0.0216	*<0.005*	0.00050	0.0002	*<0.0015*	3.59	0.00009	1.03	*<0.000025*	0.45	0.0289	18.2	0.000019	*<0.000005*	0.00015	0.000231	0.00022	*<0.001*	*<0.001*
13-Sep-18	20	500	415	7.35																						
20-Sep-18	21	500	410	7.61	0.00009	0.0026	0.925	0.0221	*<0.005*	0.00048	0.0002	*<0.0015*	3.70	0.00013	1.18	*<0.000025*	0.29	0.0282	16.6	0.000021	0.00004	0.00013	0.000250	0.00020	*<0.001*	*<0.001*
27-Sep-18	22	500	420	7.53																						
4-Oct-18	23	500	425	7.35	0.00005	0.0027	0.775	0.0210	*<0.005*	0.00032	*<0.00005*	*<0.0015*	2.94	0.00008	0.94	*<0.000025*	0.27	0.0230	12.7	0.000022	0.00003	0.00006	0.000182	0.00019	*<0.001*	*<0.001*
11-Oct-18	24	500	405	7.59																						

Loads	**mg/kg**				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
26-Apr-18	0			7.50	0.00000305	0.005185	1.83305	0.030073	0.001525	0.0001464	0.004026	0.0004575	7.7165	0.00018605	0.25315	7.625E-06	1.9398	0.04575	17.6595	1.0675E-05	0.00007625	7.625E-06	0.00014823	0.00002745	0.000305	0.000305
3-May-18	1			7.72	0.0000088	0.008052	4.2108	0.04708	0.0088	0.0039512	0.002024	0.00066	12.936	0.000462	0.66	0.000011	4.2592	0.09724	35.772	0.00001364	0.0000396	0.000011	0.0006072	0.0000924	0.00044	0.00044
10-May-18	2			7.59	0.0000138	0.005244	2.8934	0.021206	0.0023	0.003933	0.000506	0.00069	8.418	0.0003082	0.6992	0.0000115	1.9504	0.0575	22.448	0.00001104	0.0000368	0.0000115	0.00032706	0.0001058	0.00046	0.00046
17-May-18	3			7.75	0.00002325	0.0044175	1.9902	0.0176235	0.002325	0.00296205	0.0002325	0.001395	6.1845	0.00022785	0.62775	1.1625E-05	1.3113	0.045198	16.647	0.00001302	0.00004185	1.1625E-05	0.00036549	0.0001116	0.000465	0.000465
24-May-18	4			7.59																						
31-May-18	5			7.66	0.00003115	0.002047	0.9345	0.008722	0.0089	0.00140175	0.000089	0.0006675	3.48435	0.00010235	0.5963	1.1125E-05	0.4183	0.0217605	9.5675	7.565E-06	0.0000356	0.0001068	0.00013573	0.00012905	0.000445	0.000445
7-Jun-18	6			7.72																						
14-Jun-18	7			7.65	0.0000368	0.00184	0.7038	0.007544	0.0023	0.0009982	0.000092	0.00069	2.5208	0.0000966	0.6026	0.0000115	0.3174	0.016284	7.59	0.00000736	0.0000138	0.0001104	0.00015548	0.000138	0.00046	0.00046
21-Jun-18	8			7.63																						
28-Jun-18	9			7.62	0.0000774	0.001462	0.5461	0.00688	0.00215	0.0006321	0.000086	0.000645	2.1027	0.0000645	0.5418	0.00001075	0.1892	0.0132741	6.579	0.00000645	0.0000258	0.0002795	0.00010621	0.0001376	0.00043	0.00043
5-Jul-18	10			7.60																						
12-Jul-18	11			7.61	0.0000132	0.001452	0.6072	0.00792	0.0044	0.0004268	0.000088	0.00066	1.7732	0.0000748	0.4708	0.000011	0.1584	0.01408	6.864	0.00000704	0.0000308	0.0000616	0.00013596	0.0001232	0.00044	0.00044
19-Jul-18	12			7.54																						
26-Jul-18	13			7.46	0.0000273	0.001547	0.6006	0.0097825	0.002275	0.00034125	0.0000455	0.0006825	2.08845	0.0000637	0.5369	1.1375E-05	0.2184	0.0167895	7.371	8.645E-06	0.0000091	0.0000364	0.0001638	0.00010465	0.000455	0.000455
2-Aug-18	14			7.55																						
9-Aug-18	15			7.62	0.0000332	0.001411	0.52705	0.0084743	0.0249	0.00029465	0.000083	0.0006225	1.89655	0.0000581	0.51045	1.0375E-05	0.2075	0.0131555	7.055	0.0000083	0.00001245	0.0000747	0.00011371	0.00011205	0.000415	0.000415
16-Aug-18	16			7.59																						
23-Aug-18	17			7.60	0.0000294	0.001218	0.483	0.010122	0.0021	0.0003066	0.000084	0.00063	1.8816	0.0000588	0.5628	0.0000105	0.21	0.013062	7.812	0.0000084	0.0000378	0.0000546	0.00010836	0.0000924	0.00042	0.00042
30-Aug-18	18			7.51																						
6-Sep-18	19			7.52	0.00002905	0.001162	0.43575	0.008964	0.002075	0.0002075	0.000083	0.0006225	1.48985	0.00003735	0.42745	1.0375E-05	0.18675	0.0119935	7.553	7.885E-06	2.075E-06	0.00006225	9.5865E-05	0.0000913	0.000415	0.000415
13-Sep-18	20			7.35																						
20-Sep-18	21			7.61	0.0000369	0.001066	0.37925	0.009061	0.00205	0.0001968	0.000082	0.000615	1.517	0.0000533	0.4838	0.00001025	0.1189	0.011562	6.806	0.00000861	0.0000164	0.0000533	0.0001025	0.000082	0.00041	0.00041
27-Sep-18	22			7.53																						
4-Oct-18	23			7.35	0.00002125	0.0011475	0.329375	0.008925	0.002125	0.000136	0.00002125	0.0006375	1.2495	0.000034	0.3995	1.0625E-05	0.11475	0.009775	5.3975	0.00000935	0.00001275	0.0000255	0.00007735	0.00008075	0.000425	0.000425
11-Oct-18	24			7.59																						

Appendix 4-5, Table 6: Kinetic Test Results - HC5

Mass	**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**	**Fe**	**Pb**
	No.	**Input**	**Output**			**(pH 4.5)**	**(pH 8.3)**					**$CaCO_3$**														
					umhos/cm	mg$CaCO_3$/L	mg$CaCO_3$/L	mg$CaCO_3$/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	mg/L
26-Apr-18	0	500	320	7.71	430	#N/A	4.2	22.2	121	9	0.14	134	0.087	<0.0001	0.0128	0.00855	0.000008	<3.5E-06	0.015	0.000015	46.5	0.00008	0.000280	0.00067	0.018	0.00031
3-May-18	1	500	470	7.78	344	#N/A	2.0	20.7	133	9	0.14	131	0.151	<0.0001	0.0156	0.00585	<3.5E-06	<3.5E-06	0.026	0.000008	45.6	<0.000015	0.000136	0.00028	<0.0035	0.00001
10-May-18	2	500	440	7.69	336	#N/A	2.9	22.9	129	5	0.19	133	0.154	<0.0001	0.0166	0.00642	<3.5E-06	<3.5E-06	0.024	0.000011	45.3	0.00003	0.000158	0.00023	<0.0035	0.00001
17-May-18	3	500	445	7.94	265	#N/A	2.1	21.2	93	2	0.14	86.8	0.148	<0.0001	0.0140	0.00398	<3.5E-06	<3.5E-06	0.017	0.000013	29.2	<0.000015	0.000067	0.00019	<0.0035	0.00002
24-May-18	4	500	425	7.70	214	#N/A	3.5	23.1	70																	
31-May-18	5	500	440	8.00	182	#N/A	2.1	23.4	52	<0.5	0.16	66.1	0.171	<0.0001	0.0173	0.00300	<3.5E-06	<3.5E-06	0.015	0.000004	23.1	<0.000015	0.000071	0.00023	<0.0035	0.00001
7-Jun-18	6	500	515	8.10	176	#N/A	2.4	24.1	53																	
14-Jun-18	7	500	445	8.14	125	#N/A	2.2	22.2	30	1	0.11	43.9	0.195	<0.0001	0.0166	0.00164	<3.5E-06	<3.5E-06	0.010	0.000006	15.4	<0.000015	0.000053	0.00026	<0.0035	0.00004
21-Jun-18	8	500	430	8.12	123	#N/A	2.7	22.6	31																	
28-Jun-18	9	500	423	8.00	127	#N/A	3.7	22.7	34	<0.5	0.17	48.2	0.188	<0.0001	0.0164	0.00202	<3.5E-06	<3.5E-06	0.009	0.000015	17.1	<0.000015	0.000079	0.00011	0.012	0.00013
5-Jul-18	10	500	415	8.07	130	#N/A	3.2	22.9	32																	
12-Jul-18	11	500	450	8.20	127	#N/A	1.0	21.6	33	<0.5	0.08	50.9	0.198	<0.0001	0.0165	0.00207	<3.5E-06	<3.5E-06	0.009	<0.0000015	18.2	<0.000015	0.000144	0.00422	<0.0035	<0.000005
19-Jul-18	12	500	445	8.14	123	#N/A	0.8	21.5	33																	
26-Jul-18	13	500	435	7.73	111	#N/A	2.2	23.4	29	<0.5	0.06	44.5	0.170	<0.0001	0.0125	0.00175	<3.5E-06	<3.5E-06	0.003	0.000004	15.9	<0.000015	0.000076	0.00030	<0.0035	0.00004
2-Aug-18	14	500	430	8.29	102	#N/A	1.0	21.4	27																	
9-Aug-18	15	500	420	8.11	102	#N/A	1.3	20.7	27	<0.5	<0.03	42.2	0.181	<0.0001	0.0121	0.00164	<3.5E-06	<3.5E-06	0.005	0.000003	15.2	<0.000015	0.000063	0.00040	<0.0035	0.00007
16-Aug-18	16	500	440	8.26	90	#N/A	2.0	21.5	26																	
23-Aug-18	17	500	435	8.13	87	#N/A	2.7	21.3	23	<0.5	<0.03	38.8	0.156	<0.0001	0.0108	0.00131	<3.5E-06	<3.5E-06	0.006	0.000005	14.1	<0.000015	0.000056	0.00050	<0.0035	0.00003
30-Aug-18	18	500	425	8.19	88	#N/A	1.3	22.8	25																	
6-Sep-18	19	500	415	8.16	88	#N/A	1.9	22.5	24	<0.5	<0.03	41.3	0.164	<0.0001	0.0123	0.00145	<3.5E-06	<3.5E-06	0.006	0.000003	14.9	<0.000015	0.000063	0.00038	<0.0035	0.00004
13-Sep-18	20	500	425	7.67	84	#N/A	3.7	22.4	21																	
20-Sep-18	21	500	415	8.10	95	#N/A	2.1	22.5	19	<0.5	<0.03	34.7	0.136	<0.0001	0.0126	0.00117	0.000007	<3.5E-06	0.005	0.000003	12.6	0.00018	0.000063	0.00060	0.011	0.00005
27-Sep-18	22	500	430	8.25	93	#N/A	2.2	19.7	18																	
4-Oct-18	23	500	430	7.73	99	#N/A	3.7	22.4	21	<0.5	<0.03	37.5	0.139	<0.0001	0.0108	0.00115	<3.5E-06	<3.5E-06	0.006	<0.0000015	13.7	0.00003	0.000060	0.00044	<0.0035	0.00005
11-Oct-18	24	500	400	7.90	93	#N/A	3.1	21.4	19																	

Loads	**mg/kg**								mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
26-Apr-18	0			7.71					38.72	2.88	0.0448	42.88	0.02784	0.000032	0.004096	0.002736	2.56E-06	1.12E-06	0.0048	0.0000048	14.88	0.0000256	0.0000896	0.0002144	0.00576	0.0000992
3-May-18	1			7.78					62.51	4.23	0.0658	61.57	0.07097	0.000047	0.007332	0.0027495	1.645E-06	1.645E-06	0.01222	0.00000376	21.432	7.05E-06	0.00006392	0.0001316	0.001645	0.0000047
10-May-18	2			7.69					56.76	2.2	0.0836	58.52	0.06776	0.000044	0.007304	0.0028248	1.54E-06	1.54E-06	0.01056	0.00000484	19.932	0.0000132	0.00006952	0.0001012	0.00154	0.0000044
17-May-18	3			7.94					41.385	0.89	0.0623	38.626	0.06586	0.0000445	0.00623	0.0017711	1.558E-06	1.558E-06	0.007565	0.000005785	12.994	6.675E-06	0.000029815	8.455E-05	0.0015575	0.0000089
24-May-18	4			7.70					29.75																	
31-May-18	5			8.00					22.88	0.22	0.0704	29.084	0.07524	0.000044	0.007612	0.00132	1.54E-06	1.54E-06	0.0066	0.00000176	10.164	0.0000066	0.00003124	0.0001012	0.00154	0.0000044
7-Jun-18	6			8.10					27.295																	
14-Jun-18	7			8.14					13.35	0.445	0.04895	19.5355	0.086775	0.0000445	0.007387	0.0007298	1.558E-06	1.558E-06	0.00445	0.00000267	6.853	6.675E-06	0.000023585	0.0001157	0.0015575	0.0000178
21-Jun-18	8			8.12					13.33																	
28-Jun-18	9			8.00					14.382	0.2115	0.07191	20.3886	0.079524	0.0000423	0.0069372	0.0008545	1.481E-06	1.481E-06	0.003807	0.000006345	7.2333	6.345E-06	0.000033417	4.653E-05	0.005076	5.499E-05
5-Jul-18	10			8.07					13.28																	
12-Jul-18	11			8.20					14.85	0.225	0.036	22.905	0.0891	0.000045	0.007425	0.0009315	1.575E-06	1.575E-06	0.00405	0.000000675	8.19	6.75E-06	0.0000648	0.001899	0.001575	2.25E-06
19-Jul-18	12			8.14					14.685																	
26-Jul-18	13			7.73					12.615	0.2175	0.0261	19.3575	0.07395	0.0000435	0.0054375	0.0007613	1.523E-06	1.523E-06	0.001305	0.00000174	6.9165	6.525E-06	0.00003306	0.0001305	0.0015225	0.0000174
2-Aug-18	14			8.29					11.61																	
9-Aug-18	15			8.11					11.34	0.21	0.0126	17.724	0.07602	0.000042	0.005082	0.0006888	1.47E-06	1.47E-06	0.0021	0.00000126	6.384	0.0000063	0.00002646	0.000168	0.00147	0.0000294
16-Aug-18	16			8.26					11.44																	
23-Aug-18	17			8.13					10.005	0.2175	0.01305	16.878	0.06786	0.0000435	0.004698	0.0005699	1.523E-06	1.523E-06	0.00261	0.000002175	6.1335	6.525E-06	0.00002436	0.0002175	0.0015225	1.305E-05
30-Aug-18	18			8.19					10.625																	
6-Sep-18	19			8.16					9.96	0.2075	0.01245	17.1395	0.06806	0.0000415	0.0051045	0.0006018	1.453E-06	1.453E-06	0.00249	0.000001245	6.1835	6.225E-06	0.000026145	0.0001577	0.0014525	0.0000166
13-Sep-18	20			7.67					8.925																	
20-Sep-18	21			8.10					7.885	0.2075	0.01245	14.4005	0.05644	0.0000415	0.005229	0.0004856	2.905E-06	1.453E-06	0.002075	0.000001245	5.229	0.0000747	0.000026145	0.000249	0.004565	2.075E-05
27-Sep-18	22			8.25					7.74																	
4-Oct-18	23			7.73					9.03	0.215	0.0129	16.125	0.05977	0.000043	0.004644	0.0004945	1.505E-06	1.505E-06	0.00258	0.000000645	5.891	0.0000129	0.0000258	0.0001892	0.001505	0.0000215
11-Oct-18	24			7.90					7.6																	

Appendix 4-5, Table 6: Kinetic Test Results - HC5

Mass	**1**																								
Date	**Cycle**	**Volume mL**		**pH**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
	No.	**Input**	**Output**																						
					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
26-Apr-18	0	500	320	7.71	0.0183	4.32	0.0635	*<0.005*	0.00195	0.0033	0.005	11.3	0.00095	1.16	*<0.000025*	9.14	0.169	46.7	0.000054	0.00016	0.00022	0.00105	0.00025	*<0.001*	*<0.001*
3-May-18	1	500	470	7.78	0.0143	4.17	0.0453	0.02	0.00626	0.0014	*<0.0015*	8.62	0.00123	1.28	*<0.000025*	9.50	0.184	46.8	0.000033	0.00015	*<0.000025*	0.00150	0.00046	*<0.001*	*<0.001*
10-May-18	2	500	440	7.69	0.0150	4.92	0.0376	*<0.005*	0.00697	0.0010	*<0.0015*	10.1	0.00105	1.67	*<0.000025*	9.08	0.183	47.5	0.000038	0.00007	0.00009	0.00172	0.00061	*<0.001*	*<0.001*
17-May-18	3	500	445	7.94	0.0093	3.38	0.0220	*<0.005*	0.00545	0.0004	*<0.0015*	6.34	0.00091	1.36	*<0.000025*	6.42	0.129	30.5	0.000024	0.00006	*<0.000025*	0.00146	0.00050	*<0.001*	*<0.001*
24-May-18	4	500	425	7.70																					
31-May-18	5	500	440	8.00	0.0070	2.02	0.0139	*<0.005*	0.00398	0.0003	*<0.0015*	6.11	0.00038	1.71	*<0.000025*	2.79	0.0819	20.4	0.000021	0.00002	0.00005	0.000802	0.00063	*<0.001*	*<0.001*
7-Jun-18	6	500	515	8.10																					
14-Jun-18	7	500	445	8.14	0.0054	1.29	0.0101	*<0.005*	0.00255	0.0002	*<0.0015*	4.21	0.00028	1.47	*<0.000025*	1.54	0.0504	11.7	0.000020	0.00003	0.00011	0.000518	0.00068	*<0.001*	*<0.001*
21-Jun-18	8	500	430	8.12																					
28-Jun-18	9	500	423	8.00	0.0055	1.31	0.0125	*<0.005*	0.00235	0.0002	*<0.0015*	4.77	0.00025	1.71	*<0.000025*	1.22	0.05321	13.6	0.000023	0.00005	0.00064	0.000566	0.00071	*<0.001*	*<0.001*
5-Jul-18	10	500	415	8.07																					
12-Jul-18	11	500	450	8.20	0.0052	1.34	0.0113	*<0.005*	0.00209	0.0002	*<0.0015*	3.70	0.00020	1.40	*<0.000025*	0.90	0.0506	11.1	0.000020	0.00007	0.00013	0.000706	0.00074	*<0.001*	*<0.001*
19-Jul-18	12	500	445	8.14																					
26-Jul-18	13	500	435	7.73	0.0055	1.18	0.0120	0.02	0.00221	*<0.00005*	*<0.0015*	4.01	0.00017	1.44	*<0.000025*	0.86	0.0461	8.2	0.000025	0.00002	0.00014	0.000609	0.00071	*<0.001*	*<0.001*
2-Aug-18	14	500	430	8.29																					
9-Aug-18	15	500	420	8.11	0.0044	1.01	0.00985	0.06	0.00218	0.0002	*<0.0015*	3.24	0.00012	1.30	*<0.000025*	0.76	0.0438	9.1	0.000019	0.00003	0.00020	0.000517	0.00071	*<0.001*	*<0.001*
16-Aug-18	16	500	440	8.26																					
23-Aug-18	17	500	435	8.13	0.0036	0.883	0.00923	*<0.005*	0.00215	0.0001	*<0.0015*	2.83	0.00013	1.58	*<0.000025*	0.69	0.0387	8.2	0.000017	0.00016	0.00012	0.000488	0.00067	*<0.001*	*<0.001*
30-Aug-18	18	500	425	8.19																					
6-Sep-18	19	500	415	8.16	0.0042	1.00	0.00938	*<0.005*	0.00232	0.0001	*<0.0015*	2.95	0.00014	1.32	*<0.000025*	0.68	0.0391	8.9	0.000020	*<0.000005*	0.00013	0.000512	0.00075	*<0.001*	*<0.001*
13-Sep-18	20	500	425	7.67																					
20-Sep-18	21	500	415	8.10	0.0038	0.811	0.00868	*<0.005*	0.00209	0.0001	*<0.0015*	2.50	0.00018	1.24	*<0.000025*	0.46	0.0344	6.3	0.000017	0.00009	0.00031	0.000404	0.00074	*<0.001*	*<0.001*
27-Sep-18	22	500	430	8.25																					
4-Oct-18	23	500	430	7.73	0.0040	0.794	0.00953	*<0.005*	0.00160	*<0.00005*	*<0.0015*	2.33	0.00009	1.25	*<0.000025*	0.44	0.0331	7.1	0.000017	0.00003	0.00017	0.000515	0.00067	*<0.001*	*<0.001*
11-Oct-18	24	500	400	7.90																					

Loads	**mg/kg**				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
26-Apr-18	0			7.71	0.005856	1.3824	0.02032	0.0016	0.000624	0.001056	0.0016	3.616	0.000304	0.3712	0.000008	2.9248	0.05408	14.944	0.00001728	0.0000512	0.0000704	0.000336	0.00008	0.00032	0.00032
3-May-18	1			7.78	0.006721	1.9599	0.021291	0.0094	0.0029422	0.000658	0.000705	4.0514	0.0005781	0.6016	1.175E-05	4.465	0.08648	21.996	0.00001551	0.0000705	1.175E-05	0.000705	0.0002162	0.00047	0.00047
10-May-18	2			7.69	0.0066	2.1648	0.016544	0.0022	0.0030668	0.00044	0.00066	4.444	0.000462	0.7348	0.000011	3.9952	0.08052	20.9	0.00001672	0.0000308	0.0000396	0.0007568	0.0002684	0.00044	0.00044
17-May-18	3			7.94	0.0041385	1.5041	0.00979	0.002225	0.0024253	0.000178	0.0006675	2.8213	0.000405	0.6052	1.113E-05	2.8569	0.057405	13.5725	0.00001068	0.0000267	1.113E-05	0.0006497	0.0002225	0.000445	0.000445
24-May-18	4			7.70																					
31-May-18	5			8.00	0.00308	0.8888	0.006116	0.0022	0.0017512	0.000132	0.00066	2.6884	0.0001672	0.7524	0.000011	1.2276	0.036036	8.976	0.00000924	0.0000088	0.000022	0.00035288	0.0002772	0.00044	0.00044
7-Jun-18	6			8.10																					
14-Jun-18	7			8.14	0.002403	0.57405	0.0044945	0.002225	0.0011348	0.000089	0.0006675	1.87345	0.0001246	0.65415	1.113E-05	0.6853	0.022428	5.2065	0.0000089	1.335E-05	4.895E-05	0.00023051	0.0003026	0.000445	0.000445
21-Jun-18	8			8.12																					
28-Jun-18	9			8.00	0.0023265	0.55413	0.0052875	0.002115	0.0009941	0.0000846	0.0006345	2.01771	0.0001058	0.72333	1.058E-05	0.51606	0.0225078	5.7528	9.729E-06	2.115E-05	0.0002707	0.000239418	0.0003003	0.000423	0.000423
5-Jul-18	10			8.07																					
12-Jul-18	11			8.20	0.00234	0.603	0.005085	0.00225	0.0009405	0.00009	0.000675	1.665	0.00009	0.63	1.125E-05	0.405	0.02277	4.995	0.000009	0.0000315	0.0000585	0.0003177	0.000333	0.00045	0.00045
19-Jul-18	12			8.14																					
26-Jul-18	13			7.73	0.0023925	0.5133	0.00522	0.0087	0.0009614	2.175E-05	0.0006525	1.74435	7.395E-05	0.6264	1.088E-05	0.3741	0.0200535	3.567	1.0875E-05	0.0000087	0.0000609	0.000264915	0.0003089	0.000435	0.000435
2-Aug-18	14			8.29																					
9-Aug-18	15			8.11	0.001848	0.4242	0.004137	0.0252	0.0009156	0.000084	0.00063	1.3608	0.0000504	0.546	0.0000105	0.3192	0.018396	3.822	0.00000798	0.0000126	0.000084	0.00021714	0.0002982	0.00042	0.00042
16-Aug-18	16			8.26																					
23-Aug-18	17			8.13	0.001566	0.384105	0.0040151	0.002175	0.0009353	0.0000435	0.0006525	1.23105	5.655E-05	0.6873	1.088E-05	0.30015	0.0168345	3.567	7.395E-06	0.0000696	0.0000522	0.00021228	0.0002915	0.000435	0.000435
30-Aug-18	18			8.19																					
6-Sep-18	19			8.16	0.001743	0.415	0.0038927	0.002075	0.0009628	0.0000415	0.0006225	1.22425	0.0000581	0.5478	1.038E-05	0.2822	0.0162265	3.6935	0.0000083	2.075E-06	5.395E-05	0.00021248	0.0003113	0.000415	0.000415
13-Sep-18	20			7.67																					
20-Sep-18	21			8.10	0.001577	0.336565	0.0036022	0.002075	0.0008674	0.0000415	0.0006225	1.0375	0.0000747	0.5146	1.038E-05	0.1909	0.014276	2.6145	7.055E-06	3.735E-05	0.0001287	0.00016766	0.0003071	0.000415	0.000415
27-Sep-18	22			8.25																					
4-Oct-18	23			7.73	0.00172	0.34142	0.0040979	0.00215	0.000688	0.0000215	0.000645	1.0019	0.0000387	0.5375	1.075E-05	0.1892	0.014233	3.053	0.00000731	0.0000129	0.0000731	0.00022145	0.0002881	0.00043	0.00043
11-Oct-18	24			7.90																					

Appendix 4-5, Table 7: Kinetic Test Results - HC6

Mass	**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)**					**$CaCO_3$**												
					umhos/cm	$mgCaCO_3/L$	$mgCaCO_3/L$	$mgCaCO_3/L$	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
26-Apr-18	0	500	345	7.60	606	#N/A	5.0	17.3	195	13	0.25	167	0.067	0.0003	0.0093	0.0113	*<0.0000035*	*<0.0000035*	0.018	0.000010	53.0	0.00010	0.000162	0.00096
3-May-18	1	500	465	7.57	355	#N/A	2.1	14.8	141	9	0.25	117	0.135	0.0008	0.0089	0.00577	*<0.0000035*	*<0.0000035*	0.019	0.000008	36.9	*<0.000015*	0.000037	0.00024
10-May-18	2	500	460	7.49	257	#N/A	3.1	15.6	95	2	0.26	95.3	0.164	0.0007	0.0089	0.00372	*<0.0000035*	*<0.0000035*	0.017	0.000009	29.9	0.00006	0.000028	0.00021
17-May-18	3	500	445	7.49	185	#N/A	2.5	12.9	64	1	0.20	56.9	0.097	0.0005	0.0062	0.00242	*<0.0000035*	*<0.0000035*	0.011	0.000012	18.1	*<0.000015*	0.000023	0.00142
24-May-18	4	500	430	7.49	146	#N/A	3.7	14.2	46															
31-May-18	5	500	450	7.59	120	#N/A	2.6	14.0	35	*<0.5*	0.19	38.2	0.152	0.0005	0.0070	0.00141	*<0.0000035*	*<0.0000035*	0.010	0.000006	12.5	*<0.000015*	0.000018	0.00020
7-Jun-18	6	500	500	7.58	128	#N/A	3.5	14.7	40															
14-Jun-18	7	500	445	7.55	82	#N/A	3.6	12.1	22	1	0.13	26.3	0.133	0.0004	0.0062	0.00087	*<0.0000035*	*<0.0000035*	0.009	0.000004	8.72	*<0.000015*	0.000006	0.00027
21-Jun-18	8	500	440	7.49	78	#N/A	4.2	11.1	22															
28-Jun-18	9	500	430	7.44	71	#N/A	5.1	10.9	21	*<0.5*	0.13	22.9	0.109	0.0003	0.0056	0.00085	*<0.0000035*	*<0.0000035*	0.007	0.000018	7.49	0.00004	0.000005	*<0.00001*
5-Jul-18	10	500	410	7.51	80	#N/A	4.9	11.5	20															
12-Jul-18	11	500	435	7.55	81	#N/A	1.6	11.5	22	*<0.5*	0.10	28.7	0.116	0.0004	0.0066	0.00099	*<0.0000035*	*<0.0000035*	0.009	*<0.0000015*	9.42	*<0.000015*	0.000026	0.00352
19-Jul-18	12	500	425	7.47	71	#N/A	1.3	11.1	20															
26-Jul-18	13	500	440	7.39	71	#N/A	2.1	11.3	22	*<0.5*	0.09	25.3	0.089	0.0003	0.0056	0.00080	*<0.0000035*	*<0.0000035*	0.003	0.000004	8.47	*<0.000015*	0.000010	0.00017
2-Aug-18	14	500	430	7.55	69	#N/A	1.7	11.1	21															
9-Aug-18	15	500	415	7.48	71	#N/A	2.0	10.8	22	*<0.5*	0.09	25.7	0.094	0.0004	0.0069	0.00083	*<0.0000035*	*<0.0000035*	0.006	0.000004	8.62	*<0.000015*	0.000010	0.00024
16-Aug-18	16	500	440	7.71	67	#N/A	3.2	12.7	19															
23-Aug-18	17	500	430	7.62	55	#N/A	3.7	10.6	18	*<0.5*	0.07	21.8	0.076	0.0003	0.0057	0.00070	*<0.0000035*	*<0.0000035*	0.005	0.000005	7.48	0.00003	0.000014	0.00024
30-Aug-18	18	500	425	7.44	56	#N/A	2.6	10.2	18															
6-Sep-18	19	500	420	7.49	64	#N/A	3.3	10.7	20	*<0.5*	0.07	26.8	0.071	0.0004	0.0070	0.00087	*<0.0000035*	*<0.0000035*	0.006	0.000005	9.17	*<0.000015*	0.000010	0.00047
13-Sep-18	20	500	420	7.36	62	#N/A	4.0	11.0	22															
20-Sep-18	21	500	430	7.54	72	#N/A	2.4	11.5	19	*<0.5*	0.06	24.1	0.070	0.0004	0.0084	0.00075	0.000008	*<0.0000035*	0.009	0.000006	8.21	*<0.000015*	0.000016	0.00053
27-Sep-18	22	500	425	7.42	76	#N/A	3.4	8.7	22															
4-Oct-18	23	500	420	7.28	73	#N/A	3.3	9.3	21	*<0.5*	*<0.03*	25.1	0.056	0.0003	0.0059	0.00081	*<0.0000035*	*<0.0000035*	0.006	*<0.0000015*	8.74	0.00004	0.000014	0.00029
11-Oct-18	24	500	410	7.61	73	#N/A	3.4	7.9	21															

Loads	**mg/kg**								mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
26-Apr-18	0			7.60					67.275	4.485	0.08625	57.615	0.023115	0.0001035	0.0032085	0.0038985	1.2075E-06	1.2075E-06	0.00621	0.00000345	18.285	0.0000345	0.00005589	0.0003312
3-May-18	1			7.57					65.565	4.185	0.11625	54.405	0.062775	0.000372	0.0041385	0.0026831	1.6275E-06	1.6275E-06	0.008835	0.00000372	17.1585	0.000006975	0.000017205	0.0001116
10-May-18	2			7.49					43.7	0.92	0.1196	43.838	0.07544	0.000322	0.004094	0.0017112	0.00000161	0.00000161	0.00782	0.00000414	13.754	0.0000276	0.00001288	0.0000966
17-May-18	3			7.49					28.48	0.445	0.089	25.3205	0.043165	0.0002225	0.002759	0.0010769	1.5575E-06	1.5575E-06	0.004895	0.00000534	8.0545	0.000006675	0.000010235	0.0006319
24-May-18	4			7.49					19.78															
31-May-18	5			7.59					15.75	0.225	0.0855	17.19	0.0684	0.000225	0.00315	0.0006345	0.000001575	0.000001575	0.0045	0.0000027	5.625	0.00000675	0.0000081	0.00009
7-Jun-18	6			7.58					20															
14-Jun-18	7			7.55					9.79	0.445	0.05785	11.7035	0.059185	0.000178	0.002759	0.0003872	1.5575E-06	1.5575E-06	0.004005	0.00000178	3.8804	0.000006675	0.00000267	0.0001202
21-Jun-18	8			7.49					9.68															
28-Jun-18	9			7.44					9.03	0.215	0.0559	9.847	0.04687	0.000129	0.002408	0.0003655	0.000001505	0.000001505	0.00301	0.00000774	3.2207	0.0000172	0.00000215	0.0000043
5-Jul-18	10			7.51					8.2															
12-Jul-18	11			7.55					9.57	0.2175	0.0435	12.4845	0.05046	0.000174	0.002871	0.0004307	1.5225E-06	1.5225E-06	0.003915	6.525E-07	4.0977	0.000006525	0.00001131	0.0015312
19-Jul-18	12			7.47					8.5															
26-Jul-18	13			7.39					9.68	0.22	0.0396	11.132	0.03916	0.000132	0.002464	0.000352	0.00000154	0.00000154	0.00132	0.00000176	3.7268	0.0000066	0.0000044	0.0000748
2-Aug-18	14			7.55					9.03															
9-Aug-18	15			7.48					9.13	0.2075	0.03735	10.6655	0.03901	0.000166	0.0028635	0.0003445	1.4525E-06	1.4525E-06	0.00249	0.00000166	3.5773	0.000006225	0.00000415	0.0000996
16-Aug-18	16			7.71					8.36															
23-Aug-18	17			7.62					7.74	0.215	0.0301	9.374	0.03268	0.000129	0.002451	0.000301	0.000001505	0.000001505	0.00215	0.00000215	3.2164	0.0000129	0.00000602	0.0001032
30-Aug-18	18			7.44					7.65															
6-Sep-18	19			7.49					8.4	0.21	0.0294	11.256	0.02982	0.000168	0.00294	0.0003654	0.00000147	0.00000147	0.00252	0.0000021	3.8514	0.0000063	0.0000042	0.0001974
13-Sep-18	20			7.36					9.24															
20-Sep-18	21			7.54					8.17	0.215	0.0258	10.363	0.0301	0.000172	0.003612	0.0003225	0.00000344	0.000001505	0.00387	0.00000258	3.5303	0.00000645	0.00000688	0.0002279
27-Sep-18	22			7.42					9.35															
4-Oct-18	23			7.28					8.82	0.21	0.0126	10.542	0.02352	0.000126	0.002478	0.0003402	0.00000147	0.00000147	0.00252	0.00000063	3.6708	0.0000168	0.00000588	0.0001218
11-Oct-18	24			7.61					8.61															

Appendix 4-5, Table 7: Kinetic Test Results - HC6

Mass	**1**																										
Date	**Cycle**	**Volume mL**		**pH**	**Fe**	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
	No.	**Input**	**Output**																								
					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
26-Apr-18	0	500	345	7.60	*<0.0035*	0.00003	0.0266	8.46	0.163	0.03	0.00127	0.0085	0.003	33.6	0.00127	1.15	*<0.000025*	11.9	0.303	71.8	0.000033	0.00026	*<0.000025*	0.000586	0.00011	0.005	*<0.001*
3-May-18	1	500	465	7.57	*<0.0035*	*<0.000005*	0.0147	6.11	0.0721	0.01	0.00679	0.0007	*<0.0015*	19.3	0.00114	1.22	*<0.000025*	8.75	0.191	50.7	0.000017	0.00011	0.00006	0.000386	0.00024	*<0.001*	*<0.001*
10-May-18	2	500	460	7.49	0.010	0.00002	0.0117	5.03	0.0477	*<0.005*	0.00517	0.0004	*<0.0015*	14.8	0.00075	1.57	*<0.000025*	4.94	0.139	35.9	0.000020	0.00012	0.00050	0.000305	0.00036	0.003	*<0.001*
17-May-18	3	500	445	7.49	*<0.0035*	0.00015	0.0069	2.83	0.0281	*<0.005*	0.00355	0.0002	*<0.0015*	8.80	0.00044	1.08	*<0.000025*	2.89	0.0925	21.8	0.000014	0.00015	0.00005	0.000255	0.00022	0.002	*<0.001*
24-May-18	4	500	430	7.49																							
31-May-18	5	500	450	7.59	0.007	*<0.000005*	0.0043	1.71	0.0161	*<0.005*	0.00224	*<0.00005*	*<0.0015*	6.43	0.00024	1.42	*<0.000025*	1.49	0.0493	13.0	0.000006	0.00004	0.00026	0.000159	0.00037	*<0.001*	*<0.001*
7-Jun-18	6	500	500	7.58																							
14-Jun-18	7	500	445	7.55	*<0.0035*	0.00001	0.0036	1.11	0.0114	*<0.005*	0.00137	*<0.00005*	*<0.0015*	4.17	0.00014	1.12	*<0.000025*	0.90	0.0317	8.7	0.000005	0.00005	0.00019	0.000222	0.00037	*<0.001*	*<0.001*
21-Jun-18	8	500	440	7.49																							
28-Jun-18	9	500	430	7.44	0.017	0.00004	0.0030	1.01	0.0103	0.02	0.00098	*<0.00005*	*<0.0015*	3.64	0.00009	1.09	*<0.000025*	0.58	0.02684	8.0	0.000006	0.00005	0.00077	0.000151	0.00037	*<0.001*	*<0.001*
5-Jul-18	10	500	410	7.51																							
12-Jul-18	11	500	435	7.55	0.007	*<0.000005*	0.0032	1.26	0.0112	*<0.005*	0.00104	*<0.00005*	*<0.0015*	3.44	0.00009	1.12	*<0.000025*	0.55	0.0299	7.4	*<0.0000025*	0.00009	0.00059	0.000171	0.00043	*<0.001*	*<0.001*
19-Jul-18	12	500	425	7.47																							
26-Jul-18	13	500	440	7.39	*<0.0035*	*<0.000005*	0.0031	1.00	0.00962	*<0.005*	0.00066	*<0.00005*	*<0.0015*	3.34	0.00008	1.13	*<0.000025*	0.52	0.0271	6.0	0.000006	0.00004	0.00014	0.000198	0.00042	*<0.001*	*<0.001*
2-Aug-18	14	500	430	7.55																							
9-Aug-18	15	500	415	7.48	*<0.0035*	0.00003	0.0029	1.02	0.00900	0.05	0.00074	*<0.00005*	*<0.0015*	3.11	0.00006	1.12	*<0.000025*	0.56	0.0269	7.2	0.000007	0.00005	0.00032	0.000159	0.00045	*<0.001*	*<0.001*
16-Aug-18	16	500	440	7.71																							
23-Aug-18	17	500	430	7.62	*<0.0035*	*<0.000005*	0.0022	0.768	0.00929	*<0.005*	0.00043	*<0.00005*	*<0.0015*	2.40	*<0.00002*	1.14	*<0.000025*	0.40	0.0220	5.7	0.000005	*<0.000005*	0.00023	0.000135	0.00039	*<0.001*	*<0.001*
30-Aug-18	18	500	425	7.44																							
6-Sep-18	19	500	420	7.49	*<0.0035*	0.00002	0.0026	0.940	0.00960	*<0.005*	0.00051	*<0.00005*	*<0.0015*	2.72	0.00005	1.13	*<0.000025*	0.43	0.0268	8.1	0.000006	*<0.000005*	0.00014	0.000162	0.00041	0.003	*<0.001*
13-Sep-18	20	500	420	7.36																							
20-Sep-18	21	500	430	7.54	0.009	0.00002	0.0026	0.864	0.00936	*<0.005*	0.00071	*<0.00005*	*<0.0015*	2.42	0.00008	1.24	*<0.000025*	0.30	0.0239	6.8	0.000007	0.00005	0.00036	0.000165	0.00046	*<0.001*	*<0.001*
27-Sep-18	22	500	425	7.42																							
4-Oct-18	23	500	420	7.28	*<0.0035*	0.00001	0.0028	0.795	0.00965	*<0.005*	0.00026	*<0.00005*	*<0.0015*	1.99	0.00005	1.03	*<0.000025*	0.26	0.0234	7.1	0.000005	0.00004	0.00010	0.000138	0.00040	*<0.001*	*<0.001*
11-Oct-18	24	500	410	7.61																							

Loads	**mg/kg**				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
26-Apr-18	0			7.60	0.0012075	1.035E-05	0.009177	2.9187	0.056235	0.01035	0.0004382	0.0029325	0.001035	11.592	0.0004382	0.39675	8.625E-06	4.1055	0.104535	24.771	0.000011385	0.0000897	8.625E-06	0.0002022	3.795E-05	0.001725	0.000345
3-May-18	1			7.57	0.0016275	2.325E-06	0.0068355	2.84115	0.0335265	0.00465	0.0031574	0.0003255	0.0006975	8.9745	0.0005301	0.5673	1.163E-05	4.06875	0.088815	23.576	0.000007905	5.115E-05	0.0000279	0.0001795	0.0001116	0.000465	0.000465
10-May-18	2			7.49	0.0046	0.0000092	0.005382	2.3138	0.021942	0.0023	0.0023782	0.000184	0.00069	6.808	0.000345	0.7222	0.0000115	2.2724	0.06394	16.514	0.0000092	0.0000552	0.00023	0.0001403	0.0001656	0.00138	0.00046
17-May-18	3			7.49	0.0015575	6.675E-05	0.0030705	1.25935	0.0125045	0.002225	0.0015798	0.000089	0.0006675	3.916	0.0001958	0.4806	1.113E-05	1.28605	0.0411625	9.701	0.00000623	6.675E-05	2.225E-05	0.0001135	0.0000979	0.00089	0.000445
24-May-18	4			7.49																							
31-May-18	5			7.59	0.00315	2.25E-06	0.001935	0.7695	0.007245	0.00225	0.001008	0.0000225	0.000675	2.8935	0.000108	0.639	1.125E-05	0.6705	0.022185	5.85	0.0000027	0.000018	0.000117	7.155E-05	0.0001665	0.00045	0.00045
7-Jun-18	6			7.58																							
14-Jun-18	7			7.55	0.0015575	4.45E-06	0.001602	0.49395	0.005073	0.002225	0.0006097	2.225E-05	0.0006675	1.85565	0.0000623	0.4984	1.113E-05	0.4005	0.0141065	3.8715	0.000002225	2.225E-05	8.455E-05	9.879E-05	0.0001647	0.000445	0.000445
21-Jun-18	8			7.49																							
28-Jun-18	9			7.44	0.00731	0.0000172	0.00129	0.4343	0.004429	0.0086	0.0004214	0.0000215	0.000645	1.5652	0.0000387	0.4687	1.075E-05	0.2494	0.0115412	3.44	0.00000258	0.0000215	0.0003311	6.493E-05	0.0001591	0.00043	0.00043
5-Jul-18	10			7.51																							
12-Jul-18	11			7.55	0.003045	2.175E-06	0.001392	0.5481	0.004872	0.002175	0.0004524	2.175E-05	0.0006525	1.4964	3.915E-05	0.4872	1.088E-05	0.23925	0.0130065	3.219	1.0875E-06	3.915E-05	0.0002567	7.439E-05	0.0001871	0.000435	0.000435
19-Jul-18	12			7.47																							
26-Jul-18	13			7.39	0.00154	0.0000022	0.001364	0.44	0.0042328	0.0022	0.0002904	0.000022	0.00066	1.4696	0.0000352	0.4972	0.000011	0.2288	0.011924	2.64	0.00000264	0.0000176	0.0000616	8.712E-05	0.0001848	0.00044	0.00044
2-Aug-18	14			7.55																							
9-Aug-18	15			7.48	0.0014525	1.245E-05	0.0012035	0.4233	0.003735	0.02075	0.0003071	2.075E-05	0.0006225	1.29065	0.0000249	0.4648	1.038E-05	0.2324	0.0111635	2.988	0.000002905	2.075E-05	0.0001328	6.599E-05	0.0001868	0.000415	0.000415
16-Aug-18	16			7.71																							
23-Aug-18	17			7.62	0.001505	2.15E-06	0.000946	0.33024	0.0039947	0.00215	0.0001849	0.0000215	0.000645	1.032	0.0000086	0.4902	1.075E-05	0.172	0.00946	2.451	0.00000215	2.15E-06	0.0000989	5.805E-05	0.0001677	0.00043	0.00043
30-Aug-18	18			7.44																							
6-Sep-18	19			7.49	0.00147	0.0000084	0.001092	0.3948	0.004032	0.0021	0.0002142	0.000021	0.00063	1.1424	0.000021	0.4746	0.0000105	0.1806	0.011256	3.402	0.00000252	0.0000021	0.0000588	6.804E-05	0.0001722	0.00126	0.00042
13-Sep-18	20			7.36																							
20-Sep-18	21			7.54	0.00387	0.0000086	0.001118	0.37152	0.0040248	0.00215	0.0003053	0.0000215	0.000645	1.0406	0.0000344	0.5332	1.075E-05	0.129	0.010277	2.924	0.00000301	0.0000215	0.0001548	7.095E-05	0.0001978	0.00043	0.00043
27-Sep-18	22			7.42																							
4-Oct-18	23			7.28	0.00147	0.0000042	0.001176	0.3339	0.004053	0.0021	0.0001092	0.000021	0.00063	0.8358	0.000021	0.4326	0.0000105	0.1092	0.009828	2.982	0.0000021	0.0000168	0.000042	5.796E-05	0.000168	0.00042	0.00042
11-Oct-18	24			7.61																							

Appendix 4-5, Table 8: Kinetic Test Results - HC7

Mass	**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**	**Fe**	**Pb**
	No.	**Input**	**Output**			**(pH 4.5)**	**(pH 8.3)**					**$CaCO_3$**														
					umhos/cm	$mgCaCO_3/L$	$mgCaCO_3/L$	$mgCaCO_3/L$	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	mg/L
26-Apr-18	0	500	315	7.83	156	#N/A	3.0	23.8	6	18	0.12	25.8	0.052	0.0004	0.0175	0.00167	*<3.5E-06*	*<3.5E-06*	0.009	0.000003	8.99	0.00005	*<0.000002*	0.00061	*<0.0035*	*<0.000005*
3-May-18	1	500	450	8.45	141	#N/A	#N/A	26.4	11	18	0.14	29.3	0.194	0.0009	0.0413	0.00222	*<3.5E-06*	*<3.5E-06*	0.020	0.000010	9.98	0.00005	*<0.000002*	0.00050	*<0.0035*	*<0.000005*
10-May-18	2	500	435	7.85	114	#N/A	2.5	31.2	8	10	0.16	26.6	0.204	0.0010	0.0536	0.00170	*<3.5E-06*	*<3.5E-06*	0.018	0.000008	8.84	0.00007	0.000014	0.00050	*<0.0035*	*<0.000005*
17-May-18	3	500	460	8.46	77	#N/A	#N/A	25.5	4	3	0.09	19.8	0.206	0.0007	0.0463	0.00132	*<3.5E-06*	*<3.5E-06*	0.009	0.000005	6.81	0.00006	0.000014	0.00041	*<0.0035*	*<0.000005*
24-May-18	4	500	420	7.82	69	#N/A	3.0	26.9	4																	
31-May-18	5	500	450	8.43	66	#N/A	#N/A	27.7	3	1	0.07	22.1	0.211	0.0006	0.0635	0.00110	*<3.5E-06*	*<3.5E-06*	0.007	0.000003	7.73	0.00004	0.000016	0.00034	*<0.0035*	*<0.000005*
7-Jun-18	6	500	495	8.38	71	#N/A	#N/A	31.0	3																	
14-Jun-18	7	500	455	8.46	59	#N/A	#N/A	26.1	2	1	*<0.03*	22.1	0.216	0.0005	0.0604	0.00101	*<3.5E-06*	*<3.5E-06*	0.006	*<1.5E-06*	7.72	0.00004	0.000017	0.00045	*<0.0035*	*<0.000005*
21-Jun-18	8	500	445	8.36	58	#N/A	#N/A	25.9	2																	
28-Jun-18	9	500	445	8.28	55	#N/A	1.9	25.2	2	*<0.5*	*<0.03*	22.1	0.209	0.0003	0.0544	0.00108	*<3.5E-06*	*<3.5E-06*	0.005	0.000016	7.84	0.00005	0.000028	0.00023	0.013	0.00003
5-Jul-18	10	500	420	8.38	56	#N/A	#N/A	25.8	2																	
12-Jul-18	11	500	435	8.55	55	#N/A	#N/A	25.8	2	*<0.5*	*<0.03*	24.1	0.244	0.0002	0.0569	0.00110	*<3.5E-06*	*<3.5E-06*	0.005	*<1.5E-06*	8.72	0.00005	0.000059	0.00511	*<0.0035*	*<0.000005*
19-Jul-18	12	500	430	8.46	53	#N/A	#N/A	25.3	2																	
26-Jul-18	13	500	450	7.79	50	#N/A	2.3	25.9	3	*<0.5*	*<0.03*	22.2	0.204	0.0002	0.0362	0.00082	*<3.5E-06*	*<3.5E-06*	*<0.001*	*<1.5E-06*	7.96	0.00004	0.000024	0.00475	*<0.0035*	*<0.000005*
2-Aug-18	14	500	455	8.51	48	#N/A	#N/A	25.0	2																	
9-Aug-18	15	500	430	8.34	45	#N/A	#N/A	23.5	2	*<0.5*	*<0.03*	21.2	0.208	*<0.0001*	0.0343	0.00078	*<3.5E-06*	*<3.5E-06*	0.003	0.000003	7.67	0.00003	0.000021	0.00070	*<0.0035*	0.00003
16-Aug-18	16	500	440	8.49	44	#N/A	#N/A	25.4	2																	
23-Aug-18	17	500	440	8.39	42	#N/A	#N/A	24.4	2	*<0.5*	*<0.03*	21.3	0.189	0.0002	0.0296	0.00074	*<3.5E-06*	*<3.5E-06*	0.005	*<1.5E-06*	7.73	0.00003	0.000018	0.00071	*<0.0035*	*<0.000005*
30-Aug-18	18	500	425	8.36	40	#N/A	#N/A	23.3	3																	
6-Sep-18	19	500	425	8.34	39	#N/A	#N/A	23.2	2	*<0.5*	*<0.03*	21.4	0.202	*<0.0001*	0.0284	0.00074	*<3.5E-06*	*<3.5E-06*	0.004	*<1.5E-06*	7.86	0.00004	0.000016	0.00057	*<0.0035*	*<0.000005*
13-Sep-18	20	500	430	7.75	39	#N/A	3.2	23.2	*<1*																	
20-Sep-18	21	500	430	8.32	48	#N/A	#N/A	24.1	2	*<0.5*	*<0.03*	20.1	0.186	*<0.0001*	0.0280	0.00065	0.000009	*<3.5E-06*	0.005	0.000003	7.38	0.00004	0.000020	0.00081	0.007	0.00001
27-Sep-18	22	500	435	8.50	48	#N/A	#N/A	21.5	2																	
4-Oct-18	23	500	435	7.79	48	#N/A	3.5	24.1	*<1*	*<0.5*	*<0.03*	21.0	0.184	*<0.0001*	0.0234	0.00066	*<3.5E-06*	*<3.5E-06*	0.005	*<1.5E-06*	7.76	0.00004	0.000014	0.00051	*<0.0035*	*<0.000005*
11-Oct-18	24	500	415	8.02	42	#N/A	2.4	23.3	*<1*																	

Loads	**mg/kg**								mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
26-Apr-18	0			7.83					1.89	5.67	0.0378	8.127	0.01638	0.000126	0.0055125	0.0005261	1.103E-06	1.103E-06	0.002835	9.45E-07	2.83185	1.575E-05	6.3E-07	0.0001922	0.0011025	1.575E-06
3-May-18	1			8.45					4.95	8.1	0.063	13.185	0.0873	0.000405	0.018585	0.000999	1.575E-06	1.575E-06	0.009	0.0000045	4.491	0.0000225	0.0000009	0.000225	0.001575	2.25E-06
10-May-18	2			7.85					3.48	4.35	0.0696	11.571	0.08874	0.000435	0.023316	0.0007395	1.523E-06	1.523E-06	0.00783	3.48E-06	3.8454	3.045E-05	6.09E-06	0.0002175	0.0015225	2.175E-06
17-May-18	3			8.46					1.84	1.38	0.0414	9.108	0.09476	0.000322	0.021298	0.0006072	1.61E-06	1.61E-06	0.00414	0.0000023	3.1326	0.0000276	6.44E-06	0.0001886	0.00161	0.0000023
24-May-18	4			7.82					1.68																	
31-May-18	5			8.43					1.35	0.45	0.0315	9.945	0.09495	0.00027	0.028575	0.000495	1.575E-06	1.575E-06	0.00315	1.35E-06	3.4785	0.000018	0.0000072	0.000153	0.001575	2.25E-06
7-Jun-18	6			8.38					1.485																	
14-Jun-18	7			8.46					0.91	0.455	0.01365	10.0555	0.09828	0.0002275	0.027482	0.0004596	1.593E-06	1.593E-06	0.00273	6.825E-07	3.5126	0.0000182	7.735E-06	0.0002048	0.0015925	2.275E-06
21-Jun-18	8			8.36					0.89																	
28-Jun-18	9			8.28					0.89	0.2225	0.01335	9.8345	0.093005	0.0001335	0.024208	0.0004806	1.558E-06	1.558E-06	0.002225	7.12E-06	3.4888	2.225E-05	1.246E-05	0.0001024	0.005785	1.335E-05
5-Jul-18	10			8.38					0.84																	
12-Jul-18	11			8.55					0.87	0.2175	0.01305	10.4835	0.10614	0.000087	0.0247515	0.0004785	1.523E-06	1.523E-06	0.002175	6.525E-07	3.7932	2.175E-05	2.567E-05	0.0022229	0.0015225	2.175E-06
19-Jul-18	12			8.46					0.86																	
26-Jul-18	13			7.79					1.35	0.225	0.0135	9.99	0.0918	0.00009	0.01629	0.000369	1.575E-06	1.575E-06	0.00045	6.75E-07	3.582	0.000018	0.0000108	0.0021375	0.001575	2.25E-06
2-Aug-18	14			8.51					0.91																	
9-Aug-18	15			8.34					0.86	0.215	0.0129	9.116	0.08944	0.000043	0.014749	0.0003354	1.505E-06	1.505E-06	0.00129	1.29E-06	3.2981	0.0000129	9.03E-06	0.000301	0.001505	0.0000129
16-Aug-18	16			8.49					0.88																	
23-Aug-18	17			8.39					0.88	0.22	0.0132	9.372	0.08316	0.000088	0.013024	0.0003256	1.54E-06	1.54E-06	0.0022	6.6E-07	3.4012	0.0000132	7.92E-06	0.0003124	0.00154	0.0000022
30-Aug-18	18			8.36					1.275																	
6-Sep-18	19			8.34					0.85	0.2125	0.01275	9.095	0.08585	0.0000425	0.01207	0.0003145	1.488E-06	1.488E-06	0.0017	6.375E-07	3.3405	0.000017	0.0000068	0.0002423	0.0014875	2.125E-06
13-Sep-18	20			7.75					0.43																	
20-Sep-18	21			8.32					0.86	0.215	0.0129	8.643	0.07998	0.000043	0.01204	0.0002795	3.87E-06	1.505E-06	0.00215	1.29E-06	3.1734	0.0000172	0.0000086	0.0003483	0.00301	0.0000043
27-Sep-18	22			8.50					0.87																	
4-Oct-18	23			7.79					0.435	0.2175	0.01305	9.135	0.08004	0.0000435	0.010179	0.0002871	1.523E-06	1.523E-06	0.002175	6.525E-07	3.3756	0.0000174	6.09E-06	0.0002219	0.0015225	2.175E-06
11-Oct-18	24			8.02					0.415																	

Appendix 4-5, Table 8: Kinetic Test Results - HC7

Mass	**1**																								
Date	**Cycle**	**Volume mL**		**pH**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
	No.	**Input**	**Output**																						
					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
26-Apr-18	0	500	315	7.83	0.0042	0.814	0.00132	<0.005	0.00873	0.0002	0.015	6.51	0.00034	2.23	<0.000025	9.44	0.0931	2.3	0.000012	0.00029	<0.000025	0.000084	0.00160	<0.001	<0.001
3-May-18	1	500	450	8.45	0.0059	1.05	0.0023	0.02	0.0235	<0.00005	0.011	5.93	0.00042	2.03	<0.000025	11.9	0.118	3.3	0.000008	0.00017	0.00005	0.000756	0.00343	<0.001	<0.001
10-May-18	2	500	435	7.85	0.0060	1.10	0.0024	<0.005	0.0267	0.0001	0.008	5.62	0.00031	2.22	<0.000025	9.03	0.101	3.1	0.000020	0.00017	0.00051	0.00152	0.00395	<0.001	<0.001
17-May-18	3	500	460	8.46	0.0038	0.678	0.0023	<0.005	0.0127	<0.00005	0.008	2.83	0.00017	1.39	<0.000025	5.01	0.0714	2.5	0.000007	0.00009	0.00029	0.00287	0.00290	<0.001	<0.001
24-May-18	4	500	420	7.82																					
31-May-18	5	500	450	8.43	0.0028	0.669	0.00251	<0.005	0.00414	<0.00005	0.004	2.68	0.00013	1.90	<0.000025	2.37	0.0633	0.8	<2.5E-06	0.00004	0.00014	0.00532	0.00327	<0.001	<0.001
7-Jun-18	6	500	495	8.38																					
14-Jun-18	7	500	455	8.46	0.0028	0.69	0.0030	<0.005	0.00203	<0.00005	0.008	1.85	0.00017	1.64	<0.000025	1.49	0.0585	1.0	0.000005	0.00006	0.00024	0.006590	0.00304	<0.001	<0.001
21-Jun-18	8	500	445	8.36																					
28-Jun-18	9	500	445	8.28	0.0025	0.619	0.00405	<0.005	0.00127	<0.00005	0.003	1.85	0.00007	1.66	<0.000025	1.13	0.05381	1.0	0.000005	0.00005	0.00109	0.005236	0.00310	<0.001	<0.001
5-Jul-18	10	500	420	8.38																					
12-Jul-18	11	500	435	8.55	0.0024	0.559	0.00397	<0.005	0.00099	<0.00005	<0.0015	1.47	0.00005	1.59	<0.000025	0.75	0.0518	0.3	<2.5E-06	0.00008	0.00053	0.00435	0.00347	<0.001	<0.001
19-Jul-18	12	500	430	8.46																					
26-Jul-18	13	500	450	7.79	0.0023	0.556	0.00336	<0.005	0.00066	<0.00005	<0.0015	1.15	0.00005	1.52	<0.000025	0.66	0.0490	<0.05	0.000005	0.00004	0.00018	0.00319	0.00263	<0.001	<0.001
2-Aug-18	14	500	455	8.51																					
9-Aug-18	15	500	430	8.34	0.0020	0.499	0.00338	0.05	0.00064	<0.00005	<0.0015	1.11	0.00007	1.40	<0.000025	0.65	0.0436	0.5	<2.5E-06	0.00003	0.00032	0.002259	0.00282	<0.001	<0.001
16-Aug-18	16	500	440	8.49																					
23-Aug-18	17	500	440	8.39	0.0016	0.471	0.00377	<0.005	0.00054	<0.00005	<0.0015	0.938	0.00005	1.45	<0.000025	0.57	0.0417	<0.05	<2.5E-06	<0.000005	0.00031	0.00190	0.00246	<0.001	<0.001
30-Aug-18	18	500	425	8.36																					
6-Sep-18	19	500	425	8.34	0.0018	0.424	0.00346	<0.005	0.00050	<0.00005	<0.0015	0.846	0.00005	1.32	<0.000025	0.52	0.0377	<0.05	<2.5E-06	0.00008	0.00025	0.001468	0.00248	<0.001	<0.001
13-Sep-18	20	500	430	7.75																					
20-Sep-18	21	500	430	8.32	0.0016	0.396	0.00311	<0.005	0.00047	<0.00005	<0.0015	0.722	0.00006	1.40	<0.000025	0.37	0.0382	0.9	<2.5E-06	0.00007	0.00023	0.00124	0.00215	<0.001	<0.001
27-Sep-18	22	500	435	8.50																					
4-Oct-18	23	500	435	7.79	0.0018	0.380	0.00364	<0.005	0.00029	<0.00005	<0.0015	0.692	<0.00002	1.32	<0.000025	0.38	0.0342	0.9	<2.5E-06	0.00003	0.00010	0.00118	0.00214	<0.001	<0.001
11-Oct-18	24	500	415	8.02																					

Loads	**mg/kg**				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
26-Apr-18	0			7.83	0.001323	0.25641	0.0004158	0.001575	0.00275	0.000063	0.004725	2.05065	0.0001071	0.70245	7.875E-06	2.9736	0.0293265	0.7245	3.78E-06	9.135E-05	7.875E-06	2.646E-05	0.000504	0.000315	0.000315
3-May-18	1			8.45	0.002655	0.4725	0.001035	0.009	0.010575	0.0000225	0.00495	2.6685	0.000189	0.9135	1.125E-05	5.355	0.0531	1.485	0.0000036	0.0000765	0.0000225	0.0003402	0.0015435	0.00045	0.00045
10-May-18	2			7.85	0.00261	0.4785	0.001044	0.002175	0.0116145	0.0000435	0.00348	2.4447	0.0001349	0.9657	1.088E-05	3.92805	0.043935	1.3485	0.0000087	7.395E-05	0.0002219	0.0006612	0.0017183	0.000435	0.000435
17-May-18	3			8.46	0.001748	0.31188	0.001058	0.0023	0.005842	0.000023	0.00368	1.3018	0.0000782	0.6394	0.0000115	2.3046	0.032844	1.15	3.22E-06	0.0000414	0.0001334	0.0013202	0.001334	0.00046	0.00046
24-May-18	4			7.82																					
31-May-18	5			8.43	0.00126	0.30105	0.0011295	0.00225	0.001863	0.0000225	0.0018	1.206	0.0000585	0.855	1.125E-05	1.0665	0.028485	0.36	1.125E-06	0.000018	0.000063	0.002394	0.0014715	0.00045	0.00045
7-Jun-18	6			8.38																					
14-Jun-18	7			8.46	0.001274	0.31395	0.0013468	0.002275	0.0009237	2.275E-05	0.00364	0.84175	7.735E-05	0.7462	1.138E-05	0.67795	0.0266175	0.455	2.275E-06	0.0000273	0.0001092	0.0029985	0.0013832	0.000455	0.000455
21-Jun-18	8			8.36																					
28-Jun-18	9			8.28	0.0011125	0.275455	0.0018023	0.002225	0.0005652	2.225E-05	0.001335	0.82325	3.115E-05	0.7387	1.113E-05	0.50285	0.0239455	0.445	2.225E-06	2.225E-05	0.0004851	0.00233	0.0013795	0.000445	0.000445
5-Jul-18	10			8.38																					
12-Jul-18	11			8.55	0.001044	0.243165	0.001727	0.002175	0.0004307	2.175E-05	0.0006525	0.63945	2.175E-05	0.69165	1.088E-05	0.32625	0.022533	0.1305	1.088E-06	0.0000348	0.0002306	0.0018923	0.0015095	0.000435	0.000435
19-Jul-18	12			8.46																					
26-Jul-18	13			7.79	0.001035	0.2502	0.001512	0.00225	0.000297	0.0000225	0.000675	0.5175	0.0000225	0.684	1.125E-05	0.297	0.02205	0.0225	2.25E-06	0.000018	0.000081	0.0014355	0.0011835	0.00045	0.00045
2-Aug-18	14			8.51																					
9-Aug-18	15			8.34	0.00086	0.21457	0.0014534	0.0215	0.0002752	0.0000215	0.000645	0.4773	0.0000301	0.602	1.075E-05	0.2795	0.018748	0.215	1.075E-06	0.0000129	0.0001376	0.0009714	0.0012126	0.00043	0.00043
16-Aug-18	16			8.49																					
23-Aug-18	17			8.39	0.000704	0.20724	0.0016588	0.0022	0.0002376	0.000022	0.00066	0.41272	0.000022	0.638	0.000011	0.2508	0.018348	0.022	0.0000011	0.0000022	0.0001364	0.000836	0.0010824	0.00044	0.00044
30-Aug-18	18			8.36																					
6-Sep-18	19			8.34	0.000765	0.1802	0.0014705	0.002125	0.0002125	2.125E-05	0.0006375	0.35955	2.125E-05	0.561	1.063E-05	0.221	0.0160225	0.02125	1.063E-06	0.000034	0.0001063	0.0006239	0.001054	0.000425	0.000425
13-Sep-18	20			7.75																					
20-Sep-18	21			8.32	0.000688	0.17028	0.0013373	0.00215	0.0002021	0.0000215	0.000645	0.31046	0.0000258	0.602	1.075E-05	0.1591	0.016426	0.387	1.075E-06	0.0000301	0.0000989	0.0005332	0.0009245	0.00043	0.00043
27-Sep-18	22			8.50																					
4-Oct-18	23			7.79	0.000783	0.1653	0.0015834	0.002175	0.0001262	2.175E-05	0.0006525	0.30102	0.0000087	0.5742	1.088E-05	0.1653	0.014877	0.3915	1.088E-06	1.305E-05	0.0000435	0.0005133	0.0009309	0.000435	0.000435
11-Oct-18	24			8.02																					

Appendix 4-5, Table 9: Kinetic Test Results - HC8

Mass	**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**	**Fe**
	No.	**Input**	**Output**			**(pH 4.5)**	**(pH 8.3)**					**$CaCO_3$**													
					umhos/cm	$mgCaCO_3/L$	$mgCaCO_3/L$	$mgCaCO_3/L$	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
26-Apr-18	0	500	330	7.94	153	#N/A	2.8	29.2	16	6	0.20	13.1	0.353	0.0006	0.112	0.00086	*<3.5E-06*	*<3.5E-06*	0.010	*<0.0000015*	4.36	0.00006	*<0.000002*	0.00022	*<0.0035*
3-May-18	1	500	470	8.42	146	#N/A	#N/A	32.9	29	5	0.20	20.1	0.495	0.0025	0.131	0.00259	0.000007	0.000021	0.015	0.000008	6.36	0.00020	0.000015	0.00039	0.075
10-May-18	2	500	445	7.86	138	#N/A	2.4	31.4	31	1	0.16	23.7	0.321	0.0019	0.109	0.00165	*<3.5E-06*	*<3.5E-06*	0.012	*<0.0000015*	7.17	0.00007	0.000012	0.00021	0.009
17-May-18	3	500	435	8.48	90	#N/A	#N/A	23.5	16	*<0.5*	0.10	18.1	0.331	0.0011	0.0901	0.00095	*<3.5E-06*	*<3.5E-06*	0.007	0.000003	5.78	0.00003	0.000015	0.00038	0.009
24-May-18	4	500	415	7.80	99	#N/A	3.2	24.6	18																
31-May-18	5	500	445	8.30	95	#N/A	#N/A	26.6	15	*<0.5*	0.09	23.6	0.312	0.0013	0.107	0.00149	*<3.5E-06*	*<3.5E-06*	0.009	*<0.0000015*	7.38	0.00005	0.000023	0.00034	0.027
7-Jun-18	6	500	495	8.15	78	#N/A	2.2	25.7	11																
14-Jun-18	7	500	445	8.23	72	#N/A	1.8	22.1	9	*<0.5*	*<0.03*	21.5	0.283	0.0008	0.0853	0.00082	*<3.5E-06*	*<3.5E-06*	0.007	*<0.0000015*	6.88	*<0.000015*	0.000010	0.00019	*<0.0035*
21-Jun-18	8	500	430	8.22	69	#N/A	2.2	21.3	9																
28-Jun-18	9	500	430	7.95	69	#N/A	3.6	19.7	12	*<0.5*	*<0.03*	21.7	0.276	0.0005	0.0581	0.00104	*<3.5E-06*	*<3.5E-06*	0.005	0.000008	6.98	0.00008	0.000014	*<0.00001*	0.031
5-Jul-18	10	500	405	8.08	90	#N/A	3.4	22.1	16																
12-Jul-18	11	500	420	8.15	79	#N/A	1.0	20.3	12	*<0.5*	*<0.03*	27.3	0.269	0.0004	0.0625	0.00106	*<3.5E-06*	*<3.5E-06*	0.006	*<0.0000015*	9.06	0.00004	0.000033	0.0108	0.008
19-Jul-18	12	500	430	8.01	93	#N/A	1.0	22.3	20																
26-Jul-18	13	500	425	7.70	87	#N/A	2.2	22.3	20	*<0.5*	*<0.03*	31.7	0.219	0.0004	0.0480	0.00116	*<3.5E-06*	*<3.5E-06*	*<0.001*	*<0.0000015*	10.6	*<0.000015*	0.000015	0.00024	*<0.0035*
2-Aug-18	14	500	435	7.99	73	#N/A	1.2	18.7	15																
9-Aug-18	15	500	410	7.96	100	#N/A	1.9	21.2	25	*<0.5*	*<0.03*	38.7	0.207	0.0004	0.0512	0.00128	*<3.5E-06*	*<3.5E-06*	0.005	*<0.0000015*	13.2	*<0.000015*	0.000018	0.00027	*<0.0035*
16-Aug-18	16	500	425	8.08	59	#N/A	2.4	17.8	13																
23-Aug-18	17	500	425	7.90	60	#N/A	3.2	16.4	13	*<0.5*	*<0.03*	25.4	0.197	0.0002	0.0290	0.00084	*<3.5E-06*	*<3.5E-06*	0.004	0.000003	8.84	0.00003	0.000023	0.00047	0.008
30-Aug-18	18	500	430	7.85	58	#N/A	2.1	15.4	14																
6-Sep-18	19	500	410	7.87	67	#N/A	2.6	15.6	20	*<0.5*	*<0.03*	29.2	0.183	0.0003	0.0280	0.00096	*<3.5E-06*	*<3.5E-06*	0.004	0.000005	10.4	*<0.000015*	0.000012	0.00024	*<0.0035*
13-Sep-18	20	500	420	7.55	69	#N/A	3.6	16.2	20																
20-Sep-18	21	500	420	7.85	82	#N/A	2.1	16.1	20	*<0.5*	*<0.03*	28.8	0.168	0.0002	0.0265	0.00096	0.000009	*<3.5E-06*	0.005	0.000003	10.2	0.00004	0.000021	0.00056	0.012
27-Sep-18	22	500	435	7.81	88	#N/A	2.8	14.1	24																
4-Oct-18	23	500	415	7.85	141	#N/A	5.8	17.5	44	*<0.5*	*<0.03*	50.5	0.156	0.0003	0.0277	0.00140	*<3.5E-06*	*<3.5E-06*	0.005	*<0.0000015*	18.9	0.00004	0.000020	0.00041	*<0.0035*
11-Oct-18	24	500	395	7.80	115	#N/A	3.1	15.5	33																

Loads	**mg/kg**								mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
26-Apr-18	0			7.94					5.28	1.98	0.066	4.323	0.11649	0.000198	0.03696	0.0002838	1.155E-06	1.155E-06	0.0033	0.000000495	1.4388	0.0000198	0.00000066	0.0000726	0.001155
3-May-18	1			8.42					13.63	2.35	0.094	9.447	0.23265	0.001175	0.06157	0.0012173	3.29E-06	9.87E-06	0.00705	0.00000376	2.9892	0.000094	0.00000705	0.0001833	0.03525
10-May-18	2			7.86					13.795	0.445	0.0712	10.5465	0.142845	0.0008455	0.048505	0.0007343	1.558E-06	1.558E-06	0.00534	6.675E-07	3.19065	3.115E-05	0.00000534	9.345E-05	0.004005
17-May-18	3			8.48					6.96	0.2175	0.0435	7.8735	0.143985	0.0004785	0.0391935	0.0004133	1.523E-06	1.523E-06	0.003045	0.000001305	2.5143	1.305E-05	0.000006525	0.0001653	0.003915
24-May-18	4			7.80					7.47																
31-May-18	5			8.30					6.675	0.2225	0.04005	10.502	0.13884	0.0005785	0.047615	0.0006631	1.558E-06	1.558E-06	0.004005	6.675E-07	3.2841	2.225E-05	0.000010235	0.0001513	0.012015
7-Jun-18	6			8.15					5.445																
14-Jun-18	7			8.23					4.005	0.2225	0.01335	9.5675	0.125935	0.000356	0.0379585	0.0003649	1.558E-06	1.558E-06	0.003115	6.675E-07	3.0616	6.675E-06	0.00000445	8.455E-05	0.0015575
21-Jun-18	8			8.22					3.87																
28-Jun-18	9			7.95					5.16	0.215	0.0129	9.331	0.11868	0.000215	0.024983	0.0004472	1.505E-06	1.505E-06	0.00215	0.00000344	3.0014	0.0000344	0.00000602	0.0000043	0.01333
5-Jul-18	10			8.08					6.48																
12-Jul-18	11			8.15					5.04	0.21	0.0126	11.466	0.11298	0.000168	0.02625	0.0004452	1.47E-06	1.47E-06	0.00252	0.00000063	3.8052	0.0000168	0.00001386	0.004536	0.00336
19-Jul-18	12			8.01					8.6																
26-Jul-18	13			7.70					8.5	0.2125	0.01275	13.4725	0.093075	0.00017	0.0204	0.000493	1.488E-06	1.488E-06	0.000425	6.375E-07	4.505	6.375E-06	0.000006375	0.000102	0.0014875
2-Aug-18	14			7.99					6.525																
9-Aug-18	15			7.96					10.25	0.205	0.0123	15.867	0.08487	0.000164	0.020992	0.0005248	1.435E-06	1.435E-06	0.00205	0.000000615	5.412	6.15E-06	0.00000738	0.0001107	0.001435
16-Aug-18	16			8.08					5.525																
23-Aug-18	17			7.90					5.525	0.2125	0.01275	10.795	0.083725	0.000085	0.012325	0.000357	1.488E-06	1.488E-06	0.0017	0.000001275	3.757	1.275E-05	0.000009775	0.0001998	0.0034
30-Aug-18	18			7.85					6.02																
6-Sep-18	19			7.87					8.2	0.205	0.0123	11.972	0.07503	0.000123	0.01148	0.0003936	1.435E-06	1.435E-06	0.00164	0.00000205	4.264	6.15E-06	0.00000492	0.0000984	0.001435
13-Sep-18	20			7.55					8.4																
20-Sep-18	21			7.85					8.4	0.21	0.0126	12.096	0.07056	0.000084	0.01113	0.0004032	3.78E-06	1.47E-06	0.0021	0.00000126	4.284	0.0000168	0.00000882	0.0002352	0.00504
27-Sep-18	22			7.81					10.44																
4-Oct-18	23			7.85					18.26	0.2075	0.01245	20.9575	0.06474	0.0001245	0.0114955	0.000581	1.453E-06	1.453E-06	0.002075	6.225E-07	7.8435	0.0000166	0.0000083	0.0001702	0.0014525
11-Oct-18	24			7.80					13.035																

Appendix 4-5, Table 9: Kinetic Test Results - H(

Mass	**1**																									
Date	**Cycle**	**Volume mL**		**pH**	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
	No.	**Input**	**Output**																							
					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
26-Apr-18	0	500	330	7.94	<0.000005	0.0041	0.540	0.00107	0.03	0.00262	0.0005	0.014	20.2	0.00030	1.43	<0.000025	6.96	0.00992	6.9	0.000006	0.00016	0.00019	0.000043	0.00187	<0.001	<0.001
3-May-18	1	500	470	8.42	0.00017	0.0068	1.03	0.0060	0.06	0.0100	0.0003	0.006	20.3	0.00037	1.72	<0.000025	7.76	0.0171	10.1	0.000011	0.00009	0.00573	0.000575	0.00235	<0.001	<0.001
10-May-18	2	500	445	7.86	0.00003	0.0067	1.40	0.0062	<0.005	0.00974	0.0002	<0.0015	18.9	0.00033	1.59	<0.000025	5.49	0.0192	9.9	0.000007	0.00007	0.00061	0.00126	0.00216	<0.001	<0.001
17-May-18	3	500	435	8.48	0.00004	0.0044	0.900	0.0042	<0.005	0.00404	<0.00005	<0.0015	10.1	0.00022	1.17	<0.000025	2.35	0.0130	5.8	0.000006	0.00005	0.00048	0.000712	0.00172	<0.001	<0.001
24-May-18	4	500	415	7.80																						
31-May-18	5	500	445	8.30	0.00010	0.0048	1.26	0.00640	<0.005	0.00208	0.0001	<0.0015	10.4	0.00020	1.75	<0.000025	1.50	0.0145	5.2	0.000005	0.00002	0.00165	0.00137	0.00233	<0.001	<0.001
7-Jun-18	6	500	495	8.15																						
14-Jun-18	7	500	445	8.23	0.00002	0.0037	1.06	0.00570	<0.005	0.00109	<0.00005	<0.0015	6.19	0.00022	1.50	<0.000025	0.88	0.0111	4.2	0.000005	0.00003	0.00029	0.00163	0.00210	<0.001	<0.001
21-Jun-18	8	500	430	8.22																						
28-Jun-18	9	500	430	7.95	0.00013	0.0033	1.04	0.00506	<0.005	0.00072	0.0001	<0.0015	5.49	0.00017	1.28	<0.000025	0.59	0.01043	4.9	0.000005	0.00004	0.00156	0.001338	0.00167	<0.001	<0.001
5-Jul-18	10	500	405	8.08																						
12-Jul-18	11	500	420	8.15	0.00023	0.0035	1.13	0.00467	<0.005	0.00054	<0.00005	<0.0015	4.37	0.00013	1.26	<0.000025	0.38	0.0117	4.4	<0.0000025	0.00054	0.00063	0.00179	0.00183	0.005	<0.001
19-Jul-18	12	500	430	8.01																						
26-Jul-18	13	500	425	7.70	0.00006	0.0039	1.26	0.00384	<0.005	0.00053	<0.00005	<0.0015	5.09	0.00018	1.44	<0.000025	0.51	0.0146	5.5	0.000007	0.00007	0.00028	0.00218	0.00162	<0.001	<0.001
2-Aug-18	14	500	435	7.99																						
9-Aug-18	15	500	410	7.96	0.00005	0.0042	1.40	0.00317	0.06	0.00065	0.0001	<0.0015	4.97	0.00014	1.49	<0.000025	0.56	0.0170	8.6	0.000007	0.00002	0.00031	0.001848	0.00181	<0.001	<0.001
16-Aug-18	16	500	425	8.08																						
23-Aug-18	17	500	425	7.90	0.00003	0.0023	0.797	0.00195	<0.005	0.00041	0.0001	<0.0015	3.13	0.00009	1.10	<0.000025	0.36	0.00994	5.5	0.000005	<0.000005	0.00065	0.000827	0.00108	<0.001	<0.001
30-Aug-18	18	500	430	7.85																						
6-Sep-18	19	500	410	7.87	0.00004	0.0024	0.785	0.00192	0.02	0.00046	<0.00005	<0.0015	2.98	0.00007	1.01	<0.000025	0.41	0.0116	7.0	0.000006	<0.000005	0.00027	0.000890	0.00102	<0.001	<0.001
13-Sep-18	20	500	420	7.55																						
20-Sep-18	21	500	420	7.85	0.00005	0.0023	0.802	0.00261	<0.005	0.00047	<0.00005	<0.0015	2.98	0.00010	1.04	<0.000025	0.27	0.0120	6.6	0.000008	0.00008	0.00029	0.000742	0.00085	<0.001	<0.001
27-Sep-18	22	500	435	7.81																						
4-Oct-18	23	500	415	7.85	0.00002	0.0029	0.820	0.00245	<0.005	0.00033	<0.00005	<0.0015	2.84	0.00007	1.08	<0.000025	0.30	0.0207	12.6	0.000006	0.00004	0.00022	0.000987	0.00098	<0.001	<0.001
11-Oct-18	24	500	395	7.80																						

Loads	**mg/kg**				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
26-Apr-18	0			7.94	1.65E-06	0.001353	0.1782	0.0003531	0.0099	0.0008646	0.000165	0.00462	6.666	0.000099	0.4719	8.25E-06	2.2968	0.0032736	2.277	0.00000198	0.0000528	0.0000627	0.00001419	0.0006171	0.00033	0.00033
3-May-18	1			8.42	0.0000799	0.003196	0.4841	0.00282	0.0282	0.0047	0.000141	0.00282	9.541	0.0001739	0.8084	1.175E-05	3.6472	0.008037	4.747	0.00000517	0.0000423	0.0026931	0.00027025	0.0011045	0.00047	0.00047
10-May-18	2			7.86	1.335E-05	0.0029815	0.623	0.002759	0.002225	0.0043343	0.000089	0.0006675	8.4105	0.0001469	0.70755	1.113E-05	2.44305	0.008544	4.4055	0.000003115	3.115E-05	0.0002715	0.0005607	0.0009612	0.000445	0.000445
17-May-18	3			8.48	0.0000174	0.001914	0.3915	0.001827	0.002175	0.0017574	2.175E-05	0.0006525	4.3935	0.0000957	0.50895	1.088E-05	1.02225	0.005655	2.523	0.00000261	2.175E-05	0.0002088	0.00030972	0.0007482	0.000435	0.000435
24-May-18	4			7.80																						
31-May-18	5			8.30	0.0000445	0.002136	0.5607	0.002848	0.002225	0.0009256	0.0000445	0.0006675	4.628	0.000089	0.77875	1.113E-05	0.6675	0.0064525	2.314	0.000002225	0.0000089	0.0007343	0.00060965	0.0010369	0.000445	0.000445
7-Jun-18	6			8.15																						
14-Jun-18	7			8.23	0.0000089	0.0016465	0.4717	0.0025365	0.002225	0.0004851	2.225E-05	0.0006675	2.75455	0.0000979	0.6675	1.113E-05	0.3916	0.0049395	1.869	0.000002225	1.335E-05	0.0001291	0.00072535	0.0009345	0.000445	0.000445
21-Jun-18	8			8.22																						
28-Jun-18	9			7.95	0.0000559	0.001419	0.4472	0.0021758	0.00215	0.0003096	0.000043	0.000645	2.3607	0.0000731	0.5504	1.075E-05	0.2537	0.0044849	2.107	0.00000215	0.0000172	0.0006708	0.00057534	0.0007181	0.00043	0.00043
5-Jul-18	10			8.08																						
12-Jul-18	11			8.15	0.0000966	0.00147	0.4746	0.0019614	0.0021	0.0002268	0.000021	0.00063	1.8354	0.0000546	0.5292	0.0000105	0.1596	0.004914	1.848	0.00000105	0.0002268	0.0002646	0.0007518	0.0007686	0.0021	0.00042
19-Jul-18	12			8.01																						
26-Jul-18	13			7.70	0.0000255	0.0016575	0.5355	0.001632	0.002125	0.0002253	2.125E-05	0.0006375	2.16325	0.0000765	0.612	1.063E-05	0.21675	0.006205	2.3375	0.000002975	2.975E-05	0.000119	0.0009265	0.0006885	0.000425	0.000425
2-Aug-18	14			7.99																						
9-Aug-18	15			7.96	0.0000205	0.001722	0.574	0.0012997	0.0246	0.0002665	0.000041	0.000615	2.0377	0.0000574	0.6109	1.025E-05	0.2296	0.00697	3.526	0.00000287	0.0000082	0.0001271	0.00075768	0.0007421	0.00041	0.00041
16-Aug-18	16			8.08																						
23-Aug-18	17			7.90	1.275E-05	0.0009775	0.338725	0.0008288	0.002125	0.0001743	0.0000425	0.0006375	1.33025	3.825E-05	0.4675	1.063E-05	0.153	0.0042245	2.3375	0.000002125	2.125E-06	0.0002763	0.000351475	0.000459	0.000425	0.000425
30-Aug-18	18			7.85																						
6-Sep-18	19			7.87	0.0000164	0.000984	0.32185	0.0007872	0.0082	0.0001886	0.0000205	0.000615	1.2218	0.0000287	0.4141	1.025E-05	0.1681	0.004756	2.87	0.00000246	2.05E-06	0.0001107	0.0003649	0.0004182	0.00041	0.00041
13-Sep-18	20			7.55																						
20-Sep-18	21			7.85	0.000021	0.000966	0.33684	0.0010962	0.0021	0.0001974	0.000021	0.00063	1.2516	0.000042	0.4368	0.0000105	0.1134	0.00504	2.772	0.00000336	0.0000336	0.0001218	0.00031164	0.000357	0.00042	0.00042
27-Sep-18	22			7.81																						
4-Oct-18	23			7.85	0.0000083	0.0012035	0.3403	0.0010168	0.002075	0.000137	2.075E-05	0.0006225	1.1786	2.905E-05	0.4482	1.038E-05	0.1245	0.0085905	5.229	0.00000249	0.0000166	0.0000913	0.000409605	0.0004067	0.000415	0.000415
11-Oct-18	24			7.80																						

Appendix 4-6:
Shake Flask Extraction Results

ATLANTIC GOLD

Appendix 4-6: Shake Flask Extraction Results - Overburden

Parameters	**Units**	**CCME WQG**		**LX-BDT-01**	**LX-BDT-02**	**LX-BDT-03**	**LX-BDT-04**	**LX-BDT-05**
		Short Term	**Long Term**	L2178440-1	L2178440-2	L2178440-3	L2178440-4	L2178440-5
Physical Tests (Soil)								
Moisture	%	-	-	<0.25	<0.25	<0.25	<0.25	<0.25
Leachable Anions & Nutrients (Soil)								
Alkalinity, Total (as $CaCO_3$)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0
Conductivity	µS/cm	-	-	12.6	15.7	89.1	36.7	19.5
pH	pH	6.5-9	-	5.27	5.15	4.88	4.54	5.83
Sulfate (SO4)	mg/L	-	-	2.24	1.23	10.1	1.42	2.08
Leachable Metals (Soil)								
Aluminum (Al)-Leachable	mg/L	-	0.1	***0.108***	***0.683***	***1.51***	***1.26***	***0.483***
Antimony (Sb)-Leachable	mg/L	-	-	<0.00010	<0.00010	0.00015	<0.00010	<0.00010
Arsenic (As)-Leachable	mg/L	-	0.005	0.0012	0.0012	***0.315***	0.0038	***0.0084***
Barium (Ba)-Leachable	mg/L	-	-	0.0044	0.0040	0.0271	0.0066	0.0097
Beryllium (Be)-Leachable	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bismuth (Bi)-Leachable	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)-Leachable	mg/L	29	1.5	<0.010	<0.010	0.015	<0.010	<0.010
Cadmium (Cd)-Leachable	mg/L	0.001	0.00009	<0.000050	<0.000050	***0.000217***	0.000075	<0.000050
Calcium (Ca)-Leachable	mg/L	-	-	0.87	0.59	8.78	1.03	1.18
Chromium (Cr)-Leachable	mg/L	-	0.001	<0.00050	0.00088	***0.00118***	***0.00126***	0.00064
Cobalt (Co)-Leachable	mg/L	-	-	0.00084	0.00042	0.00761	0.00054	0.00101
Copper (Cu)-Leachable	mg/L	-	0.002	<0.0010	<0.0010	***0.0085***	0.0014	***0.0033***
Iron (Fe)-Leachable	mg/L	-	0.3	<0.030	0.194	***0.425***	***0.490***	0.262
Lead (Pb)-Leachable	mg/L	-	0.001	<0.00010	0.00013	0.00090	***0.00129***	0.00012
Lithium (Li)-Leachable	mg/L	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)-Leachable	mg/L	-	-	0.237	0.345	1.44	0.556	0.471
Manganese (Mn)-Leachable	mg/L	-	-	0.107	0.0446	0.131	0.0681	0.106
Mercury (Hg)-Leachable	mg/L	-	0.000026	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Molybdenum (Mo)-Leachable	mg/L	-	0.073	<0.00010	<0.00010	0.00023	<0.00010	<0.00010
Nickel (Ni)-Leachable	mg/L	-	0.025	0.00098	0.00118	***0.0360***	0.00151	0.00179
Phosphorus (P)-Leachable	mg/L	-	-	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)-Leachable	mg/L	-	-	0.286	0.551	2.92	1.72	0.793
Selenium (Se)-Leachable	mg/L	-	0.001	<0.00050	0.00068	0.00079	***0.00101***	0.00085
Silicon (Si)-Leachable	mg/L	-	-	3.44	1.37	1.52	0.752	1.71
Silver (Ag)-Leachable	mg/L	-	0.00025	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Sodium (Na)-Leachable	mg/L	-	-	0.258	0.629	2.65	1.24	0.757
Strontium (Sr)-Leachable	mg/L	-	-	0.00454	0.00563	0.0403	0.00885	0.0105
Thallium (Tl)-Leachable	mg/L	-	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)-Leachable	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Titanium (Ti)-Leachable	mg/L	-	-	<0.010	<0.010	0.016	0.027	0.011
Uranium (U)-Leachable	mg/L	0.033	0.015	0.000020	0.000087	0.000101	0.000073	0.000103
Vanadium (V)-Leachable	mg/L	-	-	<0.0010	<0.0010	0.0038	0.0023	<0.0010
Zinc (Zn)-Leachable	mg/L	0.037	0.007	<0.010	<0.010	***0.045***	***0.012***	<0.010

Notes:

Aluminum guideline is based on pH > 6.5

Hardness dependent guidelines (Cu, Pb, Ni) are based on a hardness of 10 mg/L

Grey shading indicates values above the short-term CCME water quality guideline

Bold italic text indicates values above the long-term CCME water quality guideline