

Part 3

Materials Characterisation Assessment

State Significant Development No. 5765

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Materials Characterisation

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Commonly Used Acronyms

AFP	Acid Formation Potential
ANC	Acid Neutralisation Capacity
EC	electrical conductivity
EIS	Environmental Impact Statement
FGO	Full Grade Ore
GCA	Graeme Campbell & Associates
GWC	Gravimetric Water Content
HGO	High Grade Ore
HPDW	high-purity deionised water
KBPL	Kingsgate Bowdens Pty Limited
LGO	Low Grade Ore
Mbgl	metres below ground level
MPA	Maximum Potential Acidity
NAF	Non-Acid Forming
NAG	Net Acid Generation
NAPP	Net Acid Producing Potential
nc	not calculated
nm	not measured
OCR	Oxygen Consumption Rates
PAF	Potentially-Acid Forming
PZ	Primary Zone (or Fresh Rock Zone)
SRR	Sulphate Release Rate
SVL	Silver Mines Limited
TSF	tailings storage facility
UC	Uncertain
w/w	weight for weight (mass fraction)
WRE	waste rock emplacement
WZ	Weathered Zone

Mineral Chemical Compositions (Idealised)

Alunite	$\text{KAl}_3(\text{SO}_4)_2(\text{OH})_6$
Ankerite	$\text{Ca}(\text{Fe}, \text{Mg}, \text{Mn})(\text{CO}_3)_2$
Calcite	CaCO_3
Dolomite	$\text{CaMg}(\text{CO}_3)_2$
Galena	PbS
Gibbsite	$\text{Al}(\text{OH})_3$
Goethite	FeOOH
Illite	$(\text{K}, \text{H}_3\text{O})(\text{Al}, \text{Mg}, \text{Fe})_2(\text{Si}, \text{Al})_4\text{O}_{10}(\text{OH})_2(\text{H}_2\text{O})$
Jarosite	$\text{KFe}^{3+}_3(\text{OH})_6(\text{SO}_4)_2$
Kaolinite	$\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$
K-feldspars	KAlSi_3O_8
Marcasite	FeS_2
Muscovite	$\text{KAl}_2(\text{AlSi}_3\text{O}_{10})(\text{OH})_2$
Pyrite	FeS_2
Rhodochrosite	MnCO_3
Sericite	$\text{KAl}(\text{AlSi}_3\text{O}_{10})(\text{OH})_2$
Siderite	FeCO_3
Smectite	related to bentonite / montmorillonite with a similarly variable in composition
Sphalerite	$(\text{Zn}, \text{Fe})\text{S}$

EXECUTIVE SUMMARY

During 2012-2013, 127 representative samples of waste rock, 5 samples of low grade ore, 2 samples of full grade ore, and 3 soil-clay samples, were geochemically characterised via a program of static testing (i.e. 'whole-rock' analyses and tests). These samples were derived from the weathered and fresh rock zones of the geologic profile. Eighteen samples were also subjected to kinetic testing using weathering columns. Extensive use was made of geological logging information and assay results within the Bowden Silver Project's geochemical data-base for sample selection. Process-tailings samples were also subjected to static testing in the GCA (2013) investigation.

During 2017-2018, 90 representative samples from the fresh rock zone within the northern section of the proposed open cut pit were assayed with 16 samples being subjected to static testwork.

Waste Rock and Low Grade Ore Geochemistry

The ignimbrites, crystal tuffs, and volcanic breccias, which make up the majority of the waste rock zone, are characterised by a relatively low abundance of sulphide minerals (chiefly pyrite) with Total-S values seldom above 3% (at the metre-scale). However, the Total-S values are also typically greater than 0.3%. The pervasive occurrence of sulphur means that the ignimbrites, crystal tuffs and volcanic breccias are geochemically similar to each other; waste rock and low grade ore are also geochemically identical (save for silver grade).

The sandstone unit is typically characterised by Total-S values less than 0.1%. Although variable spatially, ignimbrites, crystal tuffs and volcanic breccias with Total-S values less than 0.3% occur within the uppermost 20-30 m of the geologic profile, and locally at depth in zones amenable to selective mining.

The groundmass of all lithological units is generally deficient in carbonate minerals, and where carbonates occur, rhodochrosite (Mn-carbonate) invariably predominates. Illitic/smectitic clays are also a common prominent component of the groundmass.

All waste rock and low grade ore with Total-S values greater than 0.3% are classified as Potentially-Acid Forming (PAF). Kinetic testing using laboratory columns indicate that lag-times may range up to several months. Irrespective of the stage of weathering, PAF units constitute a source of soluble-Mn forms, and mainly reflects buffering by rhodochrosite. Release of soluble-Zn forms may also be significant, especially for Total-S values above 1%.

The sandstone stands out in being Non-Acid Forming (NAF), and reflects minimal influences from mineralisation on this unit.

In terms of demarcating mining streams for site-wide management, a distinction is made between material situated within the uppermost 20m to 30m of the proposed open cut pit (the weathered zone) and the underlying material (the primary zone, or fresh zone) with the benign waste rock (i.e. NAF) being situated within both the weathered zone and the primary zone.

The waste rock from both the weathered and primary zones is further sub-classified as follows.

Weathered Zone

- WZ1: Total S <0.3% (initially sub-neutral but evolving to NAF over time as 'trace alunites' are leached with buffering from interactions with smectites)
- WZ2: Total S >0.3% (PAF)

Primary Zone

- PZ1: Total-S <0.1% (NAF)
- PZ2: Total-S = 0.10-0.30% (NAF) within the northern section of proposed main open cut pit
- PZ3: Total-S >0.3% (PAF), and Total-S = 0.10-0.30% is areas distant from the northern section of the proposed main open cut pit

Although the environmental geochemistry of the waste rock and ore streams at Bowdens is relatively complex, a thorough understanding of this has been obtained from the investigations undertaken.

All PAF streams would report to the lined Waste Rock Emplacement (WRE).

Soil-Clays

The soil-clays were classified as NAF, and had a clay mineral suite comprising kaolinites, illites, and smectites.

Process-Tailings Geochemistry

The process-tailings stream is classified as PAF, due to pyrite being a trace component in a groundmass with a low capacity to buffer at circum-neutral-pH. Traces of rhodochrosite have implications for Mn solubility at circum-neutral-pH.

Closure Planning for Waste Rock Emplacement (WRE) and Tailings Storage Facility (TSF)

Rehabilitation and closure of the WRE and TSF would need to cater for the isolation of reactive materials. Geochemical requirements pertinent to the construction and cover design are outlined in this report to assist engineering assessment and design.

Although there would be a stockpile of low grade ore during the active lifetime of the Project, this would be removed at closure (i.e. WRE and TSF occurring as an integrated landform at closure).

1. INTRODUCTION

The majority of the testwork performed for this assessment was previously conducted for Kingsgate Bowdens Pty Limited (KBPL) on a range of waste rock, ore, soil, and process tailings samples from the Bowdens Mine Site located near Lue, NSW.

This bulk of the testwork program was completed during 2012-2013 with the Bowdens Silver Project (the "Project") subsequently being placed on hold in November 2014 at the request of KBPL.

In 2016, the Project was acquired by Silver Mines Limited (SVL) who formed a wholly owned subsidiary, Bowdens Silver Pty Limited to develop the Project.

The earlier test work program was extended for selected samples from the weathered rock zone with low Total-Sulphur ($0.1\% < S < 0.3\%$) values by re-commencing the weathering columns in late-2014. The Low-Sulphur (Low-S) samples tested in these columns are derived from the upper section of the geologic profile (i.e. within c. 30-40 m of ground level). During 2017-2018, a range of Low-S samples from the fresh rock zone within the northern section of the proposed open cut pit was also subjected to geochemical testwork.

The geochemical characterisation of waste rock, ore, soil and tailings samples conducted for this assessment forms part of the technical investigations undertaken to inform the Environmental Impact Statement (EIS) for the Project, as prepared by RW Corkery & Co Pty Limited.

A copy of the report on the initial geochemical testing of the waste rock samples from internal-waste-zone (GCA, 2012) is presented in **Annexure 1**.

A copy of the report on the geochemical testing of the tailings samples (GCA, 2013) is presented in **Annexure 2**.

Details of the sampling programs undertaken for the waste rock, ore and soil samples tested herein are presented in **Annexure 3**. Geological information and statistics of sulphur (S) assays from the geological database are also presented in **Annexure 3**.

Details of the testwork methods employed are presented in **Annexure 4**, whilst the classification criteria for determining Acid Formation Potential (AFP) are presented in **Annexure 5**.¹

Copies of the laboratory reports are presented in **Annexure 6**.

The findings of this assessment have implications for both the design and construction of the waste rock emplacement (WRE) and tailings storage facility (TSF), and the closure of these landforms (Section 6).

¹ References to the scientific and technical literature are presented in **Annexures 4** and **5**, as appropriate.

2. STATIC TESTING PROGRAM

The main aim of the static testing program was to determine the acid forming tendency of a range of representative samples that were obtained from drill holes located within the proposed open cut pit. These samples were also assayed for the range of elements associated with the deposit mineralisation with sections representing the uneconomic (or un-mineralised) waste rock) zones selected for sampling.

The selected samples correspond to downhole intervals varying in thickness from 1m to 5m, as determined by sample availability. These downhole intervals are comparable to an operating bench height of c. 5m, and therefore represent a practical 'resolution limit' for a selective mining operation.

Based on the outcomes of the static testing program (**Table 1**), selected individual samples, and composite samples prepared from individual samples, were subjected to kinetic testing, multi-element analyses and mineralogical characterisation, as detailed in Section 3.

2.1 WASTE ROCK SAMPLES

A total of 127 samples of waste rock were selected for tested comprising:

- 54 samples with Total-Sulphur (Total-S) < 0.3%
- 73 samples with Total-S > 0.3%²

2.1.1 Total-S < 0.3%

The 54 samples with Total-S < 0.3% were typically derived from less than 20-30 metres below ground-level (mbgl).

The sample set comprised:

- Shoalhaven Group
 - 17 samples (sandstone)
- Rylstone Volcanics
 - 10 samples (crystal tuff)
 - 6 samples (ignimbrite)
 - 11 samples (volcanic breccia)
 - 7 samples (laminated tuff)
 - 3 samples (ignimbrite lithic tuff)

These samples were characterised by:

- pH-(1:2) values between pH 4.0 and pH 7.9³
- Total-S values that ranged from less than 0.01% to 0.29%

² The 127 samples include the 15 samples tested in the GCA (2012) (**Annexure 1**) study undertaken as a preliminary assessment of waste rock geochemistry.

³ The pH-(1:2) tests (and other testwork) are described in **Annexure 4**.

- SO₄-S values that ranged from less than 0.01%, to 0.22%
- CO₃-C values that ranged from less than 0.01%, to 0.63%
- Acid Neutralisation Capacity (ANC) values that ranged from less than 1kg H₂SO₄/tonne (method detection limit), to 25kg H₂SO₄/tonne
- NAG-pH values between pH 4.2 and pH 9.1, and NAG-pH 7 values that ranged from less than 0.5kg H₂SO₄/tonne, to 2.3kg H₂SO₄/tonne⁴

Total-S occurs almost exclusively as SO₄-S, with the main SO₄-bearing minerals being alunites and jarosites (i.e. Al/Fe-hydroxysulphate-minerals) [Table 7]).

The ANC values were typically less than 5kg H₂SO₄/tonne, and often close to, or less than, the method detection-limit of 1kg H₂SO₄/tonne.

The sandstone samples, in particular, had ANC values close to the detection limit, and were naturally mildly-acidic with pH-(1:2) values of pH 4 to pH 5.

The low ANC values reflect a lack of reactive carbonate minerals (e.g. calcites) in a groundmass dominated by quartz, K-feldspars, muscovites and clays (see mineralogical characterisation in Section 3).

As a group, the volcanic breccia samples returned ANC values up to 25kg H₂SO₄/tonne.

Although several of the samples returned CO₃-C values within the range of 0.3 to 0.7%, the CO₃-C is mostly associated with iron carbonates such as siderite (FeCO₃), and manganese carbonates (rhodochrosite, MnCO₃).⁵ Siderites are ineffective in circumneutral buffering under aerated conditions, save for the dissolution of 'trace' amounts of Mg, Ca and Mn that may be incorporated into the crystal structure of this mineral. Rhodochrosites are generally effective at circumneutral buffering, due to the sluggish aerobic oxidation kinetics of soluble-Mn(II) at circum-neutral-pH.

All samples were assayed for Zn, Cd, Pb, Cu, Mn, As, Ba, Sr, and Ag, and although variously enriched in these elements, none of the enrichments were marked (Table 2). The solubility characteristics of these elements (as well as other elements) are assessed in the kinetic testing program (Section 3).

Almost all waste rock with Total-S concentrations of < 0.3% samples are classified as being Non-Acid Forming (NAF) material.

However, classification of sample GCA10664 (sandstone), sample GCA10674 (crystal tuff), and samples GCA10678 and GCA10679 (both volcanic breccia), is complicated by the occurrences of trace amounts of Al/Fe-hydroxysulphate minerals (e.g. alunites and jarosites). These samples are classified as Uncertain (UC), though likely UC-(NAF).

Annexure 5 details the criteria employed for classifying the waste rock samples with Total-S < 0.3% as NAF. These criteria account for the presence of Al/Fe-hydroxysulphates (e.g. 'trace alunites' and 'trace jarosites') and the results of the kinetic testing program (Section 3) in terms of the weathering pH regime whereby the source of acidity is primarily the result of the dissolution of Al/Fe hydroxysulphates (cf. oxidation products of sulphide minerals occurring in situ, and thus generated over geological time) in the presence of smectitic / illitic clays.

⁴ NAG = Net-Acid Generation.

⁵ Siderite and rhodochrosite were identified in the mineralogical study for the samples subjected to kinetic testing (Table 7).

The ability of the smectitic / illitic clays to adsorb soluble Al forms released during the dissolution of the Al/Fe hydroxysulphates, thereby suppressing acidity associated with the full hydrolysis of soluble Al forms, is an important generic feature of waste rock mineralogy and geochemistry at the Mine Site.

A key outcome of the program of kinetic testing performed on samples GCA10664, GCA10674, GCA10678, and GCA10679 (Section 3.1) is the demonstration of a weathering-pH regime near pH 5, and an eventual trending to pH 6 (with corresponding bicarbonate alkalinity) as the 'trace alunites' and 'trace jarosites' are depleted through dissolution and elution. This is shown in the extended kinetic testing program run for 162 weeks.

2.1.2 Total-S > 0.3%

The 73 samples with Total-S > 0.3% were derived from depths up to c. 150mbgl. The shallowest samples were derived from 5-10mbgl, and reflect the geology of the Project whereby both sulphide minerals (e.g. pyrite) and Al/Fe hydroxysulphate-minerals, may locally co-occur at shallow depths.

The sample set comprised:

- Shoalhaven Group
 - 2 samples (sandstone)
- Rylstone Volcanics
 - 31 samples (crystal tuff)
 - 21 samples (ignimbrite)
 - 16 samples (volcanic breccia)
 - 3 samples (laminated tuff)

The samples were characterised as follows:

- pH-(1:2) values between pH 3.5 and pH 8.2
- Total-S values between 0.30 and 5.2%
- Cr(II) Reducible S values that ranged from less than 0.01% to 0.96%⁶
- CO₃-C values that ranged from less than 0.01% to 1.4%
- ANC values that ranged from less than 1kg H₂SO₄/tonne to 61kg H₂SO₄/tonne
- NAG-pH values between pH 2.4 and pH 8.7, and NAG-pH7 values that ranged from less than 0.5kg H₂SO₄/tonne to 89kg H₂SO₄/tonne

The Total-S values obtained in this assessment were in good agreement with the corresponding Total-S values from the exploration database for the Project.

Of the 33 samples with Total-S > 1%, 31 samples had Total-S values within the range 1-3%. This corresponds with logging of drillcore at Bowdens where sulphides (typically pyrite) occur as trace to accessory components (at the metre-scale) within the waste rock zones (**Annexure 3**).

⁶ Not all samples were tested for Cr(II)-Reducible-S.

Total-S in the samples was increasingly dominated by Sulphide-S with depth and reflects the presence of sulphide minerals (e.g. pyrites and marcasites) also identified in the mineralogical study on those samples subjected to kinetic testing (Section 3). However, over all depths, $\text{SO}_4\text{-S}$ was also present as a sizeable proportion of Total-S, with Al/Fe hydroxysulphates (e.g. alunites and jarosites) being a characteristic feature of the mineralogy present throughout the various waste rock zones.

The ANC values were often between 10 and 20kg H_2SO_4 /tonne, though ANC values below, or close to, the detection limit of 1kg H_2SO_4 /tonne were recorded for a number of samples. There was a broad correlation between ANC and $\text{CO}_3\text{-C}$.

Selected samples were subjected to auto-titrations with H_2SO_4 in order to assess their acid buffering properties that would be chiefly due to the dissolution of reactive carbonate minerals (**Figures 1 and 2**). The results of the auto-titrations indicated that the carbonate minerals typically exhibit non-limiting, circumneutral dissolution kinetics for the consumption of up to c. 10kg H_2SO_4 /tonne. However, where rhodochrosite (of ideal composition MnCO_3) dominates the carbonate mineral suite, soluble Mn forms result. Manganese solubility during weathering of waste rock is addressed in the kinetic testing program (Section 3).⁷

The samples had Zn, Cd and Pb contents that ranged up to 5,000mg/kg, 24mg/kg, and 3,900mg/kg, respectively (**Table 2**), and reflect contributions from inter alia sphalerite (ZnS) and galena (PbS). The Mn content ranged up to 2.9%, and broadly correlates with $\text{CO}_3\text{-C}$ and S. This reflects the co-occurrence of rhodochrosite with pyrite. However, rhodochrosite was not the only Mn bearing mineral as Mn(II) may be substituted into the crystal structures of alunites and jarosites [Dill 2001].⁸

All samples of waste rock with Total-S concentrations of > 0.3% were classified as Potentially-Acid Forming (PAF).⁹

There was no systematic difference in the geochemical character of the ignimbrite, volcanic breccia, crystal tuff, and laminated tuff samples, suggesting that, in terms of environmental geochemistry, there is a high degree of uniformity (at the metre-scale) within the waste rock zones with Total-S > 0.3%. Therefore, this assessment indicates that, for practical purposes, all such (Total-S > 0.3%) ignimbrites, volcanic breccias, crystal tuffs, and laminated tuffs should be collectively treated as PAF.

2.1.3 Size-fraction Testing for Total-S and $\text{CO}_3\text{-C}$

Selected samples of ignimbrite and crystal tuff with Total-S values within the range 1-3% were subjected to size fraction testing to assess the possibility of a 'concentrating-up' effect in the fines (< 2mm) fraction during blasting, excavation, and disposal to the waste rock emplacement (WRE).

⁷ Release of Mn(II) through dissolution of rhodochrosite (as induced through sulphide oxidation by H_2O_2), and other sources, during NAG testing may catalyse the decomposition of H_2O_2 (e.g. Stadtman et al. 1990). This side-reaction potentially complicates the use of NAG testing of waste rock samples from the Bowdens deposit, especially for Sulphide-S values less than 1% (i.e. 'trace sulphides').

⁸ Although Mn substitution in alunites is not listed by Dill (2001), substitution of Zn and Cu(II) in the 'B' sites (of 6-fold coordination) readily occurs within the cation sub-lattice of alunite. For 6-fold coordination, the ionic radius of Mn (0.81 Å) is similar to that of Zn (0.88 Å) and Cu(II) (0.87 Å) [Cotton et al. 1999].

⁹ See **Annexure 5** for the criteria employed for classifying the waste rock samples with Total-S > 0.3% as either PAF or NAF.

This size fraction testing comprised an initial 'coarse crushing' of drillcore, where the jaw crusher was set to a nominal 20-30mm clearance, followed by dry sieving to obtain the < 2mm fraction. The resulting rejects (i.e. > 2mm fraction) were then 'fine crushed' for testing.

The results of the size fraction testing (**Table 3**) indicates that negligible enrichment of sulphide and carbonate minerals would occur in the fines generated during drill, blast and extraction of the ignimbrites and crystal tuffs (i.e. the S and C occurrences would be similar in both the < 2mm and >2mm material fractions).

This largely reflects the non-fissile nature of the ignimbrites and crystal tuffs, and a typically disseminated distribution of sulphide and carbonate minerals (where the latter occur) within the matrix of the crystal tuffs. Within the ignimbrite matrix, sulphide minerals are chiefly confined to micro-fractures which largely remain intact, so that only limited liberation of sulphide minerals would be expected to occur when subjected to mechanical stress. Geologically, the 'welded' nature of the ignimbrites renders this unit very hard and durable overall.

2.2 ORE SAMPLES

Of the 7 samples tested, 5 were Low Grade Ore (LGO) samples, and 2 were Full Grade Ore (FGO) samples.

It is noted that the Silver (Ag) equivalent grade 'cut-off' values differentiating the high and low grade ores would vary throughout the life of the Project, as governed by the evolving geological model, ongoing metallurgical evaluations, and the economics of the Project.

The FGO samples were tested for completeness as such ores would have only a transient existence on the ROM pad prior to Ag processing and recovery.¹⁰

Using the same methods applied for classifying the acid forming potential of the waste rock, both the LGO and FGO samples are classified as PAF, and variously enriched in Zn, Cd, Pb, and Mn (**Table 4**, and **Figure 3**).

These geochemical characteristics are similar to those for the waste rock samples with Total-S values between 1% and 2%, as discussed in Section 2.1.2 above.

The acid-forming potential of the LGO and waste rock is expected to be similar, since mineralised and non-mineralised zones at the Mine Site are demarcated by Ag-equivalent (Ag_{eq}) values above, or below, c. 30g Ag_{eq} /tonne (= 0.003% Ag_{eq} /tonne). That is, the majority of the Total-S occurs as pyrite, marcasites, and Al/Fe-hydroxysulphates (cf. Ag-, Zn- and Pb-sulphides).

¹⁰ The geochemical characteristics of the process-tailings samples is the subject of the GCA (2013) report [**Annexure 2**].

3. KINETIC TESTING PROGRAM

The main aim of the kinetic testing program was to assess the weathering behaviour over time for a range of waste rock and ore samples representing the different lithological units to be encountered over the life of the mine as well as the anticipated variation in Total-S values.¹¹

The initial kinetic testing program undertaken during 2012-2013 comprised the running of 18 weathering columns over varying durations (for individual columns) up to 30 weeks. The testing duration for a given column was determined by the time from which the column test commenced until the establishment of steady time trends in leachate analysis results sufficient to inform management-decision making. In the extended kinetic testing program (columns recommended in 2014) on Low-S (alunitic) samples from the weathered rock zone, 4 columns were run for up to 162 weeks of weathering.

Static testing results (including multi-element analyses and mineralogical assessment) for the samples subjected to kinetic testing are presented in **Tables 5 to 7**, and shown on **Figure 4**. Leachates produced by the columns were subjected to multi-element analyses, typically with detection-limits of 0.1-10 µg/L which is considered appropriate for environmental contexts.

In addition to the kinetic testing the <2mm fraction and rock chips, the mineralogical work included isolation of the <2µm fraction, and treatment with organic solvents and heating to varying temperatures, to allow identification of clay minerals (e.g. illites, and regularly interstratified smectites/illites).¹²

3.1 WASTE ROCK SAMPLES: TOTAL-S < 0.3%

3.1.1 Initial Testing Program

The weathering columns run for the Total-S <0.3% samples allowed for an assessment of the weathering behaviour of waste rock that would be potentially available for use as material for the construction of mine infrastructure, use as free-draining fill, and other applications (e.g. rock-armouring and bunding) characterised by seasonal wetting and drying (weathering) over the longer-term.

A key feature of the waste rock with Total-S <0.3% from the weathered rock zone is that the S occurs primarily as Al/Fe hydroxysulphates (e.g. alunites and jarosites).

Previous research has shown that the weathering and dissolution of Al/Fe hydroxysulphates in waste rock units may 'fix' the pH regime around pH 4, and the resulting acidity levels in solution are generally low to moderate (e.g. < 50mg/L as CaCO₃, Linklater et al. 2012). Whilst bereft of reactive carbonates (e.g. calcites), the Low-S waste rock at the Mine Site is characterised by a weathering pH regime near pH 5, primarily due to, in effect, the interaction between Al/Fe hydroxysulphates and the smectitic / illitic clays, as discussed below.

4 weathering columns were run for samples with Total-S <0.1%:

- Sandstone (GCA10651/53)
- Crystal tuff (GCA10668/69 and GCA10682/83)
- Volcanic breccia (GCA10687/91)

¹¹ Where composites were employed in the kinetic testing, they correspond to equal-weight-based composites of the respective individual samples subjected to static testing (Section 2.0).

¹² Regularly interstratified smectites/illites means that smectite and illite layers in the clay structure alternate in a 1:1 proportion overall.

3 weathering columns were run for samples with Total-S between 0.1% and 0.2%:

- Sandstone (GCA10663/64)
- Crystal tuff (GCA10674/75)
- Volcanic breccia (GCA10678/79)

(Note: The above three weathering columns were also included in the extended kinetic testing program as discussed in Section 3.1.2).

The design of the weathering columns was similar to that described in AMIRA (2002), and comprised 1.50kg sample beds of either a <2mm, or <5mm particle size material.¹³ The sample height in the columns was c. 50mm and columns were initially flushed with successive 1.00kg lots of deionised water to remove pre-existing solutes (**Plate 1**).¹⁴ Following flushing, drying of the sample beds occurs under non-isothermal conditions via the use of flood-lamps located above the columns (**Plate 2**). The heat loads applied from the flood-lamps correspond to pan evaporation rates of 5-10mm/day, so that drying of the sample beds is both rapid and complete (i.e. attainment of residual-moistures).¹⁵ The leachates produced from the initial 'pre-rinsing-cycles' were filtered using a 0.45µm-membrane and preserved for analysis, as were leachates generated from the subsequent weathering cycles.¹⁶

Static testing results for the samples subjected to kinetic testing are presented in **Tables 5 and 6**.

The tested samples comprised mostly quartz, clays (regularly interstratified smectites/illites, and kaolinites), and K-feldspars (**Table 7**). Manganese typically occupied a sizeable proportion of the clay cation exchange complex and attests to the 'pool' of Mn potentially available for biogeochemical cycling and leaching during weathering.¹⁷

The pH buffering curves shown on **Figure 4** are consistent with dissolution of siderites and ankerites.

In the mineralogical analyses, trace amounts of alunites and jarosites were also identified in the samples with Total-S values between 0.1% and 0.2% (**Table 7**).¹⁸

The analytical results for the leachates produced by the weathering columns are presented in **Table 8**.

¹³ 80 W flood-lamps were operated intermittently during the night-time (cf. 100 W flood-lamps operated continuously during the day-time [AMIRA 2002]) in order to constrain diurnal and seasonal variations in sample-bed temperatures (Campbell 2013; Campbell et al. 2012).

¹⁴ In terms of length-scales employed in the kinetic testing, 1.00kg of applied deionised water corresponds to an equivalent 'storm depth' of c. 40-45mm.

¹⁵ Residual-moistures correspond to a 'dry-and-dusty' state.

¹⁶ Due to some of the tested samples being quite clayey, the dried-out sample beds could develop sizeable desiccation cracks (**Plate 3**). When this occurred, the top 5-10mm of the sample beds in the columns were chipped using a steel screwdriver, and worked over so that 'short-circuiting' during flushing was prevented. A plastic syringe was used to slowly add the 1.00kg lots of deionised water, so that matrix flow occurred during flushing thereby enhancing solute elution.

¹⁷ A 1 M-NH₄Cl solution was employed to displace exchangeable-cations from the clay exchange complex of the samples. It is possible that the dissolution of alunites and jarosites released Mn during extraction with 1 M-NH₄Cl, so that the 'exchangeable-Mn' values are biased 'on-the-high-side'.

¹⁸ Due to the clay-rich state of the samples, the clay-size fraction was first separated (via dispersion and centrifugation), and the 'non-clay fraction' subjected to examination using powder X-ray diffraction with long capture times in order to identify the 'trace alunites', in particular (see mineralogical report in **Annexure 6**).

The key findings of the kinetic testing and leachate analyses are that:

- a) pH either remains stable when initially above 6, or rapidly increases to 5-6 when initially near 4; and,
- b) SO_4 and Mn was progressively removed from the columns at decreasing rates.

Columns GCA10663/64 (sandstone), GCA10674/75 (crystal tuff), and GCA10678/79 (volcanic breccia) with Total-S = 0.1-0.2% produced leachate from the initial pre-rinsing step with pH values near 4 (**Table 8**). However, following the commencement of the weathering cycles, the Leachate-pH values increased to above pH 5 (**Figure 5**). Calculations indicate that the initial acidity removed from the columns (i.e. before the pH increased above pH 5), was c. 0.02-0.2kg CaCO_3 /tonne. This acidity loading is appreciably less than a typical 'ag-lime' (e.g. crushed-limestone or limes and) application rate of c. 1-2 tonnes CaCO_3 per hectare for raising the pH of acidic soils in broad-acre agriculture (Moore et al. 2004).¹⁹ Although approximate, these estimates place the initial acidity levels of the above waste rock samples into broad perspective.

The initial Leachate-pH values near 4 are interpreted in terms of the enhanced solubility of 'trace alunites' and 'trace jarosites', attributable to the disturbed mineral-surfaces created by sample preparation (e.g. crushing). Disturbed mineral surfaces and increased reactivity are also expected from blasting, excavation and dumping during mining operations, therefore the ensuing 'first-flush' of solute release is an important aspect of the early stage, full-scale weathering of waste rock (Morin 2013).

In kinetic testing of samples of waste rock containing alunites and jarosites, Linklater et al. (2012) reported Leachate-pH values consistently near 4 over 40 weeks of testing.²⁰ This weathering-pH regime was ascribed to dissolution of alunites and jarosites, and precipitation of Al- and Fe(III)-oxyhydroxide minerals (e.g. gibbsite and goethite).

In the current work, however, Leachate-pH values initially near 4 increased to near 5 within a matter of weeks. This suggests that there is a 'sink' for soluble Al and Fe forms (released from the dissolution of alunites and jarosites), so that precipitation of Al- and Fe-oxyhydroxides is restricted. The intercalation of (weakly-hydrolysed) Al and Fe forms within the interlayer spaces of the interstratified smectites/illites is one possibility (e.g. Al- and Fe-hydroxy-interlayered smectites [Wu et al. 2009; Saha et al. 2001]).²¹ In addition, Al-hydroxysulphate-interlayered smectites may form (Singh and Brydon 1970).

Whatever the exact mechanism(s) involved, the present work indicates that, although there may be an initial 'pool' of acidity (viz. pH near 4) in waste rocks with Total-S = 0.1-0.3%, the weathering-pH regime stabilises near pH 5. Nonetheless, this 'initial' 'pool' of acidity has implications for establishing vegetation (Rengel, 2003) where such waste rocks are employed in cover profile applications (Section 5.2).²²

¹⁹ The latter application rates equate to c. 1-2kg CaCO_3 /tonne where the 'ag-lime' is worked into the plough layer of c. 0.1m.

²⁰ The groundmass of the samples tested by Linklater et al. (2012) comprised chiefly quartz, goethites and hematites. The actual kinetic testing program undertaken in the study by Linklater et al. (2012) was performed in the GCA Testing Laboratory (Bridgetown).

²¹ Regularly interstratified smectites/illites were minor-to-major components of samples GCA10663/64, GCA10674/75 and GCA10678/79.

²² Leachates from the pre-rinsing step with pH values near 4 also had Al concentrations within the mg/L range, and would include Al-hydroxy species toxic to plant roots. However, Leachate-Al concentrations for subsequent weathering cycles were less than 0.01 mg/L for Leachate-pH values of 5+.

The 'stabilised' Leachate-SO₄ concentrations of 16-45mg/L in the current study (**Table 8**) are similar to the 15-35mg/L reported by Linklater et al. (2012) for 'near-equilibrium' solubility control due to alunites. Similar Leachate-SO₄ concentrations are to be expected, since the fate of soluble SO₄ released during alunite dissolution would be minimally affected by the presence of smectites/illites (cf. soluble-Al forms).

By Week 10, Leachate-Mn concentrations had typically decreased to near 1 mg/L, or to less than 0.1mg/L (Figure 6). However, for column GCA10678/79, although steadily decreasing, the Leachate-Mn concentration was still 5-10mg/L by Week 10.

3.1.2 Extended Testing Program

The leachate-analysis results for the extended kinetic testwork program are presented in **Table 9**.

Initially, the kinetic weathering testing program of the following 3 columns (Total-S = 0.1-0.2%) was recommenced following a pre-rinsing step:

- sandstone (GCA10663/64);
- crystal tuff (GCA10674/75); and
- volcanic breccia (GCA10678/79)

In mid-2014, an additional sandstone column (GCA10664) (Total-S = 0.25%) was added to the testing program. The extended kinetic testing program therefore comprised 4 columns in total.

The extended testing program was based on the non-forced air flow Option B in ASTM D5744-13 (2013), and employed varying periods between flushing for leachate generation. The sample beds in the columns were maintained in a moist state corresponding to a Gravimetric Water Content (GWC) within the range 5-10% (w/w) with regular weighing, and misting with deionised water to compensate for any water losses via evaporation.²³ All weathering columns were stored in a constant-temperature room at 20 (+/- 2) °C. To ensure that the sample beds were desaturated swiftly following flushing, an oscillating fan was used over the first 1-2 days after drainage from flushing was complete with weighing to assess when the above GWC range had been attained. Drying with the fan then ceased.

The variation in Leachate-pH values and Leachate-Mn concentrations for the samples with Total-S values of 0.1-0.3% are shown on **Figures 7** and **8**, respectively. In terms of weathering behaviour and trends, the extended testing (to 162 weeks) was characterised by:

- Leachate-pH values close to pH 5 for the majority of the time, though trending to the pH 5.5-6.0 over the latter months of testing (**Figure 7**); and
- Leachate-Mn concentrations consistently within the range 1-2mg/L (**Figure 8**).

Leachate-SO₄ concentrations closely matched those recorded initially, and mass balance calculations indicated that a sizeable fraction (e.g. up to c. 60+%) of the Total-S had been removed from the columns during the course of the program.

²³ The tops of the columns were covered with large watch-glasses during weathering to constrain evaporative water losses to within the range c. 0.5-1mm/day.

Leachate-Acidity values, established via titration with NaOH solution to a 'pH 8.3' endpoint, typically did not exceed 5 mg/L (as CaCO₃), and may be compared with the 1-2mg/L (as CaCO₃) recorded for the high-purity deionised water (HPDW) added to the columns during flushing.²⁴ Leachate Al and Leachate-Fe concentrations were invariably below the detection limit of 0.01mg/L.

The results of recirculation testing undertaken after almost 12 months of weathering are presented in **Table 10**. This testing corresponds to leachate derived from a given weathering column being recirculated through that column up to ten times before being analysed. The results of the recirculation testing show conformity with equilibrium solubility control for 'contact-times' of-the-order hours, and is similar to the outcomes of related testing reported by Linklater et al. (2012) for samples of waste rock containing alunites.

Leachates generated at an advanced stage of weathering were also subjected to a 'full analysis' employing detection-limits for trace elements of 0.1-10µg/L relevant to environmental contexts. The results of the analytes are presented in **Table 11**, and show that, save for Mn, the concentrations of trace elements were either below, or close to, the detection limits for the respective analytes.

In summary, over a period of 162 weeks of weathering, the columns containing samples with Total-S values between 0.1-0.3% were consistently characterised as having Leachate-pH values close to pH 5, and trending towards pH 5.5 over the latter months of testing.²⁵ The Leachate-acidity values were c. 5 mg/L (as CaCO₃) during the early stages of testing, and with Leachate-Al and Leachate-Fe concentrations less than (or just above) the detection limits of 0.01mg/L. Leachate-Mn concentrations were generally 1-2mg/L.

The results of the extended kinetic testing program therefore indicate that, in terms of the quality of 'contact-water', waste rock from the weathered rock zone with Total-S values of 0.1-0.3% can be characterised as having a sub-neutral pH, and as being a weak source of SO₄ and Mn.

3.2 WASTE ROCK SAMPLES: TOTAL-S BETWEEN 0.3% AND 0.5%

The weathering columns run for the waste rock samples having Total-S between 0.3% and 0.5% allow assessment of waste rock weathering where 'trace sulphides' (e.g. pyrite and marcasite) co-occur with 'trace alunites' and 'trace jarosites'.

3 columns were run for waste rock with this range in Total-S:

- crystal tuff (GCA10730/31)
- laminated tuff (GCA10740/41)
- volcanic breccia (GCA10706/07)

As a result of static testing, all samples are classified as PAF (**Table 5**), and variously enriched in Zn, As and Sb (**Table 6**). The Zn content of GCA10740/41 was 1,400mg/kg.

The samples comprised mostly quartz, clays (regularly interstratified smectites/illites, and kaolinites), and K-feldspars (**Table 7**). Pyrites and marcasites were trace components. Although alunites and jarosites were not identified in the mineralogical study, their presence is inferred from the difference between the corresponding Total-S and Cr(II)-Reducible-S values (**Table 5**).

²⁴ The pH value of the HPDW was 5.6 (+/- 0.1-0.2) reflective of equilibration with 'atmospheric-CO₂'.

²⁵ Over the 162 weeks of testing, c. 1,800mm of deionised water had been added to the columns when summing over all of the flushing steps undertaken.

The weathering columns were run under conditions similar to those for the extended weathering of the Low-S samples, as described in Section 3.1.2, except that weathering was conducted in an incubator set at 20.0 (+/- 0.1) °C (see **Plate 4**). Also, for these columns, in order to desaturate the sample beds following completion of drainage they were first placed under flood-lamps for 2-3 nights prior to being put into the incubator.²⁶

The results of analysis of the leachates produced by the weathering columns are presented in **Table 8**.

Trends in the Sulphate Release Rates (SRRs) are shown on **Figure 9**.

The measured SRRs represent the net outcome of:

- a) SO₄ released from the dissolution of 'trace alunites' and 'trace jarosites'
- b) SO₄ produced by oxidation of 'trace pyrites, and 'trace marcasites' during the weathering cycles

In simple inorganic chemistry theory, dissolution of Al/Fe-hydroxysulphates should be suppressed by SO₄ produced from sulphide oxidation (i.e. 'common-ion' effect influencing equilibrium solubility control).

Although variable, the SRRs were 100+ mg SO₄/kg/week during the period of testing, and so represent a much stronger 'solute-source term', compared with the columns with Total-S < 0.3% above with negligible amounts of sulphide minerals.

Column GCA10730/31 was characterised by Leachate-Mn concentrations of c. 30mg/L by the end of the testing period which represents a strong source of soluble-Mn forms.

In summary, the kinetic testing showed that waste rock with Total-S values within the range 0.3-0.5% is characterised by behaviour more complex weathering behaviour, especially in terms of the solubility of Mn, and to a lesser extent Zn.

3.3 WASTE ROCK AND ORE SAMPLES: TOTAL-S > 0.5%

The majority of the waste rock and ore expected to be extracted from the proposed open cut pit would be characterised by Total-S values greater than 0.5%, though less than 3% (**Annexure 3**).

Weathering columns with Total-S >0.5% therefore provide an understanding as to the expected weathering behaviour for the bulk of the waste rock placed in the WRE. The kinetic testing results correspond to a testing period duration of up to 30 weeks.

The results for the weathering columns with waste rock and ore sample beds are discussed below. It is noted that, due to the nature of the mineralisation within the Mine Site, the overall weathering behaviour of the waste rock and the ore is similar.

2 weathering columns for waste rock with Total-S = 0.6-0.7%, were run:

- ignimbrite (GCA10053)
- volcanic breccia (GCA10747/48/49)

4 weathering columns for waste rocks with Total-S = 1-3%, were run:

- crystal tuff (GCA10754/55, GCA10043 and GCA10044)
- ignimbrite (GCA10039)

²⁶ The more clayey samples took the longest to dewater to a GWC values within the range 5-10% (w/w), as indicated by weighing.

1 weathering column for ore with Total-S = 1% was run:

- ignimbrite/ volcanic breccia (GCA10729/52)

1 weathering column for low grade ore with Total-S = 1% was run:

- ignimbrite (GCA10049)

As a result of static testing, all samples are classified as PAF (**Table 5**, and **Figure 4**), and variously enriched in Zn, Cd, Pb, Mn, As and Sb (**Table 6**). The Zn, Pb and Mn contents ranged up to 2,400mg/kg, 4,000mg/kg, and 1.4%, respectively.

The samples comprised mostly of quartz, muscovites, illites, and K-feldspars (**Table 7**). Pyrites and rhodochrosite were typically accessory components. Traces of marcasites, sphalerites and galena were also common. Alunites and jarosites are also inferred to occur as trace components based on the difference between the respective Total-S and Cr(II)-Reducible-S values (**Table 5**).

The same kinetic testing approach presented in Section 3.2 was employed (i.e. samples beds unsaturated though constantly moist during the weathering cycles). However, the SRR determinations were supplemented with direct measurement of the rate of O₂ consumption (see below), enabling an assessment of the overall relative contribution of sulphide oxidation to the SO₄ removed from the columns. The results of the analysis of the leachates produced by the weathering columns are presented in **Table 8**.

A summary of the results of analysis of the leachate during the final few weeks of testing is presented in **Table 12**.

The results indicate that the early stage weathering of the waste rock (Total-S >0.5%) would be characterised by pH regimes ranging from circum-neutral (pH 6-8) to acidic (pH 3). The 'acidic columns' produced acidic leachates from the outset (**Figure 10**), a process which continued throughout the test duration.

Although most weathering columns produced circum-neutral leachate during the period of testing, all weathering columns would eventually acidify with advancing sulphide oxidation.

During the early stages of weathering within the WRE, contact of local acidic pore fluids with circum-neutral waste rock during drainage along flow paths should result in neutralisation through buffering by carbonate minerals (e.g. rhodochrosites and ankerites). However, soluble-Mn forms would result from rhodochrosite dissolution.

Trends in the SRRs are shown on **Figure 11** with the trends in Leachate-Mn and Leachate-Zn concentrations shown on **Figure 12** for those columns with Total-S values of 1.5-2.6%.

During 30 weeks of weathering, columns GCA10043 and GCA10044 (both crystal tuff samples) were characterised by Leachate-pH values of 5-6, and SRRs which stabilised at approximately 10mg SO₄/kg/week (GCA10043) and 60mg SO₄/kg/week (GCA10044). The Leachate Mn and Leachate Zn concentrations during the final weeks of testing were 10-20mg/L and 2-3 mg/L, respectively, for GCA10043. The corresponding Leachate-Mn and Leachate-Zn concentrations for column GCA10044 were near 100 mg/L and 20-30 mg/L, respectively. The major-ion chemistry of the leachates produced by column GCA10044 was dominated by MnSO₄ and ZnSO₄.

The acidic column (GCA10039, ignimbrite) with Leachate-pH values consistently near pH 3, was characterised by Leachate-Mn and Leachate-Zn concentrations each c. 10 mg/L during the final few weeks of testing. The SRRs for this column exhibited an increasing trend that approached 100mg SO₄/kg/week by Week 30.

After the 30 week period of testing, weathering columns GCA10039, GCA10043 and GCA10044 were placed in sealed acrylic cells for the direct determination of Oxygen Consumption Rates (OCRs).²⁷ The OCRs were obtained from the decrease in the O₂ concentration in the headspace of the cells after a reaction time of 33 days. The OCRs @ 20°C were 6.3×10^{-11} kg O₂/kg/s (GCA10039), 1.4×10^{-11} kg O₂/kg/s (GCA10043), and 5.4×10^{-11} kg O₂/kg/s (GCA10044).

Based on the measured OCRs, calculations indicate that the majority of the SO₄ removed from the weathering columns by Week 30 was produced from active sulphide oxidation during the weathering cycles (cf. dissolution of pre-existing alunites and jarosites).

Where sulphide oxidation is controlled by the diffusive supply of O₂ (e.g. waste rock profile within WRE constructed by the bottom-up method [Section 5.3.1]), the measured OCRs suggest that the 'O₂-diffusion-front' would range up to c. 10m.

The results for the weathering columns in **Table 12** show that Zn solubility (generally) steadily increased as pH decreased. However, the pH relationship with Mn solubility was more complex (i.e. Mn concentrations of several tens-of-mg/L occurred even in circum-neutral leachates). Furthermore, of the weathering columns which produced acidic leachates, the highest Leachate Mn (and Zn) concentrations were produced by GCA10044 with Leachate-pH values near 5, and not GCA10039 with Leachate-pH values near 3.

Although the quality of drainage associated with percolation through the WRE would be influenced by many factors and would vary over time, the leachate analysis results indicate that the ignimbrites, crystal tuffs and volcanic breccias with Total-S >0.5% constitute a strong source of soluble forms of Mn and Zn even during lag-phase (i.e. circum-neutral) weathering of these PAF units.²⁸ Where circum-neutral pH buffering arises from rhodochrosite dissolution, soluble Mn forms are produced, and so amounts, in effect, to a parallel 'buffering' of soluble Mn concentrations at the same time.

Rhodochrosite dissolution, however, is not the only source of soluble Mn, as shown by the Mn solubility during weathering for GCA10044 (CO₃-C = 0.01%), and GCA10039 (CO₃-C < 0.01%) (see **Table 5**). Dissolution of Al/Fe-hydroxysulphates may also be significant source of soluble-Mn forms, as discussed earlier.

Other elements also displayed variable solubility during weathering of those samples with Total-S >0.5% (**Table 8**). In particular, Leachate As concentrations of 50-60mg/L were recorded for the ore sample GCA10729/52.

Whilst the weathering column containing the LGO sample (GCA10049), produced circum-neutral leachate with Mn and Zn concentrations less than 1mg/L, it is anticipated that, had a greater number of LGO samples been subjected to kinetic testing, the resulting range in leachate quality would be similar to those presented for the waste rock samples in **Table 12** with corresponding Total-S values.

²⁷ After completion of the flushing step to generate the leachates for Week 30, the columns were placed under the flood-lamps until the GWC was c. 6-7% (w/w) before being placed in the cells for determining OCR (i.e. sample beds desaturated).

²⁸ The lag-phase weathering of PAF units corresponds to the initial stages of weathering where circumneutral buffering ensues invariably via the dissolution of carbonate minerals.

4. 2017-2018 TESTING PROGRAM ON LOW-S (<0.3%) SAMPLES FROM FRESH ROCK ZONE

During 2017-2018, a program of static testing was undertaken specifically to assess the geochemical character of Low-S (< 0.3%) samples of waste rock from the fresh rock zone of the proposed open cut pit. Low-S samples from the fresh rock zone had not been tested in the historical testing programs.

Interrogation of the geological database of S assays by Bowdens Silver geologists indicated that mineable blocks of Low-S varieties from the fresh rock zone are essentially restricted to the northern end of the proposed open cut pit. Mining of such Low-S waste rock stands to be a useful source of rock for both construction, and decommissioning and closure works.

A set of samples was selected for testing, and correspond to one transect of drill holes along the western edge of the northern end of the proposed open cut pit, and another transect that cuts across the northeastern corner, as shown in **Annexure 3**. The majority of these Low-S samples correspond to volcanic breccia that geologically is generally highly siliceous, hard, and durable.

Initially, 90 samples (as 4m-composite pulps) were tested for Total-S and Total-C, and selected composites were also tested for CO₃-C. Multi-element assays from the geological database were also provided.

The key results of this initial of this initial 'screening' program are presented in **Table 13**, and shown on **Figure 13**.

This testing shows that there are multi-metre runs of volcanic breccia which are characterised by:

- Total-S values almost always less than 0.3%; and
- CO₃-C values ranging up to c. 1%, and though variable, indicate at least 'trace carbonates' being fairly common.

Within individual drill holes, the above S and C values correspond to continuous downhole runs ranging from c. 20m to c. 50m.

The pH-buffering curves (**Figure 13**) indicate that there is a wide range in the reactivity of the carbonates, and reflective of varying contributions from ankerites, rhodochrosites and siderites.

Table 13 also shows that the Mn content ranges up to c. 0.5-1.0% within the northeastern corner of the proposed open cut pit with little correlation between Mn and S contents. Along the western edge of the open cut pit, Mn contents range up to 0.2-0.3%. The Mn chiefly reflects the presence of rhodochrosite.

After reviewing the assays for the 90 pulps above, 16 samples (2m-intervals) of diamond drill core were subjected to static testing with results presented in **Tables 14** to **17**. The samples were selected on the basis of S, C and Mn contents.

Of these 16 samples, 13 were classified as NAF, whilst 3 samples were classified as PAF-[Low Capacity (LC)], where PAF-[LC] signifies an insufficient reserve of carbonates for neutralisation of acid generated by the complete oxidation of the 'trace pyrite'.²⁹ Of these PAF-[LC] samples, it should be noted that BD17007_55 had a Total-S value of 0.41% (cf. < 0.3%S). Sample

²⁹ PAF-[LC] signifies PAF rock that would produce less than 5 kg H₂SO₄/tonne of net acidity should all of the contained sulphide minerals be completely oxidised.

BD17004_48 with a CO₃-C value of only 0.04% adjoins intervals in this drill hole with CO₃-C values around 0.3% (**Table 13**), and so through mixing during actual mining, acid neutralisation of this waste rock would benefit from carbonates in neighbouring intervals.

The samples subjected to multi-element analysis were variously enriched in Sb, Ag, Cd, and Tl (**Table 15**), though the degree of enrichment was not marked.

The mineralogical results showed that the groundmass of the tested samples of volcanic breccia comprised mostly Na/K-feldspars, quartz and sericites (**Table 16**). Pyrite occurred as a trace component, and the 'trace carbonates' included rhodochrosites, ankerites, dolomites, and siderites.

The water-extraction testwork employed a solid:solution ratio of 1:2 (w/w), and showed that the tested sample from drill hole BD17007 was characterised by 'pools' of soluble-Mn forms ranging up to c. 30-40mg Mn/kg, when expressed on a dry-solids basis (**Table 17**). These samples had Total-S values of 0.32-0.41%.

Summarising, the 2017-2018 testing program on Low-S (< 0.3%) samples from the fresh rock zone has shown that down-hole runs up to some tens-of-metres of Low-S volcanic breccia occurs in the northern end of the proposed open cut pit, located chiefly along the western edge and across the northeast corner. The tested samples represent NAF variants of Low-S rock from the fresh rock zone. The corresponding groundmass commonly contains at least traces of carbonates which includes reactive carbonates such as ankerites and dolomites. However, rhodochrosites also occur, and thus where they are active neutralisers for acid produced from the oxidation of 'trace pyrite', soluble-Mn forms would result locally.

Finally, that multi-metre mineable runs of NAF variants of Low-S waste rock within the fresh rock zone are restricted within the proposed open cut pit reflects the overall style of mineralisation and alteration within the Bowdens deposit (i.e. relatively weak sulphidisation that is pervasive across all lithologies, and also related to pervasive occurrences of rhodochrosite).

5. TESTING OF SOIL SAMPLES

As part of the assessment, 3 composited soil samples, obtained from an auger drilling program in 2013, were submitted for testing. Details of this sampling program are presented in **Annexure 3**.

All samples were classified as NAF, with major/minor element contents either below, or close to, those typically recorded for unmineralised soils, regoliths and bedrocks (**Tables 18 and 19**). The clay mineral suites were dominated by kaolinites with subordinate smectites/illites (randomly interstratified varieties), and smectites (**Table 20**).

6. MANAGEMENT IMPLICATIONS

6.1 MATERIAL CLASSIFICATION SCHEME

The testing and analyses completed for this assessment, coupled with the geological understanding of the Bowdens deposit and a statistical assessment of S occurrence within the waste rock zones (**Annexure 3**), provides for a sound basis for a 'working model' of waste rock geochemistry and geochemical behaviour for the Project.

However, it is anticipated that, as operations at the mine progress and further knowledge and understanding of the geochemistry of the ore, low grade ore and waste rock is developed, this model would be regularly reviewed and refined to inform management decisions and actions.

With respect to the implications for waste rock management, the material classifications and terminology detailed below are recommended for the development of mining volumes and schedules, handling, and placement.

To assist in the development of the mining model and waste rock management strategies, it is constructive to discuss waste rock geochemistry in terms of two zones within the overall geological profile of the proposed open cut pits, namely:

- Weathered Rock Zone, designated as WZ (Weathered Zone) for brevity; and
- Fresh Rock Zone, designated as Primary Zone (PZ)

Although spatially variable, the WZ corresponds nominally to the upper 20-30m of the geologic profile.

It is understood that the information provided below serves as input to the projections of mining volumes and schedules for the Project by AMC Consultants Pty Ltd (AMC).

6.1.1 Weathered Zone

The following sub-classifications apply to waste rock derived from the weathered zone (WZ):

- WZ1: Total-S <0.3%
- WZ2: Total-S ≥0.3%

Use of the descriptor NAF (i.e. Non-Acid Forming) implies generation of 'contact waters' (leachate) from NAF waste rock that is circum-neutral (i.e. pH 6-8) with bicarbonate alkalinities within the multi-mg/L range (as CaCO₃).

The **WZ1** category captures weathered waste rock that is characterised by traces of Al/Fe-hydroxysulphates minerals (alunites and jarosites) in a groundmass devoid of carbonates, and thus which yield contact waters with pH value of 5, and essentially devoid of bicarbonate alkalinity. However, in reality the WZ1 also includes NAF (barren) waste rock that is totally devoid of both Al/Fe-hydroxysulphates and sulphides (e.g. pyrite).

This WZ1 material may be handled as a Run-of-Mine (ROM) operation, and used in site-wide applications, such as construction activities, fill, or in cover / rehabilitation profiles. For those applications, involving cover/rehabilitation profiles the WZ1 rock would be stockpiled within the southern barrier, and exposed to atmospheric conditions (seasonal wetting and drying) until required towards the end of the mine life. Where traces of Al/Fe-hydroxysulphates occur, slow dissolution would result in a weak source of SO₄ and soluble-Mn that would progressively weaken further as these minerals are depleted over time.

The **WZ1 (S <0.3%)** material is therefore a source of benign material suitable for use without geochemical constraints.

The **WZ2 (S ≥0.3%)** is considered reactive (i.e. Potentially-Acid Forming, PAF), and therefore requires management strategies to be put in place, such as selective handling, placement and isolation, as outlined in Section 5.3.

6.1.2 Primary Zone

The following sub-classifications apply to waste rock derived from the primary zone (PZ):

- PZ1: Total-S ≤0.1%
- PZ2: Total 0.1% < S <0.3% within the northern section of proposed main open cut pit
- PZ3: Total-S ≥0.3% and Total-S = 0.10-0.30% is areas distant from the northern section of the proposed main open cut pit

Geochemically, the **PZ1** category corresponds to NAF waste rock (i.e. generation of 'contact waters' that are circum-neutral (pH 6-8) with bicarbonate alkalinities within the multi-mg/L range, as CaCO₃. However, it is understood that it is unlikely that significant volumes of PZ1 would actually be mined during any given stage of mining (i.e. only rare occurrences of mineable, multi-metre runs of PZ1 waste rock). In practice, this category may therefore become redundant.

The **PZ2** category is NAF, and reflects 'trace pyrite' in a groundmass that is calcareous, albeit weakly, overall. Within the northern end of the proposed open cut pit, PZ2 chiefly comprises the volcanic breccia unit whose occurrence corresponds to some tens-of-metres in thickness vertically, and thus amenable to bulk mining. Within the majority of the primary waste zone, PZ2 occurs locally in multi-metres runs amenable to selective mining. Within the northern section of proposed open cut pit, the carbonate mineral suite comprises typically dolomites and ankerites, rhodochrosites are likely more abundant in the locally occurring PZ2 within the bulk primary waste rock zone.

Although this category should not lead to acidification through oxidation of 'trace pyrite', it may locally be a source of soluble-Mn forms where 'trace pyrite' slowly oxidises. This source of soluble-Mn would be weak, reflective of slow pyrite oxidation, and steadily decrease through time as the 'trace pyrite' is progressively decomposed.³⁰ A key attribute of the volcanic breccia is its highly siliceous, hard, and durable nature, and thus physically ideal for cladding and sheeting works for erosion control for final landforms, safety bund around pit perimeter, etc.

Material classified as **PZ3** is PAF, and therefore requires management strategies such as the selective handling, placement, and isolation, as outlined in Section 5.3.

6.2 MATERIAL FOR CONSTRUCTION USES

WZ1 material excavated during works prior to commencement of processing operations would be variously sourced for construction of the TSF embankment, and other Mine Site infrastructure.

³⁰ Further work would be needed as the Project progresses to more completely assess options for use of PZ2 rock (mostly volcanic breccia) to take as much advantage as possible of its desirable physical stability.

Based on mine scheduling developed by AMC, it is understood that c. 10 million tonnes of material classified as WZ1 would be produced, corresponding to c. 22% of the total tonnage of waste rock to be produced.³¹ WZ1 would primarily (65%) be produced during the early stages of the Project (Mining Years 1 – 4) during the mining of benches between 660 m AHD and 570 m AHD.

Where the WZ1 material contains trace amounts of Al/Fe-hydroxysulphate minerals, soluble-Mn concentrations within the range c. 1-2 mg/L may occur during weathering as these minerals slowly dissolve.³² Site wide application of agricultural lime (i.e. crushed limestone), or equivalent, is one option for restricting Mn solubility via precipitation reactions (e.g. Zachara *et al.* 1991). Broad scale surface dressing with crushed limestone is an integral method for controlling Mn solubility in PAF waste rock at the Martha Mine, New Zealand (Miller 2014).

Use of agricultural lime within the Mine Site for controlling Mn solubility would require the establishment of agricultural lime stockpiles on site for use, as required. Methods and rates of application should be developed with site experience, and periodically reviewed and revised, where required.

Ideally, rock material (Total-S <0.1%) should be separately stockpiled, where practicable within the southern barrier. As an added safeguard, agricultural lime should be applied both to the outer surfaces of the southern barrier, and the ground in the immediate vicinity of this barrier, in order to constrain Mn concentrations in runoff. Ensuring that the outer-most section of the southern barrier has a Mn content less than c. 1,000mg/kg should ensure that Mn concentrations in 'contact waters' are within the sub-mg/L range initially, and steadily decreasing over time.

Though restricted to the northern end of the proposed open cut pit, NAF **PZ2** rock (predominantly volcanic breccia) constitutes a valuable source of chunky, hard, durable rock for cladding and armouring works, and other applications where exposure to seasonal wetting and drying would occur over the longer term. Further, this material would mainly be produced beyond the initial stages of the Project (i.e. Mining Years 4 – 12), and thus its timing of mining is well suited to construction demands as the Mine advances and matures.

Though the NAF **PZ2** rock would be characterised by circum-neutral weathering, soluble-Mn concentrations in contact waters may, on occasions, be locally within the low mg/L range, as governed by the slow oxidation of contained 'trace pyrite', and water flow regime attendant with varying amounts of rainfall (i.e. dilution effects being significant for major wet-spells). Further work would be needed as the mine advances to refine how the PZ2 rock is to be best utilised in specific applications.

Given the hard, durable nature of the highly siliceous volcanic breccia, screening to +50mm is one option to consider, since this would remove the 'rock fines' fraction which is the main seat of weathering reactions, and thus potential soluble-Mn release, on surface area grounds. It might also prove useful to demarcate sub-variants of the PZ2 mining stream based on Mn content (e.g. adoption of 0.1% Mn as a cut-off between 'Low-Mn' and 'High-Mn' sub-variants of the PZ2 rock). The logistic, economics, and indicative volumes of such Mn-based sub-variants would need to be determined to allow assessment of the best way to make use of the volcanic breccia with its desirable physical stability.

³¹ Information Source: Email of 30th March 2017 from Mr Adrian Jones of AMC.

³² Soluble-Mn concentrations would necessarily decrease to within the sub-mg/L range as the AlFe-hydroxysulphates, and/or 'trace rhodochrosites' are deleted through progressive dissolution.

6.3 MATERIAL REQUIRING SPECIFIC MANAGEMENT

6.3.1 General

Waste rock in categories **WZ2** and **PZ3** is reactive (PAF), and thus needs to be isolated and encapsulated within the WRE. The tailings are also reactive (PAF) [Annexure 2], and thus also need to be encapsulated upon decommissioning of the TSF.

The reactive (PAF) WZ2 and PZ3 waste rock typically have Total-S values ranging up to 2-3% (at the metre scale), and are characterised by weathering lag-times ranging from 'near-zero' (i.e. essentially acidic rock upon excavation), to several months. Based on the samples subjected to kinetic testing (Table 12), lag-phase weathering over some months seems more common.

Irrespective of the stage of weathering and the prevailing pH regime, these reactive (PAF) materials constitute a strong source of soluble Mn. The sources of Mn include the dissolution of rhodochrosites and other Mn-bearing minerals (e.g. Mn(II)) incorporated in jarosites and alunites). Release of soluble Zn forms may also be significant during lag phase weathering, especially for material with Total S <1%.

Illitic clays are prevalent throughout the groundmass of waste rock within the Mine Site, and locally include interstratified smectite/illite forms. Following wetting-up of the waste rock profile in the WRE, pyrite oxidation within the clayey fine (<2mm) fractions of waste rock would be suppressed by being near saturated, thus reaction rates limited by oxygen diffusion. At the 'micro-scale', surface armouring of pyrite by the attachment of clays, and the resulting retardation of oxidation rates, may also occur.³³

In terms of the geochemical behaviour of the reactive (PAF) waste rock, and thus implications for management strategies, all lithologies (viz. ignimbrites, crystal tuffs, and volcanic breccias) are essentially identical.

Based on the mining schedule for the Project prepared by AMC, it is understood that, during the early years of the Project, waste rock with Total-S $\geq 0.3\%$ (WZ2 and PZ3) would be dominated by ignimbrites over crystal tuffs (and laminated tuffs) with sub-ordinate volcanic breccias. However, during the later years of the Project, crystal tuffs would predominate, since at depth these units generally occur beneath the ignimbrites within the waste rock zones of the proposed open cut pit.

6.3.2 Waste Rock Emplacement

Central to the management of the reactive (PAF) waste rock produced during the Project is the construction and development of the WRE whereby pervious, preferential drainage pathways (resulting from segregation of larger cobbles and boulders), which would lead to rapid, deep infiltration via channel flow, is prevented (Miller 2014). Such pathways are conduits for rapid ingress of air and water, which enhance sulphide oxidation rates and the generation of leachate, and where interconnected over several tens-of-metres (e.g. between adjoining lifts), advance geochemical weathering processes throughout the waste rock profile.

Management of reactive (PAF) waste rock requires the placement of low permeability material over the footprint of the WRE. This low permeability basal layer needs to be designed to intersect and direct vertical and horizontal drainage to drainage control infrastructure of sufficient design capacity. Such internal drainage control is required to prevent seepage to groundwater beneath the WRE and surface discharge to downstream watercourses.

³³ Armouring of pyrite surfaces by clays (including illites) derived from tuffaceous waste rock was inferred to be effective in reducing oxidation rates in laboratory kinetic testing reported by Pearce (2014).

Preliminary WRE design (Advisian, 2020a) identifies that the WRE would be developed in a staged fashion via cells and using methods suitable for the management of PAF waste rock (e.g. bottom-up method of lift construction via paddock dumping).

In addition, the preliminary WRE design (Advisian, 2020a) incorporates the progressive cell development via a series of 10m lifts comprised of 2m layers. Each of these layers would be compacted during WRE development. Since the crystal tufts should predominate over the ignimbrites during the later years of the Project, the layers of lifts constructed as construction of the WRE matures should be relatively 'fines-enriched'.

Construction of the WRE via the bottom-up method means that sulphide oxidation overall should be limited by the diffusive supply of O₂ (cf. convective air flow through preferential pathways). The kinetic testing results indicate that the reach of the O₂ diffusion-front within the active WRE should be to a profile depth of c. 10m. Over time, as 'fines-enriched' layers wet-up to relative saturations of >80%, rates of sulphide oxidation would be further limited by the O₂ supply. At WRE decommissioning, following reprofiling, recontouring and sheeting works, sulphide oxidation would be also limited by the infiltration-control final cover system (e.g. store-and-release cover system).

6.4 LOW-GRADE ORES

A low-grade ore (LGO) stockpile would be developed in stages predominantly to the east of the processing area and would overlie a section of the WRE as it develops into the later stages of the mining operation. It is understood that, at the conclusion of mining and processing operations, stockpiled low grade ore would either have been processed, or capped in a method similar to the WRE and incorporated into the final WRE landform.

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Pre-rinsing Treatment at Commencement of Kinetic Testing of Waste Rock and Ore Samples

Pre-rinsing undertaken to elute pre-existing solutes in dry, crushed samples packed into columns

Power of flood-lamps and operational procedures to constrain diurnal temperature variations, especially as residual moistures are approached during drying phase, are described in Campbell et al. (2012).



Desiccation Cracking During Drying of Clayey Samples

Prior to addition of deionised water for the flushing step the top 5-10 mm of the cracked, dried sample-beds were chipped back using a steel screwdriver, and worked-over so that 'short-circuiting' during flushing was prevented.

Weathering Columns in incubator @ 20°C after being dewatered, following flushing step, to a gravimetric water content (GWC) value of c. 5-10% (w/w) via either flood-lamps, or an oscillating fan at room temperature, over the course of 1-2 days. Tops of columns covered with large watch glasses to reduce evaporative drying in incubator, and every few days deionised water misted onto sample-beds to readjust GWC, as required. See Campbell (2013).



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Figure 1 pH-Buffering Curves for Selected Waste Rock Samples (Total-S = 0.3-0.6%)

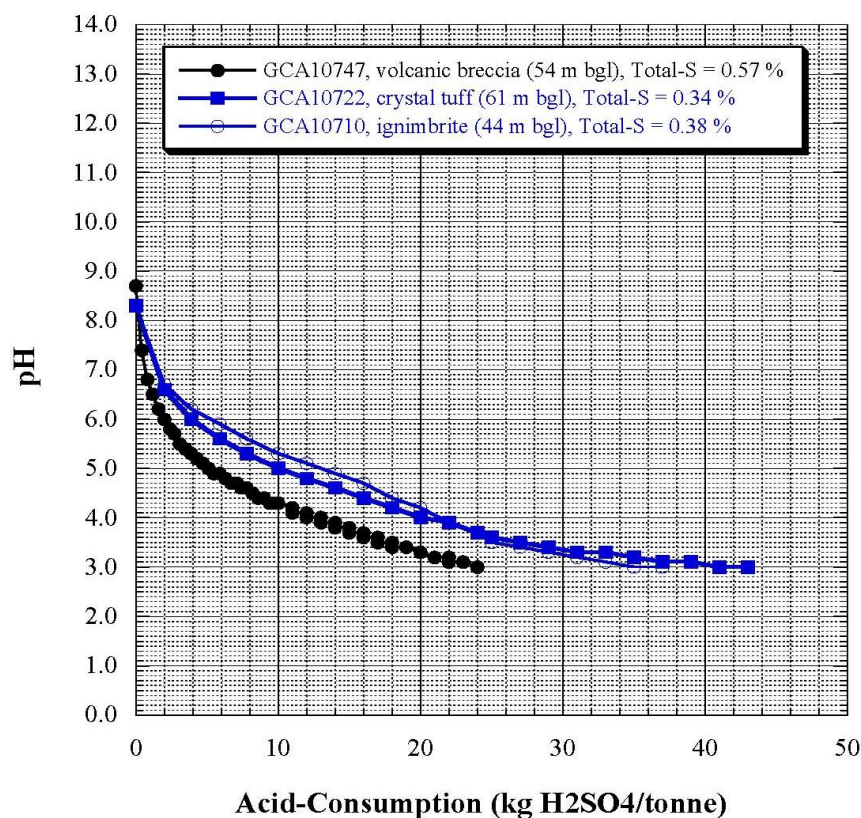


Figure 2 pH-Buffering Curves for Selected Waste Rock Samples (Total-S = 0.9-1.7%)

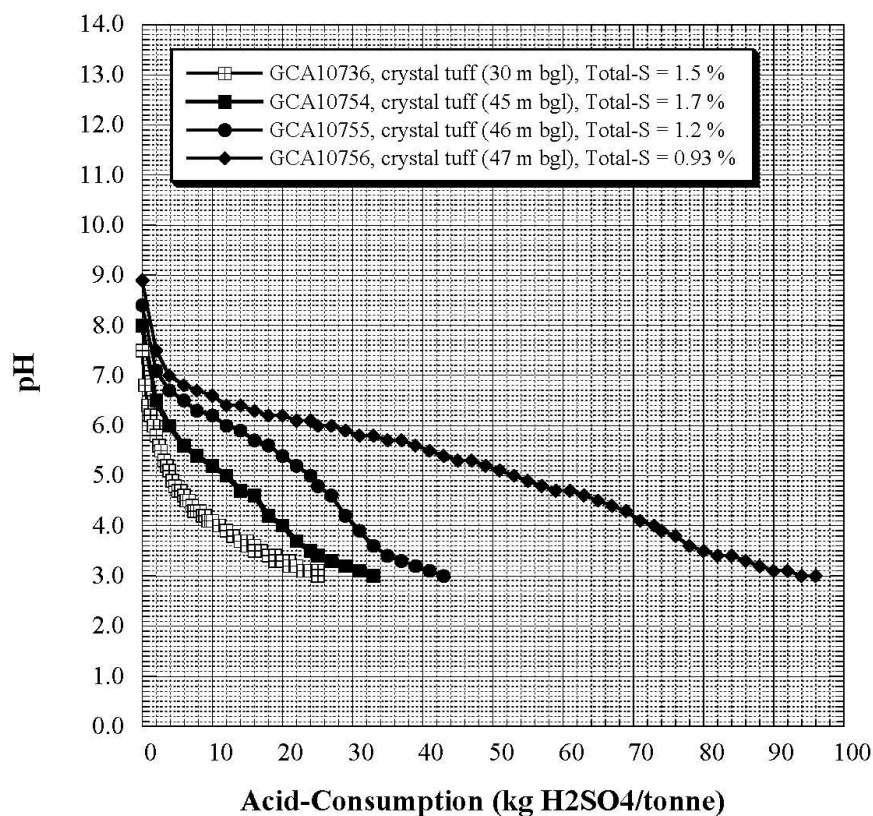


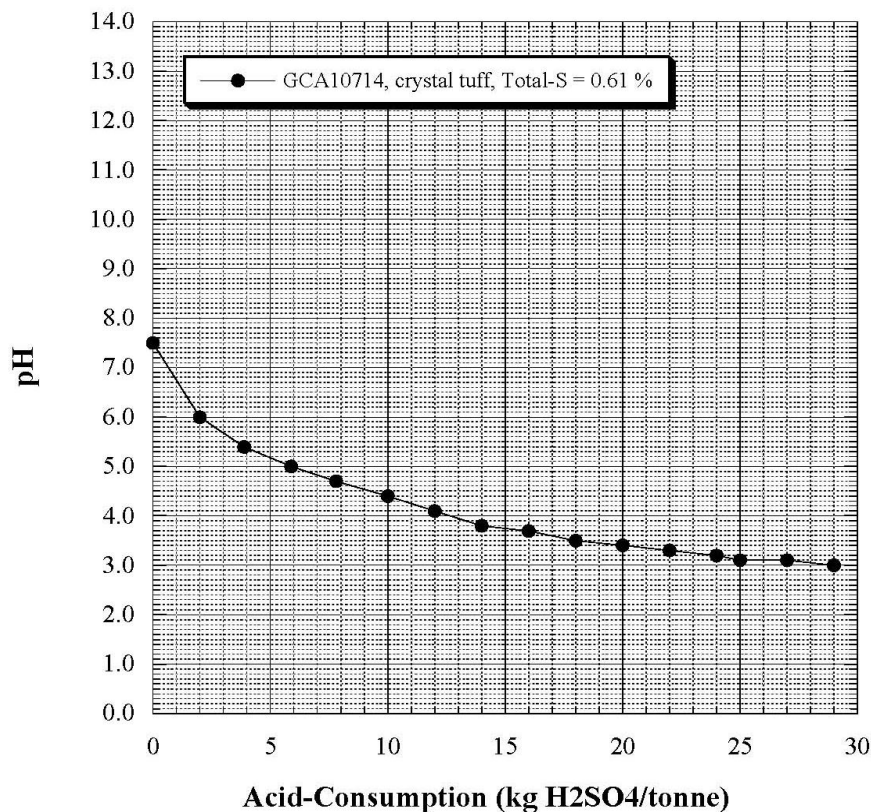
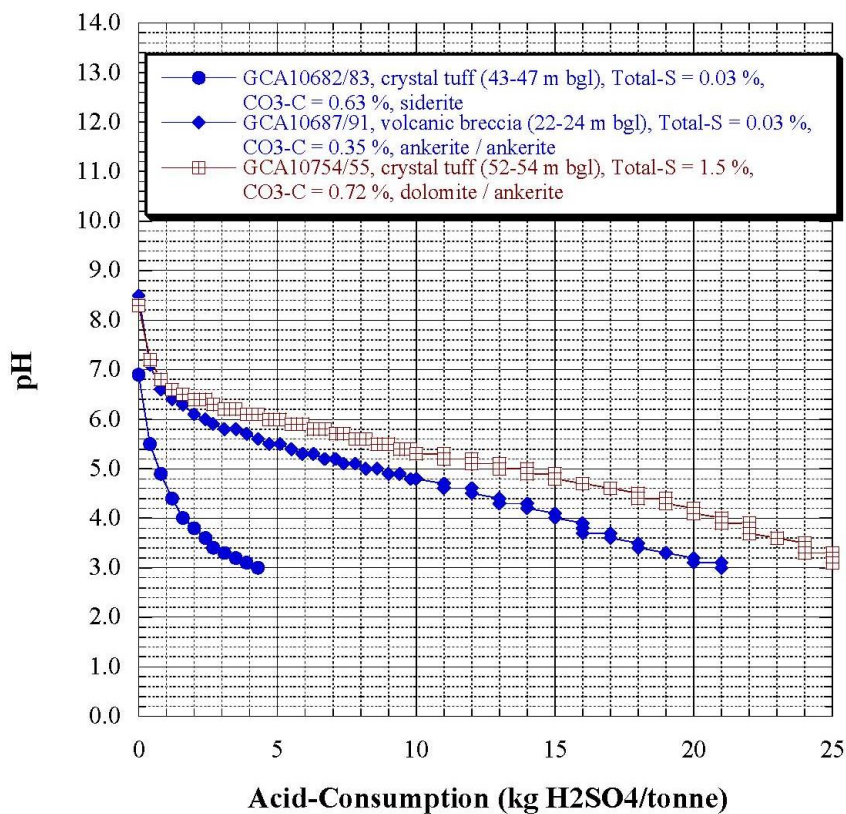
Figure 3 pH-Buffering Curve for Low grade ore Sample**Figure 4 pH-Buffering Curves for Selected Columns**

Figure 5 Variation in Leachate-pH Values for Columns (Total-S < 0.1% and Total-S = 0.1-0.2%)

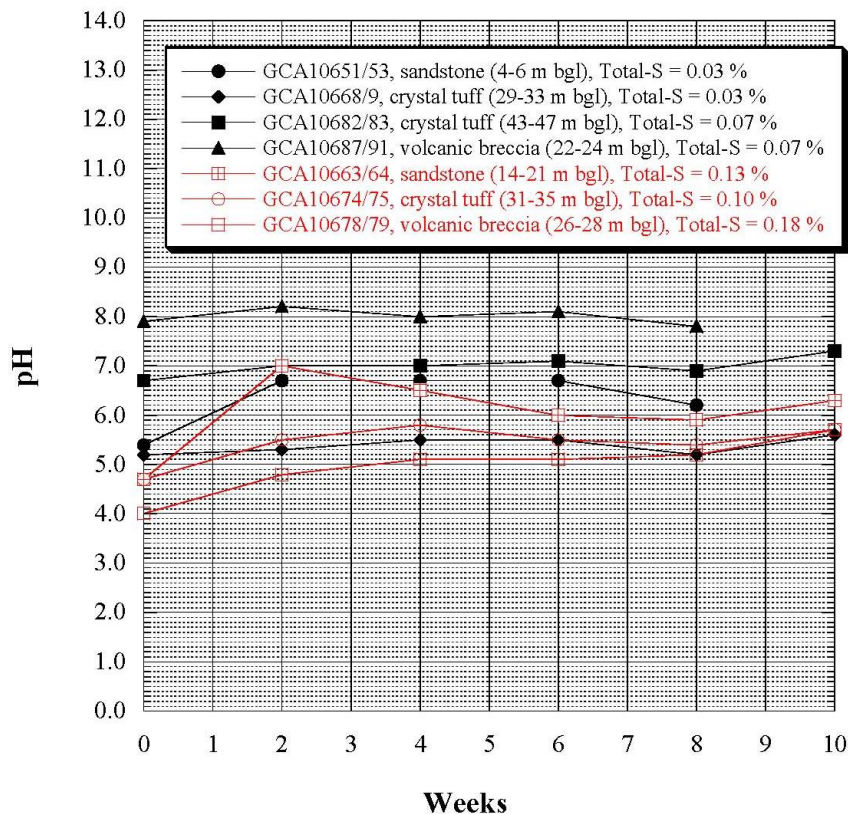


Figure 6 Variation in Leachate-Mn Concentrations for Columns (Total-S < 0.1% and Total-S = 0.1-0.2%)

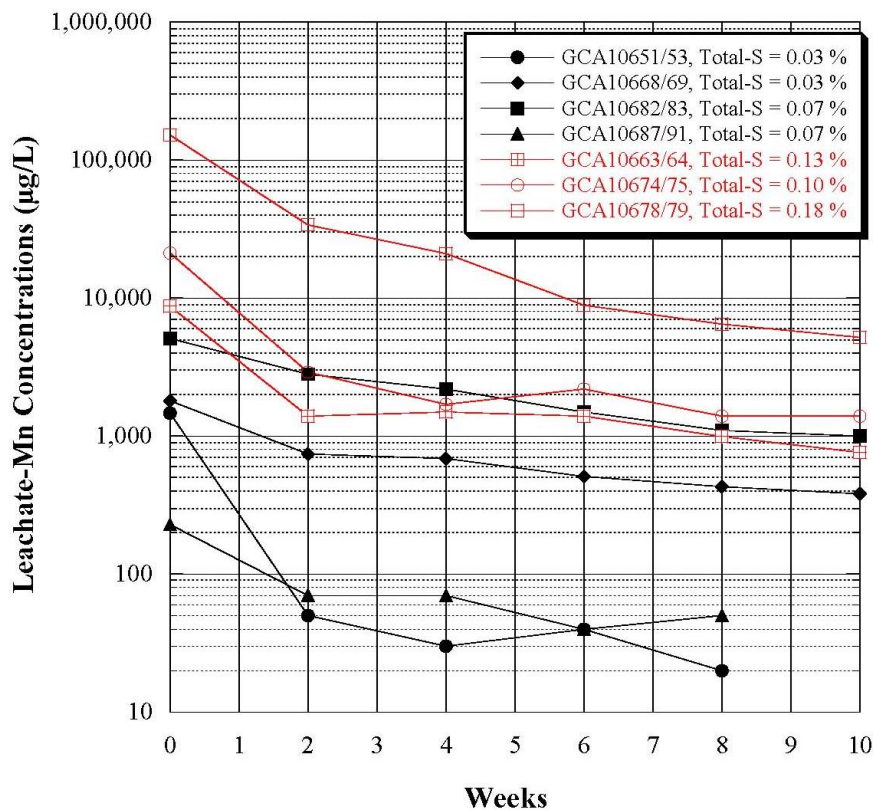


Figure 7 Variation in Leachate-pH Values for Extended Weathering of Low-S (Alunitic) Samples ($0.1\% < S < 0.3\%$) from Weathered Rock Zone

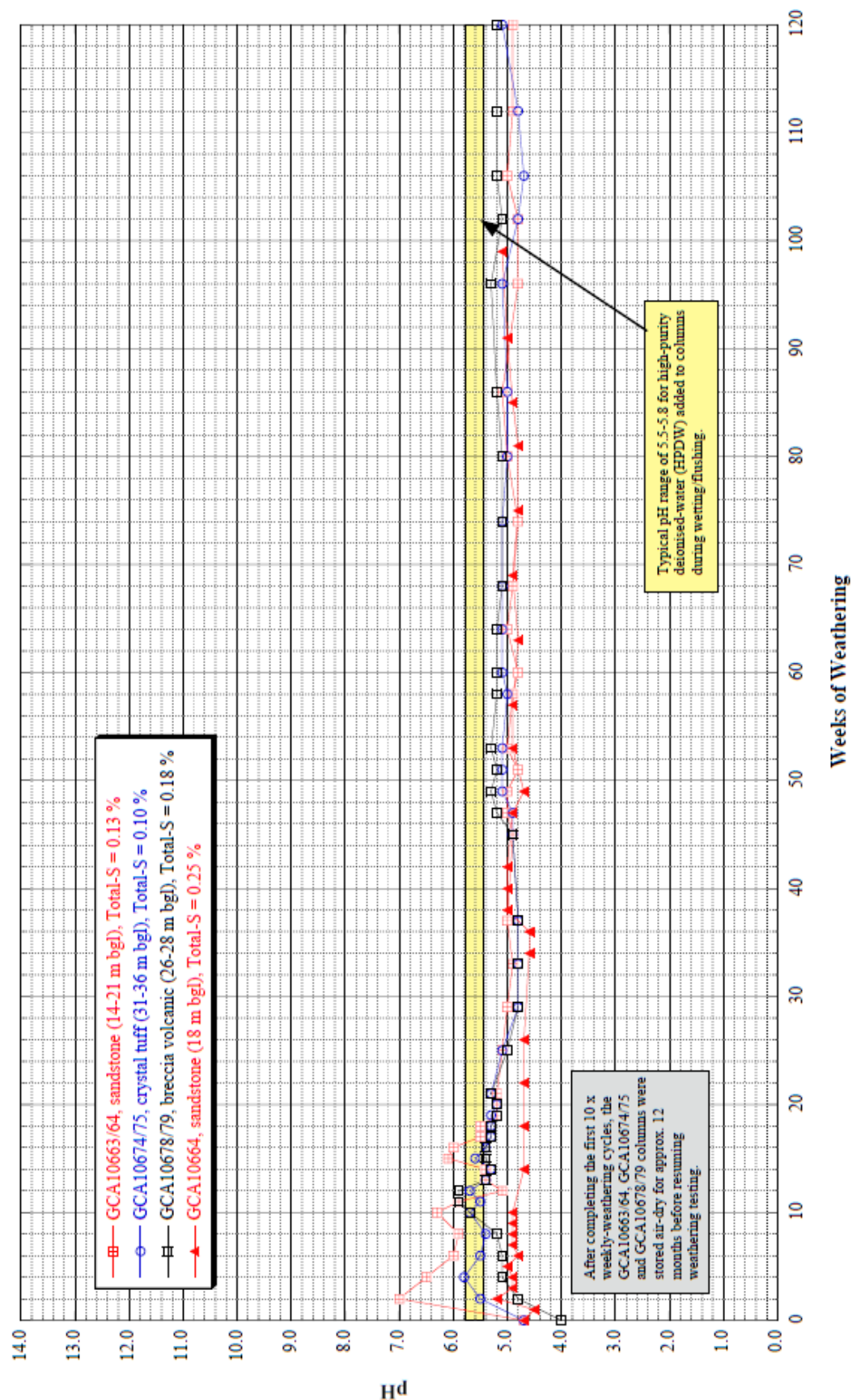


Figure 8 Variation in Leachate-Mn Concentrations for Extended Weathering of Low-S (Alunitic) Samples ($0.1\% < S < 0.3\%$) from Weathered Rock Zone

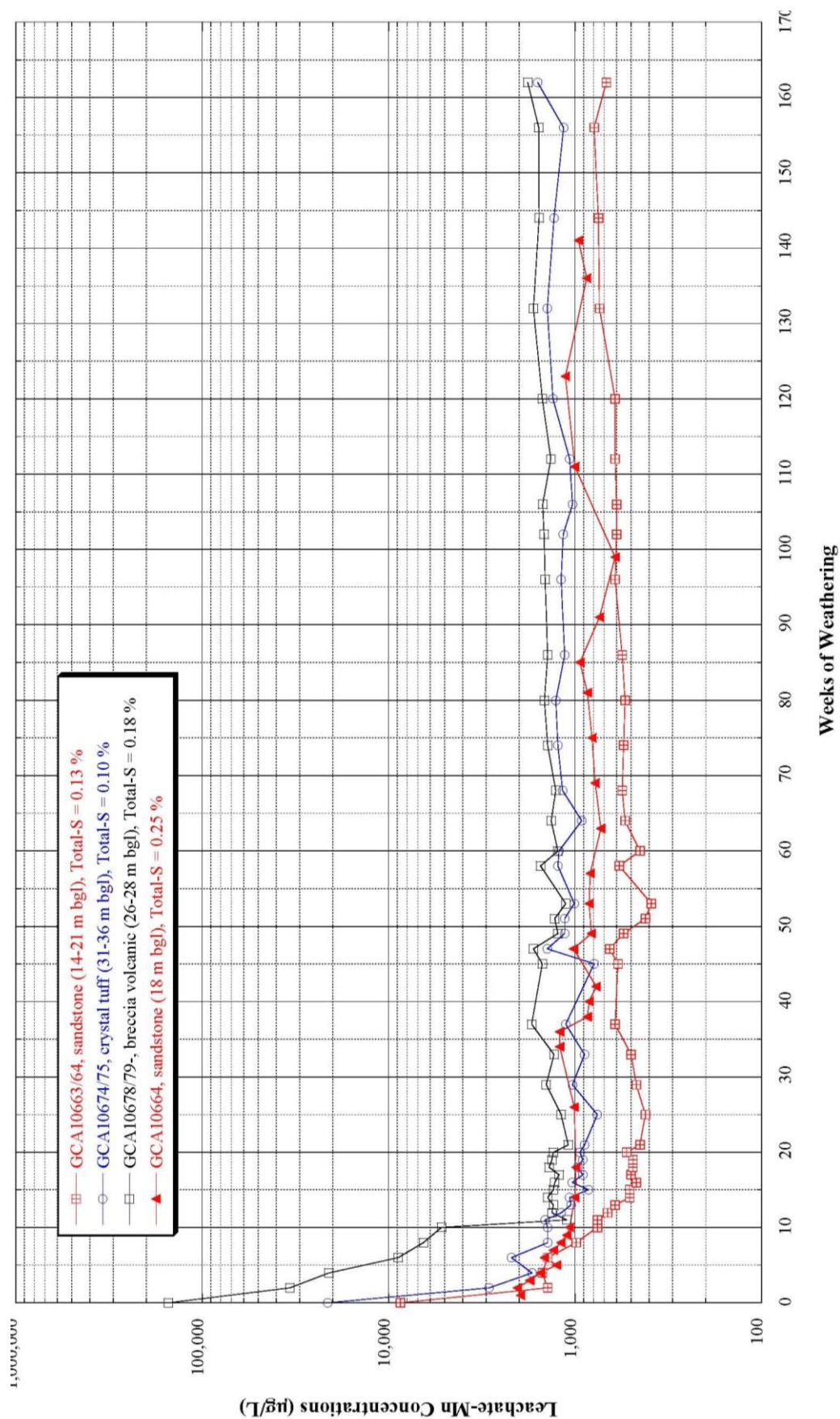


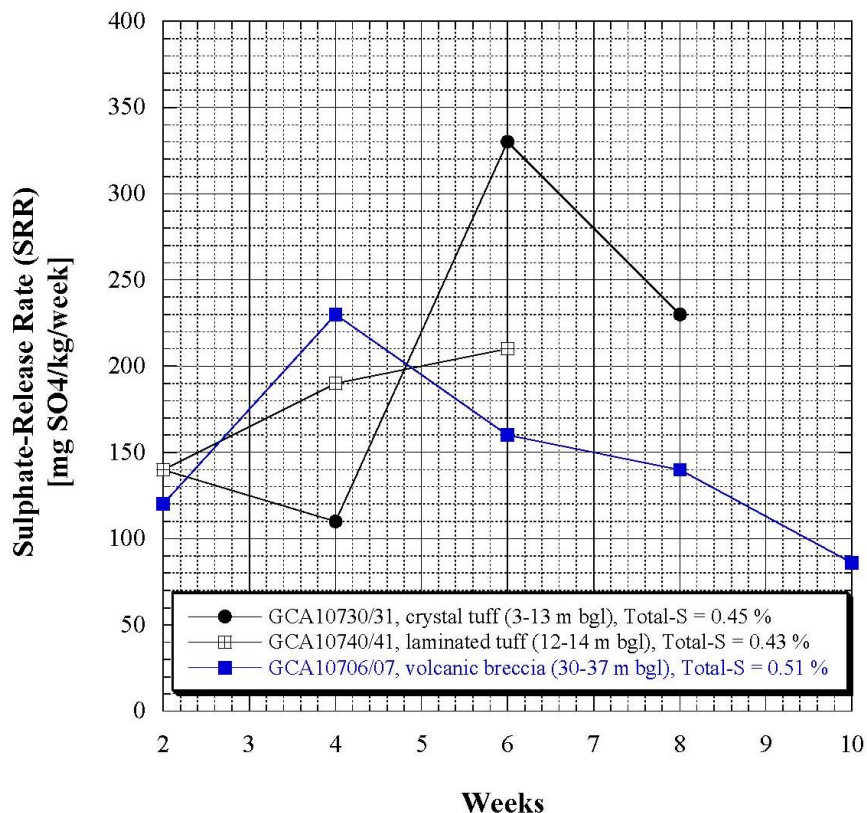
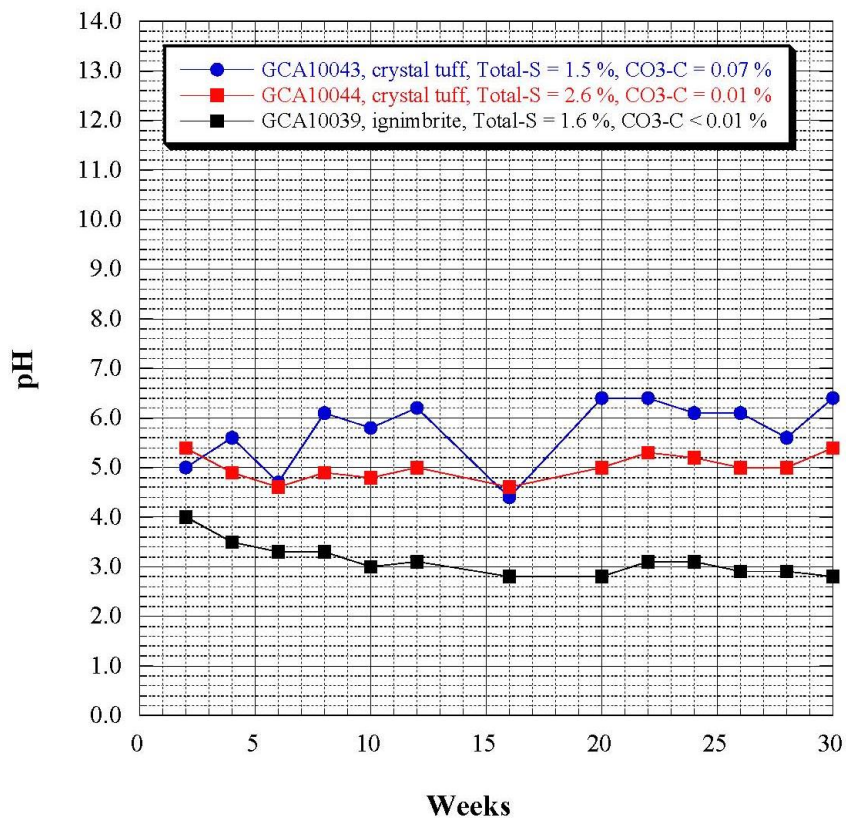
Figure 9 Variation in Sulphate Release Rates for Columns (Total-S = 0.4-0.5%)**Figure 10** Variation in Leachate-pH Values for Columns (Total-S = 1-3%)

Figure 11 Variation in Sulphate Release Rates for Columns (Total-S = 1-3%)

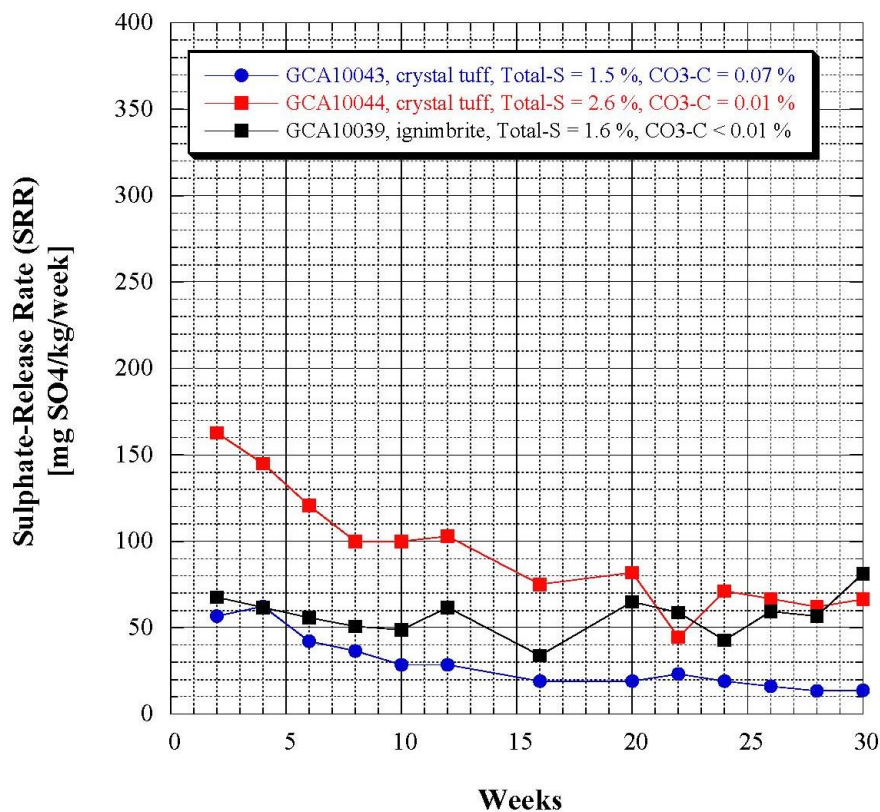


Figure 12 Variation in Leachate-Mn and Leachate-Zn Concentrations for Columns (Total-S = 1-3%)

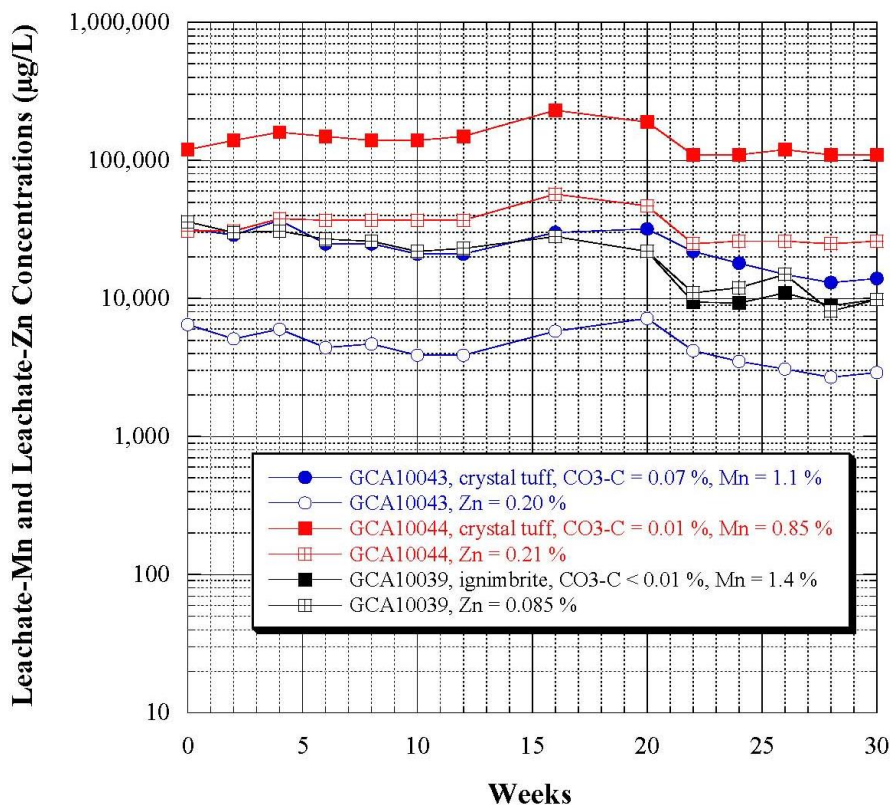
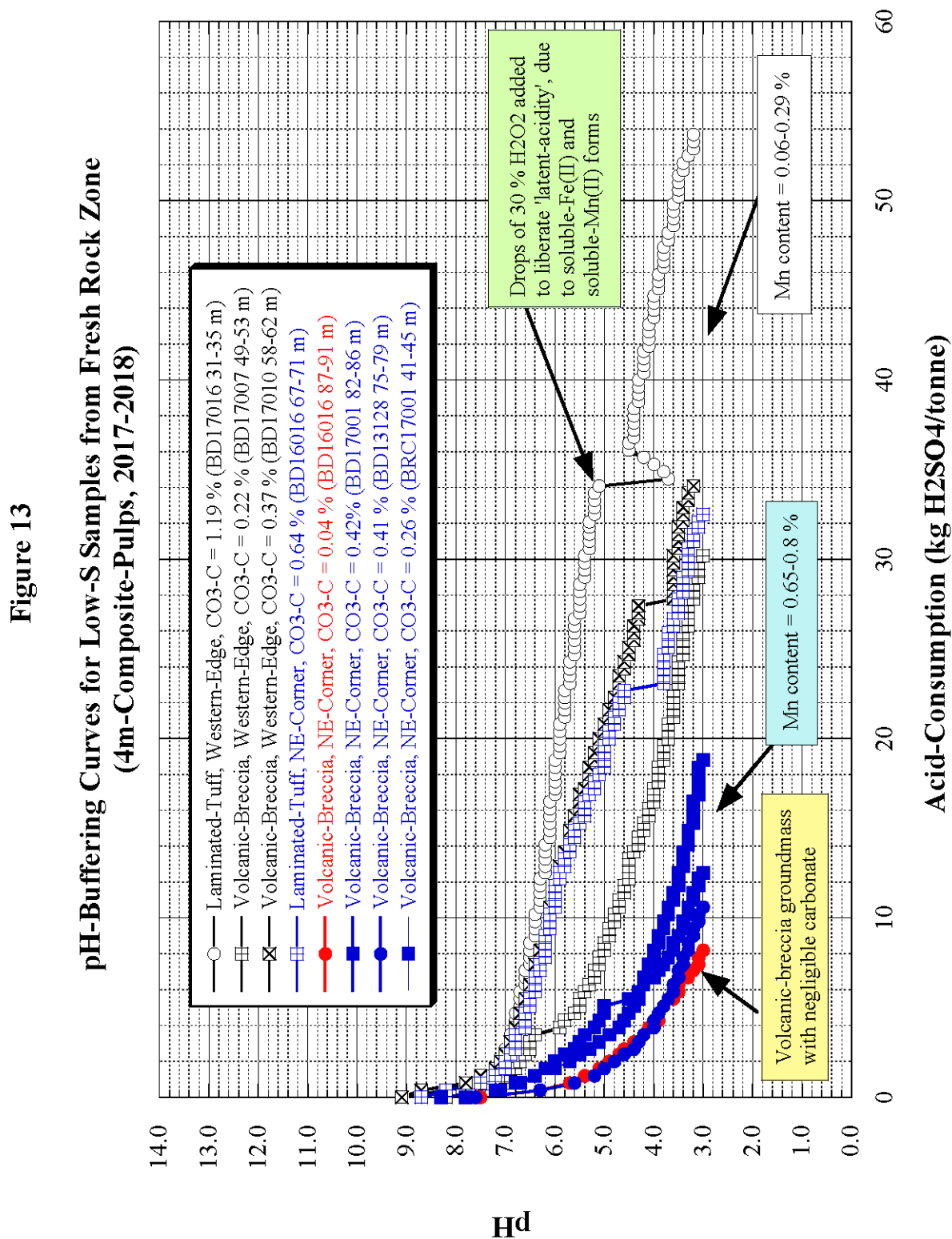


Figure 13 pH-Buffering Curves for Low-S Samples from Fresh Rock Zone
(4m Composite Pulps, 2017-2018)



TABLES

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Table 1
Results of Static Testing to Assess Acid-forming Characteristics of Waste Rock Samples

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GCA-Sample No.	Site-Sample No.	Drill hole and Down-hole interval (m)	Depth below Ground level (m)	Lithology	pH-(1:2)	EC-(1:2) [mS/cm]	Total-S (%)		SO ₄ -S [Na ₂ CO ₃] (%)	Sulphide-S [Total-S] - [SO ₄ -S] (%)	Cr(II)-Reducible - S (%)	Total-C (%)	CO ₃ -C (%)	Bulk-ANC	NAPP	NAG-(pH 7.0)		ANC / MPA Ratio	AFP Category
							Site Database	This Study						kg H ₂ SO ₄ /tonne					
Samples with Total-S < 0.3%																			
GCA10651	B000681	BD12009, 4-5	4.5	sandstone	5.3	0.11	<0.01	0.02	0.02	<0.01		0.02	0.01	1 (1)	nc	0.7	6.6	nc	NAF
GCA10652	B000685	BD12009, 8-9	8.5		5.0	0.092	<0.01	0.02	<0.01	0.02		0.02	0.01	1	nc	<0.5	6.5	nc	NAF
GCA10676	B000688	BD12009, 11-12	11.5		4.6	0.27	<0.01	0.04	0.04	<0.01		0.06	0.01	<1	nc	0.7	5.5	nc	NAF
GCA10677	B000692	BD12009, 15-16	15.5		4.4	0.23	<0.01	0.05	0.04	0.01		0.05	0.01	1	nc	<0.5	5.8	nc	NAF
GCA10653	B000864	BD12010, 5-6	4.7		5.2	0.054	<0.01	<0.01	<0.01	<0.01		0.02	<0.01	1	nc	0.9	6.2	nc	NAF
GCA10654	B000868	BD12010, 9-10	8.2		4.9	0.10	<0.01	<0.01	0.01	<0.01		0.02	<0.01	1	nc	0.9	6.0	nc	NAF
GCA10655	B000873	BD12010, 14-15	12.6		4.6	0.082	<0.01	0.02	0.02	<0.01		0.01	<0.01	1	nc	0.9	5.8	nc	NAF
GCA10656	B001043	BD12011, 4-5	3.9		4.6	0.027	<0.01	0.02	<0.01	0.02		0.07	0.04	1	nc	0.7	5.6	nc	NAF
GCA10657	B001048	BD12011, 9-10	8.2		4.6	0.073	<0.01	<0.01	<0.01	<0.01		0.04	0.02	1	nc	0.7	5.7	nc	NAF
GCA10658	B001053	BD12011, 14-15	12.6		4.3	0.068	<0.01	0.02	0.02	<0.01		0.02	0.01	<1	nc	1.0	5.4	nc	NAF
GCA10660	B012245	BRC12089, 7-8	7.5		4.8	0.15	<0.01	0.02	<0.01	0.02		0.06	0.01	3	nc	0.9	6.3	nc	NAF
GCA10661	B012248	BRC12089, 10-11	10.5		4.8 (4.8)	0.17 (0.17)	<0.01	0.02	<0.01	0.02		0.07	0.01	4	nc	1.0	6.1	nc	NAF
GCA10662	B001251	BD12012, 5-6	4.7		4.3	0.15	0.10	0.07	0.04	0.03		0.08	0.06	<1	nc	1.5	4.6	nc	NAF
GCA10663	B001260	BD12012, 14-15	12.6		4.1	0.085	<0.01	0.02	<0.01	0.02		0.03	0.02	<1	nc	1.4	4.8	nc	NAF
GCA10664	B001266	BD12012, 20.0-21.3	17.9		4.1	0.11	0.30	0.25	0.22	0.03		0.06	0.04	<1	nc	2.3	4.2	nc	UC-(NAF)
GCA10684	B009979	BRC12072, 7-8	7.5		5.4	0.27	<0.01	0.04	0.02	0.02		0.06	0.02	2	nc	0.7	5.7	nc	NAF
GCA10685	B009986	BRC12072, 13-14	13.5		7.7	0.42	<0.01	0.04	0.02	0.02		0.10	0.08	10	nc	<0.5	8.1	nc	NAF
GCA10665	B000695	BD12009, 18-19	18.5	crystal tuff	4.1	0.25	<0.01	0.05	0.05	<0.01		0.02	0.02	1	nc	1.2	5.0	nc	NAF
GCA10666	B000701	BD12009, 23-24	23.5		4.2	0.46	<0.01	0.11	0.09	0.02		<0.01	<0.01	2	nc	1.2	4.9	nc	NAF
GCA10668	B001068	BD12011, 29-30	25.5		4.5	0.096	<0.01	0.02	0.02	<0.01		<0.01	<0.01	1	nc	1.5 (1.2)	5.1 (5.1)	nc	NAF
GCA10669	B001071	BD12011, 32-33	28.1		4.8	0.045	0.10	0.04	0.02	0.02		0.06	0.06	1	nc	1.2	4.9	nc	NAF
GCA10670	B001073	BD12011, 34-35	29.9		4.0	0.13	0.10	0.15	0.14	0.01		0.01	<0.01	2	nc	2.2	4.5	nc	NAF
GCA10671	B012258	BRC12089, 19-20	19.5		5.5 (5.6)	0.084 (0.096)	<0.01	0.02	<0.01	0.02		0.10	0.07	2	nc	<0.5	5.9	nc	NAF
GCA10672	B012262	BRC12089, 22-23	22.5		5.3	0.14	<0.01	0.04	<0.01	0.04		0.11	0.10	3 (3)	nc	0.7	5.9	nc	NAF
GCA10673	B012265	BRC12089, 25-26	25.5		6.3	0.076	<0.01	0.02	<0.01	0.02		0.50	0.45	10	nc	<0.5	7.3	nc	NAF
GCA10674	B001278	BD12012, 31-32	27.3		4.3	0.23	0.20	0.15	0.14	0.01		0.01	<0.01	4	nc	1.7	4.7	nc	UC-(NAF)
GCA10675	B001282	BD12012, 35-36	30.7		5.0	0.14	0.10	0.02	<0.01	0.02		<0.01	<0.01	6	nc	0.7	5.8	nc	NAF
GCA10667	B000887	BD12010, 28-29	24.7	ignimbrite	4.4	0.19	0.10	0.05	0.05	<0.01		0.03	<0.01	2	nc	0.7	5.3	nc	NAF
GCA10681	B001289	BD12012, 41-42	35.9		4.7 (4.7)	0.12 (0.13)	0.10	0.08	0.02	0.06		<0.01	<0.01	7	nc	<0.5	4.6	nc	NAF
GCA10682	B001291	BD12012, 43-44	37.7		5.7	0.11	0.10	0.07	<0.01	0.07		0.64	0.63	12	nc	<0.5	6.7	nc	NAF
GCA10683	B001294	BD12012, 46-47	40.3		6.1	0.13	0.10	0.03	<0.01	0.03		0.54	0.53	13	nc	<0.5	7.1	nc	NAF
GCA10700	B010726	BRC12077, 10-11	10.5		5.7	0.032	<0.01	0.04	0.03	0.01		0.03	<0.01	1	nc	<0.5	5.8	nc	NAF
GCA10701	B010733	BRC12077, 17-18	17.5		5.8 (5.7)	0.062 (0.057)	0.10	0.04	0.03	0.01		0.03	<0.01	1	nc	<0.5 (0.9)	5.8 (5.8)	nc	NAF
GCA10678	B001272	BD12012, 26-27	22.9	volcanic breccia	4.3	0.80	0.10	0.19	0.20	<0.01		0.02	<0.01	3	nc	1.4	4.6	nc	UC-(NAF)

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Table 1 (Cont'd)
Results of Static Testing to Assess Acid-forming Characteristics of Waste Rock Samples

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GCA-Sample No.	Site-Sample No.	Drill hole and Down-hole interval (m)	Depth below Ground level (m)	Lithology	pH-(1:2)	EC-(1:2) [mS/cm]	Total-S (%)		SO ₄ -S [Na ₂ CO ₃] (%)	Sulphide-S [Total-S] - [SO ₄ -S] (%)	Cr(II)-Reducible - S (%)	Total-C (%)	CO ₃ -C (%)	Bulk-ANC	NAPP	NAG-(pH 7.0)	ANC / MPA Ratio	AFP Category	
							Site Database	This Study						kg H ₂ SO ₄ /tonne					
Samples with Total-S < 0.3% (Cont'd)																			
GCA10679	B001273	BD12012, 27-28	23.8		4.4	1.3	0.20	0.24	0.22	0.02		<0.01	<0.01	4	nc	1.2	4.7	nc	UC-(NAF)
GCA10680	B001274	BD12012, 28-29	24.7		4.5	0.75	0.10	0.14	0.13	0.01		0.02	<0.01	3	nc	0.9	4.9	nc	NAF
GCA10686	B009993	BRC12072, 20-21	20.5		6.5	0.30	0.10	0.10	0.03	0.07		0.11	0.09	6	nc	0.9 (<0.5)	5.7 (5.7)	nc	NAF
GCA10687	B009995	BRC12072, 22-23	22.5		7.8	0.22	0.10	0.05	<0.01	0.05		0.46	0.44	25	nc	<0.5	8.7	nc	NAF
GCA10690	B006184	BRC12036, 18-19	18.5		7.4	0.097	<0.01	0.02	<0.01	0.02		0.07	0.04	5	nc	<0.5	7.0	nc	NAF
GCA10691	B006189	BRC12036, 23-24	23.5		7.9 (7.9)	0.15 (0.14)	0.10	0.05	0.01	0.04		0.42	0.40	24	nc	<0.5	9.1	nc	NAF
GCA10692	B006592	BRC12038, 10-11	10.5		7.4	0.099	<0.01	0.02	<0.01	0.02		0.06	0.05	6	nc	<0.5	7.0	nc	NAF
GCA10693	B006429	BRC12037, 28-29	28.5		7.9	0.097	<0.01	0.02	<0.01	0.02		0.25	0.22	12	nc	<0.5	8.4	nc	NAF
GCA10694	B006438	BRC12037, 37-38	37.5		7.6	0.15	0.10	0.10	<0.01	0.10		0.35	0.33	15 (15)	-11	<0.5	8.7	>2	NAF
GCA10705	61904	BRC12040, 27-30	28.5		6.7	1.1	0.27	0.29	0.08	0.21		0.20	0.14	15	-8.5	<0.5	6.9	>2	NAF
GCA10715	61914	BRC12071, 6-11	8.5	laminated tuff	5.7	0.83	0.04	0.03	0.03	<0.01		0.04	0.01	3	nc	<0.5	6.6	nc	NAF
GCA10716	61915	BRC12071, 11-16	13.5		5.1	0.41	0.02	0.03	0.02	0.01		0.05	<0.01	3	nc	<0.5	6.3	nc	NAF
GCA10717	61916	BRC12071, 16-21	18.5		6.5	0.34	<0.01	0.02	0.02	<0.01		0.04	<0.01	7	nc	<0.5	7.0	nc	NAF
GCA10723	61922	BRC12036, 1-6	3.5		5.1	0.13	<0.01	0.02	0.02	<0.01		0.06	0.02	4	nc	<0.5	7.1	nc	NAF
GCA10724	61923	BRC12036, 6-11	8.5		5.8	0.12	<0.01	0.01	<0.01	0.01		0.03	<0.01	4	nc	<0.5	7.8	nc	NAF
GCA10695	B006171	BRC12036, 7-8	7.5		5.8	0.086	<0.01	0.01	<0.01	0.01		0.02	<0.01	4	nc	<0.5	6.8	nc	NAF
GCA10696	B006177	BRC12036, 12-13	12.5		6.2	0.19	0.10	0.05	0.03	0.02		0.08	0.05	6	nc	<0.5	6.5	nc	NAF
GCA10697	B007096	BRC12041, 10-11	10.5	ignimbrite lithic tuff	6.5	0.033	<0.01	0.02	<0.01	0.02		0.04	0.01	1	nc	<0.5	6.8	nc	NAF
GCA10698	B007105	BRC12041, 18-19	18.5		6.5	0.049	<0.01	0.04	0.02	0.02		0.05	0.04	1	nc	<0.5	6.6	nc	NAF
GCA10699	B007117	BRC12041, 30-31	30.5		5.8	0.097	0.10	0.11	0.07	0.04		0.04	0.02	1	nc	1.4	4.6	nc	NAF
Samples with Total-S = 0.3-1.0%																			
GCA10702	61901	BRC12039, 13-18	15.5	volcanic breccia	6.8	0.46	0.46	0.50 (0.51) [0.47]	0.05	0.46	0.31	0.26	0.23	19 (16)	-0.3	<0.5 (<0.5)	7.3 (7.5)	1.0	PAF
GCA10703	61902	BRC12039, 21-25	23		6.1	0.60	0.43	0.47 [0.45]	0.13	0.34	0.23	0.30	0.24	10	4.4	<0.5	7.2	<1	PAF
GCA10704	61903	BRC12040, 24-27	25.5		6.1	1.2	0.37	0.40 [0.41]	0.09	0.31	0.24	0.20	0.14	11	1.6	<0.5	5.6	<1	PAF
GCA10706	61905	BRC12072, 30-33	31.5		6.5	0.56	0.53	0.53 [0.53]	0.06	0.47	0.36	0.11	0.05	10	6.2	6.1 (4.9)	4.3 (4.1)	<1	PAF
GCA10707	61906	BRC12072, 33-37	35		7.1	0.59	0.50	0.51 [0.47]	0.06	0.45	0.32	0.38	0.32	19	-3.3	<0.5	7.3	1.2	PAF
GCA10708	61907	BRC12072, 49-53	51		4.6	0.72	0.75	0.78 [0.72]	0.12	0.66	0.50	0.11	0.08	7	17	9.0	3.7	<1	PAF
GCA10744	B001100	BD12011, 58-59	50.7		6.6	0.55	0.70	0.47 [0.42, 0.42]	<0.01	0.47	0.47	0.34	0.32	12	2.4	1.4 (1.5)	4.7 (4.8)	<1	PAF
GCA10745	B001101	BD12011, 59-60	51.5		6.7	0.36	0.40	0.38 [0.38]	<0.01	0.38	0.29	0.19	0.16	10	1.7	<0.5	7.1	<1	PAF
GCA10746	B001102	BD12011, 60-61	52.4		6.7	0.20	0.40	0.46 [0.38]	<0.01	0.46	0.29	0.12	0.11	8	6.1	0.7 (<0.5)	6.2 (6.0)	<1	PAF
GCA10747	B001104	BD12011, 62-63	54.1		7.9	0.16	0.50	0.57 [0.55]	<0.01	0.57	0.46	0.42	0.40	14	3.5	<0.5 (<0.5)	7.1 (6.7)	<1	PAF
GCA10748	B001105	BD12011, 63-64	55		7.2	0.17	0.40	0.46	<0.01	0.46	0.24	0.11	0.08	7	7.1	2.0 (1.7)	4.7 (4.6)	<1	PAF
GCA10750	B001107	BD12011, 65-66	56.7		7.3	0.16	0.60	0.51 [0.49]	0.03	0.48	0.39	0.35	0.33	18	-2.3	<0.5	7.1	1.1	PAF
GCA10751	B001108	BD12011, 66-67	57.6		6.7	0.18	0.90	1.0 [0.84]	0.04	0.96	0.71	0.14	0.11	7	24	8.7	3.4	<1	PAF
GCA10753	B001110	BD12011, 68-69	59.3		6.3	0.21	0.40	0.40 [0.38]	<0.01	0.40	0.29	0.02	<0.01	3	9.3	6.3	3.7	<1	PAF
GCA10712	61911	BRC12072, 59-64	61.5	crystal tuff	5.4 (5.4)	1.5 (1.5)	0.76	0.77 [0.79]	0.10	0.67	0.54	0.28	0.23	9	16	<0.5 (1.8)	5.7 (5.7)	<1	PAF
GCA10713	61912	BRC12072, 64-69	66.5		6.0	0.70	0.72	0.78 [0.74]	0.10	0.68	0.39	0.41	0.38	20	3.4	<0.5 (1.2)	6.5 (6.6)	<1	PAF

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Table 1 (Cont'd)
Results of Static Testing to Assess Acid-forming Characteristics of Waste Rock Samples

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GCA-Sample No.	Site-Sample No.	Drill hole and Down-hole interval (m)	Depth below Ground level (m)	Lithology	pH-(1:2)	EC-(1:2) [mS/cm]	Total-S (%)		SO ₄ -S [Na ₂ CO ₃] (%)	Sulphide-S [Total-S] - [SO ₄ -S] (%)	Cr(II)-Reducible - S (%)	Total-C (%)	CO ₃ -C (%)	Bulk-ANC	NAPP	NAG-(pH 7.0)	ANC / MPA Ratio	AFP Category	
							Site Database	This Study						kg H ₂ SO ₄ /tonne					NAG-pH
Samples with Total-S = 0.3-1.0% (Cont'd)																			
GCA10719	61918	BRC12071, 35-40	37.5		7.8	0.33	0.52	0.50 [0.51]	0.03	0.47	0.39	0.29	0.24	21	-5.3	<0.5 (<0.5)	7.9 (8.1)	1.3	PAF
GCA10720	61919	BRC12071, 40-45	42.5		7.5	0.25	0.56	0.57 [0.54]	0.02	0.55	0.38	0.17	0.10	10	7.5	3.2 (2.8)	4.5 (4.1)	<1	PAF
GCA10721	61920	BRC12071, 45-50	47.5		8.0	0.23	0.56	0.57 [0.54]	0.02	0.55	0.39	0.31	0.22	22	-4.5	<0.5	8.3	1.2	PAF
GCA10722	61921	BRC12071, 50-55	52.5		7.9 (7.9)	0.28 (0.19)	0.44	0.34	<0.01	0.34	nm	0.77	0.73	41	-30	<0.5	8.4	>2	NAF
GCA10730	61929	BRC12067, 3-7	5		4.9	0.21	0.50	0.49 [0.49]	0.45	0.04	<0.01	0.06	0.04	<1	15	<0.5	5.0	<1	PAF
GCA10731	61930	BRC12067, 8-13	10.5		3.7	0.61	0.40	0.48	0.10	0.38	0.31	0.04	<0.01	<1	15	8.2	3.3	<1	PAF
GCA10732	61931	BRC12067, 13-18	15.5		5.8	0.44	0.50	0.54 [0.50]	0.04	0.50	0.33	0.29	0.22	10	6.6	<0.5 (<0.5)	6.4 (6.5)	<1	PAF
GCA10042	30454	BGD029, 37-38	37.4		6.2	0.23	-	0.92	0.02	0.90	nm	0.63	0.05	20	8.2	7.9	4.1	<1	PAF
GCA10740	B000014	BD12001, 12.3-13.0	12.75	laminated tuff	5.9	0.31	0.50	0.45 [0.45]	0.02	0.43	0.34	0.13	0.10	9	4.8	1.2	5.6	<1	PAF
GCA10741	B000015	BD12001, 13-14	13.5		7.0	0.16	0.40	0.35 [0.37]	0.02	0.33	0.08	0.12	0.09	6	5.4	1.0	5.6	<1	PAF
GCA10742	B000016	BD12001, 14.0-14.8	14.4		7.9 (8.1)	0.19 (0.18)	0.40	0.67 [0.60]	0.04	0.63	0.34	0.22	0.20	13	7.6	<0.5 (1.2)	6.8 (6.9)	<1	PAF
GCA10709	61908	BRC12072, 37-42	39.5	ignimbrite	7.5	0.56	0.30	0.31 [0.30]	0.04	0.27	0.23	0.37	0.32	23	-13	<0.5	7.7	>2	NAF
GCA10710	61909	BRC12072, 42-47	44.5		7.8	0.51	0.40	0.38 [0.37]	0.04	0.34	0.30	0.47	0.42	24	-12	<0.5	8.3	2.0	NAF
GCA10718	61917	BRC12071, 23-28	25.5		6.2	1.2	0.54	0.53 [0.53]	0.03	0.50	0.28	0.21	0.15	13	3.2	<0.5 (<0.5)	5.5 (5.4)	<1	PAF
GCA10725	61924	BRC12094, 0-4	2		4.6	0.15	0.35	0.30 [0.33]	0.24	0.06	0.06	0.05	<0.01	<1	11	1.8	4.5	<1	PAF
GCA10726	61925	BRC12094, 4-8	6		3.7	0.34	0.63	0.64 [0.60]	0.20	0.44	0.33	0.05	0.01	<1	20	9.5	3.4	<1	PAF
GCA10047	31871	BGD042, 84-85	84.2		5.1	0.34	-	0.73	0.03	0.70	nm	0.19	0.01	13	9.4	1.5	4.0	<1	PAF
GCA10050	31926	BGD042, 134-135	134		5.9	0.43	-	0.93	0.03	0.90	nm	0.31	0.01	16	13	9.8	3.2	<1	PAF
GCA10051	31927	BGD042, 135-136	135		6.1	0.29	-	0.86	0.02	0.84	nm	0.21	<0.01	17	9.4	<0.5	8.7	<1	PAF
GCA10052	31929	BGD042, 137-138	137		5.0	0.50	-	0.76	0.04	0.72	nm	0.22	0.01	15	8.3	5.6	3.6	<1	PAF
GCA10053	31930	BGD042, 138-139	138		5.7 (5.6)	0.34 (0.33)	-	0.67	0.03	0.64	nm	0.25	0.01	20	0.6	2.0 (2.7)	4.2 (4.1)	<1	PAF
GCA10738	61937	BRC12088, 25-29	27	sandstone	4.8	0.11	<0.01	0.51 [0.53]	0.46	0.05	0.03	0.04	<0.01	<1	17	2.3	4.5	<1	PAF
GCA10739	61938	BRC12088, 36-38	37		4.1	0.38	0.70	0.57 [0.39]	0.57	<0.01	0.01	0.14	<0.01	<1	18	1.8	4.7	<1	PAF
Samples with Total-S > 1%																			
GCA10733	61932	BRC12054, 13-18	15.5	crystal tuff	3.6	0.34	1.98	1.7 [1.9]	0.21	1.6	1.1	0.06	<0.01	<1	59	38	2.7	<1	PAF
GCA10734	61933	BRC12054, 18-23	20.5		3.5	0.35	2.36	2.3 [2.5]	0.11	2.2	1.4	0.07	0.03	<1	77	56	2.5	<1	PAF
GCA10736	61935	BRC12054, 28-33	30.5		5.6	0.82	1.46	1.5	0.05	1.5	nm	0.44	0.39	7	39	15	3.2	<1	PAF
GCA10754	B001301	BD12012, 52-53	45.5		7.6	0.21	1.6	1.6 [1.7]	0.02	1.6	1.1	0.85	0.81	29	24	12	3.1	<1	PAF
GCA10755	B001303	BD12012, 53-54	46.3		7.6	0.24	1.2	1.2	0.03	1.2	1.0	0.84	0.78	40	-3.2	<0.5 (1.0)	5.4 (5.1)	1.1	PAF
GCA10756	B001304	BD12012, 54-55	47.2		8.2 (8.2)	0.14 (0.14)	1.2	0.93 [0.80]	0.02	0.91	0.06	1.6	1.4	61	-32	<0.5	8.7	>2	NAF
GCA10041	30451	BGD029, 34-35	34.4		5.6	0.33	-	2.2	0.05	2.2	nm	0.53	0.04	25	43	39	2.7	<1	PAF
GCA10043	30458	BGD029, 39-40	39.4		6.3	0.39	-	1.9	0.03	1.9	1.4	0.76	0.07	21	38	23	3.1	<1	PAF
GCA10044	30475	BGD029, 55-56	55.3		5.0	0.42	-	2.6	0.06	2.6	1.8	0.32	0.01	19	61	47	2.6	<1	PAF
GCA10045	30476	BGD029, 56-57	56.3		5.0	0.72	-	5.2	0.08	5.2	nm	0.41	0.03	28	140	89	2.4	<1	PAF
GCA10046	30488	BGD029, 65-66	65.2		5.1	0.81	-	3.3	0.08	3.3	nm	0.29	0.02	17	84	59	2.5	<1	PAF
GCA11075	B000325	BD12004, 108-109	94		6.1	0.50	1.2	1.6	0.02	1.6	nm	0.57	0.53	16	33	13	3.1	<1	PAF
GCA11076	B000513	BD12006, 85-86	85.5		6.1	0.29	1.4	1.2	0.02	1.2	nm	0.25	0.22	7	30	21	2.9	<1	PAF
GCA11077	B000703	BD12009, 25-26	25.5		3.8	1.7	1.5	1.3	0.02	1.3	nm	0.02	<0.01	-3	43	12	3.0	<1	PAF
GCA11078	B000707	BD12009, 29-30	29.5		5.7	1.4	2.3	1.9	0.11	1.8	nm	1.2	1.1	24	35	9.7	3.4	<1	PAF

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Table 1 (Cont'd)
Results of Static Testing to Assess Acid-forming Characteristics of Waste Rock Samples

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GCA-Sample No.	Site-Sample No.	Drill hole and Down-hole interval (m)	Depth below Ground level (m)	Lithology	pH-(1:2)	EC-(1:2) [mS/cm]	Total-S (%)		SO ₄ -S [Na ₂ CO ₃] (%)	Sulphide-S [Total-S] - [SO ₄ -S] (%)	Cr(II)-Reducible - S (%)	Total-C (%)	CO ₃ -C (%)	Bulk-ANC	NAPP	NAG-(pH 7.0)		ANC / MPA Ratio	AFP Category
							Site Database	This Study						kg H ₂ SO ₄ /tonne					
Samples with Total-S > 1% (Cont'd)																			
GCA11079	B000710	BD12009, 32-33	32.5		5.1	1.4	2.1	2.1	0.12	2.0	nm	0.39	0.37	8	57	42	2.5	<1	PAF
GCA11081	B000721	BD12009, 41-42	41.5		6.2	0.54	1.8	1.5	0.03	1.5	nm	0.87	0.83	27	19	5.3	4.1	<1	PAF
GCA11080	B000775	BD12009, 87-88	87.5		5.4	0.44	1.1	1.6	0.04	1.6	nm	0.31	0.29	5	44	31	2.6	<1	PAF
GCA11082	B001034	BD12010, 158-159	137.3		7.5	0.16	1.1	1.1	0.02	1.1	nm	0.66	0.61	13 (13)	21	2.3	5.0	<1	PAF
GCA11084	B001211	BD12011, 161-162	139.9		6.4 (6.3)	0.59 (0.53)	1.6	1.5	0.04	1.5	nm	0.32	0.24	10	36	20 (21)	2.9 (2.8)	<1	PAF
GCA11083	B001225	BD12011, 172-173	149.4		6.8	0.42	1.5	1.9	0.03	1.9	nm	0.34	0.28	10	49	31	2.6	<1	PAF
GCA10727	61926	BRC12094, 8-13	10.5	ignimbrite	4.1	0.54	1.36	1.3 [1.4]	0.08	1.3	0.83	0.07	0.03	<1	43	39	2.7	<1	PAF
GCA10728	61927	BRC12094, 13-17	15		5.2	0.70	1.45	1.5 [1.5]	0.09	1.5	0.96	0.18	0.12	5	41	25	2.8	<1	PAF
GCA10048	31922	BGD042, 130-131	130		6.4 (6.4)	0.38 (0.42)	-	1.2	0.02	1.2	nm	0.34	0.02	22	15	14	3.0	<1	PAF
GCA10039	30430	BGD029, 13-14	13.4		3.8	0.52	-	1.6 (1.6)	0.05	1.6	1.1	<0.01	<0.01	4 (4)	45	43	2.6	<1	PAF
GCA10040	30436	BGD029, 19-20	19.4		5.1	0.33	-	1.3	0.04	1.3	nm	0.10	<0.01	4	36	34	2.7	<1	PAF
GCA11069	B000059	BD12002, 7-8	7.5		4.0	0.74	1.3	1.5	0.05	1.5	nm	0.01	<0.01	<1	46	42	2.4	<1	PAF
GCA11070	B000578	BD12007, 43-44	43.5		5.6	0.48	1.4	1.3	0.03	1.3	nm	0.29	0.26	12	28	42	2.9	<1	PAF
GCA11071	B000769	BD12009, 83-84	83.5		5.6	0.51	2.0	1.6	0.04	1.6	nm	0.33	0.29	8	41	28	2.7	<1	PAF
GCA11072	B000955	BD12010, 88-89.4	76.7		4.7	0.47	2.1	1.9	0.04	1.9	nm	0.04	<0.01	2	57	47	2.4	<1	PAF
GCA11073	B000894	BD12010, 35-36	30.7		5.8	0.68	2.0	2.2	0.04	2.2	nm	0.75	0.70	10	58	32	2.7	<1	PAF
GCA11074	B001436	BD12012, 174-175	151.1		6.1	0.47	1.4	1.1	0.03	1.1	nm	0.21	0.18	6	28	21	2.8	<1	PAF
GCA10743	B001099	BD12011, 57-58	49.8	volcanic breccia	5.0	0.46	0.90	1.2 [1.1]	0.05	1.2	0.80	0.06	0.06	6	31	20	2.9	<1	PAF
GCA10749	B001106	BD12011, 64-65	55.8		7.3	0.16	0.80	1.1	0.03	1.1	0.74	0.35	0.29	16	18	1.5 (2.0)	5.5 (5.3)	<1	PAF
Notes: EC = Electrical Conductivity; ANC = Acid-Neutralisation-Capacity; NAPP = Net Acid Producing Potential; AFP = Acid Formation Potential; NAF = Non-Acid Forming; PAF = Potentially-Acid Forming; Cr(II)-Red.-S = Chromium(II)-Reducible-S; NAG = Net Acid Generation; MPA = Maximum Potential Acidity; nc = not calculated; nm = not measured. pH-(1:2) and EC-(1:2) values correspond to pH and EC measured on sample slurries prepared with deionised water, and a solid:solution ratio of c. 1:2 (w/w). All results expressed on a dry-weight basis, except for pH-(1:2), EC-(1:2), and NAG-pH. Values in parentheses represent duplicates. Total-S values in square-parentheses correspond to duplicate determination by SGS (cf. GLS).																			

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Table 2
Results of Selected-Assays for Waste Rock Samples

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GCA-Sample No.	Site-Sample No.	Drill hole & Down-Hole Interval (m)	Lithotype	Zn (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Cu (mg/kg)	Mn (mg/kg)	As (mg/kg)	Ba (mg/kg)	Sr (mg/kg)	Ag (mg/kg)
Samples with Total-S < 0.3%												
GCA10651	B000681	BD12009, 4-5	sandstone	27	0.04	12	4	120	30	370	300	0.11
GCA10652	B000685	BD12009, 8-9		38	0.04	12	5	230	53	560	380	0.21
GCA10676	B000688	BD12009, 11-12		60	0.10	22	10	510	31	220	130	0.05
GCA10677	B000692	BD12009, 15-16		200	0.21	25	9	1,100	24	270	220	0.23
GCA10653	B000864	BD12010, 5-6		33	<0.02	18	8	17	75	580	490	0.06
GCA10654	B000868	BD12010, 9-10		13	<0.02	13	4	12	35	180	270	0.06
GCA10655	B000873	BD12010, 14-15		10	<0.02	11	3	38	54	400	390	0.07
GCA10656	B001043	BD12011, 4-5		32	0.05	16	5	15	96	410	420	0.08
GCA10657	B001048	BD12011, 9-10		16	0.03	13	3	9	24	290	330	0.15
GCA10658	B001053	BD12011, 14-15		17	0.02	25	9	9	46	230	610	0.09
GCA10660	B012245	BRC12089, 7-8		94	0.11	38	2	130	3.4	290	36	0.12
GCA10661	B012248	BRC12089, 10-11		110	0.08	46	2	190	4.2	560	76	1.4
GCA10662	B001251	BD12012, 5-6		67	0.02	19	14	17	48	430	450	0.09
GCA10663	B001260	BD12012, 14-15		12	0.05	17	3	31	20	250	360	<0.05
GCA10664	B001266	BD12012, 20.0-21.3		29	0.12	26	8	150	110	290	510	0.07
GCA10684	B009979	BRC12072, 7-8		79	0.09	19	3	340	16	560	140	0.33
GCA10685	B009986	BRC12072, 13-14		93	0.10	21	2	2,300	9.8	1,400	65	0.57
GCA10665	B000695	BD12009, 18-19	crystal tuff	140	0.14	26	10	1,600	98	290	490	0.06
GCA10666	B000701	BD12009, 23-24		300	0.13	19	20	2,200	17	860	520	0.22
GCA10668	B001068	BD12011, 29-30		33	0.18	26	7	150	8.7	160	210	0.08
GCA10669	B001071	BD12011, 32-33		13	0.03	22	3	49	18	490	750	0.10
GCA10670	B001073	BD12011, 34-35		39	0.07	23	17	130	47	660	630	<0.05
GCA10671	B012258	BRC12089, 19-20		79	0.05	34	1	560	3.3	92	47	1.3
GCA10672	B012262	BRC12089, 22-23		110	0.05	57	3	780	8.6	210	86	1.1
GCA10673	B012265	BRC12089, 25-26		190	0.12	67	4	5,400	4.4	190	110	0.59
GCA10674	B001278	BD12012, 31-32		73	0.02	32	2	720	5.0	96	73	0.06
GCA10675	B001282	BD12012, 35-36		85	0.04	12	2	810	3.7	120	85	<0.05

Table 2 (Cont'd)
Results of Selected-Assays for Waste Rock Samples

Page 2 of 4

GCA-Sample No.	Site-Sample No.	Drill hole & Down-Hole Interval (m)	Lithotype	Zn (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Cu (mg/kg)	Mn (mg/kg)	As (mg/kg)	Ba (mg/kg)	Sr (mg/kg)	Ag (mg/kg)
Samples with Total-S < 0.3% (Cont'd)												
GCA10667	B000887	BD12010, 28-29	ignimbrite	170	0.20	27	29	1,700	12	940	550	0.09
GCA10681	B001289	BD12012, 41-42		53	0.02	32	1	340	4.4	87	64	<0.05
GCA10682	B001291	BD12012, 43-44		110	0.06	44	2	3,300	3.7	56	44	0.19
GCA10683	B001294	BD12012, 46-47		130	<0.02	27	1	3,600	4.8	60	76	0.10
GCA10700	B010726	BRC12077, 10-11		61	5.1	360	5	93	900	560	120	16
GCA10701	B010733	BRC12077, 17-18		120	2.6	300	4	130	470	570	120	9.1
GCA10678	B001272	BD12012, 26-27	volcanic breccia	110	0.25	25	4	1,300	38	330	150	0.10
GCA10679	B001273	BD12012, 27-28		110	0.28	27	3	1,600	24	140	97	0.10
GCA10680	B001274	BD12012, 28-29		89	0.17	36	2	980	9.5	120	110	0.08
GCA10686	B009993	BRC12072, 20-21		420	0.38	93	3	450	12	310	120	0.19
GCA10687	B009995	BRC12072, 22-23		450	0.19	53	2	630	9.0	290	160	0.10
GCA10690	B006184	BRC12036, 18-19		28	0.19	76	2	1,400	5.8	580	99	0.10
GCA10691	B006189	BRC12036, 23-24		46	0.11	73	2	580	4.7	630	130	0.07
GCA10692	B006592	BRC12038, 10-11		210	0.54	160	2	640	20	750	93	2.4
GCA10693	B006429	BRC12037, 28-29		23	0.24	49	2	620	3.4	490	110	0.06
GCA10694	B006438	BRC12037, 37-38		230	6.5	520	3	3,600	6.2	310	84	0.07
GCA10705	61904	BRC12040, 27-30		71	0.40	37	2	530	29	410	210	0.07
GCA10715	61914	BRC12071, 6-11	laminated tuff	75	0.12	35	3	200	15	770	49	0.19
GCA10716	61915	BRC12071, 11-16		82	0.22	44	2	370	37	510	48	0.41
GCA10717	61916	BRC12071, 16-21		210	0.67	56	9	3,100	23	500	530	0.46
GCA10723	61922	BRC12036, 1-6		98	0.26	29	3	1,300	4.0	390	60	0.16
GCA10724	61923	BRC12036, 6-11		65	0.20	26	2	1,800	7.8	590	140	0.15
GCA10695	B006171	BRC12036, 7-8		64	0.12	26	3	690	9.3	570	180	0.09
GCA10696	B006177	BRC12036, 12-13		79	0.23	44	3	350	21	1,300	81	0.44
GCA10697	B007096	BRC12041, 10-11	ignimbrite lithic tuff	30	1.2	120	2	110	170	550	140	4.8
GCA10698	B007105	BRC12041, 18-19		26	2.0	220	7	69	200	540	85	5.9
GCA10699	B007117	BRC12041, 30-31		310	16	560	4	78	440	490	86	44
AV.-Crustal Abundance (mg/kg)				75	0.03	14	50	950	1.5	500	370	0.07

Table 2 (Cont'd)
Results of Selected-Assays for Waste Rock Samples

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GCA-Sample No.	Site-Sample No.	Drill hole & Down-Hole Interval (m)	Lithotype	Zn (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Cu (mg/kg)	Mn (mg/kg)	As (mg/kg)	Ba (mg/kg)	Sr (mg/kg)	Ag (mg/kg)
Samples with Total-S = 0.3-1.0%												
GCA10702	61901	BRC12039, 13-18	volcanic breccia	350	1.6	45	2	420	24	570	230	0.33
GCA10703	61902	BRC12039, 21-25		190	0.32	110	2	2,700	45	960	220	0.74
GCA10704	61903	BRC12040, 24-27		190	0.53	53	2	790	34	460	130	0.20
GCA10706	61905	BRC12072, 30-33		170	0.51	38	2	680	30	650	230	0.16
GCA10707	61906	BRC12072, 33-37		200	0.41	64	2	4,100	20	420	150	0.17
GCA10708	61907	BRC12072, 49-53		490	1.9	130	2	3,400	140	810	160	4.8
GCA10744	B001100	BD12011, 58-59		4,100	22	1,500	4	12,000	43	250	110	5.0
GCA10745	B001101	BD12011, 59-60		490	2.3	140	1	5,500	32	450	110	1.3
GCA10746	B001102	BD12011, 60-61		750	4.1	250	4	3,300	60	660	130	2.1
GCA10747	B001104	BD12011, 62-63		2,800	17	730	7	15,000	270	470	120	12
GCA10748	B001105	BD12011, 63-64		870	4.5	190	3	3,900	230	420	140	3.0
GCA10749	B001106	BD12011, 64-65		1,600	7.2	300	5	14,000	250	370	150	5.0
GCA10750	B001107	BD12011, 65-66		1,600	8.9	560	5	14,000	110	390	200	4.9
GCA10751	B001108	BD12011, 66-67		1,200	5.7	620	9	4,600	51	450	180	18
GCA10753	B001110	BD12011, 68-69		1,100	7.1	460	5	620	38	420	120	12
GCA10712	61911	BRC12072, 59-64	crystal tuff	190	0.97	140	5	11,000	160	550	180	9.6
GCA10713	61912	BRC12072, 64-69		1,100	4.1	150	5	16,000	73	720	230	6.9
GCA10719	61918	BRC12071, 35-40		240	0.82	97	2	3,800	31	390	220	4.1
GCA10720	61919	BRC12071, 40-45		45	0.17	30	1	3,800	40	440	200	0.93
GCA10721	61920	BRC12071, 45-50		25	0.05	22	2	8,000	51	470	320	0.54
GCA10722	61921	BRC12071, 50-55		1,100	5.3	280	4	29,000	220	440	240	8.2
GCA10730	61929	BRC12067, 3-7		48	0.07	44	2	860	69	290	180	1.2
GCA10731	61930	BRC12067, 8-13		86	0.97	24	1	720	62	350	160	0.42
GCA10732	61931	BRC12067, 13-18		180	0.21	26	1	11,000	76	370	150	0.52
GCA10042	30454	BGD029, 37-38		2,300	4.8	3,600	22	13,000	110	1,100	360	9.0

Table 2 (Cont'd)
Results of Selected-Assays for Waste Rock Samples

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GCA-Sample No.	Site-Sample No.	Drill hole & Down-Hole Interval (m)	Lithotype	Zn (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Cu (mg/kg)	Mn (mg/kg)	As (mg/kg)	Ba (mg/kg)	Sr (mg/kg)	Ag (mg/kg)
Samples with Total-S = 0.3-1.0% (Cont'd)												
GCA10740	B000014	BD12001, 12.3-13.0	laminated tuff	1,600	7.7	360	3	4,400	67	300	110	2.6
GCA10741	B000015	BD12001, 13-14		2,000	11	620	2	3,800	59	210	130	1.8
GCA10742	B000016	BD12001, 14.0-14.8		540	1.9	160	1	5,500	46	640	170	0.98
GCA10709	61908	BRC12072, 37-42	ignimbrite	220	0.53	43	2	5,000	24	490	190	0.15
GCA10710	61909	BRC12072, 42-47		340	1.4	75	2	12,000	66	470	190	1.1
GCA10718	61917	BRC12071, 23-28		630	2.7	120	2	300	38	490	300	1.6
GCA10725	61924	BRC12094, 0-4		50	0.28	100	2	730	190	630	140	2.3
GCA10726	61925	BRC12094, 4-8		57	1.1	37	2	480	91	740	140	1.3
GCA10047	31871	BGD042, 84-85		220	0.76	160	8	7,800	37	1,100	370	7.2
GCA10050	31926	BGD042, 134-135		600	2.6	270	12	11,000	41	460	190	4.0
GCA10051	31927	BGD042, 135-136		340	1.5	76	6	7,600	33	520	190	3.6
GCA10052	31929	BGD042, 137-138		580	2.3	240	5	8,700	32	600	150	5.3
GCA10053	31930	BGD042, 138-139		720	2.8	150	3	9,700	44	550	170	2.7
GCA10738	61937	BRC12088, 25-29	sandstone	25	0.09	20	11	250	29	650	370	0.24
AV.-Crustal Abundance (mg/kg)				75	0.03	14	50	950	1.5	500	370	0.07
Samples with Total-S > 1%												
GCA10733	61932	BRC12054, 13-18	crystal tuff	480	1.2	120	6	560	160	1,300	730	12
GCA10734	61933	BRC12054, 18-23		1,200	2.9	350	13	1,400	210	1,500	790	54
GCA10736	61935	BRC12054, 28-33		830	2.5	350	11	14,000	250	1,200	450	18
GCA10754	B001301	BD12012, 52-53		140	0.11	27	17	1,300	30	120	510	0.19
GCA10755	B001303	BD12012, 53-54		74	0.13	22	10	1,000	33	190	720	0.18
GCA10756	B001304	BD12012, 54-55		140	0.53	19	19	2,000	29	320	930	0.14
GCA10041	30451	BGD029, 34-35		2,300	4.0	3,100	8	12,000	97	890	260	7.8
GCA10043	30458	BGD029, 39-40		2,000	2.8	1,500	7	13,000	87	900	270	5.7
GCA10044	30475	BGD029, 55-56		2,100	3.8	1,500	18	9,200	180	710	220	11

Table 3
Total-S, Total-C and CO₃-C Results for Size-fractions of Waste Rock Samples

GCA-Sample No.	Site-Sample No.	Drill hole & Downhole-Interval (m)	Total-S (5)		Total-C (%)		CO ₃ (5)	
			-2mm	+2mm	-2mm	+2mm	-2mm	+2mm
Samples of Ignimbrite								
GCA11069	B000059	B12002, 7-8	1.5	1.4	0.01	<0.01	0.01	<0.01
GCA11070	B000578	BD12007, 43-44	1.3	1.3	0.29	0.25	0.26	0.21
GCA11071	B000769	BD12009, 83-84	1.6	1.9	0.33	0.28	0.29	0.24
GCA11072	B000955	BD12010, 88.0-89.4	1.9	1.8	0.04	0.03	<0.01	<0.01
GCA11073	B000894	BD12010, 35-36	2.2	2.0	0.75	0.59	0.70	0.54
GCA11074	B001436	BD12012, 174-175	1.1	1.2	0.21	0.16	0.18	0.13
Samples of Crystal Tuff								
GCA11075	B000325	BD12004, 108-109	1.6	1.2	0.57	0.58	0.53	0.53
GCA11076	B000513	BD12006, 85-86	1.2	1.2	0.25	0.23	0.22	0.19
GCA11077	B000703	BD12009, 25-26	1.3	1.1	0.02	0.02	<0.01	<0.01
GCA11078	B000707	BD12009, 29-30	1.9	1.7	1.20	0.83	1.1	0.79
GCA11079	B000710	BD12009, 32-33	2.1	2.0	0.39	0.31	0.37	0.29
GCA11080	B000775	BD12009, 87-88	1.6	2.1	0.31	0.32	0.29	0.29
GCA11081	B000721	BD12009, 41-42	1.5	1.6	0.87	0.71	0.83	0.67
GCA11082	B001034	BD12010, 158-159	1.1	1.0	0.66	0.63	0.61	0.55
GCA11083	B001225	BD12011, 172-173	1.9	2.2	0.34	0.27	0.28	0.22
GCA11084	B001211	BD12011, 161-162	1.5	1.5	0.32	0.27	0.24	0.24

Table 4
Results of Static Testing of Ore Samples

GCA-Sample No.	Site-sample no.	Drill hole & Down-Hole Interval (m)	Lithotype	pH- (1:2)	EC-(1:2) [mS/cm]	Total-S (%)	SO ₄ -S (%)	[Total-S] - [SO ₄ -S] (%)	Cr(II)-RED.- S (%)	Total-C (%)	CO ₃ -C (%)	Bulk-ANC	NAPP	NAG
												kg H ₂ SO ₄ /tonne		
Low grade ore Samples														
GCA10711	61910	BRC12072, 54-59	Crystal tuff	6.2	1.2	1.1(1.0)	0.07	1.1	0.71	0.33	0.33	12	22	4.1 (3.6)
GCA10714	61913	BRC12072, 69-73		6.6	0.85	0.61	0.06	0.55	nm	0.60	0.58	28	-9.3	<0.5
GCA10735	61934	BRC12054, 23-28		5.3	0.69	1.8	0.09	1.8	nm	0.45	0.36	9	47	25
GCA10737	61936	BRC12054, 33-38		4.9	1.1	1.7	0.09	1.7	nm	0.13	0.01	3	50	37 (38)
GCA10049	31924	BGD042, 132-133	Ignimbrite	6.9	0.35	1.1	0.03	1.1	0.94	0.46	0.03	32	1.7	<0.5
Ore Samples														
GCA10729	61928	BRC12094, 27-32	Ignimbrite	4.6	0.43	1.5	0.06	1.5	nm	0.16	<0.01	1	45	38
GCA10752	B001109	BD12011, 67-68	volcanic breccia	6.5 (6.4)	0.24 (0.22)	0.58	0.04	0.58	nm	0.13	0.10	5	13	2.8

GCA-Sample No.	Site-sample no.	Drill hole & Down-Hole Interval (m)	NAG-pH	ANC / MPA Ratio	AFP Category	Zn (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Cu (mg/kg)	Mn (mg/kg)	As (mg/kg)	Ba (mg/kg)	Sr (mg/kg)	Ag (mg/kg)
Low grade ore Samples														
GCA10711	61910	BRC12072, 54-59	4.9 (4.6)	<1	PAF	1,700	8.6	750	5	12,000	580	570	210	32
GCA10714	61913	BRC12072, 69-73		1.5	PAF	1,700	9.5	670	3	22,000	79	690	270	22
GCA10735	61934	BRC12054, 23-28	2.9	<1	PAF	640	1.8	350	13	13,000	190	990	490	21
GCA10737	61936	BRC12054, 33-38	2.6 (2.6)	<1	PAF	1,500	4.6	580	14	4,100	260	1,100	460	35
GCA10049	31924	BGD042, 132-133	6.2	<1	PAF	710	2.9	1,700	6	16,000	51	270	210	25
Ore Samples														
GCA10729	61928	BRC12094, 27-32	2.6	<1	PAF	2,800	12	460	11	360	5,000	660	230	70
GCA10752	B001109	BD12011, 67-68	4.5	<1	PAF	1,600	9.8	730	13	4,000	60	420	120	42
AV.-Crustal Abundance (mg/kg)						75	0.03	14	50	950	1.5	500	370	0.07

Table 5
Acid-base-analysis and Net-acid-generation Results for Samples Subjected to Kinetic Testing

GCA-Sample No.	Site-sample no.	Drill hole ID	Approximate Down-hole Interval (m)	Lithotype	pH-(1:2)	EC-(1:2) [mS/cm]	TOTAL-S (%)	SO ₄ -S (%)	[Total-S] - [SO ₄ -S] (%)	Cr(II)-RED.-S (%)	Total-C (%)	CO ₃ -C (%)	Mn (%)	Bulk-ANC	NAPP	NAG		NAG-pH	ANC / MPA Ratio	AFP Category
																pH=4.5	pH=7.0			
														kg H ₂ SO ₄ /tonne						
Total-S < 0.1%																				
GCA10651/53	B000681 / B000864	BD12009/10	4-6	Sandstone	5.5	0.16	0.02 (0.03)	0.02 (<0.01)	0.03	<0.01	0.01 (-0.02)	<0.01	<0.01	<1 (2)	nc	<0.5	0.9	5.6	nc	NAF
GCA10668/69	B001068/69	BD12011	29-33	Crystal-Tuff	4.8	0.11	0.03	0.02	0.01	<0.01	<0.01	<0.01	<0.01	-1	nc	<0.5	2.5	5.2	nc	NAF
GCA10682/83	B001291/94	BD12012	43-47		6.3	0.21	0.07	0.01	0.06	0.04	0.66	0.63	0.49	8	nc	<0.5	<0.5	7.3	nc	NAF
GCA10687/91	B009995 / B006189	BRC12072/36	22-24	Volcanic Breccia	8.2 (8.3)	0.2 (0.23)	0.07	0.02	0.05	0.04	0.38	0.35	0.063	22	nc	<0.5 (<0.5)	<0.5 (<0.5)	8.9 (8.9)	nc	NAF
Total-S = 0.1-0.2%																				
GCA10663/64	B001260/64	BD12012	14-21	Sandstone	4.5	0.15	0.13	0.12	0.01	<0.01	0.04	0.01	0.012	-1	nc	<0.5	1.7	4.2	nc	UC-(NAF)
GCA10674/75	B001278/82	BD12012	31-36	Crystal-Tuff	4.8	0.24	0.1	0.1	<0.01	<0.01	0.01	0.01	0.085	<1	nc	<0.5	1.8	5.2	nc	UC-(NAF)
GCA10678/79	B001272/73	BD12012	26-28	Volcanic Breccia	4.5	1.2	0.18	0.16	0.02	<0.01	0.03	0.03	0.16	2	nc	<0.5	0.7	5.1	nc	UC-(NAF)
Total-S = 0.4-0.5%																				
GCA10730/31	61929/30	BRC12067	3-13	Crystal-Tuff	4.5	0.34	0.45	0.26	0.19	0.13	0.04	<0.01	0.082	-2	16	2.5	5.5	3.5	<1	PAF
GCA10740/41	B000014/15	BD12001	3-13	Laminated-Tuff	6.5	0.35	0.43	0.03	0.4	0.23	0.12	0.07	0.3	8	5.2	<0.5	3	5	<1	PAF
GCA10706/07	61905/06	BRC12072	30-37	Volcanic Breccia	6.8	0.41	0.49 (0.51)	0.05 (0.05)	0.46	0.33	0.24 (0.21)	0.18 (0.16)	0.24	13 (11)	4.7	<0.5	<0.5	6.9	<1	PAF
Total-S = 0.6-0.7%																				
GCA10053	61937	BRC12088	138-139	Igimbrite	5.7 (5.6)	0.34 (0.33)	0.67	0.03	0.64	0.53	0.25	0.01	0.89	20	0.6	nm	2.0 (2.7)	4.2 (4.1)	<1	PAF
GCA10747/48/49	B001104/05/06	BD12011	62-65	Volcanic Breccia	6.7	0.16	0.65	0.02	0.63	0.26	0.15	0.16	0.89	12	7.9	<0.5	1.2	5.5	<1	PAF
Total-S = 1-3%																				
GCA10754/55	B001301/03	BRC12054	52-54	Crystal-Tuff	7.5 (7.5)	0.33 (0.32)	1.5	0.03	1.5	1.1	0.75	0.72	0.12	30	16	4.8 (5.3)	7.5 (7.1)	3.3 (3.3)	<1	PAF
GCA10043	30458	BGD029	39-40		6.3	0.39	1.9	0.03	1.9	1.4	0.76	0.07	1.1	21	37	nm	23	3.1	<1	PAF
GCA10044	30475	BGD029	55-56		5	0.42	2.6	0.06	2.6	1.8	0.32	0.01	0.85	19	61	nm	47	2.6	<1	PAF
GCA10039	30430	BGD029	13-14	Igimbrite	3.8	0.52	1.6 (1.6)	0.05	1.6	1.1	<0.01	<0.01	1.4	4 (4)	45	nm	43	2.6	<1	PAF
GCA10049	31924	BGD042	Low Grade Ore		6.9	0.35	1.1	0.03	1.1	0.94	0.46	0.03	1.4	32	1.7	nm	<0.5	6.2	<1	PAF
GCA10729/52	61928/B001109	BRC12094 / BD12011	Full Grade Ore	Igimbrite / Volcanic Breccia	nm	nm	0.99 (0.97)	0.02 (0.03)	0.97	0.73	0.11 (0.12)	<0.01 (0.02)	0.18	1 (2)	30	nm	nm	nm	<1	PAF
Note: Values in parenthesis are for duplicates																				

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Table 6
Multi-element Analysis Results for Samples Subjected to Kinetic Testing

Table 6a
Multi-element Analysis Results for Samples Subjected to Kinetic Testing: Waste Rock: Total-S < 0.1%

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Element	Total-Element Content (mg/kg or %)				Average-Crustal-Abundance (mg/kg or %)	Geochemical-Abundance Index (GAI)			
	Sandstone (GCA10651/53)	Crystal Tuff (GCA10668/69)	Crystal Tuff (GCA10682/83)	Volcanic Breccia (GCA10687/91)		Sandstone (GCA10651/53)	Crystal Tuff (GCA10668/69)	Crystal Tuff (GCA10682/83)	Volcanic Breccia (GCA10687/91)
Al	7.0%	6.8%	8.9%	7.9%	8.2%	0	0	0	0
Fe	0.59%	0.73%	3.1%	0.81%	4.1%	0	0	0	0
Na	0.037%	0.039%	0.022%	0.33%	2.3%	0	0	0	0
K	1.3%	1.5%	2.3%	4.1%	2.1%	0	0	0	0
Mg	0.12%	0.05%	0.24%	0.43%	2.3%	0	0	0	0
Ca	0.2%	0.2%	0.5%	0.8%	4.1%	0	0	0	0
Ag	0.09	0.44	0.18	0.08	0.07	0	2	1	0
Cu	15	4	<1	1	50	0	0	0	0
Zn	32	23	140	260	75	0	0	0	1
Cd	0.02	0.10	0.03	0.13	0.11	0	0	0	0
Pb	22	23	62	41	14	0	0	2	1
Cr	<50	<50	<50	<50	100	0	0	0	0
Ni	2	3	13	2	80	0	0	0	0
Co	0.9	1.3	12	1.4	20	0	0	0	0
Mn	68	88	4,900	630	950	0	0	2	0
Hg	0.01	0.02	<0.01	0.06	0.05	0	0	0	0
Sn	2.3	3.1	3.8	2.9	2.2	0	0	0	0
Sr	460	410	120	150	370	0	0	0	0
Ba	540	270	59	430	500	0	0	0	0
Th	14	19	26	18	12	0	0	1	0
U	3.4	3.1	4.5	5.7	2.4	0	0	0	1

Table 6a (Cont'd)

Multi-element Analysis Results for Samples Subjected to Kinetic Testing: Waste Rock: Total-S < 0.1%

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Element	Total-Element Content (mg/kg or %)				Average Crustal Abundance (mg/kg or %)	Geochemical-Abundance Index (GAI)			
	Sandstone (GCA10651/53)	Crystal Tuff (GCA10668/69)	Crystal Tuff (GCA10682/83)	Volcanic Breccia (GCA10687/91)		Sandstone (GCA10651/53)	Crystal Tuff (GCA10668/69)	Crystal Tuff (GCA10682/83)	Volcanic Breccia (GCA10687/91)
Tl	0.87	2.1	1.2	2.4	0.6	0	1	0	1
V	79	14	9	11	160	0	0	0	0
As	220	13	4.6	7.3	1.5	6	3	1	2
Bi	0.19	0.43	0.75	0.32	0.048	1	3	3	2
Sb	2.00	2.5	0.83	1.1	0.2	3	3	1	2
Se	0.18	0.05	<0.05	<0.05	0.05	1	0	0	0
Mo	8.4	0.4	0.3	1	1.5	2	0	0	0
B	<50	<50	<50	<50	10	0	0	0	0
P	630	440	95	99	1,000	0	0	0	0
F	680	850	850	1,100	950	0	0	0	0
Notes: Average-crustal abundance based on Bowen (1979). Geochemical-Abundance Index (GAI) defined in Annexure 4.									

Table 6b

Multi-element Analysis Results for Samples Subjected to Kinetic Testing: Waste Rock: Total-S = 0.1-0.2%

Element	Total-Element Content (mg/kg or %)			Average Crustal Abundance (mg/kg or %)	Geochemical-Abundance Index (GAI)		
	Sandstone (GCA10663/64)	Crystal Tuff (GCA10674/75)	Volcanic Breccia (GCA10678/79)		Sandstone (GCA10663/64)	Crystal Tuff (GCA10674/75)	Volcanic Breccia (GCA10678/79)
Al	5.4%	9.0%	7.6%	8.2%	0	0	0
Fe	0.89%	1.2%	0.93%	4.1%	0	0	0
Na	0.028%	0.025%	0.026%	2.3%	0	0	0
K	1.6%	2.6%	2.7%	2.1%	0	0	0
Mg	0.11%	0.46%	0.18%	2.3%	0	0	0

Table 6b (Cont'd)

Multi-element Analysis Results for Samples Subjected to Kinetic Testing: Waste Rock: Total-S = 0.1-0.2%

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Element	Total-Element Content (mg/kg or %)			Average Crustal Abundance (mg/kg or %)	Geochemical-Abundance Index (GAI)		
	Sandstone (GCA10663/64)	Crystal Tuff (GCA10674/75)	Volcanic Breccia (GCA10678/79)		Sandstone (GCA10663/64)	Crystal Tuff (GCA10674/75)	Volcanic Breccia (GCA10678/79)
Ag	0.05	0.03	0.10	0.07	0	0	0
Cu	4	<1	2	50	0	0	0
Zn	21	86	120	75	0	0	0
Cd	0.07	<0.02	0.33	0.11	0	0	1
Pb	22	28	45	14	0	0	1
Cr	<50	<50	<50	100	0	0	0
Ni	3	10	15	80	0	0	0
Co	1.6	6.4	11	20	0	0	0
Mn	120	850	1,600	950	0	0	0
Hg	0.11	0.02	0.03	0.05	1	0	0
Sn	2.0	4.2	2.8	2.2	0	0	0
Sr	460	73	120	370	0	0	0
Ba	270	110	260	500	0	0	0
Th	9.1	23	11	12	0	0	0
U	3.1	2.3	3.3	2.4	0	0	0
Tl	6.7	1.6	2.9	0.6	3	1	2
V	49	6	18	160	0	0	0
As	62	3.8	37	1.5	5	1	4
Bi	0.11	0.51	0.29	0.048	1	3	2
Sb	3.7	0.72	1.7	0.2	4	1	3
Se	0.11	<0.05	0.03	0.05	1	0	0
Mo	4.6	0.6	1.3	1.5	1	0	0
B	<50	<50	<50	10	0	0	0
P	410	82	120	1,000	0	0	0
F	650	3,400	700	950	0	1	0

Table 6c

Multi-element Analysis Results for Samples Subjected to Kinetic Testing: Waste Rock: Total-S = 0.4-0.5%

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Element	Total-Element Content (mg/kg or %)			Average Crustal Abundance (mg/kg or %)	Geochemical-Abundance Index (GAI)		
	Crystal Tuff (GCA10730/31)	Laminated Tuff (GCA10740/41)	Volcanic Breccia (GCA10706/07)		Crystal Tuff (GCA10730/31)	Laminated Tuff (GCA10740/41)	Volcanic Breccia (GCA10706/07)
Al	6.9%	6.7%	8.0%	8.2%	0	0	0
Fe	0.79%	0.66%	0.86%	4.1%	0	0	0
Na	0.064%	0.046%	0.053%	2.3%	0	0	0
K	3.3%	4.0%	3.6%	2.1%	0	0	0
Mg	0.18%	0.16%	0.26%	2.3%	0	0	0
Ca	0.2%	0.3%	0.6%	4.1%	0	0	0
Ag	0.43	2.3	0.18	0.07	2	4	1
Cu	1	3	1	50	0	0	0
Zn	80	1,400	130	75	0	4	0
Cd	0.49	0.32	7.0	0.11	2	1	5
Pb	29	900	39	14	0	5	1
Cr	<50	<50	<50	100	0	0	0
Ni	<1	<1	<1	80	0	0	0
Co	0.8	0.9	0.7	20	0	0	0
Mn	820	3,000	2,400	950	0	1	1
Hg	0.07	0.03	<0.01	0.05	0	0	0
Sn	2.0	2.5	2.7	2.2	0	0	0
Sr	170	130	220	370	0	0	0
Ba	320	250	480	500	0	0	0
Th	13	17	16	12	0	0	0
U	3.5	3.8	7.1	2.4	0	0	1
Tl	3.5	4.0	3.0	0.6	2	2	2
V	10	9	11	160	0	0	0
As	65	79	21	1.5	5	5	3
Bi	0.02	0.38	0.30	0.048	0	2	2
Sb	8.3	15	5.3	0.2	5	6	4
Se	0.01	0.06	<0.01	0.05	0	0	0
Mo	2.7	2.2	2.0	1.5	0	0	0
B	<50	<50	<50	10	0	0	0
P	220	140	210	1,000	0	0	0
F	960	820	680	950	0	0	0

Table 6d

Multi-element Analysis Results for Samples Subjected to Kinetic Testing: Waste Rock: Total-S = 0.6-0.7%

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Element	Total-Element Content (mg/kg or %)		Average Crustal Abundance (mg/kg or %)	Geochemical-Abundance Index (GAI)	
	Ignimbrite (GCA10053)	Volcanic Breccia (GCA10747/48/49)		Ignimbrite (GCA10053)	Volcanic Breccia (GCA10747/48/49)
Al	6.0%	6.8%	8.2%	0	0
Fe	0.99%	0.99%	4.1%	0	0
Na	0.070%	0.067%	2.3%	0	0
K	5.0%	4.8%	2.1%	1	1
Mg	0.12%	0.19%	2.3%	0	0
Ca	0.3%	0.3%	4.1%	0	0
Ag	2.7	5.4	0.07	5	6
Cu	2	3	50	0	0
Zn	730	1,600	75	3	4
Cd	2.9	8.3	0.11	4	6
Pb	160	300	14	3	4
Cr	<50	<50	100	0	0
Ni	<1	<1	80	0	0
Co	0.8	1.8	20	0	0
Mn	8,900	8,900	950	3	3
Hg	0.02	0.03	0.05	0	0
Sn	1.5	3.1	2.2	0	0
Sr	180	110	370	0	0
Ba	550	420	500	0	0
Th	12	12	12	0	0
U	4.4	5.3	2.4	0	1
Tl	4.1	4.7	0.6	2	2
V	11	18	160	0	0
As	45	220	1.5	4	6
Bi	0.02	0.45	0.048	0	3
Sb	3.9	25	0.2	4	6
Se	<0.01	<0.01	0.05	0	0
Mo	9.2	2.2	1.5	2	0
B	<50	<50	10	0	0
P	190	130	1,000	0	0
F	950	980	950	0	0

Table 6e

Multi-element Analysis Results for Samples Subjected to Kinetic Testing: Waste Rock: Total-S = 1-3%

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Element	Total-Element Content (mg/kg or %)				Average Crustal Abundance (mg/kg or %)	Geochemical-Abundance Index (GAI)			
	Crystal Tuff (GCA10754/55)	Crystal Tuff (GCA10043)	Crystal Tuff (GCA10044)	Volcanic Breccia (GCA10039)		Crystal Tuff (GCA10754/55)	Crystal Tuff (GCA10043)	Crystal Tuff (GCA10044)	Ignimbrite (GCA10039)
Al	7.7%	7.2%	6.6%	6.2%	8.2%	0	0	0	0
Fe	3.4%	4.4%	3.0%	1.7%	4.1%	0	0	0	0
Na	0.028%	0.078%	0.065%	0.10%	2.3%	0	0	0	0
K	1.9%	6.4%	6.0%	6.2%	2.1%	0	1	1	1
Mg	0.59%	0.17%	0.10%	0.08%	2.3%	0	0	0	0
Ca	1.0%	0.3%	0.3%	0.2%	4.1%	0	0	0	0
Ag	0.18	6.3	11	9.2	0.07	1	6	6	6
Cu	11	6	15	5	50	0	0	0	0
Zn	110	2,000	2,100	640	75	0	4	4	3
Cd	0.10	2.8	4.0	3.5	0.11	0	4	5	4
Pb	26	1,700	1,600	4,000	14	0	6	6	6
Cr	<50	<50	<50	<50	100	0	0	0	0
Ni	6	<1	4	<1	80	0	0	0	0
Co	7.0	6.7	22	4.2	20	0	0	0	0
Mn	1,200	11,000	8,500	14,000	950	0	3	3	3
Hg	0.01	0.01	0.03	0.02	0.05	0	0	0	0
Sn	2.9	3.9	4.5	3.3	2.2	0	0	0	0
Sr	600	280	230	220	370	0	0	0	0
Ba	150	920	730	1,100	500	0	0	0	1
Th	14	8.0	6.7	11	12	0	0	0	0
U	3.0	2.1	2.1	3.7	2.4	0	0	0	0
Tl	1.7	4.1	5.3	5.2	0.6	1	2	3	3
V	90	52	41	17	160	0	0	0	0
As	31	89	180	230	1.5	4	5	6	6
Bi	0.42	0.80	0.08	0.05	0.048	3	3	0	0
Sb	3.7	5.0	15	12	0.2	4	4	6	5
Se	0.20	<0.01	0.03	0.02	0.05	1	0	0	0
Mo	0.6	1.4	3.3	4.7	1.5	0	0	1	1
B	<50	<50	<50	<50	10	0	0	0	0
P	460	460	420	210	1,000	0	0	0	0
F	810	690	590	560	950	0	0	0	0

Table 6f
Multi-element Analysis Results for Samples Subjected to Kinetic Testing: Ore: Total-S = 1-3%

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Element	Total-Element Content (mg/kg or %)		Average Crustal Abundance (mg/kg or %)	Geochemical-Abundance Index (GAI)	
	Low-grade ore	Ore		Low-grade ore	Low-grade ore
	Ignimbrite (GCA10049)	Ignimbrite / Volcanic Breccia (GCA10729/52)		Ignimbrite (GCA10049)	Volcanic Breccia (GCA10729/52)
Al	5.9%	6.3%	8.2%	0	0
Fe	1.6%	1.3%	4.1%	0	0
Na	0.038%	0.077%	2.3%	0	0
K	3.5%	6.0%	2.1%	0	1
Mg	0.17%	0.10%	2.3%	0	0
Ca	0.4%	0.3%	4.1%	0	0
Ag	26	63	0.07	6	6
Cu	5	13	50	0	0
Zn	720	2,400	75	3	4
Cd	3.1	12	0.11	4	6
Pb	1,800	670	14	6	5
Cr	<50	<50	100	0	0
Ni	<1	2	80	0	0
Co	1.0	1.2	20	0	0
Mn	14,000	1,800	950	3	0
Hg	0.02	0.05	0.05	0	0
Sn	1.6	2.5	2.2	0	0
Sr	210	210	370	0	0
Ba	270	630	500	0	0
Th	11	14	12	0	0
U	2.4	5.4	2.4	0	1
Tl	3.1	7.7	0.6	2	3
V	9	8	160	0	0
As	53	3,000	1.5	5	6
Bi	0.09	0.29	0.048	0	2
Sb	9.3	18	0.2	5	6
Se	<0.01	0.17	0.05	0	1
Mo	3.9	7.9	1.5	1	2
B	<50	<50	10	0	0
P	240	140	1,000	0	0
F	1,300	580	950	0	0

Table 7
Mineralogical Results for Samples Subjected to Kinetic Testing

Table 7a
Mineralogical Results for Samples Subjected to Kinetic Testing: Total-S < 0.1%

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Sandstone [4-6 m approx.] (GCA10651/53)						Crystal Tuff [29-33 m approx.] (GCA10668/69)						Crystal Tuff [43-47 m approx.] (GCA10682/83)						Volcanic Breccia [22-24 m approx.] (GCA10687/91)					
Dominant						Dominant		quartz				Dominant						Dominant					
Major		kaolinite quartz				Major						Major		smectite/ illite quartz				Major		smectite/illite quartz			
Minor						Minor		kaolinite				Minor		kaolinite				Minor		K-feldspar			
Accessory		smectite/illite muscovite/illite K-feldspar Ti-oxides				Accessory		smectite/illite K-feldspar				Accessory		Siderite				Accessory		Ankerite kaolinite plagioclase			
Trace		hematite tourmaline zircon				Trace		hematite Goethite				Trace		chlorite Hematite				Trace		siderite (?) hematite goethite Ti-oxides			
eCEC [cmol (p+)/kg]	%-Proportion of eCEC					eCEC [cmol (p+)/kg]	%-Proportion of eCEC					eCEC [cmol (p+)/kg]	%-Proportion of eCEC					eCEC [cmol (p+)/kg]	%-Proportion of eCEC				
	Na	K	Mg	Ca	Mn		Na	K	Mg	Ca	Mn		Na	K	Mg	Ca	Mn		Na	K	Mg	Ca	Mn
4.4	19	20	47	9	5	3.2	<1	37	39	20	4	20	<1	5	41	52	2	20	2	9	44	45	<1
Notes: eCEC = effective Cation Exchange Capacity dominant = greater than 50%; major = 20-50%; minor = 10-20%; accessory = 2-10%; and, trace is less than 2%																							

Table 7b
Mineralogical Results for Samples Subjected to Kinetic Testing: Total-S = 0.1-0.2%

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Sandstone [14-21 m approx.] (GCA10663/64)						Crystal Tuff [31-36 m approx.] (GCA10674/75)						Volcanic Breccia [26-28 m approx.] (GCA10678/79)					
Dominant	quartz					Dominant						Dominant					
Major						Major	smectite/illite quartz					Major	smectite/illite quartz				
Minor	smectite/illite					Minor	kaolinite					Minor					
Accessory	kaolinite muscovite/illite Ti-oxides					Accessory	K-feldspar					Accessory	Kaolinite K-feldspar				
Trace	Alunite jarosite hematite goethite tourmaline zircon					Trace	Alunite jarosite hematite goethite					Trace	Alunite jarosite hematite zircon				
eCEC [cmol (p+)/kg]	%-Proportion of eCEC					eCEC [cmol (p+)/kg]	%-Proportion of eCEC					eCEC [cmol (p+)/kg]	%-Proportion of eCEC				
	Na	K	Mg	Ca	Mn		Na	K	Mg	Ca	Mn		Na	K	Mg	Ca	Mn
3.2	3	41	32	12	12	23	<1	10	55	22	13	26	<1	9	38	31	22

Table 7c
Mineralogical Results for Samples Subjected to Kinetic Testing: Total-S = 0.4-0.5%

Crystal Tuff [3-13 m approx.] (GCA10730/31)		Laminated Tuff [12-14 m approx.] (GCA10740/41)		Volcanic Breccia [30-37 m approx.] (GCA10706/07)	
Dominant	quartz	Dominant		Dominant	
Major	illite/muscovite	Major	smectite/illite K-feldspar quartz	Major	smectite/illite quartz
Minor		Minor		Minor	K-feldspar
Accessory	K-feldspar	Accessory	rhodochrosite Ti-oxides	Accessory	rhodochrosite
Trace	Pyrite marcasite jarosite hematite goethite Ti-oxides	Trace	Pyrite marcasite sphalerite galena	Trace	Pyrite marcasite barite Ti-oxides

Table 7d
Mineralogical Results for Samples Subjected to Kinetic Testing: Total-S = 0.6-0.7%

Ignimbrite [138-139 m approx.] (GCA10053)		Volcanic Breccia [62-65 m approx.] (GCA10747/48/49)	
Major	feldspar quartz	Major	illite/muscovite quartz
Minor	illite	Minor	K-feldspar
Accessory	Pyrite rhodochrosite muscovite Ti-oxides	Accessory	rhodochrosite Ti-oxides
Trace	Sphalerite galena zircon	Trace	pyrite marcasite sphalerite galena zircon

Table 7e

Mineralogical Results for Samples Subjected to Kinetic Testing: Total-S = 1-3%

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Crystal Tuff [52-54 m approx.] (GCA10754/55)		Crystal Tuff [39-40 m approx.] (GCA10043)		Crystal Tuff [55-56 m approx.] (GCA10044)		Ignimbrite [13-14 m approx.] (GCA10039)	
Major	smectite/illite quartz	Major	Muscovite K-feldspar quartz	Major	muscovite K feldspar quartz	Major	Feldspar quartz
Minor	kaolinite	Minor		Minor		Minor	muscovite
Accessory	pyrite dolomite siderite chlorite Ti-oxides	Accessory	pyrite sphalerite rhodochrosite siderite Ti-oxides	Accessory	Pyrite marcasite rhodochrosite Ti-oxides	Accessory	pyrite Ti-oxides
Trace	marcasite	Trace	galena	Trace	sphalerite galena apatite	Trace	sphalerite galena apatite

Table 7f

Mineralogical Results for Samples Subjected to Kinetic Testing: Low Grade Ore

Ignimbrite (GCA10049)	
Major	quartz
Minor	illite
Accessory	pyrite rhodochrosite K-feldspar muscovite Ti-oxides
Trace	sphalerite galena

Table 8
Analysis Results for Leachates Produced by Weathering Columns

Table 8a(i)
Analysis Results for Leachates Produced by Weathering Columns: Total-S < 0.1%
GCA10651/53 sandstone (c. 4-5 m bgl), Total-S = 0.03%, Cr(II)-Red.-S < 0.01%, CO₃ < 0.01%, Mn < 0.01%

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Element/ Parameter	Pre-Rinse-Cycles		Weeks of Weathering				Element	Pre-Rinse-Cycles		Weeks of Weathering			
	0a	0b	2	4	6	8		0a	0b	2	4	6	8
Major-Parameters							Other Elements (mostly metals) [µg/L]						
pH	5.4 [5.9]	7.0 [6.5]	6.7 [6.4]	6.7 [6.4]	6.7 [6.3]	6.2 [6.1]	Mn	2,800	200	50	30	40	20
EC (µS/cm)	1,200 [980]	210 [200]	130 [120]	64 [65]	93 [54]	49 [37]	Zn	840	40	20	<10	<10	20
HCO ₃ (mg/L)	8	6	4	5	5	4	Cd	0.8	0.02	<0.02	<0.02	<0.02	0.04
Major-Ions (mg/L)													
Na	180	31	19	11	8.3		Pb	3.0	<0.5	2.1	<0.5	<0.5	<0.5
K	7.6	1.4	1.1	0.6	0.4		Co	11	0.7	1.0	0.2	0.2	
Mg	8.6	0.6	0.25	0.16	0.15		As	1.8	1.4	1.2	1.5	0.8	42
Ca	29	6.4	9.2	0.93	1.3		Cu	10	<10	<10	<10	<10	
SO ₄	360	69	36	19	15		Ni	<10	<10	<10	<10	<10	
Cl	65	4	3	<2	<2		Cr	<10	<10	<10	<10	<10	
F	0.2	0.1	0.2	0.3	0.3		Hg	0.1	<0.1	<0.1	<0.1	<0.1	
						10	Sb	0.30	0.30	0.36	0.33	0.35	0.48
Fe	0.24	<0.01	0.02	0.02	<0.01		Bi	<0.005	<0.005	<0.005	<0.005	<0.005	
Al	0.27	0.08	<0.01	0.01	<0.01		Se	<0.05	<0.05	<0.5	<0.5	<0.5	
Si	11	9.9	13	11	11		B	20	20	30	<10	<10	
							Mo	0.11	<0.05	0.15	0.17	0.32	
						11	P	<100	<100	<100	<100	<100	
							Ag	<0.01	<0.01	0.01	<0.01	0.04	
							Ba	10	2.6	1.2	0.77	0.90	
							Sr	130	24	5.5	3.8	5.9	
							Tl	0.68	0.10	0.06	0.03	0.03	0.02
							V	<10	<10	<10	<10	<10	
							Sn	<0.1	0.1	<0.1	<0.1	0.1	
							U	0.41	0.016	0.017	0.026	0.011	
							Th	0.054	<0.005	0.020	0.011	<0.005	
Leachate Wt (kg)	0.61	0.95	0.64	0.62	0.64	0.66							
Notes: EC = Electrical Conductivity; Cr(II)-Red.-S = Cr(II)-Reducible-S; m bgl = metres below ground-level pH and EC values in square-parentheses correspond to determinations in GCA Testing Laboratory. Values in parenthesis are for duplicates													

Table 8a(ii)

Analysis Results for Leachates Produced by Weathering Columns: Total-S < 0.1%
GCA10668/69, crystal tuff (c. 29-33 m bgl), Total-S = 0.03%, Cr(II)-Red.-S < 0.01%, CO₃ < 0.01%, Mn < 0.01%

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Element/ Parameter	Pre-Rinse-Cycles			Weeks of Weathering					Element	Pre-Rinse-Cycles			Weeks of Weathering				
	0a	0b	0c	2	4	6	8	10		0a	0b	0c	2	4	6	8	10
Major-Parameters									Other Elements (mostly metals) [µg/L]								
pH	5.2 [5.4]	5.0 [5.0]	5.9 [5.1]	5.3 [5.3]	5.5 [5.3]	5.5 [5.2]	5.2 [5.2]	5.6 [5.3]	Mn	1,700	2,600	1,100	740	690	510	430	380
EC (µS/cm)	280 [250]	270 [260]	160 [130]	120 [110]	98 [96]	90 [71]	73 [66]	68 [56]	Zn	370	470	210	140	120	80	80	70
acidity (mg H ₂ SO ₄ /L)		10							Cd	2.7	3.6	1.6	1.1	1.1	0.69	0.61	0.50
HCO ₃ (mg/L)	5	2	2	2	2	2	2	2	Pb	1.2	1.4	1.0	0.7	3.0	0.7	1.2	<0.5
Major-Ions (mg/L)									Co	24	37	14	15	9.4	6.9		
Na	9.1	6.7	2.4	3.1	1.5	1.0			As	1.1	0.4	0.3	0.7	1.0	0.6	2.0	0.6
K	30	27	14	13	13	10			Cu	40	<10	10	20	<10	<10		
Mg	6.4	8.6	3.4	2.6	2.4	1.7			Ni	40	40	20	<10	<10	10		
Ca	6.7	7.6	3.0	2.4	2.1	1.5			Cr	<10	<10	<10	<10	<10	<10		
SO ₄	83	95	42	35	31	23			Hg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Cl	6	2	<2	<2	<2	<2	22	17	Sb	0.02	0.07	0.02	0.06	0.04	0.04	0.01	0.06
F	<0.1	0.1	<0.1	<0.1	<0.1	<0.1			Bi	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		
Fe	0.21	0.08	0.04	0.02	0.02	<0.01			Se	<0.5	0.6	<0.5	<0.5	<0.5	<0.5		
Al	0.16	0.29	0.13	0.03	0.04	<0.01			B	<10	<10	10	30	<10	<10		
Si	4.1	9.8	6.8	6.2	6.2	6.4			Mo	<0.05	<0.05	<0.05	0.13	<0.05	<0.05		
							6.4	5.9	P	<100	<100	<100	<100	<100	<100		
									Ag	<0.01	<0.01	<0.01	0.01	0.01	<0.01		
									Ba	38	21	15	16	19	20		
									Sr	43	51	20	17	14	11		
									Tl	5.8	6.5	3.6	3.4	3.3	2.6		
									V	<10	<10	<10	<10	<10	<10	2.7	2.2
									Sn	<0.1	<0.1	0.1	<0.1	<0.1	<0.1		
									U	0.57	0.61	0.22	0.10	0.13	0.095		
									Th	<0.005	<0.005	0.006	0.014	<0.005	<0.005		
Leachate Wt (kg)	0.67	0.97	0.95	0.70	0.75	0.75	0.74	0.73									
Note: Values in parenthesis are for duplicates																	

Table 8a(iii)

Analysis Results for Leachates Produced by Weathering Columns: Total-S < 0.1%
 GCA10682/83 crystal tuff (c. 43-47 m bgl), Total-S = 0.07%, Cr(II)-Red.-S = 0.04%, CO₃ = 0.63%, Mn = 0.49%

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Element/ Parameter	Pre-Rinse-Cycles		Weeks of Weathering					Element	Pre-Rinse-Cycles		Weeks of Weathering				
	0a	0b	2	4	6	8	10		0a	0b	2	4	6	8	10
Major-Parameters								Other Elements (mostly metals) [µg/L]							
pH	6.7 [7.1]	7.5 [7.2]	7.0 [6.5]	7.0 [6.8]	7.1 [6.9]	6.9 [6.9]	7.3 [7.1]	Mn	11,000	1,600	2,800	2,200	1,500	1,100	1,000
EC (µS/cm)	1,200 [950]	200 [190]	320 [300]	240 [230]	220 [160]	120 [120]	64 [100]	Zn	130	30	50	20	<10	10	10
HCO ₃ (mg/L)	56	37	9	12	12	14		Cd	0.35	0.08	0.06	0.03	0.02	0.02	0.03
Major-Ions (mg/L)								Pb	<0.5	<0.5	0.7	0.5	<0.5	<0.5	<0.5
Na	25	5.4	5.5	5.0	3.5			Co	50	5.9	7.1	4.3	2.5		
K	29	11	11	12	8.7			As	0.5	0.4	0.3	0.3	0.2	1.1	0.3
Mg	54	6.7	11	8.2	5.4			Cu	<10	<10	10	<10	<10		
Ca	110	13	21	16	11			Ni	60	<10	<10	<10	<10		
SO ₄	470	58	130	93	50	36	26	Cr	<10	<10	<10	<10	<10		
Cl	14	4	6	7	<2	<2		Hg	<0.1	<0.1	<0.1	<0.1	<0.1		
F	0.3	0.5	0.9	1.2	1.3	1.6		Sb	0.07	0.05	0.07	0.07	0.07	0.06	0.09
Fe	<0.01	<0.01	<0.01	<0.01	<0.01			Bi	<0.005	<0.005	<0.005	<0.005	<0.005		
Al	0.08	0.05	0.02	0.01	<0.01			Se	0.9	<0.5	<0.5	<0.5	<0.5		
Si	6.6	3.4	2.1	2.1	1.7	1.6	1.4	B	<10	<10	20	<10	<10		
								Mo	<0.05	<0.05	0.06	0.08	<0.05		
								P	<100	<100	<100	<100	<100		
								Ag	<0.01	<0.01	<0.01	0.01	<0.01		
								Ba	13	2.4	4.7	3.6	2.8		
								Sr	740	90	160	120	76		
								Tl	0.51	0.21	0.28	0.23	0.16	0.15	0.16
								V	<10	<10	<10	<10	<10		
								Sn	<0.1	<0.1	0.2	<0.1	<0.1		
								U	1.2	0.36	0.10	0.11	0.085		
								Th	0.005	<0.005	0.036	<0.005	<0.005		
Leachate Wt (kg)	0.57	0.96	0.64	0.61	0.63	0.64	0.66								
Note: Values in parenthesis are for duplicates															

Table 8a(iv)

Analysis Results for Leachates Produced by Weathering Columns: Total-S < 0.1%

GCA10687/91, volcanic breccia (c. 22-24 m bgl), Total-S = 0.07%, Cr(II)-Red.-S = 0.04%, CO₃ = 0.35%, Mn = 0.063%

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Element/ Parameter	Pre-Rinse-Cycles			Weeks of Weathering				Element	Pre-Rinse-Cycles			Weeks of Weathering			
	0a	0b	0c	2	4	6	8		0a	0b	0c	2	4	6	8
Major-Parameters									Other Elements (mostly metals) [µg/L]						
pH	7.9 [7.3]	8.4 [7.6]	8.4 [8.0]	8.2 [7.6]	8.0 [7.9]	8.1 [7.6]	7.8 [7.6]	Mn	700	100	100	70	70	40	50
EC (µS/cm)	1,800 [1,500]	420 [400]	290 [270]	240 [230]	200 [190]	210 [160]	140 [140]	Zn	<10	10	<10	10	<10	<10	20
HCO ₃ (mg/L)	240	170	140	83	82	70	69	Cd	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Major-Ions (mg/L)								Pb	0.7	<0.5	<0.5	<0.5	0.6	<0.5	1.3
Na	130	48	33	21	17	13		Co	4.8	0.7	0.5	0.9	0.5	0.2	
K	35	16	14	9.4	9.5	8.5		As	7.0	5.9	4.9	6.0	5.7	5.5	8.9
Mg	90	12	7.4	5.7	5.4	4.7		Cu	10	<10	<10	10	<10	<10	
Ca	150	18	12	9.2	8.6	7.5		Ni	20	<10	<10	<10	<10	<10	
SO ₄	630	58	28	30	21	14	12	Cr	<10	<10	<10	<10	<10	<10	
Cl	80	2	<2	<2	<2	<2		Hg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
F	2.6	2.9	2.7	2.2	1.5	0.7		Sb	3.1	2.1	1.8	1.4	1.3	1.1	1.1
Fe	0.02	<0.01	<0.01	<0.01	<0.01	<0.01		Bi	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Al	0.07	0.02	0.02	<0.01	0.09	0.02		Se	1.3	<0.5	<0.5	<0.5	<0.5	<0.5	
Si	4.1	4.5	4.4	3.0	2.8	2.6	2.8	B	<10	<10	<10	30	<10	<10	
								Mo	42	32	13	14	7.8	5.5	
								P	<100	<100	<100	<100	<100	<100	
								Ag	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
								Ba	28	41	51	55	71	63	
								Sr	1400	170	110	87	83	74	
								Tl	0.44	0.21	0.18	0.16	0.14	0.12	
								V	<10	<10	<10	<10	<10	<10	0.13
								Sn	0.1	<0.1	<0.1	0.2	0.1	<0.1	
								U	95	85	36	20	24	19	
								Th	0.041	<0.005	<0.005	0.034	0.005	<0.005	
Leachate Wt (kg)	0.53	0.97	0.96	0.58	0.53	0.61	0.55								

Note: Values in parenthesis are for duplicates

Table 8b(i)

Analysis Results for Leachates Produced by Weathering Columns: Total-S = 0.1-0.2%
 [GCA10663/64, sandstone (c. 14-21 m bgl), Total-S = 0.13%, Cr(II)-Red.-S = <0.01%, CO₃ = 0.01%, Mn = 0.012%

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Element/ Parameter	Pre-Rinse-Cycles			Weeks of Weathering					Element	Pre-Rinse-Cycles			Weeks of Weathering				
	0a	0b	0c	2	4	6	8	10		0a	0b	0c	2	4	6	8	10
Major-Parameters									Other Elements (mostly metals) [µg/L]								
pH	4.7 [4.7]	4.9 [5.0]	5.5 [5.4]	7.0 [6.5]	6.5 [6.2]	6.0 [5.7]	5.9 [5.7]	6.3 [5.9]	Mn	15,000	9,900	3,000	1,400	1,500	1,400		
EC (µS/cm)	910 [820]	550 [500]	200 [200]	120 [110]	97 [95]	110 [82]	66 [63]	60 [49]	Zn	1,200	750	230	80	110	90	990	760
acidity (mg H ₂ SO ₄ /L)	37	17							Cd	7.2	4.3	1.6	0.44	0.59	0.57	90	50
HCO ₃ (mg/L)			3	6	4	3	2	3	Pb	1.2	0.9	<0.5	<0.5	0.6	<0.5	0.44	0.30
Major-Ions (mg/L)									Co	140	92	28	13	14	13	<0.5	<0.5
Na									As	1.2	1.2	2.1	0.6	0.9	1.1		
K	46	16	3.0	1.3	1.0	0.7			Cu	50	20	<10	<10	<10	<10	2.6	0.7
Mg	36	30	15	8.0	8.7	8.2			Ni	240	160	60	<10	30	20		
Ca	17	11	3.4	1.8	1.8	1.6			Cr	10	<10	<10	<10	<10	<10		
SO ₄	67	43	13	7.1	5.3	4.3			Hg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Cl	340	230	68	33	31	26	21		Sb	0.19	0.08	0.06	0.07	0.07	0.05		
F	42	5	<2	<2	<2	<2		16	Bi	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.04	0.09
Fe	<0.1	0.1	<0.1	<0.1	<0.1	<0.1			Se	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		
Al									B	<10	20	20	30	<10	<10		
Si	0.58	0.37	0.13	<0.01	0.03	0.07			Mo	0.09	0.06	<0.05	<0.05	0.07	<0.05		
	4.3	1.2	0.11	0.03	0.03	<0.01			P	<100	<100	<100	<100	<100	<100		
	5.3	14	13	8.0	9.6	11	9.1	7.7	Ag	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
									Ba	38	21	23	12	12	15		
									Sr	190	150	45	25	22	19		
									Tl	42	33	16	8.1	7.7	7.4		
									V	<10	<10	<10	<10	<10	<10		
									Sn	<0.1	<0.1	0.1	<0.1	<0.1	<0.1		
									U	11	3.5	0.71	0.10	0.14	0.25	6.5	4.7
									Th	<0.005	<0.005	<0.005	0.015	<0.005	<0.005		
Leachate Wt (kg)	0.64	0.98	0.93	0.70	0.68	0.70	0.71	0.69									

Note: Values in parenthesis are for duplicates

Table 8b(ii)

Analysis Results for Leachates Produced by Weathering Columns: Total-S = 0.1-0.2%
 GCA10674/75, crystal tuff (c. 31-36 m bgl), Total-S = 0.10%, Cr(II)-Red.-S < 0.01%, CO₃ = 0.01%, Mn = 0.085%

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Element/ Parameter	Pre-Rinse-Cycles			Weeks of Weathering					Element	Pre-Rinse-Cycles			Weeks of Weathering				
	0a	0b	0c	2	4	6	8	10		0a	0b	0c	2	4	6	8	10
Major-Parameters									Other Elements (mostly metals) [µg/L]								
pH	4.7 [5.0]	5.7 [5.6]	5.9 [5.5]	5.5 [5.5]	5.8 [6.7]	5.5 [5.4]	5.4 [5.4]	5.7 [5.4]	Mn	74,000	11,000	2,100	2,900	1,700	2,200	1,400	1,400
EC (µS/cm)	1,800 [1,400]	380 [370]	120 [110]	160 [160]	96 [93]	150 [120]	81 [98]	93 [79]	Zn	2,400	360	70	110	60	80	60	40
acidity (mg H ₂ SO ₄ /L)	43								Cd	2.0	0.25	0.05	0.10	0.07	0.07	0.04	0.04
HCO ₃ (mg/L)		4	3	2	3	2	2	2	Pb	14	1.4	9.9	15	8.1	11	1.0	0.6
Major-Ions (mg/L)									Co	330	50	0.4	0.6	0.9	0.7		
Na									As	0.7	0.8	<10	<10	<10	<10		
K									Cu	30	<10	20	<10	20	10		
Mg									Ni	260	60	<10	<10	<10	<10	1.5	0.5
Ca	27	8.0	2.3	2.8	1.9	2.1			Cr	40	10	<0.1	<0.1	<0.1	<0.1		
SO ₄	58	25	11	13	9.3	11			Hg	<0.1	<0.1	0.03	0.04	0.06	0.02		
Cl	120	18	3.6	4.9	2.9	3.8			Sb	0.07	0.16	<0.005	<0.005	<0.005	<0.005		
F	86	14	2.7	3.5	2.0	2.9			Bi	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		
Fe	840	160	39	50	32	38	28	26	Se	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		
Al	16	<2	<2	<2	<2	<2			B	<10	<10	<10	20	<10	<10	0.02	0.03
Si	0.4	0.2	0.1	<0.1	<0.1	0.1			Mo	0.07	<0.05	<0.05	<0.05	<0.05	<0.05		
									P	<100	<100	<100	<100	<100	<100		
									Ag	<0.01	<0.01	<0.01	<0.01	<0.01	0.09		
									Ba	17	11	5.2	12	7.0	9.9		
									Sr	660	110	20	29	17	24		
									Tl	5.8	2.7	1.2	1.3	0.98	1.1		
	0.25	0.09	0.04	0.01	0.03	<0.01			V	<10	<10	<10	<10	<10	<10		
	2.1	0.14	0.07	0.04	<0.01	<0.01			Sn	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
	24	22	9.8	12	9.4	12	9.5	11	U	7.7	0.68	0.15	0.20	0.082	0.12		
									Th	0.063	<0.005	<0.005	0.025	<0.005	<0.005	0.86	0.87
Leachate Wt (kg)	0.54	0.96	0.98	0.60	0.54	0.61	0.63	0.66									
Note: Values in parenthesis are for duplicates																	

Table 8b(iii)
Analysis Results for Leachates Produced by Weathering Columns: Total-S = 0.1-0.2%
GCA10678/79, volcanic breccia (c. 26-28 m bgl), Total-S = 0.18%, Cr(II)-Red.-S < 0.01%, CO₃ = 0.03%, Mn = 0.16%

Element/ Parameter	Pre-Rinse-Cycles					Weeks of Weathering					Element	Pre-Rinse-Cycles					Weeks of Weathering				
	0a	0b	0c	0d	0e	2	4	6	8	10		0a	0b	0c	0d	0e	2	4	6	8	10
Major-Parameters											Other Elements (mostly metals) [µg/L]										
pH	4.0 [4.2]	4.4 [4.6]	4.6 [4.8]	4.6 [4.7]	4.6 [4.8]	4.8 [4.9]	5.1 [5.0]	5.1 [5.1]	5.2 [5.1]	5.7 [5.2]	Mn	480,000	150,000	69,000	95,000	91,000	34,000	21,000	8,900	6,500	5,200
EC (µS/cm)	4,100 [3,100]	1,600 [1,400]	900 [820]	1,200 [1,100]	1,100 [1,100]	620 [570]	410 [400]	240 [200]	170 [160]	150 [130]	Zn	17,000	5,100	2,500	3,300	3,200	1,200	780	330	250	190
acidity (mg H ₂ SO ₄ /L)	130	42	21	29	27	20	11				Cd	73	22	11	15	14	5.2	3.3	1.4	1.1	0.71
HCO ₃ (mg/L)								2	2	2	Pb	6.0	2.3	1.5	0.8	0.7	0.7	2.4	3.7	2.4	1.1
Major-Ions (mg/L)											Co	2,000	610	290	410	400	160	99	42		
Na											As	1.7	0.8	0.5	30	20	20	20	<10	1.4	0.5
K											Cu	100	30	20	500	490	180	130	60		
Mg	29	7.5	3.3	4.2	3.7	2.6	1.5	1.0			Ni	2,000	710	370	60	70	20	30	<10		
Ca	79	37	23	28	26	21	18	12			Cr	320	90	50	<0.1	<0.1	<0.1	<0.1	<0.1		
SO ₄	320	98	46	64	62	24	16	6.6			Hg	<0.1	<0.1	<0.1	0.28	0.13	0.17	0.12	0.07		
Cl	290	87	50	69	70	36	24	11			Sb	0.65	0.18	0.08	<0.005	<0.005	0.017	<0.005	<0.005		
F	2,800	860	430	590	570	270	180	72			Bi	<0.005	<0.005	<0.005	<0.5	<0.5	<0.5	<0.5	<0.5	0.07	0.09
Fe	7	<2	<2	<2	<2	3	<2	<2	59	45	Se	<0.5	<0.5	<0.5	<10	<10	50	<10	<10		
Al	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			B	<10	<10	<10	0.10	<0.05	0.09	<0.05	<0.05		
Si											Mo	0.15	<0.05	<0.05	<100	<100	<100	<100	<100		
	0.29	0.07	0.04	0.03	0.03	<0.01	<0.01	<0.01			P	<100	<100	<100	<0.01	<0.01	<0.01	0.01	0.01		
	8.7	2.0	0.83	1.2	1.3	0.17	0.13	0.02			Ag	0.01	<0.01	<0.01	12	12	14	9.2	8.5		
	9.8	11	6.4	10	11	9.6	9.4	7.8	8.1	9.6	Ba	30	9.5	7.6	240	240	110	69	32		
											Sr	1200	340	170	8.7	7.8	6.2	4.8	3.0		
											Tl	23	12	6.8	<10	<10	<10	<10	<10		
											V	<10	<10	<10	<0.1	<0.1	<0.1	0.2	<0.1		
											Sn	0.3	<0.1	<0.1	2.7	2.5	0.60	0.31	0.15	3.1	2.6
											U	25	4.5	1.8	0.025	0.018	0.017	0.005	<0.005		
											Th	0.72	0.055	0.027							
Leachate Wt (kg)	0.61	0.95	0.98	0.94	0.98	0.66	0.66	0.68	0.69	0.70											
Note: Values in parenthesis are for duplicates																					

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Table 8c(i)

Analysis Results for Leachates Produced by Weathering Columns: Total-S = 0.4-0.5%
 GCA10730/31, crystal tuff (c. 3-13 m), Total-S = 0.45%, Cr(II)-Red.-S = 0.13%, CO₃ < 0.01%, Mn = 0.082%

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Element/ Parameter	Pre-Rinse-Cycles		Weeks of Weathering				Element	Pre-Rinse-Cycles		Weeks of Weathering			
	0a	0b	2	4	6	8		0a	0b	2	4	6	8
Major-Parameters							Other Elements (mostly metals) [µg/L]						
pH	4.0 [4.0]	4.7 [4.9]	4.7 [4.8]	4.7 [4.8]	4.2 [4.0]	4.3 [4.1]	Mn	260,000	8,400	9,200	7,900	37,000	29,000
EC (µS/cm)	4,900 [3,900]	560 [560]	360 [350]	280 [270]	790 [780]	1,300 [580]	Zn	12,000	400	420	360	1,700	1,400
acidity (mg H ₂ SO ₄ /L)	420	13	11	11	40	31	Cd	250	5.9	7.5	6.3	33	24
Major-Ions (mg/L)							Pb	8.9	0.8	1.1	1.9	3.6	2.6
Na							Co	290	9.8	12	8.6	45	32
K	500	64	23	13	30	17	As	130	67	36	11	15	16
Mg	120	31	22	19	43	35	Cu	30	<10	10	<10	<10	10
Ca	220	8.0	8.3	7.3	33	25	Ni	290	10	<10	10	50	40
SO ₄	67	2.8	3.2	2.9	12	9.0	Cr	250	10	<10	10	30	30
Cl	2,500	210	140	110	330	230	Hg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
F	250	12	6	8	5		Sb	3.7	2.7	1.2	0.76	1.1	0.91
Fe	1.4	0.2	0.1	0.1	0.3		Bi	0.01	<0.005	<0.005	<0.005	0.008	0.006
Al	7.2	0.39	0.27	0.35	1.8	1.8	Se	1.0	<0.5	<0.5	<0.5	<0.5	<0.5
Si	54	0.36	0.52	0.30	2.0	1.4	B	10	<10	40	60	10	10
	21	17	6.2	4.4	19	19	Mo	0.23	0.09	0.09	0.22	0.07	<0.05
							P	<100	<100	<100	<100	<100	<100
							Ag	<0.01	<0.01	0.02	<0.01	0.01	<0.01
							Ba	19	7.3	14	9.5	31	25
							Sr	830	35	38	32	150	120
							Tl	8.6	1.9	1.2	0.94	2.3	1.9
							V	<10	<10	<10	<10	<10	<10
							Sn	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
							U	95	1.6	1.2	0.79	5.8	4.8
							Th	1.2	0.014	0.012	<0.005	0.014	0.012
Leachate Wt (kg)	0.40	0.98	0.47	0.53	0.44	0.51							
Note: Values in parenthesis are for duplicates													

Table 8c(ii)

Analysis Results for Leachates Produced by Weathering Columns: Total-S = 0.4-0.5%
 GCA10740/41, laminated tuff (c. 12-14 m bgl) Total-S = 0.43%, Cr(II)-Red.-S = 0.23%, CO₃ = 0.07%, Mn = 0.30%

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Element/ Parameter	Pre-Rinse-Cycles		Weeks of Weathering			Element	Pre-Rinse-Cycles		Weeks of Weathering		
	0a	0b	2	4	6		0a	0b	2	4	6
Major-Parameters						Other Elements (mostly metals) [µg/L]					
pH	6.8 [7.1]	7.7 [7.1]	6.5 [6.3]	6.5 [6.5]	6.5 [6.5]	Mn	6,300	710	2,500	4,700	7,200
EC (µS/cm)	2,200 [1,800]	280 [290]	360 [360]	470 [460]	470 [530]	Zn	1,700	80	260	560	900
acidity (mg H ₂ SO ₄ /L)	28	30	4	6	7	Cd	2.0	0.13	0.69	1.7	3.2
Major-Ions (mg/L)						Pb	18	7.2	14	65	130
Na	160	26	20	18	17	Co	23	1.1	5.9	5.7	7.8
K	41	12	14	18	21	As	21	30	7.8	2.6	2.6
Mg	89	5.7	12	19	23	Cu	<10	<10	10	<10	<10
Ca	130	8.0	17	26	33	Ni	20	<10	<10	<10	<10
SO ₄	920	80	140	190	210	Cr	<10	<10	<10	<10	<10
Cl	57	2	2	2	5	Hg	<0.1	<0.1	<0.1	<0.1	<0.1
F	0.3	0.6	0.6	0.3	0.3	Sb	9.7	12	10	7.4	7.1
Fe	<0.01	0.03	<0.01	<0.01	<0.01	Bi	<0.005	<0.005	<0.005	<0.005	<0.005
Al	0.08	0.40	0.06	0.03	<0.01	Se	1.6	<0.5	<0.5	<0.5	<0.5
Si	7.0	6.1	4.0	5.3	6.6	B	30	40	20	30	30
						Mo	4.8	5.0	1.9	0.88	0.59
						P	<100	<100	<100	<100	<100
						Ag	0.05	<0.01	0.02	<0.01	<0.01
						Ba	17	3.1	7.5	12	17
						Sr	1200	72	160	240	310
						Tl	1.8	0.43	0.57	0.72	0.99
						V	<10	<10	<10	<10	<10
						Sn	<0.1	0.2	<0.1	<0.1	<0.1
						U	0.35	0.082	0.025	0.015	0.016
						Th	0.014	0.188	0.012	<0.005	0.006
Leachate Wt (kg)	0.60	0.97	0.62	0.44	0.44						
Note: Values in parenthesis are for duplicates											

Table 8c(iii)

Analysis Results for Leachates Produced by Weathering Columns: Total-S = 0.4-0.5%
GCA10706/07, volcanic breccia (c. 30-37 m bgl), Total-S = 0.51%, Cr(II)-Red.-S = 0.33%, CO₃ = 0.16%, Mn = 0.24%

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Element/ Parameter	Pre-Rinse-Cycles			Weeks of Weathering					Element	Pre-Rinse-Cycles			Weeks of Weathering				
	0a	0b	0c	2	4	6	8	10		0a	0b	0c	2	4	6	8	10
Major-Parameters									Other Elements (mostly metals) [µg/L]								
pH	7.6 [7.1]	7.6 [7.5]	8.2 [8.1]	7.5 [7.2]	7.2 [7.4]	7.6 [7.4]	7.8 [7.5]	7.7 [7.7]	Mn	18,000	5,700	890	610	1,600	1,100	980	710
EC (µS/cm)	4,000 [3,400]	1,600 [1,500]	370 [390]	290 [270]	620 [560]	560 [480]	420 [400]	320 [290]	Zn	90	20	<10	270	<10	<10	20	20
HCO ₃ (mg/L)	63	140	140	19	34	33	48	47	Cd	1.9	0.38	0.04	0.05	0.04	0.06	0.12	0.02
Major-Ions (mg/L)									Pb	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Na	130	33	12	17	8.6	6.4	6.8	5.3	Co	26	6.5	0.9	1.5	1.4	0.6	0.7	0.9
K	81	40	19	18	19	15	16	14	As	3.7	6.5	3.7	2.0	2.4	1.7	3.2	6.3
Mg	280	85	14	8.6	24	17	16	12	Cu	30	10	<10	<10	10	<10	<10	<10
Ca	560	190	31	9.3	53	41	36	25	Ni	50	10	<10	<10	<10	<10	<10	<10
SO ₄	2,900	770	67	120	230	160	140	86	Cr	<10	<10	<10	<10	<10	<10	<10	<10
Cl	110	4	<2	3	5	5			Hg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
F	0.3	0.5	0.8	0.8	1.0	0.9		0.9	Sb	3.4	4.1	5.3	2.3	3.0	2.7	3.6	3.7
Fe	<0.01	<0.01	<0.01	0.17	<0.01	<0.01	0.02	<0.01	Bi	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Al	0.01	<0.01	<0.01	0.32	0.05	0.03	<0.01	0.20	Se	0.7	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Si	4.9	3.8	3.1	4.4	1.5	1.3	1.6	2.0	B	<10	<10	20	<10	<10	<10	<10	<10
									Mo	9.4	32	55	29	61	55	68	55
									P	<100	<100	<100	<100	<100	<100	<100	<100
									Ag	0.09	0.02	<0.01	<0.01	<0.01	0.02	0.02	<0.01
									Ba	20	22	37	27	26	28	44	48
									Sr	5,600	1,800	290	190	470	350	340	250
									Tl	1.3	0.54	0.25	0.15	0.22	0.17	0.19	0.21
									V	<10	<10	<10	<10	<10	<10	<10	<10
									Sn	<0.1	<0.1	0.1	<0.1	0.9	0.2	<0.1	<0.1
									U	2.4	8.0	3.9	0.12	1.1	0.79	1.8	1.5
									Th	0.013	<0.005	<0.005	0.013	0.006	0.020	<0.005	0.030
Leachate Wt (kg)	0.39	0.95	0.98	0.45	0.33	0.42	0.32	0.45									
Note: Values in parenthesis are for duplicates																	

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Table 8d(i)
Analysis Results for Leachates Produced by Weathering Columns: Total-S = 0.6-0.7%
GCA10053, ignimbrite (c. 138-139 m bgl), Total-S = 0.67%, Cr(II)-Red.-S = 0.53%, CO₃ = 0.01%, Mn = 0.89%

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Element/ Parameter	Pre-Rinse-Cycle	Weeks of Weathering													Element/ Parameter	Pre-Rinse-Cycle	Weeks of Weathering												
		2	4	6	8	10	12	16	20	22	24	26	28	30			2	4	6	8	10	12	16	20	22	24	26	28	30
	0															0													
Major-Parameters															Other Elements (mostly metals) [µg/L]														
pH	4.8 [5.0]	4.4 [4.4]	4.9 [5.0]	5.3 [5.4]	5.7 [5.5]	5.7 [5.5]	5.7 [5.6]	5.4 [5.4]	5.5 [5.4]	5.8 [5.7]	5.8 [5.8]	5.8 [5.6]	5.8 [5.7]	5.8 [5.6]	Mn	45,000	59,000	62,000	49,000	47,000	47,000	48,000	83,000	81,000	51,000	45,000	38,000	36,000	41,000
EC [µS/cm]	900 [850]	830 [800]	720 [690]	580 [500]	510 [450]	440 [410]	400 [370]	540 [520]	540 [490]	350 [340]	310 [320]	270 [250]	230 [230]	280 [260]	Zn	2,900	2,400	2,000	1,400	1,300	1,300	1,300	2,200	2,300	1,300	1,200	930	890	1,100
HCO ₃ (mg/L)	1		2	2	3	3	3	2.7	2	2.6	3	3	3	3	Cd	4.4	4.0	3.7	2.9	2.8	2.8	3.0	5.2	5.1	3.3	2.9	2.3	2.3	2.6
acidity (mg/L H ₂ SO ₄)	24	25													Cu	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	
Major-Ions (mg/L)															Ni									10					
Na															Co									16	9.9	8.0	6.8	6.4	19
K							0.7	0.6	0.6						Pb	42	18	15	13	15	18	19	41	60	22	19	19	16	19
Mg															Cr									60					
Ca															Hg									<0.1					
SO ₄															As	11	5.8	3.4	2.2	3.1	2.7	2.3	3.1	2.3	1.2	1.3	0.8	0.9	0.8
Fe	410	400	320	230	190	170									Sb									0.35					0.21
Al							0.02	0.08	0.10						Bi									<0.005					
Si	1.7	0.41	0.17	0.04	0.10	0.10	0.12	0.12	0.17	0.03	<0.01	<0.01	<0.01		Se									<0.5					
	0.52	0.14	0.10	0.09	0.06	0.06	2.7	2.9	2.5	0.03	0.07	0.03	0.04	1.7	B									<10					
															Mo									0.12					
															P									<100					
															Ag									0.02					
															Ba									11					
															Sr									330					
															Tl									0.74					
															V									<10					0.39
															Sn									<0.1					
															U									0.31					
															Th									<0.005					
Leachate Wt (kg)	1.21	0.82	0.79	0.79	0.77	0.80	0.80	0.79	0.82	0.83	0.84	0.84	0.84	0.86															
Note: Values in parenthesis are for duplicates																													

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Table 8d(ii)
Analysis Results for Leachates Produced by Weathering Columns: Total-S = 0.6-0.7%
GCA10747/48/49 volcanic breccia Total-S = 0.65% Cr(II)-Red.-S = 0.26% CO₃ = 0.16% Mn = 0.89%

Element/ Parameter	Pre-Rinse-Cycles		Weeks of Weathering				Element	Pre-Rinse-Cycles		Weeks of Weathering			
	0a	0b	2	4	6	8		0a	0b	2	4	6	8
Major-Parameters							Other Elements (mostly metals) [µg/L]						
pH	7.1 [7.3]	8.2 [7.7]	7.1 [5.1]	7.1 [6.9]	7.1 [7.1]	7.5 [7.4]	Mn	3,500	990	790	870	790	930
EC (µS/cm)	1,300 [1,200]	360 [380]	210 [220]	170 [160]	160 [160]	240 [170]	Zn	30	10	30	50	20	20
HCO ₃ (mg/L)	37	81	2	14	18	27	Cd	0.06	<0.02	0.17	0.15	0.09	0.11
Major-Ions (mg/L)							Pb	<0.5	1.0	1.3	3.6	1.9	1.8
							Co	1.9	0.6	3.7	0.8	0.4	0.5
							As	39	260	130	72	55	81
	Na	24	8.0	4.0	3.3	2.0	Cu	<10	<10	20	10	<10	<10
	K	60	32	17	14	14	Ni	<10	<10	<10	<10	<10	<10
	Mg	55	13	6.1	4.5	4.6	Cr	<10	<10	<10	<10	<10	<10
	Ca	120	24	12	8.6	9.0	Hg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	SO ₄	540	91	69	45	39	Sb	14	27	29	20	23	32
	Cl	17	<2	2	<2	<2	Bi	<0.005	<0.005	0.006	<0.005	<0.005	0.005
	F	1.3	1.8	2.4	1.9	1.6	Se	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
							B	10	20	50	40	10	10
	Fe	<0.01	<0.01	0.01	0.01	<0.01	Mo	40	24	32	20	23	31
	Al	0.02	0.01	0.06	0.06	0.48	P	<100	<100	<100	<100	<100	<100
	Si	3.0	4.9	3.4	2.9	3.9	Ag	<0.01	<0.01	0.02	0.01	0.02	0.01
							Ba	25	6.3	3.7	3.0	3.3	3.9
							Sr	570	120	60	45	45	60
							Tl	0.89	0.45	0.27	0.20	0.24	0.23
							V	<10	<10	<10	<10	<10	<10
							Sn	0.1	<0.1	0.1	0.2	0.2	<0.1
							U	1.1	4.1	0.11	0.079	0.19	0.41
							Th	0.006	0.007	0.047	0.012	0.054	0.008
Leachate Wt (kg)	0.63	0.96	0.62	0.63	0.67	0.70							
Note: Values in parenthesis are for duplicates													

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Table 8e(i)
Analysis Results for Leachates Produced by Weathering Columns: Total-S = 1-3%
GCA10754/55 crystal tuff (c. 52-54 m bgl) Total-S = 1.5% Cr(II)-Red.-S = 1.1% CO₃ = 0.72% Mn = 0.12%

Element/ Parameter	Pre-Rinse-Cycles		Weeks of Weathering					Element	Pre-Rinse-Cycles		Weeks of Weathering				
	0a	0b	2	4	6	8	10		0a	0b	2	4	6	8	10
Major-Parameters								Other Elements (mostly metals) [µg/L]							
pH	7.5 [7.3]	8.1 [7.9]	7.8 [7.4]	7.9 [7.8]	7.9 [7.8]	7.8 [7.7]	7.9 [7.9]	Mn	2,600	500	270	260	160	120	120
EC (µS/cm)	1,900	490 [490]	430 [420]	410 [390]	280 [250]	230 [220]	240 [220]	Zn	<10	<10	30	20	<10	10	20
HCO ₃ (mg/L)	[1,700]	110	35	69	69	64	67	Cd	0.11	<0.02	0.07	<0.02	<0.02	<0.02	<0.02
Major-Ions (mg/L)	73							Pb	1.4	<0.5	<0.5	0.9	<0.5	0.7	<0.5
								Co	27	4.0	3.7	1.4	0.7	0.8	0.4
								As	0.5	0.7	0.9	1.2	0.5	3.8	12
								Cu	<10	<10	10	<10	<10	<10	<10
								Ni	20	<10	<10	<10	<10	<10	<10
								Cr	<10	<10	<10	<10	<10	<10	<10
								Hg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
								Sb	0.28	0.40	0.59	0.75	0.76	0.80	1.1
								Bi	<0.005	<0.005	<0.005	<0.005	0.007	<0.005	<0.005
								Se	8.4	1.2	0.8	1.2	<0.5	<0.5	<0.5
Na		6.1	4.4	4.8	2.9	2.2	1.9	B	<10	<10	40	20	<10	<50	<10
K	24	22	16	16	12	12	11	Mo	0.88	3.6	5.0	6.5	4.0	2.5	2.3
Mg	49	21	17	16	9.2	8.8	8.5	P	<100	<100	<100	<100	<100	<100	<100
Ca	110	47	39	36	22	22	21	Ag	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	<0.01
SO ₄	250	150	150	120	47	49	43	Ba	32	7.2	7.5	6.8	5.2	5.6	5.0
Cl	950	<2	<2	4	<2			Sr	1600	310	260	240	140	140	140
F	12	0.7	1.3	1.4	1.2			Tl	1.1	0.41	0.27	0.25	0.18	0.17	0.18
Fe	0.5							V	<10	<10	<10	<10	<10	<10	<10
Al	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	Sn	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1
Si	0.03	0.04	0.04	0.02	<0.01	<0.01	0.05	U	0.86	1.4	0.20	0.51	0.33	0.47	0.32
	1.9	1.7	1.1	1.2	1.1	1.1	1.1	Th	<0.005	<0.005	0.012	<0.005	<0.005	0.006	0.006
Leachate Wt (kg)															
Note: Values in parenthesis are for duplicates															

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Table 8e(ii)

Analysis Results for Leachates Produced by Weathering Columns: Total-S = 1-3%

GCA10043 crystal tuff (c. 39-40 m bgl) Total-S = 1.9% Cr(II)-Red.-S = 1.4% CO₃ = 0.07% Mn = 1.1%

Element/ Parameter	Pre- Rinse- Cycle	Weeks of Weathering													Element/ Parameter	Pre- Rinse- Cycle	Weeks of Weathering													
	0	2	4	6	8	10	12	16	20	22	24	26	28	30		0	2	4	6	8	10	12	16	20	22	24	26	28	30	
Major-Parameters															Other Elements (mostly metals) [µg/L]															
pH	5.5 [6.6]	5.0 [5.0]	5.6 [5.8]	4.7 [5.8]	6.1 [5.9]	5.8 [5.8]	6.2 [6.1]	4.4 [5.9]	6.4 [6.2]	6.4 [6.0]	6.1 [6.3]	6.1 [6.2]	5.6 [6.0]	6.4 [6.1]	Mn	32,000	29,000	37,000	25,000	25,000	21,000	21,000	30,000	32,000	22,000	18,000	15,000	13,000	14,000	
EC [µS/cm]	610 [580]	500 [480]	570 [570]	440 [380]	400 [350]	290 [280]	280 [250]	380 [330]	330 [310]	230 [230]	190 [200]	200 [160]	150 [140]	150 [140]	Zn	6,500	5,100	6,000	4,400	4,700	3,900	3,900	5,800	7,200	4,200	3,500	3,100	2,700	2,900	
HCO ₃ (mg/L)	8	2		3	4	4	4	3.3	4	3.2	4	4	3	4	Cd	0.32	0.18	0.28	0.28	0.35	0.21	0.35	0.56	0.59	0.42	0.39	0.36	0.41	0.29	
acidity (mg/L H ₂ SO ₄)		26	130												Cu	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		
Major-Ions (mg/L)															Ni								<10							
Na															Co								31	21	16	15	12			
K								1.2	1.1	0.9					Pb	4.7	40	28	29	28	27	21	42	84	39	30	30	27	27	
Mg								7.4	7.9	8.0					Cr								30							
Ca								5.9	7.5	7.4					Hg								<0.1							
SO ₄	250	210	240	160	140	110	110	15	19	18					As	1.6	0.9	1.3	0.7	0.8	0.5	0.6	0.8	0.3	0.4	0.5	0.4	0.9	0.3	
Fe								15	19	18					Sb								0.31						0.17	
Al	0.03	0.32	0.03	0.06	0.06	0.04	0.05	0.08	<0.01	0.04	<0.01	<0.01	0.10		Bi								<0.005							
Si	0.04	0.06	0.07	0.05	0.03	0.03	1.1	1.1	0.93	0.01	0.02	<0.01	<0.01	0.63	Se								<0.5							
															B								<10							
															Mo								0.08							
															P								<100							
															Ag								<0.01							
															Ba								8.4							
															Sr								190							
															Tl								0.57							
															V								<10						0.27	
															Sn								<0.1							
															U								0.012							
															Th								<0.005							
Leachate Wt (kg)	1.19	0.81	0.78	0.79	0.78	0.78	0.78	0.82	0.82	0.82	0.84	0.84	0.84	0.86																
Note: Values in parenthesis are for duplicates																														

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Table 8e(iii)
Analysis Results for Leachates Produced by Weathering Columns: Total-S = 1-3%
GGCA10044 crystal tuff (c. 55-56 m bgl) Total-S = 2.6% Cr(II)-Red.-S = 1.8% CO₃ = 0.01% Mn = 0.85%

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ELEMENT/ PARAMETER	PRE- RINSE- CYCLE	WEEKS OF WEATHERING													ELEMENT/ PARAMETER	PRE- RINSE- CYCLE	WEEKS OF WEATHERING												
		2	4	6	8	10	12	16	19	22	24	26	28	30			2	4	6	8	10	12	16	19	22	24	26	28	30
	0															0													
Major-Parameters															Other Elements (mostly metals) [µg/L]														
pH	4.6 [5.4]	5.4 [7.2]	4.9 [5.2]	4.6 [5.0]	4.9 [5.1]	4.8 [5.0]	5.0 [5.1]	4.6 [4.9]	5.0 [4.9]	5.3 [5.4]	5.2 [5.4]	5.0 [5.2]	5.0 [5.2]	5.4 [5.1]	Mn	120,000	140,000	160,000	150,000	140,000	140,000	150,000	230,000	190,000	110,000	110,000	120,000	110,000	110,000
EC [µS/cm]	1,100 [1,100]	1,100 [1,100]	1,200 [1,100]	1,100 [900]	970 [840]	850 [770]	800 [720]	1,100 [960]	860 [780]	550 [540]	560 [570]	600 [550]	520 [520]	580 [520]	Zn	31,000	31,000	38,000	37,000	37,000	37,000	37,000	57,000	47,000	25,000	26,000	26,000	25,000	26,000
HCO3 (mg/L)		3	2	2	3		2			2		2	2	2	Cd	4.0	3.5	3.9	4.0	3.6	3.7	4.0	6.7	5.9	3.4	3.6	3.7	3.5	3.6
acidity (mg/L H2SO4)	93						93	130	98						Cu	20	<10	<10	<10	<10	<10	<10	<10	10	10	<10	<10	<10	
Major-Ions (mg/L)															Ni								140						
															Co								240	130	140	140	130		
Na							0.9	0.8	0.6						Pb	150	84	360	530	580	560	530	590	570	420	440	480	480	430
K							7.6	7.8	7.1						Cr								150						
Mg							8.3	9.7	7.1						Hg								<0.1						
Ca							27	32	22						As	9.1	6.4	1.3	1.3	1.6	2.0	1.7	2.9	1.6	3.8	1.5	1.2	1.2	1.1
SO4	540	610	580	470	400	380	390	570	460	250	260	250	230	240	Sb								0.16						0.08
															Bi								<0.005						
Fe	4.1	0.14	0.23	0.27	0.44	0.46	0.19	0.25	0.15	0.02	0.02	<0.01	<0.01		Se								<0.5						
Al	0.68	0.26	0.31	0.28	0.21	0.21	0.23	0.47	0.34	<0.01	0.16	0.15	0.15		B								<10						
Si							2.1	2.2	2.0					1.3	Mo								0.05						
															P								<100						
															Ag								0.02						
															Ba								4.4						
															Sr								180						
															Tl								2.7						
															V								<10						1.5
															Sn								<0.1						
															U								1.1						
															Th								<0.005						
Leachate Wt (kg)	1.19	0.80	0.75	0.77	0.75	0.79	0.79	0.79	0.80	0.80	0.82	0.80	0.81	0.83															

Table 8e(iv)
Analysis Results for Leachates Produced by Weathering Columns: Total-S = 1-3%
GCA10039 ignimbrite (c. 13-14 m bgl) Total-S = 1.6% Cr(II)-Red.-S = 1.1% CO₃ < 0.01% Mn = 1.4%

ELEMENT/ PARAMETER	PRE- RINSE- CYCLE	WEEKS OF WEATHERING													ELEMENT/ PARAMETER	PRE- RINSE- CYCLE	WEEKS OF WEATHERING														
		2	4	6	8	10	12	16	19	22	24	26	28	30			2	4	6	8	10	12	16	19	22	24	26	28	30		
	0														0																
Major-Parameters															Other Elements (mostly metals) [µg/L]																
pH	3.3 [3.3]	4.0 [3.6]	3.5 [3.6]	3.3 [3.5]	3.3 [3.3]	3.0 [3.2]	3.1 [2.9]	2.8 [2.7]	2.8 [2.8]	3.1 [3.1]	3.1 [3.1]	2.9 [2.9]	2.9 [2.8]	2.8 [2.7]	Mn	36,000	30,000	31,000	27,000	26,000	22,000	23,000	28,000	22,000	9,400	9,300	11,000	8,100	9,800		
EC [µS/cm]	1,300 [1,200]	630 [640]	640 [610]	690 [570]	710 [610]	620 [620]	800 [780]	1,100 [1,100]	1,200 [1,100]	620 [570]	650 [640]	940 [880]	990 [820]	1,300 [1,100]	Zn	42,000	32,000	32,000	29,000	28,000	24,000	25,000	34,000	28,000	11,000	12,000	15,000	12,000	15,000		
acidity (mg/L H2SO4)	220	110	130	130	150	150	200	330	330	150	170	250	260	350	Cd	250	130	120	91	79	67	77	98	75	29	31	40	32	41		
Major-Ions (mg/L)															Cu	80	<10	<10	10	10	30	60	140	120	40	50	70	90			
															Ni								50								
															Co								110	45	46	59	50				
															Pb	2,300	1,500	990	760	860	590	620	370	490	450	400	480	380	430		
Na															Cr								20								
K															Hg								<0.1								
Mg															As	910	400	310	270	280	250	230	210	180	72	63	90	95	120		
Ca															Sb								2.3								
SO4	540	260	250	220	200	190	240	360	330	140	160	220	210	290	Bi								0.006								
															Se								<0.5								
Fe	9.2	7.9	12	14	19	19	29	47	57	29	33	48	47		B								<10								
Al	15	3.2	3.2	3.4	3.7	4.5	7.0	16	12	4.1	5.1	7.8	7.8		Mo								0.4								
Si															P								<100								
															Ag								0.08								
															Ba								3.6								
															Sr								22								
															Tl								1.8								
															V								<10								
															Sn								0.1								
															U								5.5								
															Th								0.24								
Leachate Wt (kg)	1.16	0.78	0.74	0.76	0.76	0.77	0.77	0.78	0.81	0.80	0.80	0.81	0.81	0.84																	

Note: Values in parenthesis are for duplicates

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Table 8f
Analysis Results for Leachates Produced by Weathering Columns: Low grade ore
GCA10049 ignimbrite Total-S = 1.1% Cr(II)-Red.-S = 0.94% CO₃ = 0.03% Mn = 1.4%

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ELEMENT/ PARAMETER	PRE- RINSE- CYCLE	WEEKS OF WEATHERING													ELEMENT/ PARAMETER	PRE- RINSE- CYCLE	WEEKS OF WEATHERING													
		2	4	6	8	10	12	16	20	22	24	26	28	30			2	4	6	8	10	12	16	19	22	24	26	28	30	
	0															0														
Major-Parameters															Other Elements (mostly metals) [µg/L]															
pH	5.8 [6.9]	5.8 [4.8]	6.2 [6.6]	6.0 [6.8]	7.0 [6.6]	7.2 [6.9]	7.2 [7.0]	6.8 [6.9]	7.0 [6.9]	7.4 [6.7]	6.8 [6.8]	6.9 [6.8]	6.9 [6.6]	6.4 [6.9]	Mn	3,500	2,200	1,400	1,100	820	700	920	880	610	430	1,100	270	150	270	
EC [µS/cm]	570 [540]	390 [370]	240 [220]	240 [180]	180 [170]	160 [140]	130 [120]	160 [130]	110 [90]	110 [110]	82 [82]	86 [71]	54 [51]	95 [76]	Zn	160	50	90	70	30	40	130	130	100	40	200	10	<10	50	
HCO3 (mg/L)	20	10	10	11	13	18	15	11	10	8	9	9	8	11	Cd	0.12	0.09	0.13	0.07	0.07	0.06	0.07	0.09	0.08	0.06	0.07	0.04	0.04	0.04	
Major-Ions (mg/L)															Cu	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	<10	<10	<10		
															Ni															
															Co															
															Pb	1.0	1.6	3.3	4.0	9.4	5.6	4.1	4.3	0.5	1.3	1.0	0.3	<0.1	2.0	
															Cr															
															Hg															
															As	1.8	1.5	1.9	1.7	1.9	1.7	1.2	1.0	0.4	0.7	0.7	0.4	0.5	0.6	
															Sb														0.57	
															Bi															
															Se															
															B															
															Mo															
															P															
															Ag															
															Ba															
														Sr																
														Tl																
														V																
														Sn																
														U																
														Th																
Leachate Wt (kg)	1.17	0.80	0.76	0.75	0.75	0.76	0.76	0.80	0.83	0.83	0.84	0.83	0.83	0.85																

Note: Values in parenthesis are for duplicates

Table 8g
Analysis Results for Leachates Produced by Weathering Columns: Low grade ore
GCA10729/52 ignimbrite/volcanic breccia Total-S = 0.99% Cr(II)-Red.-S = 0.73% CO₃ < 0.01% Mn = 0.18%

ELEMENT/ PARAMETER	PRE-RINSE-CYCLES			WEEKS OF WEATHERING				ELEMENT	PRE-RINSE-CYCLES			WEEKS OF WEATHERING			
	0a	0b	0c	2	4	6	8		0a	0b	0c	2	4	6	8
Major-Parameters								Minor-Ions (µg/L)							
pH	4.7 [4.6]	5.0 [5.0]	5.3 [5.3]	3.8 [3.7]	4.4 [4.3]	4.5 [4.6]	4.6 [4.7]	Mn	96,000	27,000	3,200	19,000	21,000	11,000	6,000
EC (µS/cm)	3,100 [2,600]	1,200 [990]	240 [220]	620 [640]	590 [600]	410 [390]	280 [240]	Zn	95,000	21,000	2,200	13,000	16,000	9,400	4,700
Acidity (mg/L)	250	78		84	88	59	33	Cd	200	50	5.0	38	51	28	18
Major-Ions (mg/L)								Pb	1,500	430	26	58	130	52	33
Na	42	11	1.8	2.1	2.1	1.2	0.7	Co	280	65	6	41	47	24	13
K	350	130	38	43	44	29	21	As	31,000	41,000	24,000	81,000	110,000	69,000	56,000
Mg	120	26	2.7	12	13	6.5	3.4	Cu	50	<10	<10	<10	<10	<10	<10
Ca	220	59	6.0	28	28	14	7.1	Ni	580	130	10	70	80	30	20
SO ₄	1,800	530	93	510	510	240	130	Cr	130	40	10	20	20	<10	<10
Cl	20	6	<2	10	10	11	7	Hg	<1	<1	<1	<0.1	<0.1	<0.1	<0.1
F	0.5	0.5	0.2	0.4	0.5	0.4	0.3	Sb	5.5	7.1	9.4	3.6	3.8	6.4	10
Fe	12	7.3	1.2	9.4	15	7.6	3.8	Bi	<0.005	<0.005	<0.005	0.019	0.013	<0.005	0.015
Al	8.1	1.2	0.05	1.1	1.4	0.66	0.32	Se	<5	<5	<5	1.3	1.2	0.8	0.6
Si	8.5	15	9.5	6.7	9.9	7.6	8.6	B	50	40	30	<10	<10	<10	<10
Leachate Wt (kg)	0.48	0.95	0.96	0.65	0.62	0.66	0.71	Mo	0.8	1.2	3.1	0.15	0.50	0.88	1.2
								P	<100	<100	<100	<100	<100	100	<100
								Ag	<0.1	<0.1	<0.1	0.04	0.12	0.10	0.07
								Ba	29	30	32	25	21	18	20
								Sr	1,300	430	52	220	230	120	66
								Tl	13	4.8	1.5	2.0	2.0	1.3	1.1
								V	<10	<10	<10	<10	<10	<10	<10
								Sn	<1	<1	<1	<0.1	<0.1	<0.1	<0.1
								U	1.6	0.16	<0.05	0.069	0.63	0.090	0.022
								Th	<0.05	<0.05	<0.05	0.011	0.012	0.010	<0.005

Note: Values in parenthesis are for duplicates

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Table 9
Analysis Results for Leachates Produced by Weathering Columns: Extended Weathering of Low-S (Alunitic) Samples (0.1% < S < 0.3%) from Weathered Rock Zone

Table 9a(i)
Analysis Results for Leachates Produced by Weathering Columns: Extended Weathering of Low-S (Alunitic) Samples (0.1% < S < 0.3%) from Weathered Rock Zone
GCA10663/64, Sandstone (c. 14-21 m bgl), Total-S = 0.13%, Cr(II)-Red.-S < 0.01%, CO₃-C = 0.01%, Mn = 120 mg/kg

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ELEMENT/ PARAMETER	PRE-RINSE-CYCLES			WEEKS					Re-Pre- Rinse After 12 months Ambient Storage	WEEKS															Recirculation Testing		
	0a	0b	0c	2	4	6	8	10		11	12	13	14	15	16	17	18	19	20	21	25	29	33	37		45	47
Major-Parameters																											
pH	4.7	5.0	5.4	6.5	6.2	5.7	5.7	5.9	6.0	5.9	5.1	5.4	5.4	6.1	6.0	5.5	5.5	5.2	5.2	5.2	5.1	5.0	4.9	5.0	4.9	5.0	
pH (GCA)	4.7	4.9	5.5	7.0	6.5	6.0	5.9	6.3																			
EC (µS/cm)	820	500	200	110	95	82	63	49																			
EC (GCA, µS/cm)	91	550	200	120	97	110	66	60	72	44	49	39	36	31	24	28	30	33	27	24	32	34	37	37	46	34	
acidity (mg CaCO3/L)	37	17																									
acidity (GCA, mg/L CaCO3)																											
HCO3 (GCA, mg/L CaCO3)			3	6	4	3	2	3	2	1	1												2	2			
Major-Ions (mg/L)																											
Na	46	16	3.0	1.3	1.0	0.7																					
K	36	30	15	8.0	8.7	8.2																					
Mg	17	11	3.4	1.8	1.8	1.6																					
Ca	67	43	13	7.1	5.3	4.3																					
SO4	340	230	68	33	31	26	21	16		16	15	13	12	12	10	11 (11)	9	10	9	9	10	10	12	15	15	15	
Mn (µg/L)	15,000	9,900	3,000	1,400	1,500	1,400	990	760		760	670	610	510	510	470	480 (500)	490	490	530	450	420	470	500	610	590	650	
Mn (GCA, µg/L)											800								600								
Fe	0.58	0.37	0.13	<0.01	0.03	0.07				0.05	0.02	0.03	0.06	0.06	0.02	0.03 (0.02)	0.03	0.02	<0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	
Al	4.3	1.2	0.11	0.03	0.03	<0.01				0.02	0.03	0.02	0.01	0.03	0.02	0.02 (0.02)	0.04	0.02	0.01	0.01	0.01	0.02	0.01	0.03	0.03	0.03	
Si	5.3	14	13	8.0	9.6	11	9.1	7.7		6.9	7.1	6.3	5.1	6.1	4.5	5.7 (5.7)	4.7	4.9	4.3	4.4	5.5	5.4	6.2	6.8	6.8	8.2	
Leachate Wt (kg)	0.64	0.98	0.93	0.70	0.68	0.70	0.71	0.69	0.63	0.70	0.69	0.71	0.68	0.67	0.68	0.69	0.67	0.68	0.69	0.68	0.67	0.66	0.65	0.66	0.68	0.69	

Note:
EC = Electrical-Conductivity; values in parentheses signify duplicate determinations.
Ambient Storage for 12 months corresponds to air-dry state of sample-beds in columns.
Refer Table 10 for outcomes of Recirculation Testing.

ELEMENT/ PARAMETER	WEEKS																		
	49	51	53	58	60	64	68	74	80	86	96	102	106	112	120	132	144	156	162
Major-Parameters																			
pH													4.9	5.2	5.0	5.8	5.2	5.7	6.1
pH (GCA)	5.0	4.8	5.0	4.9	4.8	5.0	-	4.8	5.0	5.1	4.8	4.8	5.0	-	4.9	5.5	5.3	5.1	5.4
EC (µS/cm)													34	-	-	32	35	40	43
EC (GCA, µS/cm)	34	34	24	42	38	32	-	32	28	48	43	43	34	-	46	36	41	44	44
acidity (mg/L CaCO3)													5	3 (4*)	3 (4*)	3	4		
acidity (GCA, mg/L CaCO3)			2						2				2 (3)						
HCO3 (mg/L CaCO3)																		3	4
HCO3 (GCA, mg/L CaCO3)																		2	3
Major-Ions (mg/L)																			
Na													0.1	<0.1	0.2			0.2	
K													3.2	3.3	3.2			3.6	
Mg													0.65	0.63	0.65			0.83	
Ca													0.52	0.49	0.76			0.69	
SO4	10	9	7	10	9	10	9	9	9	9	9	-	10	9	10	11	12	12	12
Mn (µg/L)	550	420	390	580	450	540	560	550	540	560	610	-	600	610	610	740	750	790	680
Mn (GCA, µg/L)									700				500						
Fe	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	-	<0.01	<0.01	0.01			0.01	0.02
Al	0.02	0.02	0.01	0.02	0.01	0.02	0.03	0.02	0.02	0.02	0.02	-	0.02	<0.01	0.09	0.02	0.02	<0.01	0.01
Si	3.8	3.9	2.8	3.7	3.7	3.6	3.5	3.0	2.8	2.9	3.0	-	3.3	3.3	3.1	3.2	3.7	3.8	4.6
Leachate Wt (kg)	0.74	0.75	0.73	0.69	0.73	0.81	-	0.76	0.77	0.78	0.80	0.81	0.78	0.79	0.77	0.78	0.76	0.74	0.77

Note:
Acidity values labelled with asterisk correspond to H₂O₂ addition prior to attainment of pH=8.3 end-point.

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Table 9a(ii)

Analysis Results for Leachates Produced by Weathering Columns: Extended Weathering of Low-S (Alunitic) Samples (0.1% < S < 0.3%) from Weathered Rock Zone
GCA10674/75, Crystal-Tuff (c. 31-36 m bgl), Total-S = 0.10%, Cr(II)-Red.-S < 0.01%, CO₃-C = 0.01%, Mn = 850 mg/kg

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ELEMENT/ PARAMETER	PRE-RINSE-CYCLES			WEEKS					Re-Pre- Rinse After 12 months Ambient Storage	WEEKS																Recirculation Testing
	0a	0b	0c	2	4	6	8	10		11	12	13	14	15	16	17	18	19	20	21	25	29	33	37	45	
Major-Parameters																										
pH	5.0	5.6	5.5	5.5	6.7	5.4	5.4	5.4																		
pH (GCA)	4.7	5.5	5.9	5.5	5.8	5.5	5.4	5.7	5.8	5.5	5.7	5.4	5.3	5.6	5.4	5.3	5.3	5.3	5.2	5.3	5.1	4.8	4.8	4.8	4.9	4.9
EC (µS/cm)	1,400	370	110	160	93	120	98	79																		
EC (GCA, µS/cm)	1,800	380	120	160	96	150	81	93	110	82	87	65	72	70	62	59	64	62	64	56	60	79	66	72	76	77
acidity (mg/L CaCO3)	43																									
acidity (GCA, mg/L CaCO3)																										
HCO3 (GCA, mg/L CaCO3)		4	3	2	3	2	2	2	2	1	2												2	3		
Major-Ions (mg/L)																										
Na	27	8.0	2.3	2.8	1.9	2.1																				
K	58	25	11	13	9.3	11																				
Mg	120	18	3.6	4.9	2.9	3.8																				
Ca	86	14	2.7	3.5	2.0	2.9																				
SO4	840	160	39	50	32	38	28	26		31	29	24	24	21	24	22	22	21	22	22	21	25	24	28	22	34
Mn (µg/L)	74,000	11,000	2,100	2,900	1,700	2,200	1,400	1,400		1,450	1,190	1,050	1,070	850	1,040	910	970	910	940	892	760	1,030	890	1,120	790	1,410
Mn (GCA, µg/L)											1,300								1,000							
Fe	0.25	0.09	0.04	0.01	0.03	<0.01				0.07	0.02	0.09	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Al	2.1	0.14	0.07	0.04	<0.01	<0.01				0.08	0.03	0.10	0.03	0.02	0.03	0.03	0.02	0.03	0.02	0.03	0.03	0.03	0.02	0.02	0.05	0.04
Si	24	22	9.8	12	9.4	12	9.5	11		9.8	9.4	8.9	8.8	8.3	8.0	8.6	8.0	8.0	8.0	8.2	8.2	9.6	8.8	9.5	7.3	12.7
Leachate Wt (kg)	0.54	0.96	0.98	0.60	0.54	0.61	0.63	0.66	0.60	0.62	0.63	0.61	0.61	0.60	0.61	0.62	0.61	0.62	0.61	0.60	0.61	0.60	0.62	0.61	0.62	0.60

ELEMENT/ PARAMETER	WEEKS																		
	49	51	53	58	60	64	68	74	80	86	96	102	106	112	120	132	144	156	162
Major-Parameters																			
pH													4.6	5.5	5.3	6.0	5.4	5.8	6.4
pH (GCA)	5.1	5.1	5.1	5.0	5.1	5.1	-	5.1	5.0	5.0	5.1	4.8	4.7	-	5.1	5.6	5.2	5.1	5.5
EC (µS/cm)													81	-	-	71	71	70	101
EC (GCA, µS/cm)	76	69	82	83	70	74	-	73	64	85	86	85	80	-	92	85	80	76	89
acidity/L (mg CaCO ₃)													7	4 (7*)	3 (4*)				
acidity (GCA, mg/L CaCO ₃)			2						3				5 (6)						
HCO ₃ (mg/L CaCO ₃)																		3	5
HCO ₃ (GCA, mg/L CaCO ₃)																		2	4
Major-Ions (mg/L)																			
Na													0.3	0.2	0.4			0.4	
K													8.6	8.1	8.7			8.5	
Mg													1.85	1.80	2.24			1.96	
Ca													1.31	1.17	1.72			1.39	
SO ₄	26	27	23 (24)	27	27	21	25	27	27	25	25	-	25	21	27	27	25	22	30
Mn (µg/L)	1,140	1,140	1,010 (1,000)	1,240	1,220	920	1,170	1,240	1,270	1,140	1,190	-	1,030	1,070	1,320	1,410	1,300	1,150	1,590
Mn (GCA, µg/L)									2,200				800						
Fe	<0.01	<0.01	<0.01 (<0.01)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	0.89	<0.01	0.02	<0.01	<0.01	0.01	0.01
Al	0.03	0.03	0.02 (0.03)	0.03	0.03	0.03	0.02	0.03	0.02	0.02	0.02	-	0.05	<0.01	0.06	<0.01	0.06	0.01	0.03
Si	5.8	7.1	5.7 (5.7)	6.0	6.5	5.1	5.6	5.5	5.1	4.8	5.1	-	4.8	5.0	5.0	4.9	4.8	5.0	6.4
Leachate Wt (kg)	0.63	0.59	0.63	0.59	0.62	0.65	-	0.58	0.63	0.61	0.66	0.70	0.67	0.69	0.67	0.71	0.72	0.69	0.68

Note: Values in parenthesis are for duplicates

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Table 9a(iii)
Analysis Results for Leachates Produced by Weathering Columns: Extended Weathering of Low-S (Alunitic) Samples (0.1% < S < 0.3%) from Weathered Rock Zone
GCA10678/79, Volcanic Breccia (c. 26-28 m bgl), Total-S = 0.18%, Cr(II)-Red.-S < 0.01%, CO₃-C = 0.03%, Mn = 1,600 mg/kg

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ELEMENT/ PARAMETER	PRE-RINSE-CYCLES					WEEKS					Re-Pre-Rinses After12 Months Ambient Storage				WEEKS																Recirculation Testing		
	0a	0b	0c	0d	0e	2	4	6	8	10	1st	2nd	3rd	4th	11	12	13	14	15	16	17	18	19	20	21	25	29	33	37	45		47	
Major-Parameters																																	
pH	4.2	4.6	4.8	4.7	4.8	4.9	5.0	5.1	5.1	5.2	5.7	5.7	5.4	5.4	5.5	5.9	5.9	5.4	5.3	5.4	5.4	5.3	5.3	5.2	5.2	5.3	5.0	4.8	4.8	4.8	4.9	5.2	
pH (GCA)	4.0	4.4	4.6	4.6	4.6	4.8	5.1	5.1	5.2	5.7																							
EC (µS/cm)	3,100	1,400	820	1,100	1,100	570	400	200	160	130																							
EC (GCA, µS/cm)	4,100	1,600	900	1,200	1,100	620	410	240	170	150	120	96	51	45	42	48	50	53	61	45	43	59	49	46	40	58	79	66	72	76	49		
acidity (mg/L CaCO3)	130	42	21	29	27	20	11																										
acidity (GCA, mg/L CaCO3)																																	
HCO3 (GCA, mg/L CaCO3)								2	2	2	2	2	1	2	1	1																	
Major-Ions (mg/L)																																	
Na	29	7.5	3.3	4.2	3.7	2.6	1.5	1.0																									
K	79	37	23	28	26	21	18	12																									
Mg	320	98	46	64	62	24	16	6.6																									
Ca	290	87	50	69	70	36	24	11																									
SO4	2,800	860	430	590	570	270	180	72	59	45					16	18	18	19	18	17	17	18	18	18	16	18	19	19	24	21	24		
Mn (µg/L)	480,000	150,000	69,000	95,000	91,000	34,000	21,000	8,900	6,500	5,200					1,110	1,330	1,310	1,400	1,310	1,290	1,220	1,380	1,330	1,310	1,090	1,190	1,430	1,300	1,710	1,500	1,670		
Mn (GCA, µg/L)																1,500								1,300									
Fe	0.29	0.07	0.04	0.03	0.03	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Al	8.7	2.0	0.83	1.2	1.3	0.17	0.13	0.02							<0.01	0.01	<0.01	0.02	0.02	<0.01	0.02	0.01	0.01	<0.01	0.02	0.01	0.01	0.02	0.02	0.03	0.02		
Si	9.8	11	6.4	10	11	9.6	9.4	7.8	8.1	9.6					5.7	6.4	6.1	6.3	6.5	5.6	6.4	6.2	5.9	6.0	5.7	6.3	8.0	6.9	8.0	7.0	10.7		
Leachate Wt (kg)	0.61	0.95	0.98	0.94	0.98	0.66	0.66	0.68	0.69	0.70	0.68	0.98	0.97	0.98	0.68	0.67	0.69	0.70	0.71	0.68	0.69	0.68	0.70	0.68	0.68	0.67	0.63	0.65	0.66	0.65	0.67		

ELEMENT/ PARAMETER	WEEKS																		
	49	51	53	58	60	64	68	74	80	86	96	102	106	112	120	132	144	156	162
Major-Parameters																			
pH													5.1	6.0	5.4	6.1	5.5	5.8	6.4
pH (GCA)	5.3	5.2	5.3	5.2	5.2	5.2	-	5.1	5.1	5.2	5.3	5.1	5.2	-	5.2	5.6	5.3	5.2	5.5
EC (µS/cm)													61	-	-	54	53	62	75
EC (GCA, µS/cm)	51	57	49	63	63	51	-	62	52	66	72	68	59	-	75	65	62	72	89
acidity (mg CaCO3/L)													2	3 (4*)	3 (5*)	2	6		
acidity (GCA, mg/L CaCO3)													2 (3)						
HCO3 (mg/L CaCO3)																		3	5
HCO3 (GCA, mg/L CaCO3)																		2	3
Major-Ions (mg/L)																			
Na													0.2	<0.1	0.2			0.2	
K													6.4	5.9	6.0			6.7	
Mg													1.14	1.02	1.12			1.18	
Ca													1.67	1.43	1.72			1.77	
SO4	17	18	15 (15)	20	18	17	17	18	18	18	19	-	19	17	18	20	19	20	22
Mn (µg/L)	1,240	1,290	1,120 (1,090)	1,530	1,240	1,340	1,270	1,400	1,460	1,400	1,450	-	1,490	1,350	1,500	1,670	1,560	1,570	1,800
Mn (GCA, µg/L)									1,800				1,600						
Fe	0.01	<0.01	<0.01 (<0.01)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Al	0.02	<0.01	<0.01 (<0.01)	<0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	0.05	<0.01	<0.01
Si	5.3	6.3	4.7 (4.7)	5.3	5.2	5.0	4.8	4.3	4.4	4.4	4.4	-	4.6	4.6	4.3	4.2	4.3	4.6	5.9
Leachate Wt (kg)	0.65	0.67	0.64	0.61	0.68	0.73	-	0.69	0.67	0.68	0.70	0.75	0.69	0.71	0.69	0.71	0.68	0.71	0.72

Note: Values in parenthesis are for duplicates

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Table 9a(iv)
Analysis Results for Leachates Produced by Weathering Columns: Extended Weathering of Low-S (Alunitic) Samples (0.1% < S < 0.3%) from Weathered Rock Zone
GCA10664, Sandstone (c. 18 m bgl), Total-S = 0.25%, SO₄-S-[Na₂CO₃] = 0.22% CO₃-C = 0.04%, Mn = 150 mg/kg

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ELEMENT/ PARAMETER	PRE-RINSE-CYCLES		WEEKS																		Recirculation Testing
	0a	0b	1				2	3	4	5	6	7	8	9	10	14	19	23	34	36	
			1a	1b	1c	1d															
Major-Parameters																					
pH																					
pH (GCA)	4.8	4.6	4.5	4.8	4.8	5.1	5.2	4.9	4.9	5.0	4.8	4.9	4.9	4.9	4.9	4.7	4.7	4.7	4.7	4.6	
EC (µS/cm)																					
EC (GCA, µS/cm)	300	220	330	150	78	55	76	73	76	47	55	62	54	50	42	55	50	47	53	65	
acidity (mg/L CaCO3)																					
acidity (GCA, mg/L CaCO3)																		2	3		
Major-Ions (mg/L)																					
Na																					
K																					
Mg																					
Ca																					
SO4					28	21	28	24 (24)	22	18	21	18	18	16	15	16	15	16	19	19	
Mn (µg/L)					1,960	1,380	2,040	1,750 (1,750)	1,530	1,260	1,460	1,310	1,190	1,110	1,070	1,000	990	1,160	1,210	1,210	
Mn (GCA, µg/L)														1,200						1,400	
Fe					0.10	<0.01	<0.01	<0.01 (<0.01)	<0.01	<0.01	0.02	0.02	<0.01	<0.01	<0.01	0.04	0.02	0.01	0.03	0.03	
Al					0.14	0.04	0.06	0.06 (0.05)	0.04	0.03	0.03	0.03	0.03	0.03	0.02	0.03	0.02	0.03	0.03	0.03	
Si					4.7	3.8	7.0	7.0 (7.0)	8.2	6.1	8.3	7.3	7.4	7.2	6.8	6.9	7.6	7.3	7.1	9.0	
Leachate Wt (kg)	0.71	0.98	0.70	0.96	0.98	1.01	0.70	0.71	0.71	0.70	0.71	0.72	0.72	0.71	0.72	0.71	0.72	0.71	0.72	0.71	

ELEMENT/ PARAMETER	WEEKS																	
	38	40	42	47	49	53	57	63	69	75	81	85	91	99	111	123	135	141
Major-Parameters																		
pH																		
pH (GCA)	5.0	5.0	5.0	4.9	4.7	4.9	4.9	4.8	4.9	4.8	4.8	5.0	5.1	5.1	5.5	5.0	6.0	6.2
EC (µS/cm)												4.9	-	5.1	5.6	5.0	5.3	5.7
EC (GCA, µS/cm)	41	46	38	48	47	44	46	35	33	51	51	35	-	-	34	41	43	49
acidity (mg CaCO ₃ /L)												38	-	37	46	45	40	46
acidity (GCA, mg/L CaCO ₃)			2						2			5	3 (4*)	2 (4*)	4	4		
HCO ₃ (mg/L CaCO ₃)												3						
HCO ₃ (GCA, mg/L CaCO ₃)																	3	4
Major-Ions (mg/L)																		
Na												0.1	<0.1	0.1			0.3	
K												3.3	3.1	2.6			4.7	
Mg												0.76	0.69	0.57			0.85	
Ca												0.52	0.42	0.49			0.63	
SO ₄	12	12	12	13	12	12	11	10	10	10	-	11	10	9	12	15	13	14
Mn (µg/L)	860	840	770	1,020	820	840	830	730	780	810	-	940	740	610	1,000	1,130	867	960
Mn (GCA, µg/L)	700											1,400						
Fe	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Al	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.02	-	0.02	<0.01	0.03	0.01	0.05	0.02	0.03
Si	4.4	5.5	4.1	5.0	4.8	4.4	4.4	3.3	3.3	3.5	-	3.9	3.4	2.4	3.7	4.8	4.6	5.1
Leachate Wt (kg)	0.75	0.77	0.74	0.75	0.77	0.79	0.84	0.78	0.82	0.83	0.82	0.78	0.80	0.81	0.82	0.79	0.81	0.83

Note: Values in parenthesis are for duplicates

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Table 10

Analysis Results for Recirculation Testing During Extended Weathering of Low-S (Alunitic) Samples (0.1% < S < 0.3%) from Weathered Rock Zone

	GCA10664 Sandstone (0.25%S)		GCA10663/64 Sandstone (0.13%S)		GCA10674/75 Crystal-Tuff (0.10%S)		GCA10678/79 Volcanic Breccia (0.18%S)	
	FEED	RC10	FEED	RC10	FEED	RC10	FEED	RC10
pH	4.9	4.8	5.1	4.9	5.5	5.0	5.8	5.2
pH (GCA)	4.8	4.7	5.2	4.9	5.4	5.1	5.8	5.2
EC (μS/cm)	54	68	43	46	81	107	61	84
EC (GCA, μS/cm)	47	62	38	43	71	97	59	75
Acidity (mg/L CaCO ₃)	11	12	10	9	5	8	6	5
SO ₄ (mg/L)	16	21	12	13	25	34	20	27
Al (mg/L)	0.02	0.05	0.02	0.04	0.02	0.03	<0.01	0.01
Fe (mg/L)	0.02	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Si (mg/L)	6.61	8.50	5.98	5.34	9.16	8.72	8.21	7.16
Mn (mg/L)	0.94	1.74	0.50	0.80	1.02	1.77	1.36	2.42
Na (mg/L)	0.5	0.4	0.5	0.5	0.8	0.7	0.5	0.3
K (mg/L)	6.7	6.3	5.4	4.8	11.4	12.3	8.2	8.1
Mg (mg/L)	0.90	1.74	0.57	0.88	1.77	3.12	1.07	1.82
Ca (mg/L)	0.61	1.1	0.61	0.70	1.20	2.09	1.64	2.68
Notes: EC= Electrical Conductivity. Leachates recirculated 10 times corresponding to residence-times of ca. 1 day for each recirculation. For GCA10663/64, GCA10675/75, and GCA10678/79, the recirculation testing was performed after 47 weeks of weathering. For GCA10663, the recirculation testing was performed after 36 weeks of weathering.								

Table 11

Multi-element Analysis Results for Leachates Produced by Weathering Columns:
Extended Weathering of Low-S (Alunitic) Samples (0.1% < S < 0.3%) from Weathered Rock Zone

PARAMETER / ELEMENT	GCA10664 Sandstone (0.25% S)		GCA10663/64 Sandstone (0.13% S)		GCA10674/75 Crystal-Tuff (0.10% S)		GCA10678/79 Breccia-Volcanic (0.18% S)		ELEMENT	GCA10664 Sandstone (0.25% S)		GCA10663/64 Sandstone (0.13% S)		GCA10674/75 Crystal-Tuff (0.10% S)		GCA10678/79 Breccia-Volcanic (0.18% S)	
	Week-85	Week-135	Week-106	Week-156	Week-106	Week-156	Week-106	Week-156		Week-85	Week-135	Week-106	Week-156	Week-106	Week-156	Week-106	Week-156
pH	5.0	6.0	5.0	5.7	4.6	5.8	5.1	5.8	Cu (µg/L)	<10	<10	<10	<10	<10	<10	<10	<10
pH (GCA)	4.9		4.9		4.7		5.2		Ni (µg/L)	10	10	10	10	10	<10	10	10
EC (µS/cm)	35	43	34	40	80	70	61	62	Zn (µg/L)	70	80	50	70	50	60	80	70.0
EC (GCA, µS/cm)	38		34		81		59		Co (µg/L)	6.9	7.4	6.0	7.4	5.6 (5.6)	5.6	7.3	7.8
Acidity (mg/L CaCO ₃)	5		5		7		2		Cd (µg/L)	<0.5	<0.5	<0.5	<0.5	<0.5 (<0.5)	<0.5	<0.5	<0.5
HCO ₃ (mg/L CaCO ₃)		3		3		3		6	Pb (µg/L)	<2	<2	<2	<2	<2	3	<2	<2
Na (mg/L)	0.1	0.3	0.1	0.2	0.3	0.4	0.2	0.2	Cr (µg/L)	<10	<10	<10	<10	<10	<10	<10	<10
K (mg/L)	3.3	4.7	3.2	3.6	8.6	8.5	6.4	6.7	Hg (µg/L)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Mg (mg/L)	0.76	0.85	0.65	0.83	1.85	1.96	1.14	1.18	As (µg/L)	0.4	5.6	1.1	4.9	0.5 (0.5)	6.2	0.4	6.9
Ca (mg/L)	0.52	0.63	0.52	0.69	1.31	1.39	1.67	1.77	Sb (µg/L)	0.04	0.07	0.01	0.03	<0.01 (<0.01)	0.06	0.03	0.1
Cl (mg/L)	<2	<2	<2	<2	<2	<2	<2	<2	Se (µg/L)	<0.5	<0.5	<0.5	<0.5	<0.5 (<0.5)	<0.5	<0.5	<0.5
SO ₄ (mg/L)	12	13	10	12	25	22	19	19	B (µg/L)	60	80	80	130	70	110	90	130
F (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Mo (µg/L)	<0.05	<0.05	<0.05	<0.05	<0.05 (<0.05)	0.06	<0.05	<0.05
Al (mg/L)	0.02	0.02	0.02	<0.01	0.05	0.01	<0.01	<0.01	P (µg/L)	<100	<50	<100	<50	<100	<50	<100	<50
Fe (mg/L)	<0.01	<0.01	<0.01	0.01	0.89	0.01	<0.01	<0.01	Ag (µg/L)	0.55	<0.01	0.01	0.01	<0.01 (<0.01)	0.15	<0.01	<0.01
Mn (mg/L)	0.78	0.87	0.60	0.79	1.03	1.15	1.49	1.57	Ba (µg/L)	60.86	60.84	96.36	117.1	15.28 (15.52)	17.54	54.69	57.61
Si (mg/L)	3.72	4.53	3.31	3.77	4.78	5.00	4.57	4.54	Sr (µg/L)	5.69	6.24	6.18	7.91	10.88 (11.20)	10.38	5.69	5.68
reactive-Si (mg/L)	3.7		3.3		4.8		4.6		Tl (µg/L)	2.84	3.66	2.94	3.11	0.27 (0.28)	0.36	0.88	0.79
									V (µg/L)	<10	<10	<10	<10	<10	<10	<10	<10
									Sn (µg/L)	<0.1	<0.1	<0.1	<0.1	<0.1 (<0.1)	<0.1	<0.1	<0.1
									Bi (µg/L)	<0.005	0.017	<0.005	0.006	<0.005 (<0.005)	0.005	<0.005	<0.005
									U (µg/L)	0.140	0.161	0.126	0.172	0.167 (0.164)	0.093	0.034	0.030
									Th (µg/L)	<0.005	<0.005	<0.005	<0.005	<0.005 (<0.005)	<0.005	<0.005	<0.005

Notes:

EC = Electrical-Conductivity

Values in parentheses represent duplicate determinations.

Note: Values in parenthesis are for duplicates

Table 12

Key Analysis Results for Final Few Weeks of Kinetic Testing of Waste Rock and Ore Samples (Total-S > 0.5%)

Column	Rock Type	Total-S (%)	CO ₃ -C (%)	Weeks Tested	Leachate Concentration (mg/L)		
					HCO ₃	Mn	Zn
Leachate-pH = 6-8							
10053	ignimbrite	0.67	0.01	30	<5	30-40	1
10049 LGO		1.1	0.03	30	10	<0.5	<0.2
10754/55	crystal tuff	1.5	0.72	10	60-70	<0.2	<0.1
10043		1.9	0.07	30	<5	10-20	2-3
10747/48/49	volcanic breccia	0.65	0.16	8	20-30	1	<0.1
Leachate-pH = 4-5							
10044	crystal tuff	2.6	0.01	30		100-120	20-30
10729/52 HGO	ignimbrite/volcanic breccia	0.99	<0.01	8		5-10	5-10
Leachate-pH = 3							
10039	ignimbrite	1.6	<0.01	30		10	10-20

Table 13
Assay Results for Low-S Samples from Fresh Rock Zone (2017-2018)

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Composite_ID	Hole_ID	From	To	Downhole	Lithology	S	Total-S	Total-C	CO ₃ -C	Mn	Ca	Mg	K	Na	Fe	Al	Ti
		(m)	(m)	Run (m)		(%)	(%, IR07)	(%, IR07)	(%)	mg/kg				%			
Transect Along Western Edge of Pit (Drill holes in North-to-South Location Order)																	
BD17016_031035	BD17016	31	35		Laminated tuff	0.02	0.02	1.19	1.19	2,900	1.96	0.71	2.15	0.04	1.26	6.33	0.17
BD17016_035039	BD17016	35	39	10-15	Laminated tuff	0.04	0.03	0.54		2,200	0.84	0.30	3.32	0.06	1.04	6.72	0.15
BD17016_039043	BD17016	39	43		Laminated tuff	0.03	0.03	0.32	0.32	700	0.46	0.19	4.67	0.07	0.56	7.26	0.16
BD17018_013017	BD17018	12.8	17		Laminated tuff	0.03	0.02	0.52		600	0.69	0.41	3.70	0.06	1.15	7.02	0.16
BD17018_017022	BD17018	17	22.3		Laminated tuff	0.06	0.04	0.17	0.17	600	0.19	0.16	4.32	0.09	0.89	6.57	0.17
BD17018_022026	BD17018	22.3	26	20	Volcanic Breccia	0.02	0.01	0.37		700	0.54	0.28	5.21	0.19	1.00	6.86	0.13
BD17018_026030	BD17018	26	30		Volcanic Breccia	0.05	0.04	0.39	0.39	1,700	0.39	0.26	4.23	0.13	1.36	6.94	0.14
BD17018_030034	BD17018	30	34		Volcanic Breccia	0.05	0.04	0.37		600	0.69	0.33	3.62	0.07	0.80	6.98	0.14
BD16003_027033	BD16003	27	31		Volcanic Breccia	0.02	0.01	0.23	0.21	500	0.35	0.21	4.27	0.41	0.70	6.79	0.13
BD16003_031035	BD16003	31	35.3		Volcanic Breccia	0.02	0.01	0.58	0.55	2,500	1.02	0.37	4.46	0.56	1.11	6.64	0.12
BD16003_035039	BD16003	35.3	39		Volcanic Breccia	0.01	<0.01	0.20	0.20	400	0.49	0.22	3.92	0.23	0.76	7.03	0.16
BD16003_039043	BD16003	39	43	30-35	Volcanic Breccia	0.03	0.02	0.36	0.36	400	0.67	0.36	3.64	0.13	0.66	6.46	0.14
BD16003_043047	BD16003	43	47.2		Volcanic Breccia	0.06	0.05	0.71	0.69	700	0.93	0.44	3.74	0.08	0.65	6.77	0.17
BD16003_047051	BD16003	47.2	51		Volcanic Breccia	0.04	0.02	0.51	0.49	900	0.93	0.32	3.23	0.09	0.77	6.17	0.17
BD16003_051055	BD16003	51	55.2		Volcanic Breccia	0.03	0.03	0.36	0.36	1,100	0.68	0.25	2.76	0.03	0.66	8.38	0.25
BD16003_055059	BD16003	55.2	59.8		Volcanic Breccia	0.07	0.04	0.23	0.20	800	0.50	0.18	3.74	0.08	0.54	5.51	0.18
BD17007_025029	BD17007	25.2	29		Volcanic Breccia	0.02	0.02	0.27		300	0.69	0.28	4.12	0.96	0.93	6.93	0.13
BD17007_029033	BD17007	29	33		Volcanic Breccia	0.03	0.02	0.44	0.44	400	1.16	0.34	3.75	0.82	0.96	7.10	0.14
BD17007_033037	BD17007	33	37		Volcanic Breccia	0.02	0.01	0.27		400	0.63	0.23	4.74	0.72	0.69	6.76	0.13
BD17007_037041	BD17007	37	41		Volcanic Breccia	0.03	0.02	0.32	0.32	500	0.70	0.27	4.10	0.33	0.88	6.64	0.14
BD17007_041045	BD17007	41	45		Volcanic Breccia	0.03	0.02	0.42		900	0.85	0.35	3.81	0.10	0.90	7.00	0.13
BD17007_045049	BD17007	45	49	45	Volcanic Breccia	0.16	0.14	0.26	0.22	500	0.63	0.20	4.70	0.10	0.43	6.98	0.17
BD17007_049053	BD17007	49	53		Volcanic Breccia	0.21	0.16	0.44		900	1.00	0.31	2.36	0.04	0.59	6.95	0.24
BD17007_053057	BD17007	53	57		Volcanic Breccia	0.33	0.31	0.31		1,100	0.57	0.21	2.44	0.04	0.89	6.43	0.20
BD17007_057061	BD17007	57	61		Volcanic Breccia	0.15	0.10	0.32	0.26	800	0.71	0.29	3.72	0.06	0.64	7.39	0.17

Table 13 (Cont'd)
Assay Results for Low-S Samples from Fresh Rock Zone (2017-2018)

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Composite_ID	Hole_ID	From (m)	To (m)	Downhole Run (m)	Lithology	S (%)	Total-S (%, IR07)	Total-C (%, IR07)	CO ₃ -C (%)	Mn mg/kg	Ca	Mg	K	Na %	Fe	Al	Ti
Transect Along Western Edge of Pit (Drill holes in North-to-South Location Order) (Cont'd)																	
BD17007_061065	BD17007	61	65		Volcanic Breccia	0.18	0.14	0.35		700	0.69	0.28	4.64	0.17	0.65	7.13	0.13
BD17007_065069	BD17007	65	69		Volcanic Breccia	0.23	0.21	0.27	0.25	600	0.58	0.31	3.31	0.05	0.72	7.57	0.15
BD17017_019023	BD17017	19	23		Volcanic Breccia	0.05	0.04	0.43	0.43	1,300	0.72	0.42	3.80	0.36	0.85	6.59	0.17
BD17017_023027	BD17017	23	26.7	10-15	Volcanic Breccia	0.04	0.03	0.18	0.18	500	0.31	0.25	3.30	0.71	0.45	6.65	0.13
BD17017_027031	BD17017	26.7	31		Volcanic Breccia	0.04	0.03	0.34		900	0.54	0.34	4.36	0.34	0.60	7.08	0.13
BD17014_031035	BD17014	31.2	35		Volcanic Breccia	0.05	0.05	0.37	0.35	1,000	0.32	0.43	3.22	0.21	1.09	7.48	0.21
BD17014_035039	BD17014	35	39		Volcanic Breccia	0.07	0.06	0.24		800	0.29	0.32	2.87	0.43	0.67	6.63	0.16
BD17014_039043	BD17014	39	43	20	Volcanic Breccia	0.07	0.06	0.29	0.29	1,500	0.27	0.42	2.26	0.05	0.84	7.34	0.14
BD17014_043047	BD17014	43	47		Volcanic Breccia	0.05	0.04	0.40		2,000	0.30	0.54	2.38	0.05	1.02	7.27	0.15
BD17014_047051	BD17014	47	51		Volcanic Breccia	0.22	0.21	0.25		600	0.23	0.21	3.02	0.08	0.61	6.69	0.17
BD17010_038042	BD17010	37.9	41.5		Laminated tuff	0.21	0.18	0.09		500	0.22	0.26	3.04	0.05	0.66	7.86	0.10
BD17010_042046	BD17010	41.5	46		Volcanic Breccia	0.10	0.08	0.40	0.40	700	0.65	0.28	4.26	0.08	0.70	6.99	0.23
BD17010_046050	BD17010	46	50		Volcanic Breccia	0.04	0.03	0.34		500	0.70	0.38	3.23	0.03	0.80	9.02	0.23
BD17010_050054	BD17010	50	54	30-35	Volcanic Breccia	0.06	0.05	0.35	0.35	400	0.68	0.34	4.31	0.07	0.57	7.53	0.16
BD17010_054058	BD17010	54	58		Volcanic Breccia	0.06	0.04	0.29		400	0.55	0.22	5.78	0.18	0.53	6.55	0.17
BD17010_058062	BD17010	58	62		Volcanic Breccia	0.28	0.25	0.39	0.37	600	0.74	0.24	5.29	0.15	0.88	6.78	0.18
BD17010_062066	BD17010	62	66		Volcanic Breccia	0.29	0.25	0.07		400	0.20	0.11	4.66	0.07	0.54	7.18	0.15
Transect Across Northeastern Corner of Pit																	
BD17001_075078	BD17001	74.5	78		Volcanic Breccia	0.22	0.21	0.89	0.86	5,000	1.65	0.53	2.20	0.03	0.87	6.63	0.15
BD17001_078082	BD17001	78	82		Volcanic Breccia	0.13	0.10	0.29	0.27	5,000	0.46	0.22	2.62	0.03	0.58	6.69	0.15
BD17001_082086	BD17001	82	86	25	Volcanic Breccia	0.11	0.10	0.45	0.42	9,200	0.47	0.24	2.71	0.03	0.82	6.93	0.17
BD17001_086090	BD17001	86	90		Volcanic Breccia	0.16	0.14	0.26		4,200	0.41	0.19	3.15	0.03	0.83	6.60	0.15
BD17001_090094	BD17001	90	94		Volcanic Breccia	0.2	0.13	0.17	0.15	3,600	0.24	0.17	4.25	0.05	1.10	6.93	0.15
BD17001_094098	BD17001	94	98		Volcanic Breccia	0.22	0.21	0.33	0.29	7,800	0.21	0.15	4.53	0.06	1.24	6.82	0.19
BD16005_106110	BD16005	106	110		Volcanic Breccia	0.19	0.15	0.35		2,100	0.65	0.24	2.60	0.03	0.75	6.89	0.20
BD16005_110114	BD16005	110	114		Volcanic Breccia	0.19	0.17	0.20	0.18	700	0.54	0.22	2.19	0.04	0.69	6.08	0.16

Table 13 (Cont'd)
Assay Results for Low-S Samples from Fresh Rock Zone (2017-2018)

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Composite_ID	Hole_ID	From (m)	To (m)	Downhole Run (m)	Lithology	S (%)	Total-S (%, IR07)	Total-C (%, IR07)	CO ₃ -C (%)	Mn mg/kg	Ca	Mg	K	Na %	Fe	Al	Ti
Transect Across Northeastern Corner of Pit (Cont'd)																	
BD16005_114118	BD16005	114	118	20	Volcanic Breccia	0.11	0.09	0.21	0.21	1,100	0.33	0.20	2.81	0.04	0.97	7.30	0.13
BD16005_118122	BD16005	118	122		Volcanic Breccia	0.03	0.02	0.15	0.12	400	0.28	0.11	5.32	0.12	0.43	6.34	0.11
BD16005_122126	BD16005	122	126		Volcanic Breccia	0.04	0.04	0.24	0.24	600	0.34	0.14	4.96	0.09	0.60	6.76	0.13
BD16016_054059	BD16016	54.5	59		Laminated tuff	0.05	0.04	0.75	0.69	2,200	0.27	0.31	2.87	0.03	3.38	7.95	0.36
BD16016_059063	BD16016	59	63		Laminated tuff	0.07	0.06	0.78		1,800	0.84	0.42	3.10	0.04	2.14	7.22	0.31
BD16016_063067	BD16016	63	67		Laminated tuff	0.07	0.06	0.73		1,800	0.65	0.40	2.61	0.03	2.15	7.40	0.34
BD16016_067071	BD16016	67	71		Laminated tuff	0.23	0.22	0.68	0.64	2,200	0.91	0.36	1.98	0.04	1.54	6.79	0.23
BD16016_071075	BD16016	71	75		Volcanic Breccia	0.09	0.07	0.26	0.23	1,200	0.41	0.18	1.91	0.03	0.81	6.75	0.15
BD16016_075079	BD16016	75	79		Volcanic Breccia	0.04	0.02	0.29	0.27	900	0.41	0.21	2.47	0.03	0.97	7.33	0.16
BD16016_079083	BD16016	79	83	50-55	Volcanic Breccia	0.02	0.01	0.35		800	0.67	0.27	2.14	0.03	0.82	6.19	0.21
BD16016_083087	BD16016	83	87		Volcanic Breccia	0.02	0.02	0.11		400	0.28	0.15	3.05	0.04	0.51	7.01	0.16
BD16016_087091	BD16016	87	91		Volcanic Breccia	0.03	0.02	0.04		200	0.19	0.10	4.45	0.06	0.34	7.17	0.13
BD16016_091095	BD16016	91	94.8		Volcanic Breccia	0.03	0.02	0.07		200	0.23	0.13	3.94	0.06	0.44	7.68	0.14
BD16016_095099	BD16016	94.8	99		Volcanic Breccia	0.16	0.13	0.06		200	0.19	0.09	4.63	0.08	0.45	6.78	0.13
BD16016_099103	BD16016	99	103		Volcanic Breccia	0.14	0.11	0.04		200	0.17	0.08	4.85	0.07	0.36	6.68	0.13
BD16016_103107	BD16016	103	107		Volcanic Breccia	0.17	0.14	0.15	0.12	500	0.22	0.12	4.29	0.06	0.78	7.08	0.14
BD16016_107111	BD16016	107	111		Volcanic Breccia	0.07	0.06	0.22	0.18	600	0.23	0.14	4.87	0.07	0.94	7.52	0.14
BD17008_058062	BD17008	58	62		Volcanic Breccia	0.11	0.09	0.13		900	0.15	0.10	5.47	0.10	0.71	7.17	0.19
BD17008_062066	BD17008	62	66		Volcanic Breccia	0.04	0.03	0.13	0.13	900	0.15	0.12	4.29	0.06	0.69	6.69	0.19
BD17008_066070	BD17008	66	70		Volcanic Breccia	0.09	0.07	0.09		800	0.19	0.17	2.29	0.03	0.68	6.91	0.12
BD17008_070074	BD17008	70	74		Volcanic Breccia	0.08	0.06	0.05		400	0.14	0.12	4.38	0.09	0.47	6.70	0.12
BD17008_074078	BD17008	74	78		Volcanic Breccia	0.06	0.05	0.08		700	0.12	0.08	6.25	0.16	0.45	7.11	0.13
BD17008_078082	BD17008	78	82	40-45	Volcanic Breccia	0.04	0.04	0.05		300	0.07	0.02	6.97	0.29	0.38	6.23	0.11
BD17008_082086	BD17008	82	86		Volcanic Breccia	0.14	0.12	0.09	0.07	1,000	0.07	0.04	6.64	0.19	0.53	6.25	0.17
BD17008_086090	BD17008	86	90		Volcanic Breccia	0.08	0.06	0.11		600	0.07	0.06	6.30	0.16	0.69	6.26	0.18
BD17008_090094	BD17008	90	94		Volcanic Breccia	0.08	0.06	0.12		600	0.09	0.07	6.47	0.16	0.71	6.88	0.12

Table 13 (Cont'd)
Assay Results for Low-S Samples from Fresh Rock Zone (2017-2018)

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Composite_ID	Hole_ID	From	To	Downhole	Lithology	S	Total-S	Total-C	CO ₃ -C	Mn	Ca	Mg	K	Na	Fe	Al	Ti
		(m)	(m)	Run (m)		(%)	(%, IR07)	(%, IR07)	(%)	mg/kg				%			
Transect Across Northeastern Corner of Pit (Cont'd)																	
BD17008_094098	BD17008	94	98		Volcanic Breccia	0.18	0.15	0.10	0.07	600	0.10	0.09	5.58	0.13	0.67	6.17	0.16
BD17008_098102	BD17008	98	102		Volcanic Breccia	0.10	0.08	0.06		400	0.07	0.04	6.11	0.15	0.57	6.14	0.15
BD13128_071075	BD13128	71	75		Volcanic Breccia	0.06	0.04	0.32	0.32	6,000	0.11	0.11	5.23	0.09	1.01	6.00	0.19
BD13128_075079	BD13128	75	79		Volcanic Breccia	0.02	0.02	0.41	0.41	8,000	0.12	0.12	4.94	0.07	1.22	5.99	0.19
BD13128_079083	BD13128	79	83		Volcanic Breccia	0.03	0.02	0.37	0.30	3,700	0.13	0.21	3.36	0.03	1.28	6.66	0.26
BD13128_083087	BD13128	83	87	40-45	Volcanic Breccia	0.14	0.17	0.27	0.25	3,600	0.11	0.16	5.70	0.05	1.22	7.17	0.18
BD13128_102106	BD13128	102	106		Welded Tuff	0.04	0.04	0.08		400	0.05	0.01	7.65	0.15	0.46	5.94	0.14
BD13128_106110	BD13128	106	110		Welded Tuff	0.06	0.05	0.07		400	0.05	0.01	7.63	0.15	0.51	5.93	0.14
BD13128_110114	BD13128	110	114		Welded Tuff	0.08	0.07	0.05		300	0.05	0.02	7.01	0.14	0.40	5.75	0.13
BRC17001_037041	BRC17001	37	41		Volcanic Breccia	0.07	0.05	0.14		2,000	0.06	0.07	6.08	0.10	0.91	6.46	0.14
BRC17001_041045	BRC17001	41	45		Volcanic Breccia	0.08	0.06	0.30	0.26	6,500	0.09	0.04	6.66	0.20	0.80	6.88	0.13
BRC17001_045049	BRC17001	45	49	20	Volcanic Breccia	0.24	0.23	0.09	0.05	1,100	0.06	0.04	5.91	0.17	0.81	6.77	0.12
BRC17001_049053	BRC17001	49	53		Volcanic Breccia	0.02	0.02	0.24		4,700	0.09	0.09	5.87	0.10	1.08	6.55	0.12
BRC17001_053057	BRC17001	53	57		Volcanic Breccia	0.02	0.01	0.32	0.29	4,500	0.10	0.06	6.40	0.16	1.12	6.43	0.13

Table 14

Results for Acid-Base-Analysis (ABA) and Net-Acid-Generation (NAG) Testing for Low-S Samples from Fresh Rock Zone (2017-2018)

Sample_ ID	Drill hole ID	Downhole-Interval (m)	Lithology	pH-(1:2)	EC-(1:2) [mS/cm]	Total-S (%)	Cr(II)-RED.-S (%)	Sulphide- S (%)	Total-C (%)	CO ₃ -C (%)	Bulk-ANC	NAG-pH4.5	NAG-pH7.0	NAG-pH	ANC/ MPA Ratio	AFP Category
				GCA	GCA	GLS	SGS		GLS	GLS	GCA	GCA	GCA			
Transect Along Western Edge of Pit (Drill holes in North-to-South Location Order)																
BD17016_35	BD17016	35-37	laminated tuff	7.3	0.27	0.02		<0.1	0.59	0.56	34				nc	NAF
BD16003_57	BD16003	57-58	Volcanic Breccia	6.6	0.19	0.02		<0.1	0.02	<0.01	2				nc	NAF
BD17007_53	BD17007	53-55	Volcanic Breccia	6.6	1.61	0.32	0.14	0.14	0.58	0.55	34	<0.5	<0.5	8.5	>2	NAF
BD17007_55	BD17007	55-57	Volcanic Breccia	5.1	2.47	0.41	0.13	0.13	0.14	0.10	6	<0.5	1.1	4.7	1.5	PAF-[LC]
BD17007_65	BD17007	65-67	Volcanic Breccia	6.2	2.22	0.32	0.14	0.14	0.41	0.38	15	<0.5	0.6	5.9	>2	NAF
BD17014_48	BD17014	48-50	Volcanic Breccia	5.1	1.65	0.25	0.11	0.11	0.24	0.04	3	<0.5	2.9	4.0	<1	PAF-[LC]
BD17010_60	BD17010	60-62	Volcanic Breccia	7.1	0.94	0.57	0.34	0.34	0.44	0.40	21 (21)	<0.5	<0.5	8.0	2.0	NAF
Transect Across Northeastern Corner of Pit																
BD17001_74	BD17001	74.5-76	Volcanic Breccia	7.2	0.94	0.27	0.16	0.16	1.08	1.05	58 (63)	<0.5 (<0.5)	<0.5 (<0.5)	8.9 (8.8)	>2	NAF
BD17001_76	BD17001	76-78	Volcanic Breccia	7.2	0.54	0.12	0.086	<0.1	1.02	0.99	35 (39)	<0.5	<0.5	9.1	nc	NAF
BD17001_96	BD17001	96-98	Volcanic Breccia	7.3	0.55	0.23	0.20	0.20	0.24	0.21	10	<0.5	<0.5	7.3	1.6	PAF-[LC]
BD16005_114	BD16005	114-116	Volcanic Breccia	7.4 (7.3)	0.50 (0.48)	0.11	0.068	<0.1	0.28	0.28	12				nc	NAF
BD13128_73	BD13128	73-75	Volcanic Breccia	7.1 (6.9)	0.33 (0.35)	0.05		<0.1	0.26	0.22	8				nc	NAF
BD16016_105	BD16016	105-107	Volcanic Breccia	6.5	0.31	0.08		<0.1	0.15	0.12	6 (6)				nc	NAF
BD16016_67	BD16016	67-69	laminated tuff	7.4	0.86	0.38	0.22	0.22	0.73	0.70	37	<0.5	<0.5	8.7	>2	NAF
BD16016_69	BD16016	69-71	laminated tuff	7.6	0.39	0.05		<0.1	0.76	0.73	41				nc	NAF
BD13128_111	BD13128	111-113	welded tuff	5.8	0.55	0.08		<0.1	0.05	0.02	2				nc	NAF
Notes: EC = Electrical Conductivity; ANC = Acid-Neutralisation Capacity; NAG = Net-Acid Generation; MPA = Maximum-Potential Acidity; AFP = Acid-Formation Potential; NAF = Non-Acid Forming; PAF = Potentially-Acid Forming; PAF-[LC] = PAF-[Low Capacity]. pH-(1:2) and EC-(1:2) values correspond to pH and EC measured on sample slurries prepared with deionised water, and a solid:solution ratio of ca. 1:2 (w/w). All results expressed on a dry-weight basis, except for pH-(1:2), EC-(1:2), and NAG-pH. Values in parentheses represent duplicates.																

Table 15
Multi-element Analysis Results for Low-S Samples from Fresh Rock Zone (2017-2018)

Element	Total-Element Content (mg/kg or %)				Average Crustal Abundance (mg/kg or %)	Geochemical-Abundance Index (GAI)			
	Western Edge of Pit		Northeastern Corner of Pit			Western Edge of Pit		Northeastern Corner of Pit	
	Volcanic Breccia (BD17007_53)	Volcanic Breccia (BD17014_48)	Volcanic Breccia (BD17001_96)	Laminated Tuff (BD16016_67)		Volcanic Breccia (BD17007_53)	Volcanic Breccia (BD17014_48)	Volcanic Breccia (BD17001_96)	Laminated Tuff (BD16016_67)
Al	7.14%	8.00%	7.98%	7.57%	8.2%	0	0	0	0
Fe	1.22%	0.53%	0.93%	1.52%	4.1%	0	0	0	0
Na	0.040%	0.050%	0.066%	0.027%	2.3%	0	0	0	0
K	2.60%	2.91%	6.23%	2.30%	2.1%	0	0	1	0
Mg	0.37%	0.22%	0.18%	0.46%	2.3%	0	0	0	0
Ca	1.0%	0.3%	0.2%	1.1%	4.1%	0	0	0	0
Ag	0.10	1.45	0.45	0	0.07	0	4	2	1
Cu	<1	<1	1	9	50	0	0	0	0
Zn	269	169	93	205	75	1	1	0	1
Cd	1.26	0.78	0.11	1.20	0.11	3	2	0	3
Pb	54.7	269.3	17.8	25.3	14	1	4	0	0
Cr	<50	<50	<50	<50	100	0	0	0	0
Ni	<1	<1	<1	5	80	0	0	0	0
Co	1.5	0.7	0.7	9.8	20	0	0	0	0
Mn	517	1,940	6,890	1,500	950	0	0	2	0
Hg	0.02	0.03	0.01	0.02	0.05	0	0	0	0
Sn	2.4	2.6	2.4	2.5	2.2	0	0	0	0
Sr	237.2	87.22	227.9	817.4	370	0	0	0	1
Ba	427.8	480.5	508.7	427.7	500	0	0	0	0
Th	14.83	14.78	14.44	12.53	12	0	0	0	0
U	4.27	8.03	3.37	7.20	2.4	0	1	0	1
Tl	3.16	3.01	5.28	2.79	0.6	2	2	3	2
V	17	13	12	64	160	0	0	0	0
As	11.5	11.1	15.8	15.0	1.5	2	2	3	3
Bi	0.23	0.31	0.17	0.36	0.048	2	2	1	2
Sb	6.33	5.01	8.76	5.90	0.2	4	4	5	4
Se	0.03	0.04	0.01	0.09	0.05	0	0	0	0
Mo	1.6	0.9	0.6	1.1	1.5	0	0	0	0
B	<50	<50	<50	<50	10	0	0	0	0
P	207	87	278	681	1,000	0	0	0	0
F	506	1,030	869	576	950	0	0	0	0
Notes: Average-crustal abundance based on Bowen (1979). Geochemical-Abundance Index (GAI) defined in Annexure 4 .									

Table 16
Mineralogical Results for Low-S Samples from Fresh Rock Zone (2017-2018)

Western Edge of Pit				Northeastern Corner of Pit	
Volcanic Breccia (BD16003_57)		Volcanic Breccia (BD17007_53)		Volcanic Breccia (BD16003_57)	
Na/K-feldspar quartz	major	Na/K-feldspar quartz	major	Na/K-feldspar quartz	major
sericite	minor	sericite	minor	sericite	minor
leucoxene	trace	Pyrite Rhodochrosite Dolomite Mn-siderite leucoxene	trace	Pyrite Ankerite Mg-siderite leucoxene	trace
Notes: major = 20-50%; minor = 10-20%; and, trace is less than 2%					

Table 17

Water-Extraction-Testwork Results for Low-S Samples from Fresh Rock Zone (2017-2018)

Sample_ID	Hole_ID	Downhole-Interval (m)	Lithology	Total-S (%)	CRS (%)	CO ₃ -C (%)	AFP	pH	EC	HCO ₃ (as mg/L CaCO ₃)	Cl (mg/L)	SO ₄ (mg/L)	F (mg/L)	Ca	Mg	K	Na	Al	Fe	Mn	Si	As	Sb	Se	Mo	B
								(µS/cm)		mg/L								µg/L								
Transect Along Western Edge of Pit																										
BD17007_53	BD17007	53-55	Volcanic Breccia	0.32	0.14	0.55	NAF	6.8	1,216	98	3.8	628	0.3	181.9	66.33	17.0	16.1	0.05	<0.01	8.13	4.04	1.7	2.18	<0.5	3.03	<10
BD17007_55	BD17007	55-57	Volcanic Breccia	0.41	0.13	0.10	PAF-[LC]	4.9	1,716	7	7.6	1,140	<0.1	259.8	101.0	20.9	22.1	0.23	10.3	16.90	6.85	2.1	0.25	<0.5	3.30	<10
BD17007_65	BD17007	65-67	Volcanic Breccia	0.32	0.14	0.38	NAF	5.9	1,875	53	8.7	1,260	<0.1	302.3	113.0	29.4	25.7	0.08	0.14	13.33	4.83	1.6	0.83	<0.5	0.31	<10
BD17014_48	BD17014	48-50	Volcanic Breccia	0.25	0.11	0.04	PAF-[LC]	5.0	928	5	4.4	490	<0.1	96.33	44.57	22.6	17.4	0.07	1.11	8.08	9.29	3.4	0.28	1.5	0.12	<10
Transect Across Northeastern Corner of Pit																										
BD17001_74	BD17001	74.5-76	Volcanic Breccia	0.27	0.16	1.05	NAF	7.8	677	51	4.0	288	1.5	80.18	28.53	16.5	8.9	0.01	<0.01	0.49	2.55	2.0	4.07	<0.5	72.59	<10
BD17001_96	BD17001	96-98	Volcanic Breccia	0.23	0.20	0.21	PAF-[LC]	7.8	397	70	3.0	103	2.0	35.71	13.24	22.0	6.8	0.03	<0.01	0.22	7.10	5.1	2.97	<0.5	9.75	<10
BD16016_67	BD16016	67-69	laminated tuff	0.38	0.2	0.70	NAF	7.6	-	100	4.0	271	0.5	85.47	33.31	18.3	8.8	0.02	<0.01	0.94	2.57	2.0	2.07	3.4	14.95	<10
Sample_ID	Hole_ID	Downhole-Interval (m)	Lithology	Total-S (%)	CRS (%)	CO ₃ -C (%)	AFP	Ni	Cr	Co	Cu	Zn	Cd	Pb	Hg	Ag	Bi	Sn	Ba	Sr	P	Tl	Th	U	V	
								µg/L																		
Transect Along Western Edge of Pit																										
BD17007_53	BD17007	53-55	Volcanic Breccia	0.32	0.14	0.55	NAF	<10	<10	20.4	<10	150	2.3	56	<0.1	<0.01	0.012	<0.1	15.24	1,576	<100	1.07	<0.005	1.599	<10	
BD17007_55	BD17007	55-57	Volcanic Breccia	0.41	0.13	0.10	PAF-[LC]	20	<10	73.3	<10	3,820	18.2	81	<0.1	0.02	0.015	<0.1	16.05	2,494	<100	4.16	0.016	1.938	<10	
BD17007_65	BD17007	65-67	Volcanic Breccia	0.32	0.14	0.38	NAF	<10	<10	20.3	<10	40	1.9	3	<0.1	0.10	0.011	<0.1	21.90	3,269	<100	5.61	<0.005	0.202	<10	
BD17014_48	BD17014	48-50	Volcanic Breccia	0.25	0.11	0.04	PAF-[LC]	20	<10	17.4	<10	140	3.2	15	<0.1	0.02	0.009	<0.1	15.08	1,083	<100	1.04	0.035	3.384	<10	
Transect Across Northeastern Corner of Pit																										
BD17001_74	BD17001	74.5-76	Volcanic Breccia	0.27	0.16	1.05	NAF	<10	<10	0.6	<10	<10	<0.5	4	<0.1	<0.01	<0.005	<0.1	10.88	596.0	<100	0.15	<0.005	0.495	<10	
BD17001_96	BD17001	96-98	Volcanic Breccia	0.23	0.20	0.21	PAF-[LC]	<10	<10	<0.1	<10	<10	<0.5	<2	<0.1	<0.01	<0.005	0.2	8.26	333.3	<100	0.18	<0.005	3.406	<10	
BD16016_67	BD16016	67-69	laminated tuff	0.38	0.2	0.70	NAF	<10	<10	11.3	<10	<10	<0.5	<2	<0.1	<0.01	<0.005	<0.1	12.98	716.1	<100	0.38	<0.005	18.82	<10	
Notes: EC = Electrical Conductivity; CRS = Cr(II)-Reducible-S; AFP = Acid Formation Potential; NAF = Non-Acid Forming; PAF = Potentially-Acid Forming; PAF-[LC] = PAF-[Low Capacity] Water-Extraction Testwork corresponds to slurries prepared from the crushed (nominal -2mm) samples prepared using high-purity-deionised water (HPDW), and a solid:water ratio of 1:2 (w/w). Test-slurries bottle-rolled overnight and then left to 'still-stand' for ca. 1-2 days prior to decanting supernatants for vacuum filtration (0.45µm-membrane) for analysis.																										

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Table 18
Static Testing to Assess Acid-forming Characteristics of Soil-clay samples

GCA-Sample No.	Site-sample No.	Total-S (%)	SO ₄ -S [Na ₂ CO ₃] (%)	Total-C (combustion) (%)	Total-C (Walkley-Black, %)	Bulk-ANC	AFP Category
						(kg H ₂ SO ₄ /tonne)	
GCA11380	A00428	0.02 (0.02)	<0.01 (<0.01)	0.40 (0.40)	0.4 (0.4)	4 (4)	NAF
GCA11381	A00429	0.02	<0.01	0.51	0.6	3	NAF
GCA11382	A00430	0.01	<0.01	0.24	0.3	4	NAF

Table 19
Multi-element Analysis Results for Soil-clay Samples

Element	Total-Element Content (mg/kg or %)			Average- Crustal Abundance (mg/kg or %)	Geochemical-Abundance Index (GAI)		
	GCA11380 (A00428)	GCA11381 (A00429)	GCA11382 (A00430)		GCA11380 (A00428)	GCA11381 (A00429)	GCA11382 (A00430)
Al	5.1%	5.2%	6.0%	8.2%	0	0	0
Fe	2.0%	2.5%	2.8%	4.1%	0	0	0
Na	0.079%	0.053%	0.28%	2.3%	0	0	0
K	1.1%	0.74%	1.2%	2.1%	0	0	0
Mg	0.23%	0.19%	0.24%	2.3%	0	0	0
Ca	<0.1	0.1%	0.1%	4.1%	0	0	0
Ag	0.07	0.07	1.1	0.07	0	0	3
Cu	10	14	34	50	0	0	0
Zn	49	44	79	75	0	0	0
Cd	<0.02	0.05	0.13	0.11	0	0	0
Pb	17	19	43	14	0	0	1
Cr	70	80	79	100	0	0	0
Ni	22	25	22	80	0	0	0
Co	9.1	9.2	13	20	0	0	0
Mn	370	290	810	950	0	0	0
Hg	0.03	0.02	0.02	0.05	0	0	0
Sn	2.1	2.4	2.2	2.2	0	0	0
Sr	89	79	110	370	0	0	0
Ba	320	260	430	500	0	0	0
Th	10	9.8	9.7	12	0	0	0
U	2.1	2.4	2.3	2.4	0	0	0
Tl	0.34	0.38	0.83	0.6	0	0	0
V	42	59	79	160	0	0	0
As	4.6	7.5	16	1.5	1	2	3
Bi	0.23	0.28	0.20	0.048	2	2	1
Sb	0.43	0.67	1.2	0.2	1	1	2
Se	0.07	0.18	0.09	0.05	0	1	0
Mo	1.0	1.1	1.2	1.5	0	0	0
B	<50	<50	<50	10	0	0	0
P	340	270	400	1,000	0	0	0
F	400	260	300	950	0	0	0

Notes: Average-crustal abundance based on Bowen (1979). Geochemical-Abundance Index (GAI) defined in **Annexure 4**.

Table 20
Mineralogical Results for Soil-clay samples

GCA11380 (A00428)					GCA11381 (A00429)					GCA11382 (A00430)				
Dominant		quartz			Dominant		quartz			Dominant		quartz		
Major					Major		kaolinite			Major				
Minor		kaolinite			Minor					Minor		kaolinite		
Accessory		smectite/illite (RI) muscovite/illite K-feldspar goethite			Accessory		muscovite/illite goethite K-feldspar			Accessory		muscovite/illite goethite K-feldspar		
Trace		T-oxides carbonaceous material			Trace		smectite/illite (RI) smectite carbonaceous material			Trace		smectite/illite (RI) smectite carbonaceous material		
eCEC [cmol (p+)/kg]	%-Proportion of eCEC				eCEC [cmol (p+)/kg]	%-Proportion of eCEC				eCEC [cmol (p+)/kg]	%-Proportion of eCEC			
	Na	K	Mg	Ca		Na	K	Mg	Ca		Na	K	Mg	Ca
9.4 (9.9)	4.9 (4.8)	4.8 (4.8)	55.2 (55.2)	35.1 (35.2)	7.0	8.5	4.2	53.2	34.1	9.9	6.9	3.7	47.1	42.3
Notes: eCEC = effective Cation Exchange Capacity; RI = randomly interstratified dominant = greater than 50%; major = 20-50%; minor = 10-20%; accessory = 2-10%; and, trace is less than 2%														

Annexures

(Total No. of pages including blank pages = 442)

- Annexure 1* GCA (2012) Report on Initial Geochemical Testing of Waste Rock Samples from Internal Waste Zone (14 pages)
- Annexure 2* GCA (2013) Report on Process-Tailings Geochemistry (60 pages)
- Annexure 3* Details of Sampling Programs for Waste Rock, Ore and Soil Samples (52 pages)
- Annexure 4 Testwork Methods (8 pages)
- Annexure 5 Acid-Formation Potential (AFP): Classification Criteria (4 pages)
- Annexure 6* Laboratory Reports (302 pages)

* This Annexure is only available on the digital version of this document

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Annexure 1

GCA (2012) Report on Initial Geochemical Testing of Waste Rock Samples from Internal Waste Zone

(Total No. of pages including blank pages = 14)

Note: This Annexure is only available on the digital version of this document

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GRAEME CAMPBELL & ASSOCIATES PTY LTD
Specialists in Mine-Waste Geochemistry,
& Soil-Moisture-Retention Testing

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1201

COMPANY: Kingsgate Bowdens Pty Ltd
ATTENTION: Rob Gobert
FROM: Graeme Campbell
SUBJECT: Bowdens Silver Project: Initial Geochemical Testing of
Mine-Waste samples from Internal-Waste-Zone
NO. PAGES (including this page): 11 DATE: 22nd June 2012

Rob,

The testwork results obtained in this initial study are presented in Table 1. Sample details are presented in Attachment I, and copies of the laboratory reports are presented in Attachment II.

All samples are classified as Potentially-Acid Forming (PAF), due to "trace/accessory-sulphides" in a groundmass devoid of reactive-carbonate-minerals (e.g. calcites).

Given this "gutless-groundmass", the "lag-phase" (i.e. period during which sulphide-oxidation occurs, but acidification does not develop) should be short (e.g. a matter of weeks over winter/spring when conditions are near-optimal for sulphide-oxidation via regular flushing by rainfall). The sulphide-mineral suite would need to have sluggish intrinsic-oxidation kinetics in order for the lag-phase to be appreciably longer than this seasonal estimate.

Given the Zn contents (presumably chiefly as sphalerites) up to several thousand mg/kg (Attachment I), Zn (and Cd) solubility may be significant during lag-phase weathering, due to the pH-solubility relationship of these metals (i.e. potential generation of metalliferous-drainage).

Further work is clearly needed on mine-waste geochemistry for this Project.

I trust the above is useful to you.

Regards,

Dr GD Campbell
Director

encl. Table 1.
Attachments I-II.

Graeme Campbell & Associates Pty Ltd

TABLE

Graeme Campbell & Associates Pty Ltd

Table 1: Acid-Base-Analysis and Net-Acid-Generation Results for Mine-Waste Samples

GCA-SAMPLE NO.	SITE-SAMPLE NO.	DRILLHOLE & DOWN-HOLE INTERVAL (m)	LITHOTYPE	pH-(1:2)	EC-(1:2) [mS/cm]	TOTAL-S (%)	SO ₄ -S (%)	SULPHIDE-S (%)	TOTAL-C (%)	CO ₂ -C (%)	kg H ₂ SO ₄ /tonne			NAG	NAG-pH	AFP CATEGORY
											Bulk-ANC	NAPP				
GCA10039	30430	BGD029, 13-14	Weathered-Ignimbrite	3.8	0.52	1.6 (1.6)	0.05	1.6	<0.01	<0.01	4 (4)	45	43	2.6	PAF	
GCA10040	30436	BGD029, 19-20	Weathered-Ignimbrite	5.1	0.33	1.3	0.04	1.3	0.10	<0.01	4	36	34	2.7	PAF	
GCA10041	30451	BGD029, 34-35	Crystal-Tuff	5.6	0.33	2.2	0.05	2.2	0.53	0.04	25	43	39	2.7	PAF	
GCA10042	30454	BGD029, 37-38	Crystal-Tuff	6.2	0.23	0.92	0.02	0.90	0.63	0.05	20	7.6	7.9	4.1	PAF	
GCA10043	30458	BGD029, 39-40	Crystal-Tuff	6.3	0.39	1.9	0.03	1.9	0.76	0.07	21	38	23	3.1	PAF	
GCA10044	30475	BGD029, 55-56	Crystal-Tuff	5.0	0.42	2.6	0.06	2.6	0.32	0.01	19	61	47	2.6	PAF	
GCA10045	30476	BGD029, 56-57	Crystal-Tuff	5.0	0.72	5.2	0.08	5.2	0.41	0.03	28	140	89	2.4	PAF	
GCA10046	30488	BGD029, 65-66	Crystal-Tuff	5.1	0.81	3.3	0.08	3.3	0.29	0.02	17	84	59	2.5	PAF	
GCA10047	31871	BGD042, 84-85	Ignimbrite	5.1	0.34	0.73	0.03	0.70	0.19	0.01	13	8.5	1.5	4.0	PAF	
GCA10048	31922	BGD042, 130-131	Ignimbrite	6.4 (6.4)	0.38 (0.42)	1.2	0.02	1.2	0.34	0.02	22	15	14	3.0	PAF	
GCA10049	31924	BGD042, 132-133	Ignimbrite	6.9	0.35	1.1	0.03	1.1	0.46	0.03	32	1.7	<0.5	6.2	PAF	
GCA10050	31926	BGD042, 134-135	Ignimbrite	5.9	0.43	0.93	0.03	0.90	0.31	0.01	16	12	9.8	3.2	PAF	
GCA10051	31927	BGD042, 135-136	Ignimbrite	6.1	0.29	0.86	0.02	0.84	0.21	<0.01	17	8.8	<0.5	8.7	PAF	
GCA10052	31929	BGD042, 137-138	Ignimbrite	5.0	0.50	0.76	0.04	0.72	0.22	0.01	15	7.1	5.6	3.6	PAF	
GCA10053	31930	BGD042, 138-139	Ignimbrite	5.7 (5.6)	0.34 (0.33)	0.67	0.03	0.64	0.25	0.01	20	-0.4	2.0 (2.7)	4.2 (4.1)	PAF	

Notes:
EC = Electrical Conductivity; ANC = Acid-Neutralisation-Capacity; NAPP = Net-Acid-Producing-Potential; AFP = Acid-Formation-Potential; NAF = Non-Acid-Forming; PAF = Potentially-Acid-Forming; NAG = Net-Acid Generation.
pH(1:2) and EC(1:2) values correspond to pH and EC measured on sample slurries prepared with deionised-water, and a solid:solution ratio of c. 1:2 (w/w).
All results expressed on a dry-weight basis, except for pH(1:2), EC(1:2), and NAG-pH.
Values in parentheses represent duplicates.

ATTACHMENT I

SAMPLE DETAILS

Graeme Campbell & Associates Pty Ltd

Bowdens Silver project M2521
Preliminary waste geochemistry samples
Dec-11

Sample							ME-ICP61 [acid digest with ICP finish]							Leco
	Sample	Hole ID	m	AgE (ppm)	mass (kg)	Lithology	ppm Ag	ppm Cd	ppm Pb	% S	ppm Zn	ppm As	% S	
1	30430	BGD029	13 to 14	15.15	2.72	Weathered ignimbrite	9.0	3.3	4160	1.80	653	228	1.65	
2	30436	BGD029	19 to 20	16.14	2.74	Weathered ignimbrite	9.0	22.1	1030	1.61	4930	1050	1.55	
3	30451	BGD029	34 to 35	18.92	2.84	crystal tuff	7.5	3.7	3110	2.13	2430	86.9	2.00	
4	30454	BGD029	37 to 38	17.88	3.36	crystal tuff	8.0	3.7	3040	1.13	2110	110.5	10.3	
5	30458	BGD029	39 to 40	15.6	2.96	crystal tuff	5.7	2.9	1610	1.98	2050	91.8	1.85	
6	30475	BGD029	55 to 56	18.52	3.8	crystal tuff	11.7	4.1	1560	2.41	2220	179.5	2.35	
7	30476	BGD029	56 to 57	10.34	3.06	crystal tuff	2.3	<0.5	109	4.69	3410	166.5	4.58	
8	30488	BGD029	65 to 66	12.45	3.1	crystal tuff	5.1	3.8	1580	2.80	1440	120	2.71	
9	31871	BGD042	84 to 85	6.59	3.09		6.1	0.7	156	0.71	226	35.8	0.66	
10	31922	BGD042	130 to 131	17.05	2.26	Ignimbrite	4.8	9.5	2090	1.25	2520	70.1	1.28	
11	31924	BGD042	132 to 133	9.15	3.02	Ignimbrite	17.0	2.4	1990	1.14	659	50	1.15	
12	31926	BGD042	134 to 135	12.75	3.78	Ignimbrite	3.8	2.5	328	0.99	605	39.8	0.92	
13	31927	BGD042	135 to 136	4.89	2.36	Ignimbrite	3.9	1.6	107	0.85	376	37.6	0.78	
14	31929	BGD042	137 to 138	6.46	3.02	Ignimbrite	4.9	2.1	229	0.75	570	35.3	0.67	
15	31930	BGD042	138 to 139	5.45	3.16	Ignimbrite	1.9	2.6	151	0.70	798	42.1	0.64	

ATTACHMENT II

LABORATORY REPORTS

Graeme Campbell & Associates Pty Ltd

GLS Job Code 143.0/1200903

Client ON GCA 1201



Dr G Campbell
CAMPBELL, GRAEME and ASSOCIATES PTY LTD
PO Box 247
BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1200903
No. of SAMPLES	15
CLIENT O/N	GCA 1201
PROJECT	Bowdens
STATE	Solid
DATE RECEIVED	19/01/2012
DATE COMPLETED	09/02/2012

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

The samples were received as Solids which were dried at 80°C.
The samples were crushed to a nominal 2mm a split was then taken and fine pulverised to a nominal -75um

Results of analysis on:

Element		S	S-SO ₄	C	TOC+C	C-CO ₃
Method		/CSA	S72/GR	/CSA	C71/CSA	/CA
Detection		0.01	0.01	0.01	0.01	0.01
Units		%	%	%	%	%
Sample Name						
Control Blank		X	X	X	X	X
GCA10039		1.55	0.05	0.01	0.02	0
GCA10039	check	1.58	0.05	0	0.02	0
GCA10040		1.29	0.04	0.1	0.1	0
GCA10041		2.12	0.05	0.53	0.49	0.04
GCA10042		0.92	0.02	0.63	0.58	0.05
GCA10043		1.81	0.03	0.76	0.69	0.07
GCA10044		2.52	0.06	0.32	0.31	0.01
GCA10045		5.19	0.08	0.41	0.38	0.03
GCA10046		3.24	0.08	0.29	0.27	0.02
GCA10047		0.73	0.03	0.19	0.18	0.01
GCA10048		1.18	0.02	0.34	0.32	0.02
GCA10049		1.09	0.03	0.46	0.43	0.03
GCA10050		0.93	0.03	0.31	0.3	0.01
GCA10051		0.86	0.02	0.21	0.21	0

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GLS Job Code 143.0/1200903

Client ON GCA 1201

Element		S	S-SO4	C	TOC+C	C-CO3
Method		/CSA	S72/GR	/CSA	C71/CSA	/CA
Detection		0.01	0.01	0.01	0.01	0.01
Units		%	%	%	%	%
Sample Name						
GCA10052		0.76	0.04	0.22	0.21	0.01
GCA10053		0.67	0.03	0.25	0.24	0.01
MA-1b		1.16		2.36		2.36
PD-1			4.28			0
S_SO4_A			0.58			0
S_SO4_B			1.32			0

Notes

1. Total-S and Total-C were determined on the pulps
2. Total-C and Total-S was determined using an induction furnace according to Genalysis method number MPL_W043. The samples are ignited in oxygen ~1700C and the CO2 and SO2 measured by infrared detectors
3. S-SO4 was determined on the pulps by precipitation of BaSO4 according to Genalysis method number ENV_W039, after digestion with Na2CO3 (S72/GR)
4. TOC+C (acid insoluble carbon compounds and elemental carbon) by a C&S analyser after removal of carbonates and soluble organic carbon using hot hydrochloric acid according to Genalysis method number MPL_W046.

Results of analysis on:

Element		Fizz	volume	HCl	NaOH	Colour	pH	ANC	ANC
Method		Rate	ml	M	M	Change	Drop	soln pH	kgH2SO4/t
GCA10039		0	8	0.563	0.169	N	0	1.6	4
GCA10039	check	0	8	0.563	0.169	N	0	1.6	4
GCA10040		0	8	0.563	0.169	N	3.0	1.7	4
GCA10041		0	8	0.563	0.169	Y	2.9	1.6	25
GCA10042		0	8	0.563	0.169	Y	2.7	1.7	20
GCA10043		0	8	0.563	0.169	Y	0	1.6	21
GCA10044		0	8	0.563	0.169	N	3.7	1.7	19
GCA10045		0	8	0.563	0.169	Y	0	1.5	28
GCA10046		0	8	0.563	0.169	Y	0	1.6	17
GCA10047		0	8	0.563	0.169	N	0	1.6	13
GCA10048		0	8	0.563	0.169	N	0	1.7	22
GCA10049		0	8	0.563	0.169	N	0	1.6	32
GCA10050		0	8	0.563	0.169	N	0	1.5	16
GCA10051		0	8	0.563	0.169	N	0	1.6	17
GCA10052		0	8	0.563	0.169	N	0	1.6	15
GCA10053		0	8	0.563	0.169	N	0	1.5	20

Notes:

1. ANC was determined on 2g -. Acid concentrations are as stated.
2. Colour change: Y indicates the appearance of a green colouration as the pH=7 endpoint was approached. N indicates no colour change. Two drops of 30 % hydrogen peroxide are added to each sample as the endpoint is approached to oxidise any ferrous iron.
3. pH drop : Result reported when the pH drops to a value below 4 on addition of peroxide
4. This "Bulk-ANC" static-testing procedure is based on AMIRA (2002), according to Genalysis method number ENV_W035

GLS Job Code 143.0/1200903

Client ON GCA 1201

NATA ENDORSED DOCUMENT
Company Accreditation Number 3244

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NATA Signatory: Manel Geevaratne

Manel Geevaratne

Date: 9/02/2012



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NATA accreditation requirements.

*Graeme Campbell & Associates Pty Ltd**Laboratory Report***pH-(1:2) & EC-(1:2) TESTWORK**

SAMPLE NO.	SAMPLE WEIGHT (g)	SAMPLE + DEION.-W WEIGHT (g)	pH-(1:2)	EC-(1:2) (µS/cm)
GCA10039	30.0	60.0	3.8	520
GCA10040	30.0	60.0	5.1	330
GCA10041	30.0	60.0	5.6	330
GCA10042	30.0	60.0	6.2	230
GCA10043	30.0	60.0	6.3	390
GCA10044	30.0	60.0	5.0	420
GCA10045	30.0	60.0	5.0	720
GCA10046	30.0	60.0	5.1	810
GCA10047	30.0	60.0	5.1	340
GCA10048	30.0	60.0	6.4	380
GCA10048-1	30.0	60.0	6.4	420
GCA10049	30.0	60.0	6.9	350
GCA10050	30.0	60.0	5.9	430
GCA10051	30.0	60.0	6.1	290
GCA10052	30.0	60.0	5.0	500
GCA10053	30.0	60.0	5.7	340
GCA10053-1	30.0	60.0	5.6	330

Note: EC = Electrical-Conductivity.

Testwork performed on the as-supplied 'pulp' samples (nominal -75 µm).

pH-(1:2) and EC-(1:2) values correspond to pH and EC values of suspensions with a solid:solution ratio of c. 1:2 (w/w) prepared using deionised-water.

Drift in pH-glass-electrode less than 0.1 pH unit between commencement, and completion, of testwork.

Drift in EC-electrode less than 5 µS/cm between commencement, and completion, of testwork.

Testwork performed in a constant-temperature room (viz. 21 +/- 2 °C).

Dr GD Campbell**22nd June 2012**

Graeme Campbell & Associates Pty Ltd

Laboratory Report

NET-ACID-GENERATION (NAG) TESTWORK

Sample Number	Sample Weight (g)	Comments	pH of Test Mixture Before Boiling Step	Test Mixture After Boiling Step		Titre [0.1 M-NaOH] (mL)	NAG (kg H ₂ SO ₄ /tonne)
				pH	EC (µS/cm)		
GCA10039	3.0	Reaction peaked overnight	2.3	2.6	2,200	25.80	43
GCA10040	3.0	Reaction peaked overnight	2.4	2.7	1,600	20.40	34
GCA10041	3.0	Reaction peaked within 90 minutes	2.4	2.7	1,800	23.50	39
GCA10042	3.0	Reaction peaked overnight	3.0	4.1	530	4.80	7.9
GCA10043	3.0	Reaction peaked overnight	2.5	3.1	1,100	13.90	23
GCA10044	3.0	Reaction peaked within 90 minutes	2.3	2.6	2,200	28.20	47
GCA10045	3.0	Reaction peaked within 1 hour	2.1	2.4	4,000	54.10	89
GCA10046	3.0	Reaction peaked within 1 hour	2.2	2.5	2,700	35.80	59
GCA10047	3.0	Reaction peaked overnight	4.1	4.0	470	0.90	1.5
GCA10048	3.0	Reaction peaked overnight	4.5	3.0	900	8.50	14
GCA10049	3.0	Reaction peaked overnight	4.1	6.2	420	0.20	<0.5
GCA10050	3.0	Reaction peaked overnight	3.5	3.2	610	6.00	9.8
GCA10051	3.0	Reaction peaked overnight	9.6	8.7	130	-	<0.5
GCA10052	3.0	Reaction peaked overnight	3.6	3.6	410	3.40	5.6
GCA10053	3.0	Reaction peaked overnight	3.8	4.2	350	1.20	2.0
GCA10053-1	3.0	Reaction peaked overnight	3.8	4.1	350	1.60	2.7
BLANK1	3.0	Reaction peaked overnight	5.8	7.1	81	-	<0.5

Notes: Test conditions based on those described by Miller *et al.* (1997), and AMIRA (2002) for the 'Static-NAG-Test' in its 'Single-Addition-Mode'. The pH of the 15 % (v/v) H₂O₂ solution was adjusted to 4.5 using 0.1 M-NaOH prior to commencing the NAG Tests. Following an overnight-reaction period, the test-mixtures were boiled for c. 2 hours. Then, after allowing the test-mixtures to cool, c. 1.0 mL of 0.016 M-CuSO₄ solution was added, and the test-mixtures again boiled for c. 2 hours. The addition of Cu(II) catalyses the decomposition of any residual, unreacted-H₂O₂ in the test-mixtures (McInnea and Ahern 2004; O'Shay *et al.* 1990). K-Feldspar was employed for the Blank.

Dr GD Campbell
10th June 2012

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Annexure 2

GCA (2013) Report on Process-Tailings Geochemistry

(Total No. of pages including blank pages = 60)

Note: This Annexure is only available on the digital version of this document

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GRAEME CAMPBELL & ASSOCIATES PTY LTD
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1220/2

COMPANY: Kingsgate Consolidated Limited
ATTENTION: Rob Gobert
FROM: Graeme Campbell
SUBJECT: Bowdens Project: Geochemical Characterisation of
Tailings-Slurry Samples and Implications for Process-
Tailings Management

NO. PAGES (including this page): 58 DATE: 12th March 2013

Rob,

Details of the bench-scale-metallurgical-testwork programme undertaken to generate the tailings-slurry samples are presented in Attachment I.

The "tailings-types" tested herein correspond to:

- (a) **Flotation-Tailings;**
- (b) **Flotation-Tailings-[-pyrite];** and,
- (c) **Flotation-Tailings-[pyrite-leach].**

The 6 tailings-slurry samples submitted for testing correspond to each of the above tailings-types for both Stage-1 and Stage-2 of the Project.

It is understood that the currently preferred processing route will produce Flotation-Tailings as in (a).

The testwork results obtained in this study are presented in Tables 1-4.

Details of the testwork methods employed herein are presented in Attachment II, and criteria for classifying the Acid-Formation Potential (AFP) of the tailings-solids samples are summarised in Attachment III. Copies of the laboratory reports are presented in Attachment IV.

1.0 GEOCHEMISTRY OF TAILINGS-SOLIDS SAMPLES

For a specific tailings-type, there is negligible difference in the geochemistry of the Stage-1 and Stage-2 samples which attests to a high degree of uniformity in the composition and mineralogy of the ore-zone overall.

Graeme Campbell & Associates Pty Ltd

1.1 Flotation-Tailings and Flotation-Tailings-[pyrite-leach] Samples

1.1.1 Acid-Forming Characteristics

These samples were characterised by (Table 1):

- Sulphide-S values of 0.63-1.1 %;
- Acid-Neutralisation-Capacity (ANC) values of 8-14 kg H₂SO₄/tonne, and CO₃-C values of 0.15-0.27 %; and,
- Net-Acid-Generation (NAG) values of 13-19 kg H₂SO₄/tonne, and NAG-pH values of 2.8-3.6.

All tailings-solids samples are classified as **Potentially-Acid-Forming (PAF)**, and reflect "trace/accessory-sulphides" (pyrite) in a gangue devoid of reactive-carbonates (e.g. calcites).

1.1.2 Multi-Element Composition and Mineralogy

The tailings-solids samples were variously enriched in Ag, Pb, As and Sb (Table 2). However, the degree of enrichment in these minor-elements was not marked.

All samples had an identical mineralogy (Table 3), viz.

- a gangue comprising mostly K-feldspar, quartz, and illite; and
- accessory amounts of pyrite and rhodochrosite (i.e. MnCO₃).

The rhodochrosite has important implications for Mn solubility both during weathering, and within the ex-mill-tailings-slurry-waters, as discussed below.

1.2 Flotation-Tailings-[-pyrite] Sample

The geochemistry of this sample was essentially identical to that of the other tailings-solids samples (see above), save for having lower Sulphide-S values of 0.19-0.26 % (Table 1).

In terms of acid-forming tendency, the classification of the Flotation-Tailings-[-pyrite] sample is Uncertain (UC), based on the available information.

This sample did not acidify in the Static-NAG Test (i.e. NAG-pH values of 5.6-5.9), and so its classification may be Non-Acid-Forming (NAF). However, further testing (including kinetic-testing employing weathering-columns) would be needed to fully assess the AFP of the Flotation-Tailings-[-pyrite] sample. Assessing the acid-forming tendency of lithotypes with a "trace-sulphide/carbonate-deficient" mineralogy is not without its technical challenges (Campbell *et al.* 2012).¹

Provisionally, this sample is classified herein as **UC-[NAF?]**.

¹ Reference: Campbell GD, Haymont R, and Amoah N, 2012, "A Testing Approach to Assess the Weathering Behaviour of Lithotypes Characterised by a Trace-sulphide/Carbonate-deficient Mineralogy: Application to Altered Andesites/Diorites at the Boddington Gold Mine, Western Australia", paper presented at the *9th International Conference on Acid Rock Drainage*, Ottawa, May 21-25, 2012.

2.0 QUALITY OF TAILINGS-SLURRY-WATER SAMPLES

All tailings-slurry-water samples had a similar quality (Table 4), viz.

- pH 7-8 with HCO_3 concentrations of c. 50-60 mg/L;
- Electrical-Conductivity (EC) values of c. 500-700 $\mu\text{S}/\text{cm}$; and,
- Mn concentrations of c. 10-30 mg/L.

The concentrations of minor-elements in these neutral-to-alkaline, dilute (viz. "potable-salinity") waters were below, or close to, the respective detection-limits (typically 0.1-10 $\mu\text{g}/\text{L}$), save for Mn. The Mn concentrations are elevated, and likely reflect dissolution of rhodochrosites during processing.

The CN_{tot} and CN_{wad} concentrations in the tailings-slurry-waters were less than 1 mg/L, and the SCN concentration was c. 25-40 mg/L.² Given the pH values of the tailings-slurry samples, some loss (via volatilisation) of cyanide forms from solution was likely prior to analysis for this study. Nonetheless, the indications are that within the tailings-storage-facility (TSF), the decant-pond-water should have CN_{wad} concentrations below the 50 mg/L guideline value generally accepted for the protection of wildlife (e.g. birds).³ Monitoring during TSF operation would be needed to fully assess the concentrations of cyanide forms.

3.0 IMPLICATIONS FOR PROCESS-TAILINGS MANAGEMENT

3.1 Active-Lifetime of TSF

Due to the discharge of process-tailings in a slurry form to the TSF, circum-neutral (viz. pH 6-8) conditions should prevail during the operational phase, since the near-saturated conditions will suppress pyrite-oxidation. It is assumed here that the dormant-beaches do not remain exposed for longer than several months.

Pore-fluids within the porous framework of the tailings-bed should be circum-neutral, and of "near-potable-salinity", assuming that the mill uses makeup-water of potable-salinity (as for the scheme-water employed in the bench-scale-metallurgical-testwork programme).

Porefluid-Mn concentrations should be within the range c. 10-30 mg/L, due to *inter alia* rhodochrosite dissolution during processing. Such elevated Mn concentrations have implications for seepage-control measures for the TSF.

The above remarks do not depend on which "tailings-type" is discharged to the TSF, and so are generic for the Project.

3.2 Decommissioning Phase

Since it is understood that the currently favoured processing route will produce a stream of Flotation-Tailings, decommissioning of the TSF will need to cater for a tailings-bed which has the potential to acidify if pyrite-oxidation is not constrained over the longer-

² CN_{tot} = Total-Cyanide; CN_{wad} = Weak-Acid-Dissociable-Cyanide.

³ Reference: Environment Australia, 1998, "Cyanide Management", Best Practice Environmental Management in Mining, Commonwealth of Australia.

term. A TSF-cover system will therefore need to be designed which restricts both water infiltration and O₂ ingress.

In considering options for designing the TSF-cover system, the generation of a Flotation-Tailings-[-pyrite] stream during the latter stages of the Project may benefit TSF-closure overall. That is, placement of a "trace-pyrite-tailings" in the uppermost 1-2 m (nominal) of the tailings-bed which forms a basal-zone for the TSF-cover profile overall. The weathering behaviour of the Flotation-Tailings-[-pyrite] would need to be assessed as part of this potential option for decommissioning the TSF.

4.0 CLOSURE

I trust the above is useful to your current needs.

Regards,

Dr GD Campbell

Director

encl. Tables 1-4.
Attachments I to IV.

Graeme Campbell & Associates Pty Ltd

TABLES

Graeme Campbell & Associates Pty Ltd

Table 1: Acid-Base-Analysis and Net-Acid-Generation Results for Tailings-Solids Samples

GCA-SAMPLE NO.	SITE-SAMPLE NO.	PROJECT STAGE	TOTAL-S (%)	SO ₄ -S (%)	SULPHIDE-S (%)	TOTAL-C (%)	CO ₃ -C (%)	BULK-ANC		NAG	NAG-pH	AFP CATEGORY
								kg H ₂ SO ₄ /tonne				
<u>Flotation-Tailings</u>												
GCA10610	A	Stage-1	1.0 (1.1)	0.24 (0.23)	0.87	0.19 (0.19)	0.17 (0.15)	8 (9)	19	17	2.8	PAF
GCA10613	D	Stage-2	1.2	0.14	1.1	0.30	0.27	14	20	19	3.0	PAF
<u>Flotation-Tailings-[pyrite]</u>												
GCA10611	B	Stage-1	0.26	0.07	0.19	0.19	0.17	10	-4.1	<0.5	5.6	UC-[NAF?]
GCA10614	E	Stage-2	0.37	0.11	0.26	0.30	0.27	13	-5.0	<0.5	5.9	UC-[NAF?]
<u>Flotation-Tailings-[pyrite-leach]</u>												
GCA10612	C	Stage-1	0.77	0.14	0.63	0.19	0.15	10	9.3	19	3.0	PAF
GCA10615	F	Stage-2	0.82	0.14	0.68	0.30	0.27	13	7.9	13 (13)	3.6 (3.6)	PAF

Notes:

ANC = Acid-Neutralisation-Capacity; NAPP = Net-Acid-Producing-Potential; AFP = Acid-Formation-Potential; NAG = Net-Acid Generation; PAF = Potentially-Acid-Forming; UC = Uncertain; NAF = Non-Acid-Forming.

All results expressed on a dry-weight basis, except for NAG-pH.

Values in parentheses represent duplicates.

Table 2: Multi-Element-Analysis Results for Tailings-Solids Samples

ELEMENT	TOTAL-ELEMENT CONTENT (mg/kg or %)				AVERAGE-CRUSTAL-ABUNDANCE (mg/kg or %)	GEOCHEMICAL-ABUNDANCE INDEX (GAI)			
	Flotation-Tailings [Stage-1] (A, GCA10610)	Flotation-Tailings [Stage-2] (D, GCA10613)	Flot.-Tailings [-pyrite] [Stage-1] (B, GCA10611)	Flot.-Tailings [-pyrite] [Stage-2] (E, GCA10614)		Flotation-Tailings [Stage-1] (A, GCA10610)	Flotation-Tailings [Stage-2] (D, GCA10613)	Flot.-Tailings [-pyrite] [Stage-1] (B, GCA10611)	Flot.-Tailings [-pyrite] [Stage-2] (E, GCA10614)
Al	6.1%	6.8%	6.2%	6.9%	8.2%	0	0	0	0
Fe	1.6%	1.8%	0.84%	1.0%	4.1%	0	0	0	0
Na	0.082%	0.090%	0.087%	0.088%	2.3%	0	0	0	0
K	5.7%	6.3%	5.9%	6.5%	2.1%	1	1	1	1
Mg	0.11%	0.13%	0.12%	0.12%	2.3%	0	0	0	0
Ca	0.080%	0.15%	0.12%	0.17%	4.1%	0	0	0	0
Ag	12	12	4.3	5.8	0.07	6	6	5	6
Cu	45	46	37	38	50	0	0	0	0
Zn	410	260	330	210	75	2	1	2	1
Cd	0.89	0.63	0.49	0.41	0.11	2	2	2	1
Pb	270	240	200	160	14	4	4	3	3
Cr	260	250	230	270	100	1	1	1	1
Ni	110	110	99	110	80	0	0	0	0
Co	3.0	4.7	2.0	3.6	20	0	0	0	0
Mn	6,400	12,000	6,300	11,000	950	2	3	2	3
Hg	0.03	0.08	0.03	0.03	0.05	0	0	0	0
Sn	2.1	2.0	2.3	2.0	2.2	0	0	0	0
Sr	290	250	280	240	370	0	0	0	0
Ba	810	720	830	750	500	0	0	0	0
Th	11	11	11	11	12	0	0	0	0
U	3.5	3.5	3.6	3.4	2.4	0	0	0	0
Tl	5.0	6.9	4.8	5.3	0.6	2	3	2	3
V	19	33	19	34	160	0	0	0	0
As	170	340	63	190	1.5	6	6	5	6
Bi	0.24	0.11	0.13	0.05	0.048	2	1	1	0
Sb	13	12	12	12	0.2	5	5	5	5
Se	0.05	0.04	0.03	0.02	0.05	0	0	0	0
Mo	11	7.2	9.3	6.9	1.5	2	2	2	2
B	<50	<50	<50	<50	10	0	0	0	0
P	350	410	350	420	1,000	0	0	0	0
F	470	560	500	580	950	0	0	0	0

Note: Average-crustal abundance of elements based on Bowen (1979), and the Geochemical-Abundance Index (GAI) is based on Förstner *et al.* (1993). Refer Attachment I.

Table 2 (Cont'd): Multi-Element-Analysis Results for Tailings-Solids Samples

ELEMENT	TOTAL-ELEMENT CONTENT (mg/kg or %)		AVERAGE- CRUSTAL ABUNDANCE (mg/kg or %)	GEOCHEMICAL- ABUNDANCE INDEX (GAI)	
	Flot.-Tailings- [pyrite-leach] [Stage-1] (C, GCA10612)	Flot.-Tailings- [pyrite-leach] [Stage-2] (F, GCA10615)		Flot.-Tailings- [pyrite-leach] [Stage-1] (C, GCA10612)	Flot.-Tailings- [pyrite-leach] [Stage-2] (F, GCA10615)
Al	6.1%	6.9%	8.2%	0	0
Fe	1.4%	1.5%	4.1%	0	0
Na	0.082%	0.093%	2.3%	0	0
K	5.8%	6.6%	2.1%	1	1
Mg	0.11%	0.13%	2.3%	0	0
Ca	0.12%	0.19%	4.1%	0	0
Ag	7.4	8.1	0.07	6	6
Cu	36	49	50	0	0
Zn	370	250	75	2	1
Cd	0.69	0.51	0.11	2	2
Pb	250	200	14	4	3
Cr	240	280	100	1	1
Ni	110	120	80	0	0
Co	2.7	4.3	20	0	0
Mn	6,100	11,000	950	2	3
Hg	0.04	0.04	0.05	0	0
Sn	2.1	2.2	2.2	0	0
Sr	260	240	370	0	0
Ba	780	750	500	0	0
Th	9.5	11	12	0	0
U	3.4	3.3	2.4	0	0
Tl	5.0	6.3	0.6	2	3
V	17	34	160	0	0
As	140	280	1.5	6	6
Bi	0.21	0.08	0.048	2	0
Sb	14	13.00	0.2	6	5
Se	0.04	0.04	0.05	0	0
Mo	9.7	7.2	1.5	2	2
B	54	<50	10	2	0
P	310	430	1,000	0	0
F	500	590	950	0	0

Table 3: Mineralogical Results for Tailings-Solids Samples

Flotation Tailings				Flotation Tailings [-pyrite]			
Stage-1 (A, GCA10610)		Stage-2 (D, GCA10613)		Stage-1 (B, GCA10611)		Stage-2 (E, GCA10614)	
Component	Abundance	Component	Abundance	Component	Abundance	Component	Abundance
K-feldspar quartz	major	K-feldspar quartz	major	K-feldspar quartz	major	K-feldspar quartz	major
illite	minor	illite	minor	illite	minor	illite	minor
pyrite	accessory	pyrite rhodochrosite	accessory	rhodochrosite	accessory	pyrite rhodochrosite	accessory
rhodochrosite hornblende goethite leucoxene zircon	trace	leucoxene zircon anatase	trace	pyrite siderite zircon anatase rutile	trace	zircon leucoxene goethite anatase	trace

Note:

major = 20-50 %; minor = 10-20 %; accessory = 2-10 %; and, trace = less than 2 %

Flotation Tailings [-pyrite-leach]			
Stage-1 (C, GCA10612)		Stage-2 (F, GCA10615)	
Component	Abundance	Component	Abundance
K-feldspar quartz	major	K-feldspar quartz	major
illite	minor	illite	minor
pyrite rhodochrosite	accessory	pyrite rhodochrosite	accessory
leucoxene zircon anatase	trace	leucoxene zircon anatase	trace

Table 4: Analysis Results for Tailings-Slurry-Water Samples

ELEMENT/ PARAMETER	Flotation- Tailings [Stage-1] (A, GCA10610)	Flotation- Tailings [Stage-2] (D, GCA10613)	Flot.-Tailings- [-pyrite] [Stage-1] (B, GCA10611)	Flot.-Tailings- [-pyrite] [Stage-2] (E, GCA10614)	ELEMENT/ PARAMETER	Flotation- Tailings [Stage-1] (A, GCA10610)	Flotation- Tailings [Stage-2] (D, GCA10613)	Flot.-Tailings- [-pyrite] [Stage-1] (B, GCA10611)	Flot.-Tailings- [-pyrite] [Stage-2] (E, GCA10614)
Minor-Ions (µg/L)									
Major-Parameter									
pH	7.2	7.3	6.8	7.2	Fe	<10	<10	<10	<10
EC (µS/cm)	560	690	440	560	Cu	170	620	110	620
Major-Ions (mg/L)									
Na	25	28	26	27	Ni	<10	20	<10	10
K	38	37	32	32	Zn	1,100	810	420	40
Mg	9.5	16	7.1	12	Co	55	72	34	49
Ca	45	63	32	46	Al	80	20	<10	20
Cl	38	40	37	40	Cd	6.2	4.6	1.7	1.7
SO ₄	150	310	120	160	Pb	51	2.3	2.2	1.7
HCO ₃	51	52	51	48	Cr	20	20	<10	20
CO ₃	<1	<1	<1	<1	Hg	<0.1	<0.1	<0.1	<0.1
Si	7.1	6.5	7.4	6.6	As	33	64	40	86
Nitrogen-Forms (mg/L)									
NH ₃ -N	1.9	2.0	0.86	0.94	Sb	31	21	36	28
NO ₃ -N	0.23	0.26	0.22	0.24	Bi	<0.005	<0.005	<0.005	<0.005
Cyanide Forms (mg/L)									
CN _{tot}	0.53	0.29	0.03	0.49	Se	1.5	1.3	1.3	1.1
CN _{rad}	<0.01	0.21	0.03	0.49	B	<10	20	<10	20
CN _{free}	<0.1	0.1	<0.1	0.2	Mo	30	56	68	72
SCN	25	26	26	24	P	100	100	<100	100
					F	1.5	1.6	1.5	2
					Ag	0.62	12	11	31
					Ba	52	42	57	50
					Sr	160	300	120	220
					Tl	1.4	1.9	0.91	1.4
					V	<10	<10	<10	<10
					Sn	<0.1	<0.1	<0.2	<0.01
					U	0.12	0.23	0.16	0.18
					Th	<0.005	<0.005	<0.005	<0.005
					Mn	19,000	32,000	9,600	18,000

Notes:

EC = Electrical-Conductivity; CN_{tot} = Total Cyanide; CN_{rad} = Weak-Acid-Dissociable Cyanide; CN_{free} = Free Cyanide

Table 4 (Cont'd): Analysis Results for Tailings-Slurry-Water Samples

ELEMENT/ PARAMETER	Flot.-Tailings- [pyrite-leach] [Stage-1] (C, GCA10612)	Flot.-Tailings- [pyrite-leach] [Stage-2] (F, GCA10615)	ELEMENT/ PARAMETER	Flot.-Tailings- [pyrite-leach] [Stage-1] (C, GCA10612)	Flot.-Tailings- [pyrite-leach] [Stage-2] (F, GCA10615)
Major-Parameters					
pH	7.5	7.4	Fe	<10	<10
EC (µS/cm)	450	580	Cu	940	1,500
Major-Ions (mg/L)					
Na	32	35	Ni	<10	<10
K	32	34	Zn	410	320
Mg	7.0	12	Co	37	47
Ca	32	45	Al	<10	40
Cl	42	45	Cd	2.0	1.7
SO ₄	130	240	Pb	2.1	5.9
HCO ₃	59	53	Cr	10	20
CO ₃	<1	<1	Hg	<0.1	<0.1
Si	7.3	6.9	As	30	38
Nitrogen-Forms (mg/L)					
NH ₃ -N	1.1	0.83	Sb	42	32
NO ₃ -N	0.22	0.24	Bi	<0.005	<0.005
Cyanide Forms (mg/L)					
CN _{tot}	0.33	0.48	Se	1.3	0.9
CN _{head}	0.21	0.33	B	<10	20
CN _{free}	0.1	0.2	Mo	72	83
SCN	39	40	P	100	100
			F	1.6	1.7
			Ag	30	8.4
			Ba	61	45
			Sr	120	210
			Tl	0.98	1.5
			V	<10	<10
			Sn	<0.1	<0.1
			U	0.25	0.45
			Th	<0.005	<0.005
			Mn	11,000	20,000

ATTACHMENT I

**DETAILS OF BENCH-SCALE-METALLURGICAL STUDY EMPLOYED
TO GENERATE TAILINGS-SLURRY SAMPLES FOR TESTING**

Graeme Campbell & Associates Pty Ltd



MEMORANDUM

TO: Graeme Campbell
CC: Bob Markovich
DATE: 10/01/2013
FROM: Rob Gobert
SUBJECT: Bowdens Silver Project –
Tailings samples

Summary

Metallurgical samples were obtained from drill core of all three major rock types at the Bowdens silver project: ignimbrite, breccia and crystal tuff. Production period composite samples were then prepared by combining proportional quantities of the rock types from within the relevant pit shell. A mining stage 1 sample was prepared from core within the pit shell of the first 10Mt. The mining stage 2 sample was prepared from core within the pit shell containing the subsequent 20Mt.

The Bowdens process will use flotation to recover separate concentrates of Ag/Pb and Zn. Process tailings were prepared for geo-chemical analysis by using locked cycle flotation:

- (A) Flotation tailings – Stage 1;
- (D) Flotation tailings – Stage 2;

To gain additional information, the tailings produced via two additional different flowsheets were also submitted for geo-chemical analysis:

- (B) Flotation Tailings with most of the pyrite removed – Stage 1;
- (C) Flotation Tailings including leached pyrite – Stage 1;
- (E) Flotation Tailings with most of the pyrite removed – Stage 2;
- (F) Flotation Tailings including leached pyrite – Stage 2;

1.0 Introduction

The Bowdens silver deposit is located approximately 30km from Mudgee in NSW and is hosted by flat-lying acid volcanic rocks of the early Permian Rylstone Volcanics (280 million years old) that unconformably overlie a sequence basic volcanics of Ordovician age (460 million years old). The Rylstone Volcanics are partially overlain by Shoalhaven Group sediments of the Sydney Basin, approximately 250 million years old. The Rylstone Volcanics range in thickness from 10m to 200m and comprise mainly acidic breccias, ignimbrites and tuffs.

Silver mineralisation at Bowdens occurs within flat-lying to moderately dipping zones in the Rylstone Volcanics and is primarily hosted by sulphides of iron, arsenic, lead and zinc. High grade silver mineralisation is also hosted in steeply-dipping fracture zones which host banded sulphide veins.

The bulk of the mineralisation within the site occurs as a zone extending from surface, and near surface, to vertical depths of approximately 200m.

Previous mineralogical examination of both core and concentrate indicates:

- The dominant gangue minerals are quartz and feldspar, with trace to minor muscovite, rhodochrosite and traces of rutile and zircon;

- Sulphide minerals are present as pyrite, sphalerite, and galena, with traces of arsenopyrite and chalcopyrite;
- The sphalerite has low iron content at 1.7% - 4.0% Fe;
- Silver mineralisation has been identified present as acanthite (Ag_2S), stephanite (Ag_2SbS_4), pearceite ($\text{Ag,Cu}_{16}(\text{As,Sb})_2\text{S}_{11}$), polybasite [$(\text{Ag,Cu})_6(\text{Sb,As})_2\text{S}_7$][Ag_9CuS_4], tetrahedrite ($\text{Cu,Fe}_{12}\text{Sb}_4\text{S}_{13}$) and freibergite $\text{Ag,Cu,Fe}_{12}(\text{Sb,As})_4\text{S}_{13}$.

2. METALLURGICAL SAMPLES

2.1 Sample preparation

A series of 12 diamond core holes were drilled in 2012 across the orebody to obtain sample for metallurgical testing from each of the dominant lithology types: ignimbrite, breccia and crystal tuff. The whole core was cut to ½ core with a subsample from each 1m section being assayed for major elements. Samples were selected from each lithology based on preparing composites with a contained silver grade approximating the processing grade. Selected sections of ½ core were wrapped in plastic and placed in core trays labeled with the hole number and meter sections for dispatch. The samples were selected based on rock type to represent mining in Stage 1 (first 10Mt of ore) and Stage 2 (subsequent 20Mt of ore).

Stage1:

Crystal Tuff: B002-MET, B004-MET & B006-MET

Breccia: B003-MET & B007-MET

Ignimbrite: B005-MET & B008-MET

Stage 2:

Crystal Tuff: B009-MET & B011-MET

Breccia: B012-MET(11.4-21m only TBC) & B013-MET

Ignimbrite: B010-MET & B014-MET"

Table 1: Initial composite weight

Sample ID	Hole ID	Depth From	Depth To	Wt rec'd kg	Rock Type	Expected Ag ppm
B001-MET	BD12001	3.4	12.3	23.9	Breccia	88.6
B002-MET	BD12002	35	47	36.6	Crystal Tuff	68.06
B003-MET	BD12004	38	53	45.5	Breccia	59.66
B004-MET	BD12005	34	40	19.7	Crystal Tuff	75.96
B005-MET	BD12007	23	36	43.1	Ignimbrite	56.23
B006-MET	BD12008	34	46	39.9	Crystal Tuff	105.8
B007-MET	BD12009	54	69	51.7	Breccia	103.34
B008-MET	BD12010	62	79	55.9	Ignimbrite	127.81
B009-MET	BD12002	62	73	34.8	Crystal Tuff	51.05
B010-MET	BD12002	13	33.25	59.5	Ignimbrite	44.83
B011-MET	BD12004	72	91	60.4	Crystal Tuff	49.61
B012-MET	BD12007	7	21	44.0	Breccia	56
B013-MET	BD12011	71	84	41.5	Breccia	49.42
B014-MET	BD12012	118	128	33.4	Ignimbrite	63.03

Photographs of the core samples are shown in Figure 1 and sample hole details are listed in Table 2:

Table 2: Selected Bowdens drill core sections

FLOTATION SAMPLES (Yrs 1-4)										
Sample ID	Hole_Id	Depth From	Depth To	Interval	Wt Ag Grade (ppm)	Wt Age Grade (ppm)	Ag Yrs Age Diff (%)	Rock Type	Weathering and Oxidation	Comments
B001-MET	*BD12001*	34	12.3	8.9	88.6	102.38	13.5	Breccia	3.4-7.1m: mod-strongly weathered, oxidised	
B002-MET	BD12002	35	47	12	68.06	83.74	18.7	Crystal Tuff	7.1-8.9: slightly weathered, no oxidation	
B003-MET	BD12004	38	53	15	59.66	68.76	13.2	Breccia	Fresh, v minor surface oxidation	
B004-MET	*BD12005*	34	40	6	75.96	82.74	8.2	Crystal Tuff	Fresh, v minor pervasive oxidation	
B005-MET	BD12007	23	36	13	56.23	77.27	27.2	Ignimbrite	Fresh, v minor pervasive oxidation	
B006-MET	BD12008	34	46	12	105.8	130.58	19.0	Crystal Tuff	Fresh, no oxidation	
B007-MET	BD12009	54	69	15	103.34	152.19	32.1	Breccia	Fresh, no oxidation	
B008-MET	BD12010	62	79	17	127.81	154.43	17.2	Ignimbrite	Fresh, no oxidation	
				Total mtr	98.9					
FLOTATION SAMPLES (Yrs 5-13)										
Sample ID	Hole_Id	Depth From	Depth To	Interval	Wt Ag Grade (ppm)	Wt Age Grade (ppm)	Ag Yrs Age Diff (%)	Rock Type	Weathering and Oxidation	Comments
B009-MET	BD12002	62	73	11	51.05	68.82	25.8	Crystal Tuff	Fresh, no oxidation	
B010-MET	*BD12002*	13	33.25	20.25	44.83	56.37	20.5	Ignimbrite	Fresh, v minor oxidation	
B011-MET	BD12004	72	91	19	49.61	53.98	8.1	Crystal Tuff	Fresh, no oxidation	
B012-MET	*BD12007*	7	21	14	56	71.48	21.7	Breccia	7-11.4m: mod weathered and oxidised 11.4-21m: Fresh, no oxidation	
B013-MET	BD12011	71	84	13	49.42	56.34	12.3	Breccia	Fresh, no oxidation	
B014-MET	BD12012	118	128	10	63.03	71.5	11.8	Ignimbrite	Fresh, no oxidation	
				Total mtr	87.25					
COMMUNUTION SAMPLES										
Sample ID	Hole_Id	Depth From	Depth To	Interval	Wt Ag Grade (ppm)	Wt Age Grade (ppm)	Ag Yrs Age Diff (%)	Rock Type	Weathering and Oxidation	Comments
BD12004-COM	BD12004	92	107	15	61.35	66.76	8.1	Crystal Tuff	Fresh, no oxidation	Extends below final pit design
BD12006-COM	BD12006	5	25	20	6.98	36.41	80.8	Ignimbrite	Fresh, no oxidation	Very high Zn credits
BD12009-COM	BD12009	89	106	17	17.48	49.67	64.8	Crystal Tuff	Fresh, no oxidation	Outside 4th yr pit
BD12010-COM	BD12010	48	60	12	13.16	19.32	31.9	Breccia	Fresh, minor oxidation	Sub economic grade
BD12011-COM	BD12011	87	100.2	13.2	167.94	180.09	6.7	Ignimbrite	Fresh, no oxidation	
BD12012-COM	BD12012	103.3	110.7	7.4	125.97	145.14	13.2	Breccia	Fresh, no oxidation	
				Total mtr	84.6					

Total Interval (mtrs) / Proportion Per Rock Type			
Type			
Rock Type	Mtrs	%	
Breccia	38.9	39.3	
Ignimbrite	30	30.3	
Crystal Tuff	30	30.3	
Wt Average Grades All Intervals Per Rock Type			
Wt Ag Grade (ppm)			
Breccia			83.1
Ignimbrite			79.64
Crystal Tuff			84.74

Total Interval (mtrs) / Proportion Per Rock Type			
Type			
Rock Type	Mtrs	%	
Breccia	27	30.9	
Ignimbrite	30.25	34.7	
Crystal Tuff	30	34.4	
Wt Average Grades All Intervals Per Rock Type			
Wt Ag Grade (ppm)			
Breccia			52.8
Ignimbrite			53.6
Crystal Tuff			50.1

Total Interval (mtrs) / Proportion Per Rock Type			
Type			
Rock Type	Mtrs	%	
Breccia	19.4	22.9	
Ignimbrite	33.2	39.2	
Crystal Tuff	32	37.9	
Wt Average Grades All Intervals Per Rock Type			
Wt Ag Grade (ppm)			
Breccia			59.3
Ignimbrite			71
Crystal Tuff			38

* Samples to undergo separate floatation batch tests

* Samples to undergo separate floatation batch tests

Figure 1: Half core in sample trays



2.2 Sample Head Assays

Each of the lithology composites were crushed to minus 2mm and blended to allow for sampling. A head sample was riffled from each and assayed for silver. Samples with the same lithology were then combined into lithology composites.

For instance composites B002, B004 and B006 were each classified as 'crystal tuff' from Stage 2 and so were combined into one composite (B016-TUFF). Similarly B010 and B014 were both classified as 'ignimbrite' from Stage 2 and were combined into one composite (B020-IGN). The methodology is shown in Figure 2.

Figure 2: Composite preparation

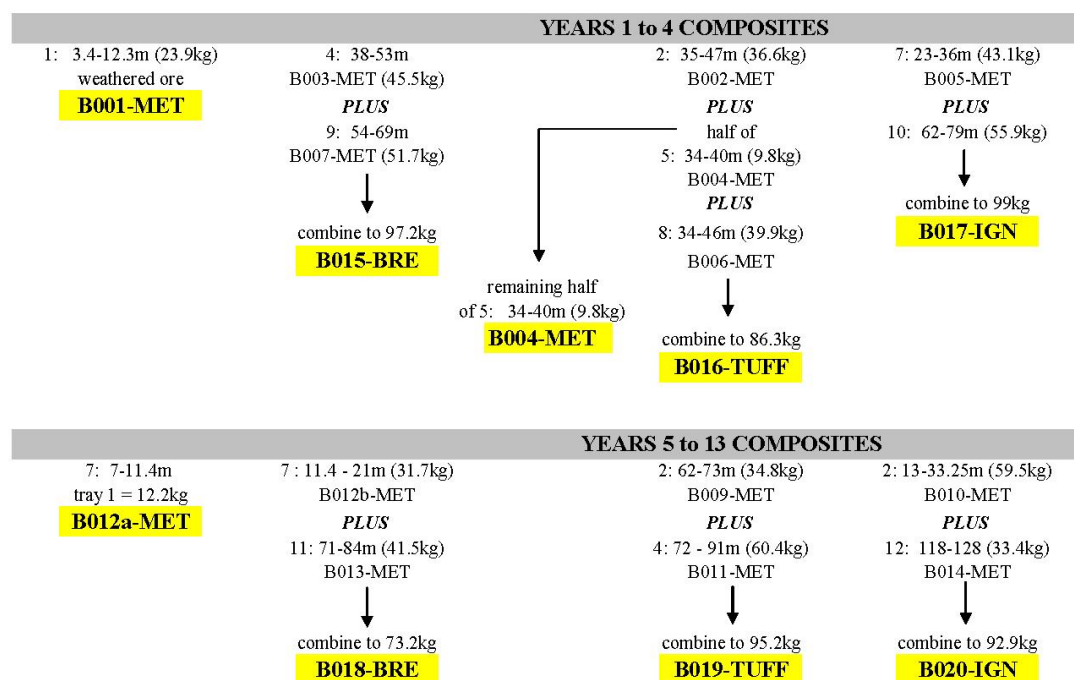


Table 3 shows the calculated silver composite grades based on the core assays and the metallurgy lab (Metcon) assays.

Table 3: Predicted composite grades

Test Composite	years	B00.. MET B00...	kg	expected ppm Ag	Metcon ppm Ag
B001 - MET	weathered	1 - 4			82
B004 - MET	weathered	1 - 4			100
B012a-MET	weathered	5 - 13			30
B015 -BRE	breccia	1 - 4	3	45.2	60
			7	51.4	103
				96.6	83
B016 - TUFF	crystal tuff	1 - 4	2	36.5	68
			4	8.8	76
			6	39.6	106
				84.9	86
B017-IGN	ignimbrite	1 - 4	5	43	56
			8	55.1	128
				98.1	96
B018 - BRE	breccia	5 - 13	12b	31	-
			13	41.3	49
				72.3	97
B019 - TUFF	crystal tuff	5 - 13	9	34.7	51
			11	60.3	50
				95	50
B020-IGN	ignimbrite	5 - 13	10	59.1	45
			14	33.1	63
				92.2	51

The lithology composites were riffle sampled and assayed in more detail for the elements shown in Table 4.

Table 4: Assay of lithology composites

Comp.	% moisture	ppm Ag	ppm As	ppm Cu	% Fe	ppm Pb	ppm Zn	% S
B001	1.58	78.4	529	10	0.78	1930	2460	0.66
B004	0.33	88.2	125	20	1.64	1330	2710	1.56
B012a	0.86	75.1	48	11	0.86	1390	622	0.20
B015	0.63	77.4	156	93	0.92	8070	5640	1.28
B016	0.68	50.2	277	14	2.2	2340	4290	1.93
B017	0.57	80.4	179	31	1.09	4040	6740	1.35
B018	0.43	104	96	21	0.71	2590	3880	0.86
B019	0.6	52.7	138	23	1.91	1470	2650	1.75
B020	1.04	44.8	604	15	0.83	1520	2420	0.90

Adjustments to Composites

Based on the assays in Table 4 additional sample was provided to increase the silver grade of BO16.

Additional core sample was provided as follows: BD12005: from 28 to 34m 18.5kg

This was crushed to minus 2mm, blended and assayed at 187ppm Ag before combining with the existing composite. Final assays are shown in Table 5

Table 5: Head assays adjusted for composite BO16

Comp.	% moisture	ppm Ag	ppm As	ppm Cu	% Fe	ppm Pb	ppm Zn	% S
B001	1.58	78.4	529	10	0.78	1930	2460	0.66
B004	0.33	88.2	125	20	1.64	1330	2710	1.56
B012a	0.86	75.1	48	11	0.86	1390	622	0.20
B015	0.63	77.4	156	93	0.92	8070	5640	1.28
B016	0.68	84.1	235	14	2.08	2970	4970	1.88
B017	0.57	80.4	179	31	1.09	4040	6740	1.35
B018	0.43	104	96	21	0.71	2590	3880	0.86
B019	0.6	52.7	138	23	1.91	1470	2650	1.75
B020	1.04	44.8	604	15	0.83	1520	2420	0.90

Master composites:

The mine average composites were prepared using the lithology proportions shown in Table 6. Once they were combined they were thoroughly blended and then divided into 2kg portions.

Table 6: Preparation of Average Mine Ore Composites

Lithology Type	Stage 1 – AM1		Stage 2 – AM2	
	Sample	Wt %	Sample	Wt %
Breccia	BO15-BRE	29.1	BO18-BRE	8.2
Crystal Tuff	BO16-TUFF	16.3	BO19-TUFF	49.3
Ignimbrite	BO17-IGN	54.6	BO20-IGN	42.5
	Total	100.0	Total	100.0

Head assays were completed on each composite with the results shown in Table 7.

Table 7: Average mine ore head assays

Comp.	ppm Ag	ppm As	% Fe	ppm Pb	ppm Zn	% S
AM1	84	210	1.63	5280	6965	1.52
AM2	56	350	1.74	1760	2970	1.36

The following flotation tailings samples were prepared from each composite as slurry at approximately 30% solids w/w. The conceptual process flowsheets are shown below.

Stage 1 (AM1) samples:

A – Flotation tailings (Flowsheet 1 attached)

B – Flotation tailings with most of the pyrite removed.

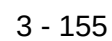
C – Flotation tailings including a pyrite leach residue (Flowsheet 2 attached)

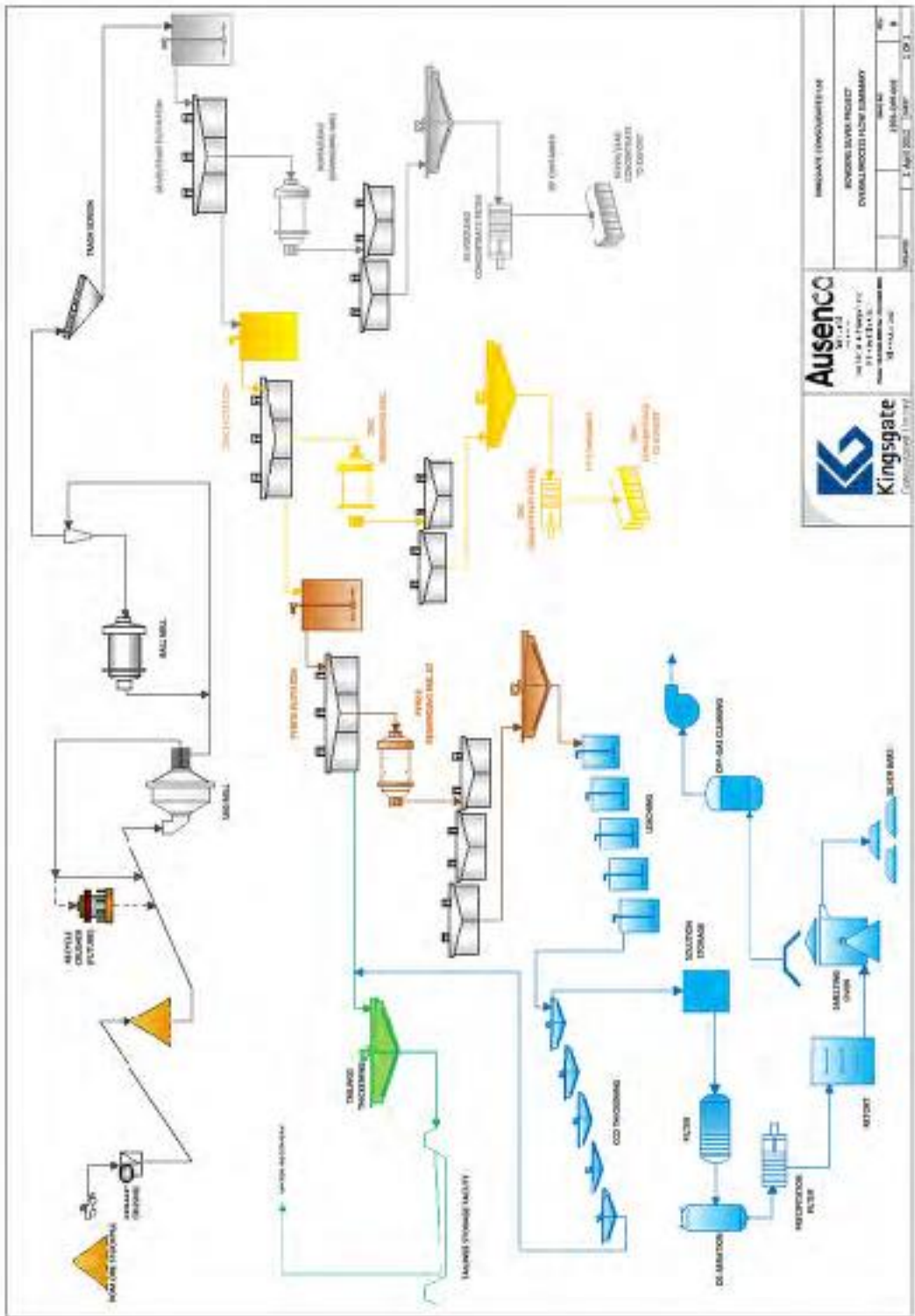
Stage 2 samples:

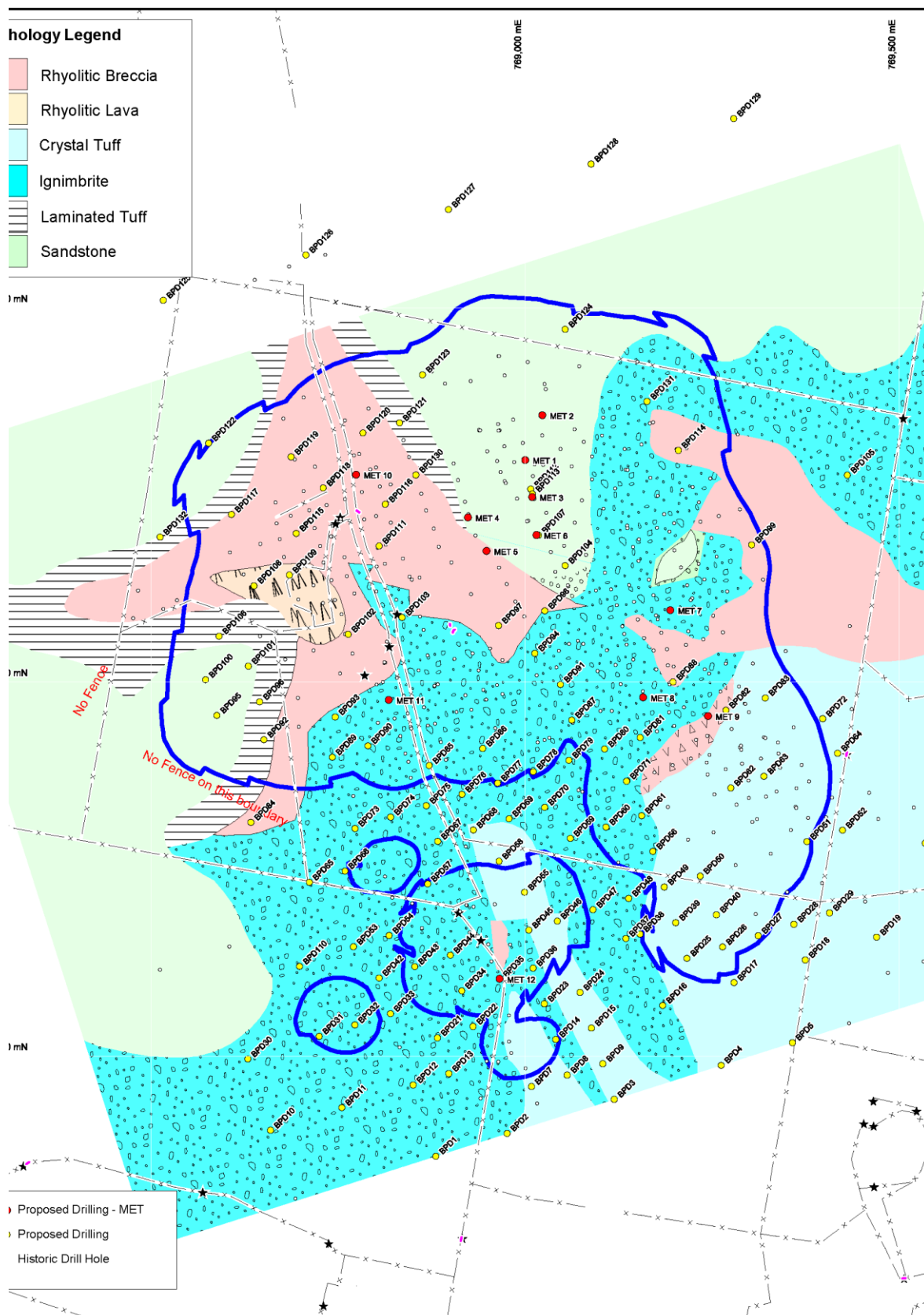
D – Flotation tailings (zinc rougher tails), float test BF62, approximately 3.74kg

E – Flotation tailings with most of the pyrite removed (float test BF63), approximately 3.71kg

F – Flotation tailings including a pyrite leach residue (float test BF64, leach test BL38), 3.75kg







ATTACHMENT II

TESTWORK METHODS

Graeme Campbell & Associates Pty Ltd

ATTACHMENT II

TESTWORK METHODS

The testwork methods outlined below are proven approaches to 'static-testing' within the Australian, and international mining-industries (e.g. Price 2009; Stewart *et al.* 2006; AMIRA 2002; Morin and Hutt 1997).¹ The MEND-document prepared by Price (2009), and some 0-20 years in the making by experienced practitioners (including Dr. Kevin Morin, MDAG, Vancouver), is an invaluable source of information on testing methods on mine-waste geochemistry. There is also the Global-Acid-Rock-Drainage-Guide (GARD Guide) which is an INAP initiative (go to: www.gardguide.com). However, in terms of comprehensiveness, structure, and clarity, the document by Price (2009) is recommended.

Part of the acid-base-account (ABA) testing, and all of the multi-element analyses, and clay-surface-chemical determinations, are carried out by Genalysis Laboratory Services Pty Ltd [GLS] (Maddington). Specialised ABA-testing is undertaken by GCA (Bridgetown), and characterisation of rock- and clay-mineralogy is carried out by Roger Townend & Associates (Malaga).

Samples are crushed to 2mm (nominal) in a jaw/rolls-crusher, and pulverised to 75µm (nominal), for specific tests, as required. These sample-splits are referred to herein as "crushings" and "pulp", respectively.

It should be noted that the testwork methods described below are routinely employed in work programmes undertaken by GCA. However, the testwork methods described are generic, and specific tests may not necessarily be undertaken in a given study.

1.0 ACID-BASE-CHEMISTRY AND SALINITY TESTWORK

Acid-base chemistry and salinity are assessed by determining:

- pH and Electrical-Conductivity (EC) on sample slurries;
- Total-Sulphur (Total-S), and Sulphate-Sulphur (SO₄-S);
- Acid-Neutralisation-Capacity (ANC), and CO₃-C;
- Net-Acid-Producing-Potential (NAPP); and,
- Net-Acid-Generation (NAG).

Relevant details of the testwork methods employed are discussed below. Further details are presented in the laboratory reports.

¹ 'Static'-testing' corresponds to "whole-rock" analyses and tests.

1.1 pH-(1:2) and EC-(1:2) Tests

Measurements of pH and EC are performed on slurries prepared using deionised-water, and a solid:water ratio of *c.* 1:2 (w/w). The slurries are allowed to age for *c.* 24 hours, prior to measuring pH and EC.² These tests are performed on the crushings.

pH-(1:2) and EC-(1:2) values provide a measure of the inherent acidity/alkalinity and salinity.³

1.2 Total-S and SO₄-S

Total-S is determined by Leco combustion (@ 1300 °C) with detection of evolved SO_{2(g)} by infra-red spectroscopy. SO₄-S is determined by the Na₂CO₃-Extraction Method (Berigari and Al-Any 1994; Lenahan and Murray-Smith 1986).⁴ The difference between Total-S and SO₄-S indicates the Sulphide-S (strictly Non-Sulphate-S) value. The Total-S and SO₄-S tests are performed on pulps.

1.3 Acid-Consuming Properties

1.3.1 ANC

ANC is determined by a procedure based on that of Sobek *et al.* (1978) which is the "standard" ANC-testing method (AMIRA 2002; Morin and Hutt 1997).

Samples (as crushings) are reacted with dilute HCl for *c.* 2 hours at 80-90 °C, followed by back-titration with NaOH to a pH=7 end-point to determine the amount of acid consumed.⁵ The simmering step for *c.* 2 hours differs from the Sobek *et al.* procedure wherein test-mixtures are heated to near boiling until reaction is deemed to be complete, followed by boiling for one minute. In terms of the dissolution of carbonate- and primary-silicate-minerals, this variation to the Sobek *et al.* method is inconsequential.

The Sobek *et al.* (1978) procedure subjects samples to both strongly-acidic conditions (e.g. pH of 1-2), and a near-boiling temperature. Provided excess acid is added, the dissolution of carbonate-minerals is near-quantitative, and traces of primary-silicates

² The slurries are stirred at the beginning of the testwork, and once again immediately prior to measuring pH and EC.

³ The pH-(1:2) values approximate the "Abrasion-pH" values for identifying minerals in the field (e.g. Stevens and Carron 1948).

⁴ The Na₂CO₃-reagent extracts SO₄ which occurs as soluble sulphates, and calcium sulphates (e.g. gypsum and anhydrite). It also extracts SO₄ sorbed to the surfaces of sesquioxides, clays and primary-silicates. However, SO₄ present as barytes (BaSO₄) is not extracted, and SO₄ associated with jarositic-type and alunitic-type compounds is incompletely extracted.

⁵ A few drops of 30 % (w/w) H₂O₂ are added to the test mixtures as the pH=7 end-point is approached, so that Fe(II) forms released by the acid-attack of ferroan-carbonates (and -silicates) are oxidised to Fe(III) forms (which then hydrolyse to "Fe(OH)₃"). This step ensures that the resulting ANC values are not unduly biased "on-the-high-side", due to the release of Fe(II) during the acid-digestion step (AMIRA 2002), provided that the ferroan-carbonate content is not excessive (e.g. siderite-C values less than 1.5 % [Stewart *et al.* 2006]).

also dissolve. However, at circum-neutral-pH (viz. pH 6-8) relevant to mine-waste and environmental management, the dissolution of primary-silicates is kinetically limiting (e.g. see review-monograph by White and Brantley [1995]).

In the absence of inhibiting alteration-rims, dissolution rates of mafic/felsic-silicates generally equate to H_2SO_4 -consumption rates 'of-the-order' 10^{-11} - 10^{-12} moles/ m^2 /s. Accordingly, for particle-sizes within the sub-mm range, circum-neutral-dissolution rates of primary-silicates correspond to Sulphide-Oxidation Rates (SORs) 'of-the-order' 1-10 mg SO_4 /kg/week (= c. 0.1-1.0 kg H_2SO_4 /tonne/year).⁶ In practice, circum-neutral buffering through the surface-hydrolysis/dissolution of primary-silicates is therefore restricted to both particle-gradings akin to "rock-flour" (viz. sub-mm), and slow rates of sulphide-oxidation (e.g. as exhibited by "trace-sulphides" which are not atypically reactive).⁷

Despite aggressive-digestion conditions, the ANC values determined by the Sobek *et al.* (1978) method allow an informed "screening" of acid-consuming properties, especially when due regard is given to groundmass-mineralogy (Morin and Hutt 1997). Jambor *et al.* (2005, 2002, 2000) list 'Sobek-ANC' values for different types of primary-silicates which assists interpretation of ANC-testwork results.

That the ANC value is not an intrinsic property of a sample of geologic media, but rather the outcome of the particular ANC-testwork method employed, is shown by Morin and Hutt (2009).

1.3.2 $\text{CO}_3\text{-C}$

$\text{CO}_3\text{-C}$ is the difference between the Total-C and Total-Organic-C (TOC). Total-C is measured by Leco combustion (@ 1300 °C) with detection of evolved $\text{CO}_{2(g)}$ by infra-red spectroscopy. TOC is determined by Leco combustion on a sub-sample which had been treated with strong HCl to decompose carbonate-minerals. Pulps are used for these determinations.

1.3.3 pH-Buffering Properties

pH-Buffering properties are determined via a Metrohm® 736 Titrino auto-titrator, and 0.05 M- H_2SO_4 . Auto-titrations comprise regular addition of H_2SO_4 to decrease the pH values of the test-suspensions (prepared using pulps) to 3.0 typically over the course of

⁶ SORs of this magnitude (at circum-neutral-pH) would typically only be recorded for the oxidation of "trace-sulphides" (e.g. Sulphide-S contents less than c. 0.5 %) which are not hyper-reactive, and so excludes *inter alia* framboidal-pyrite, and marcasite.

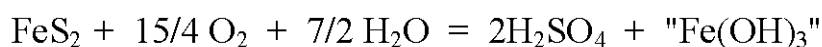
⁷ Primary-particle-sizes within the "rock-flour" range is a given for process-tailings-solids. In the case of mine-wastes, despite its usually small weight-based abundance, this size-fraction is invariably the main seat of geochemical-weathering reactions within waste-dumps, and thereby the main "source-term" for solute generation (e.g. Price and Kwong 1997). Such "rock-flour" occurs in two forms: that obtained via dry-sieving, and that associated with the surfaces of clasts of wide-ranging sizes, and which can only be obtained via wet-sieving.

c. 1 day.⁸ Despite taking up to 1 day to complete, the H₂SO₄-addition rates employed in the auto-titrations are 'orders-of-magnitude' faster than the sulphide-oxidation rates typically observed under "ambient-weathering" conditions.

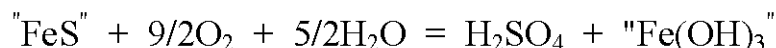
1.4 NAPP Calculations

NAPP values are calculated from Total-S, SO₄-S and ANC values, assuming that **all** of the Sulphide-S occurs in the form of pyrite, and/or pyrrhotite. NAPP values facilitate assessment of Acid-Formation Potential (AFP).

The complete-oxidation of pyrite (and/or marcasite) may be described by:



The complete-oxidation of pyrrhotite may be described by:



Since pyrrhotite is non-stoichiometric, expressing it as "FeS" is approximate (Janzen *et al.* 2000). Elemental-S may also be produced during pyrrhotite weathering (Nicholson and Scharer 1994), especially at low-pH. However, Elemental-S is ultimately oxidised to H₂SO₄.

It may be shown that, if the Sulphide-S (in %S) occurs as pyrite/pyrrhotite, then the amount of acid (in kg H₂SO₄/tonne) produced through complete-oxidation is given by **30.6 x %S**. That is, the same conversion-factor of 30.6 applies for both pyrite-, and pyrrhotite-oxidation.

Note: The above treatment of oxidation-reaction stoichiometry is restricted to oxidation by 'atmospheric-O₂' which is the dominant oxidant at circum-neutral-pH. A different oxidation-stoichiometry applies under acidic conditions (e.g. pH less than 3-4) where soluble-Fe(III) forms prevail, and then function as the chief oxidant (e.g. Rimstidt and Newcomb 1993).

Mechanistic aspects of pyrite- and pyrrhotite-oxidation were reviewed by Rimstidt and Vaughan (2003), and Belzile *et al.* (2004), respectively.

1.5 NAG Tests

The NAG Test is a direct measure of the potential for acid-production through sulphide-oxidation, and also provides an indication of the reactivity of the sulphide-minerals, and the availability of alkalinity-forms (AMIRA 2002; Miller *et al.* 1997, 1994). Since this test is performed on pulps, sulphide-grains are fully liberated, and available for reaction.

⁸ In titrating to a pH=3.0 end-point, any Fe(II) released through acid attack of ferroan-carbonates and -silicates is not quantitatively oxidised to Fe(III), and subsequently hydrolysed/precipitated to "Fe(OH)₃". The equivalent of c. 0.5 kg H₂SO₄/tonne is generally required to decrease the pH of the "solution-only" to pH=3.0. No correction is made for this "electrolyte-consumption" of H₂SO₄.

The sample is reacted with H_2O_2 to oxidise sulphide-minerals, and allow the produced acid to react with the acid-neutralising components (chiefly carbonate-minerals). The results from NAG testwork supplement the NAPP-based assessment of AFP (Stewart *et al.* 2006; Shaw 2005; Morin and Hutt 1997).

The NAG-testing methodology used by GCA is the 'Static-NAG Test' in its "single-addition" mode, with NaOH-titration to a pH=7 end-point (AMIRA 2002; Miller *et al.* 1994, 1997). The Start-pH of the 15 % (v/v) H_2O_2 solution (prepared from A.R.-grade H_2O_2) is adjusted to pH=4.5 using 0.1 M-NaOH. The boiling treatment to decompose residual, unreacted- H_2O_2 following overnight reaction is carried out in two stages (viz. boiling for *c.* 2 hours initially, cooling and addition of 1 mL of 0.02 M- CuSO_4 , followed by boiling for a further *c.* 2 hours). The addition of Cu(II) catalyses the decomposition of unreacted- H_2O_2 , and thereby prevents "positive-blank" values (McElnea and Ahern 2004; O'Shay *et al.* 1990).⁹

Prior to the boiling steps, the pH values of the test-suspensions are measured. Such pH values reflect buffering under ambient conditions without accelerated dissolution of groundmass-minerals through boiling. In the interpretation of NAG-testwork results, it is important to note the pH values prior to the boiling steps, especially for lithotypes characterised by "trace-sulphides" (e.g. Sulphide-S within the sub-% range), and ANC values less than *c.* 10-20 kg H_2SO_4 /tonne (e.g. a groundmass devoid of carbonate-minerals). The rates of "peroxide-oxidation" are orders-of-magnitude faster than those of "ambient-oxidation" (viz. SORs recorded in kinetic-testing employing Weathering-Columns). If circum-neutral-pH is to prevail during NAG testwork, then the rate of acid-consumption must be proportionately faster than that for "ambient-oxidation", and is essentially restricted to buffering by reactive-carbonate-minerals (e.g. calcites, dolomites, and ankerites). This aspect must be borne in mind when interpreting NAG-testwork results, especially for samples that contain "trace-sulphides" in a carbonate-deficient groundmass.

2.0 MULTI-ELEMENT ANALYSES

The total content of a wide range of major- and minor-elements are determined through the use of various digestion and analytical techniques. The respective detection-limits are appropriate for environmental investigations.

Element enrichments are identified using the *Geochemical Abundance Index (GAI)*.¹⁰ The GAI quantifies an assay result for a particular element in terms of the average-

⁹ Where samples contain sufficient Cu(II), then Cu(II) forms will be released to solution during reaction with H_2O_2 , especially at low-pH.

¹⁰ The GAI was developed by Förstner *et al* (1993), and is defined as:

$$\text{GAI} = \log_2 [C_n / (1.5 \times B_n)]$$

where:

C_n = measured content of n-th element in the sample.

B_n = "background" content of the n-th element in the sample.

crustal-abundance of that element.¹¹ The latter corresponds to the typical composition of soils, regoliths and bedrocks derived from unmineralised terrain.

The GAI (based on a log-2 scale) is expressed in 7 integer increments (viz. 0 to 6). A GAI of 0 indicates that the content of the element is less than, or similar to, the average-crustal-abundance; a GAI of 3 corresponds to a 12-fold enrichment above the average-crustal-abundance; and so forth, up to a GAI of 6 which corresponds to a 96-fold, or greater, enrichment above average-crustal-abundances.

3.0 MINERALOGY AND CLAY-SURFACE CHEMISTRY

The semi-quantitative mineralogy, and clay-surface chemistry (generally restricted to waste-regoliths, oxide-ores, and/or soils), are determined using methods routinely used in geology, and soil science.

Indicative abundances of mineral fall into one of the following broad classes, viz.

•	dominant	greater than 50 %
•	major	20-50 %
•	minor	10-20 %
•	accessory	2-10 %
•	trace	less than 2 %

Randomly- and preferentially-oriented specimens are prepared, and variously treated with sodium-hexametaphosphate (dispersant), ethylene-glycol, and heating, to quantify non-expansive, and expansive (e.g. smectites), varieties of clay-minerals.

The Effective-Cation-Exchange Capacity (eCEC), and suite of Exchangeable-Cations, are determined by different methods for samples (as crushings) of non-calcareous and calcareous materials (Rengasamy and Churchman 1999). In both cases, soluble-salts are initially removed via pre-washing using a "mixed-organic-solvent" (viz. ethylene-glycol and ethanol). Method 15A2 in Rayment and Higginson (1992) is then employed for non-calcareous samples to determine eCEC, and Exchangeable-Sodium Percentage (ESP). In the case of calcareous samples, a method based on that described by Pierce and Morris (2004) is used, and prevents the dissolution of carbonate-minerals (e.g. calcites and dolomites).¹² After the initial pre-washing step above, extraction is carried out with 1 M-NH₄Cl buffered at pH=8.5 in an ethanolic-aqueous solution. Without such precautions to suppress dissolution of carbonate-minerals, the eCEC is biased "on-the-high-side", and ESP biased "on-the-low-side". Depending on the abundance and nature of the carbonate-minerals, the magnitude of this bias can be marked.

¹¹ The average-crustal-abundances of the elements for the GAI calculations are based on the values listed in Bowen (1979).

¹² The procedure described by Pierce and Morris (2004) is closely related to that originally developed by Tucker (1974).

4.0 QUALITY OF TAILINGS-WATERS

Tailings-water samples are analysed for pH, Electrical Conductivity (EC), salinity (as Total-Dissolved Solids, TDS), alkalinity forms, Cl, SO₄, NO₃, NH₃-N, and a wide range of major/minor-elements. The concentrations of cyanide forms (viz. Total Cyanide, CN_{tot}; Weak-Acid-Dissociable Cyanide, CN_{wad}; Thiocyanate, SCN) are determined by standard methods (APHA 1992).

All analyses were performed on appropriately-preserved 'splits' for the determination of specific analytes (see Attachment IV).

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ATTACHMENT III

ACID-FORMATION POTENTIAL (AFP):

CALCULATED PARAMETERS AND CLASSIFICATION CRITERIA

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ATTACHMENT III

ACID-FORMATION POTENTIAL (AFP):

CALCULATED PARAMETERS AND CLASSIFICATION CRITERIA

Notes: The geochemically-based parameters, and AFP-classification criteria, indicated below apply equally to samples of mine-wastes (e.g. waste-regoliths and waste-bedrocks), low-grade-ores, and process-tailings-solids. The generic descriptor "test-sample" is employed below.

1.0 CALCULATED PARAMETERS

Maximum-Potential-Acidity (MPA) values (in kg H₂SO₄/tonne) of test-samples are typically calculated by multiplying the Sulphide-S values (in %) by 30.6. The multiplication-factor of 30.6 reflects both the reaction stoichiometry for the complete-oxidation of pyrite, by O₂ to "Fe(OH)₃" and H₂SO₄, and the different weight-based units of %, and kg H₂SO₄/tonne.

Net-Acid-Producing-Potential (NAPP) values (in kg H₂SO₄/tonne) are calculated from the corresponding MPA and Acid-Neutralisation-Capacity (ANC) values (i.e. NAPP = MPA - ANC).

2.0 CLASSIFICATION CRITERIA

In terms of AFP, test-samples may be classified into one of the following categories, viz.

- Non-Acid Forming (NAF)
- Potentially-Acid Forming (PAF)

There are **no** unifying, "standard" criteria for classifying the AFP of test-samples (e.g. Price 2009; AMIRA 2002), and reflects the diversity of sulphide- and gangue-mineral assemblages within (un)mineralised-lithotypes of varying weathering- and alteration-status. Rather, criteria for classifying AFP may need to be tailored to deposit-specific geochemistry, mineralogy, and site-specific climate.

The AFP-classification criteria often employed at mining-operations worldwide are:

- **NAF:** Sulphide-S < 0.3 %. For Sulphide-S ≥ 0.3 %, both a negative NAPP value, and an ANC/MPA ratio ≥ 2.0
- **PAF:** For Sulphide-S ≥ 0.3 %, any positive-NAPP value; negative-NAPP value with an ANC/MPA ratio < 2.0

Graeme Campbell & Associates Pty Ltd

In assessing AFP, lithotypes from hard-rock mines with Sulphide-S values less than 0.3 % are unlikely to acidify (e.g. pH less than 4-5) through sulphide-oxidation. This position holds especially where the groundmass hosting the "trace-sulphides" is not simply quartz, soil-clays, and/or sesquioxides (Price *et al.* 1997), and where the sulphide-minerals are not hyper-reactive varieties (e.g. framboidal-pyrite). A "cut-off" of 0.3 % for Sulphide-S also accords with the findings of kinetic-testing, since the late-1980s, by Dr. Graeme Campbell for test-samples of diverse mineralogy in terms of sulphide-weathering dynamics, and solubility behaviour.

The risk posed by PAF-lithotypes during the active-mine-life is governed primarily by the duration of the lag-phase (i.e. the period during which sulphide-oxidation occurs, but acidification does not develop, due to circum-neutral buffering by gangue-phases [chiefly reactive-carbonate-minerals]).¹ Although the duration of the lag-phase for mine-wastes at field-scale cannot be accurately predicted *a priori*, estimates may still be needed to identify threshold exposure-times for the safe handling of PAF-lithotypes. Lag-phase duration may be estimated via kinetic-testing (viz. Weathering-Columns), and consideration of the moisture/aeration/thermal-regimes of exposed (i.e. uncovered) mine-wastes under the site's climatic conditions. In the absence of results from kinetic-testing, experience permits "first-pass" estimates of sulphide-oxidation rates and lag-phase duration to be made from the results of static-testing, and thereby classify PAF-lithotypes into **PAF-[Short-Lag]** and **PAF-[Long-Lag]** sub-categories. Such "first-pass" estimations are necessarily provisional, and subject to revision, in the light of the outcomes of kinetic-testing, and field observations.

3.0 REFERENCES

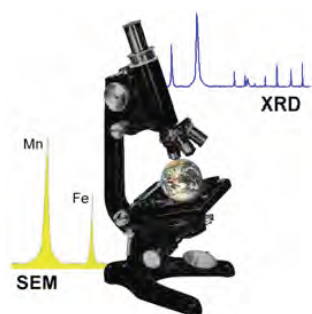
- AMIRA International Ltd, 2002, "ARD Test Handbook", Prepared by Ian Wark Research Institute, and Environmental Geochemistry International Pty Ltd
- Price W, 2009, "Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials", MEND Report 1.20.1
- Price WA, Morin K and Hutt N, 1997, "Guidelines for the Prediction of Acid Rock Drainage and Metal Leaching for Mines in British Columbia: Part II. Recommended Procedures for Static and Kinetic Testing", pp. 15-30 in "Proceedings of the Fourth International Conference on Acid Rock Drainage", Volume I, Vancouver

¹ SO₄ is still produced by sulphide-oxidation during the lag-phase, and appreciable amounts of soluble-forms of certain minor-elements (e.g. Ni and As) may be released at circum-neutral-pH during lag-phase weathering. However, in the latter case, the mine-wastes would need to be sufficiently enriched in Total-Ni and Total-As to begin with.

ATTACHMENT IV

LABORATORY REPORTS

Graeme Campbell & Associates Pty Ltd



Roger Townend and Associates *Consulting Mineralogists*

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Fax: (08) 9248 1502

GRAEME CAMPBELL AND ASSOC.

1-02-2013

PO BOX 247,

BRIDGETOWN

WA

OUR REFERENCE: 23366

YOUR REFERENCE: 1220/2

SIX TAILINGS SAMPLES FOR XRD AND OPTICAL MINERALOGY ANALYSES, CLAY TESTING FOR 1 SAMPLE.

D TOWNEND

Correspondence to Box 3129, Malaga D.C. WA 6945
ACN 069 920 476 ABN 92 076 109 663

<GRAEME CAMPBELL>

2

Ref No <23366>

XRD PROCEDURES

XRD	PANALYTICAL XPERT PRO
DETECTOR	PIXCEL 1D
ANGULAR RANGE	5° TO 110°
DIVERGENCE SLIT	1/4°
ANTI SCATTER SLIT	1/2°
RADIATION	Co Kα 1.788965
SLIT TYPE	FIXED
GENERATOR	40Kv 40 Ma

PLM/SEMI-QUANTITATIVE XRD RESULTS

	GCA10610	GCA10611	GCA10612	GCA10613	GCA10614	GCA10615
QUARTZ	MAJOR	MAJOR	MAJOR	MAJOR	MAJOR	MAJOR
K-FELDSPAR	MAJOR	MAJOR	MAJOR	MAJOR	MAJOR	MAJOR
ILLITE	MINOR	MINOR	MINOR	MINOR	MINOR	MINOR
PYRITE	ACCESSORY	TRACE	ACCESSORY	ACCESSORY	ACCESSORY	ACCESSORY
RHODOCHROSITE	TRACE	ACCESSORY	ACCESSORY	ACCESSORY	ACCESSORY	ACCESSORY
ZIRCON	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
HORNBLende	TRACE					
GOETHITE	TRACE				TRACE	
RUTILE		TRACE				
LEUCOXENE	TRACE		TRACE	TRACE	TRACE	TRACE
SIDERITE		TRACE				
ANATASE		TRACE	TRACE	TRACE	TRACE	TRACE

Note. Rietveld analyses could not be performed on the samples due to the presence of illite.

Roger Townend and Associates

<GRAEME CAMPBELL>

3

Ref No <23366>

CLAY TESTING

METHODS

Ten grams of sample GCA10613 was weighed into a 50 mL centrifuge tube with 20 mL of DI water. The clay fraction ($\sim 2 \mu\text{m}$) was separated using ultrasonic treatment and centrifugation. The sample was then saturated/treated using the following 4 treatments, then examined by XRD analysis:

1. MgCl_2 saturated
2. MgCl_2 saturated and Glycerol
3. KCl saturated
4. KCl saturated and heated at 550°C for 2 hours.

The results of these treatments indicate the peak at $\sim 10\text{\AA}$ is illite. All six samples have very similar broad peaks at $\sim 10\text{\AA}$, and similar patterns, therefore only one sample was tested.

RHODOCHROSITE SEM/EDS ANALYSES

GCA10610	A	B
MgO	1.7	
CaO	1.0	1.2
MnO	48.1	54.3
FeO	9.2	4.4

GCA10611	A
CaO	0.9
MnO	55.0
FeO	4.1

GCA10612	A	B
CaO	2.9	1.2
MnO	51.8	46.5
FeO	5.2	12.2

GCA10613	A	B
MgO	1.3	
CaO	0.9	2.4
MnO	43.1	53.2
FeO	14.6	4.4

GCA10614	A	B
CaO	1.4	2.2
MnO	54.6	47.0
FeO	4.0	10.8

Roger Townend and Associates

<GRAEME CAMPBELL>

4

Ref No <23366>

GCA10615	A	B
CaO	1.1	1.4
MnO	54.3	50.4
FeO	4.5	8.2

SIDERITE SEM/EDS ANALYSES

GCA10611	A	B
MgO	1.7	9.5
CaO	4.8	1
MnO	7.4	4.8
FeO	46.1	44.7

Roger Townend and Associates

GLS Job Code 143.0/1222024

Client ON GCA1220/2



Dr G Campbell
CAMPBELL, GRAEME and ASSOCIATES PTY LTD
PO Box 247
BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1222024
No. of SAMPLES	6
CLIENT O/N	GCA 1220/2
PROJECT	Bowdens
STATE	Tailings solids
DATE RECEIVED	21/11/2012
DATE COMPLETED	21/12/2012

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

The samples were received as tailings solids which were dried at 45C

The samples were crushed to a nominal 2mm a split was then taken and fine pulverised to a nominal -75um

Results of analysis on:

Element		S	S-SO ₄	C	TOC+C	C-CO ₃
Method		/CSA	S72/GR	/CSA	C71/CSA	/CALC
Detection		0.01	0.01	0.01	0.01	0.01
Units		%	%	%	%	%
Sample Name						
Control Blank		0.01	X	X	X	
GCA10610		1	0.24	0.2	0.03	0.17
GCA10610	check	1.01	0.23	0.19	0.04	0.15
GCA10611		0.26	0.07	0.19	0.02	0.17
GCA10612		0.77	0.14	0.19	0.04	0.15
GCA10613		1.11	0.14	0.3	0.03	0.27
GCA10614		0.37	0.11	0.3	0.03	0.27
GCA10615		0.82	0.14	0.3	0.03	0.27
MA-3a		0.94		2.5		
PD-1			4.54			
OREAS 501		0.35		0.27		
S_SO4_A			0.59			
S_SO4_B			1.34			

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Page 1 of 2

GLS Job Code 143.0/1222024

Client ON GCA1220/2

Notes

1. Total-S and Total-C were determined on the pulps
2. Total-C and Total-S was determined using an induction furnace according to Genalysis method number MPL_W043. The samples are ignited in oxygen ~1700C and the CO₂ and SO₂ measured by infrared detectors
3. S-SO₄ was determined on the pulps by precipitation of BaSO₄ according to Genalysis method number ENV_W039, after digestion with Na₂CO₃ (S72/GR)
4. TOC+C (acid insoluble carbon compounds and elemental carbon) by a C&S analyser after removal of carbonates and soluble organic carbon using hot hydrochloric acid according to Genalysis method number MPL_W046.

Results of analysis on:

Sample		fizz	volume	HCl	NaOH	colour	pH	ANC	ANC
Name		rate	ml	M	M	change	drop	soln pH	kgH ₂ SO ₄ /t
GCA10610		0	8	0.5325	0.179	N		1.3	9
GCA10610	check	0	8	0.5325	0.179	N		1.3	8
GCA10611		0	8	0.5325	0.179	N		1.2	10
GCA10612		0	8	0.5325	0.179	N		1.2	10
GCA10613		0	8	0.5325	0.179	N		1.3	14
GCA10614		0	8	0.5325	0.179	N		1.3	13
GCA10615		0	8	0.5325	0.179	N		1.4	13

Notes:

1. ANC was determined on 2g -. Acid concentrations are as stated.
2. Colour change: Y indicates the appearance of a green colouration as the pH=7 endpoint was approached. N indicates no colour change. Two drops of 30 % hydrogen peroxide are added to each sample as the endpoint is approached to oxidise any ferrous iron.
3. pH drop : Result reported when the pH drops to a value below 4 on addition of peroxide
4. This "Bulk-ANC" static-testing procedure is based on AMIRA (2002), according to Genalysis method number ENV_W035

NATA ENDORSED DOCUMENT**Company Accreditation Number 3244**

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NATA Signatory: Ann Evers

Ann Evers

Date: 21/12/2012



Accredited for compliance with ISO/IEC 17025

Graeme Campbell & Associates Pty Ltd

Laboratory Report

NET-ACID-GENERATION (NAG) TESTWORK

Sample Number	Sample Weight (g)	Comments	pH of Test Mixture Before Boiling Step	Test Mixture After Boiling Step		Titre [0.1 M-NaOH] (mL)	NAG (kg H ₂ SO ₄ /tonne)
				pH	EC (µS/cm)		
GCA10610	3.0	Reaction peaked overnight	2.7	2.8	1,400	13.40	17
GCA10611	3.0	Reaction peaked overnight	5.6	5.6	170	0.10	<0.5
GCA10612	3.0	Reaction peaked overnight	2.8	3.1	740	9.00	15
GCA10613	3.0	Reaction peaked overnight	2.8	3.0	880	11.20	19
GCA10614	3.0	Reaction peaked overnight	5.4	5.9	230	0.20	<0.5
GCA10615	3.0	Reaction peaked overnight	3.0	3.6	500	8.00	13
GCA10615-1	3.0	Reaction peaked overnight	3.0	3.6	510	7.50	13
BLANK1	3.0	Reaction peaked overnight	5.9	6.9	44	-	<0.5

Notes: Test conditions based on those described by Miller *et al.* (1997), and AMIRA (2002) for the 'Static-NAG-Test' in its 'Single-Addition-Mode'. The pH of the 15 % (v/v) H₂O₂ solution was adjusted to 4.5 using 0.1 M-NaOH prior to commencing the NAG Tests. Following an overnight-reaction period, the test-mixtures were boiled for c. 2 hours. Then, after allowing the test-mixtures to cool, c. 1.0 mL of 0.016 M-CuSO₄ solution was added, and the test-mixtures again boiled for c. 2 hours. The addition of Cu(II) catalyses the decomposition of any residual, unreacted-H₂O₂ in the test-mixtures (McEInea and Ahern 2004; O'Shay *et al.* 1990). K-Feldspar was employed for the Blank.

Dr GD Campbell
25th February 2013



ANALYTICAL REPORT

Dr G. CAMPBELL
CAMPBELL, GRAEME and ASSOCIATES
PO Box 247
BRIDGETOWN, W.A. 6255
AUSTRALIA

JOB INFORMATION

JOB CODE : 143.0/1222025
No. of SAMPLES : 6
No. of ELEMENTS : 33
CLIENT O/N : GCA1220/2 (Job 2 of 2)
SAMPLE SUBMISSION No. :
PROJECT : BOWDENS
STATE : Ex-Pulp
DATE RECEIVED : 21/11/2012
DATE COMPLETED : 28/12/2012
DATE PRINTED : 28/12/2012
PRIMARY LABORATORY : Genalysis Main Laboratory

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method
OV = Value over-range for Package

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SAMPLE DETAILS

DISCLAIMER

Intertek Genalysis wishes to make the following disclaimer pertaining to the accompanying analytical results.

All work is performed in accordance with the Intertek Minerals Standard Terms and Conditions of work <http://www.intertek.com/terms/>

This report relates specifically to the sample(s) that were drawn and/or provided by the client or their nominated third party. The reported result(s) provide no warranty or verification on the sample(s) representing any specific goods and/or shipment and only relate to the sample(s) as received and tested. This report was prepared solely for the use of the client named in this report. Intertek accepts no responsibility for any loss, damage or liability suffered by a third party as a result of any reliance upon or use of this report.

SIGNIFICANT FIGURES

It is common practice to report data derived from analytical instrumentation to a maximum of two or three significant figures. Some data reported herein may show more figures than this. The reporting of more than two or three figures in no way implies that the third, fourth and subsequent figures may be real or significant.

Intertek Genalysis accepts no responsibility whatsoever for any interpretation by any party of any data where more than two or three significant figures have been reported.

SAMPLE STORAGE DETAILS

GENERAL CONDITIONS

SAMPLE STORAGE OF SOLIDS

Bulk Residues and Pulps will be stored for 60 DAYS without charge. After this time all Bulk Residues and Pulps will be stored at a rate of \$3.30 per cubic metre per day until your written advice regarding collection or disposal is received. Expenses related to the return or disposal of samples will be charged to you at cost. Current disposal cost is charged at \$100.00 per cubic metre.

SAMPLE STORAGE OF SOLUTIONS

Samples received as liquids, waters or solutions will be held for 60 DAYS free of charge then disposed of, unless written advice for return or collection is received.

143.0/1222025 (28/12/2012) CLIENT O/N: GCA1220/2

Page 3 of 9

NOTES

*** NATA ENDORSED DOCUMENT ****

Company Accreditation Number 3244

The contents of this report have been prepared in accordance with the terms of NATA accreditation and as such should only be reproduced in full.

The analysis results reported herein have been obtained using the following methods and conditions:

The samples as listed were received as being ex pulp from jobs 1222024 which had been pulverised in a zirconia bowl.

The results have been determined according to Genalysis methods codes :

Digestions : MPL_W002 (4A), MPL_W005 (SE1/), ENV_W012 (FC7/SIE), MPL_W011 (FP1/), MPL_W008 (HG1/)

Analytical Finishes: ICP_W004 (/OE), ICP_W003 (/MS), and AAS_W004 (/CV).

The results included the assay of blanks and international reference standards:

SARM48,GTS-2a and OREAS 24b

and Genalysis in-house standards:

OREAS 97.01, 79a 1%, MPL-5 and HgSTD-5

The results are expressed as parts per million or percent by mass in the dried and prepared material.

NATA Signatory: A Evers

Chief Chemist

143.0/1222025 (28/12/2012) CLIENT O/N: GCA1220/2

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NOTES

Date: 28/12/2012

This document is issued in accordance with NATA's accreditation requirements.

143.0/1222025 (28/12/2012) CLIENT O/N: GCA1220/2

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Part 1/4

ANALYSIS

ELEMENTS	Ag	Al	As	B	Ba	Bi	Ca	Cd	Co	Cr
UNITS	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.01	0.5	50	0.1	0.01	0.02	0.02	0.1	50
DIGEST	4A/	FP1/	4A/	FP1/	4A/	4A/	FP1/	4A/	4A/	FP1/
ANALYTICAL FINISH	MS	OE	MS	OE	MS	MS	OE	MS	MS	OE

SAMPLE NUMBERS

0001 GCA10610	11.88	6.01	163.9	X	805.1	0.24	0.08	0.89	3.0	256
0002 GCA10611	4.28	6.12	62.2	X	830.2	0.13	0.12	0.49	2.0	226
0003 GCA10612	7.36	6.03	131.6	54	773.2	0.21	0.12	0.69	2.7	238
0004 GCA10613	11.83	6.77	336.7	X	715.8	0.11	0.15	0.63	4.7	248
0005 GCA10614	5.79	6.83	186.2	X	748.1	0.05	0.17	0.41	3.6	261
0006 GCA10615	8.02	6.87	276.3	X	741.8	0.08	0.19	0.51	4.3	279

CHECKS

0001 GCA10610	11.49	5.98	165.0	X	797.9	0.25	0.13	0.90	3.1	238
---------------	-------	------	-------	---	-------	------	------	------	-----	-----

STANDARDS

0001 79a 1%										
0002 GTS-2a										
0003 OREAS 24b	0.12		9.4		739.9	0.62		0.09	16.9	
0004 OREAS 97.01										
0005 SARM48		6.01		X			6.58			X

BLANKS

0001 Control Blank	0.06	X	X	X	0.3	X	0.02	X	X	X
0002 Control Blank										
0003 Acid Blank	0.04		X		0.2	X		X	X	
0004 Acid Blank		X		X			X			X
0005 Se-0.1ppm										

143.0/1222025 (28/12/2012) CLIENT O/N: GCA1220/2

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Part 2/4

ANALYSIS

ELEMENTS	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni
UNITS	ppm	ppm	%	ppm	%	%	ppm	ppm	ppm	ppm
DETECTION LIMIT	1	50	0.01	0.01	0.05	0.01	1	0.1	20	1
DIGEST	4A/	FC7/	FP1/	HG1/	FP1/	FP1/	4A/	4A/	4A/	4A/
ANALYTICAL FINISH	OE	SIE	OE	CV	OE	OE	OE	MS	OE	OE
SAMPLE NUMBERS										
0001 GCA10610	45	463	1.60	0.03	5.63	0.11	6364	10.5	820	105
0002 GCA10611	37	491	0.84	0.03	5.86	0.12	6215	9.3	861	99
0003 GCA10612	36	495	1.34	0.04	5.74	0.11	6070	9.7	811	104
0004 GCA10613	46	551	1.79	0.08	6.30	0.13	1.11%	7.2	896	107
0005 GCA10614	38	575	1.00	0.03	6.47	0.12	1.05%	6.9	875	109
0006 GCA10615	49	584	1.47	0.04	6.57	0.13	1.10%	7.2	929	119
CHECKS										
0001 GCA10610	44	519	1.59	0.04	5.80	0.11	6209	10.8	805	102
STANDARDS										
0001 79a 1%		4478								
0002 GTS-2a				0.32						
0003 OREAS 24b	38						478	3.9	8491	62
0004 OREAS 97.01										
0005 SARM48			0.46		3.89	0.05				
BLANKS										
0001 Control Blank	X	51	X	X	X	X	X	X	X	1
0002 Control Blank										
0003 Acid Blank	X						X	X	X	X
0004 Acid Blank			X		X	X				
0005 Se-0.1ppm										

143.0/1222025 (28/12/2012) CLIENT O/N: GCA1220/2

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Part 3/4

ANALYSIS

ELEMENTS	P	Pb	S	Sb	Se	Si	Sn	Sr	Th	Tl
UNITS	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
DETECTION LIMIT	10	0.5	50	0.05	0.01	0.1	0.1	0.05	0.01	0.02
DIGEST	4A/	4A/	4A/	4A/	SE1/	FP1/	4A/	4A/	4A/	4A/
ANALYTICAL FINISH	OE	MS	OE	MS	MS	OE	MS	MS	MS	MS

SAMPLE NUMBERS

0001 GCA10610	349	267.4	1.14%	12.36	0.05	34.4	2.1	288.25	10.85	4.92
0002 GCA10611	344	191.5	2791	11.27	0.03	35.0	2.3	273.64	10.02	4.72
0003 GCA10612	307	247.6	8023	13.09	0.04	34.4	2.1	258.84	9.45	4.98
0004 GCA10613	407	231.8	1.21%	11.76	0.04	32.7	2.0	243.01	10.72	6.83
0005 GCA10614	411	155.6	3793	11.14	0.02	33.4	2.0	239.37	10.88	5.21
0006 GCA10615	421	197.7	8854	12.68	0.04	33.2	2.2	236.50	10.57	6.24

CHECKS

0001 GCA10610	325	280.2	1.11%	12.70	0.04	34.4	2.2	266.92	9.87	5.10
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STANDARDS

0001 79a 1%										
0002 GTS-2a										
0003 OREAS 24b	729	22.5	1992	1.02			4.5	125.26	16.63	0.92
0004 OREAS 97.01					0.72					
0005 SARM48						30.3				

BLANKS

0001 Control Blank	X	X	X	X	X	X	X	0.11	0.01	X
0002 Control Blank					X					
0003 Acid Blank	X	X	X	X			X	0.08	X	X
0004 Acid Blank						X				
0005 Se-0.1ppm					0.20					

143.0/1222025 (28/12/2012) CLIENT O/N: GCA1220/2

Page 8 of 9
 Part 4/4

ANALYSIS

ELEMENTS	U	V	Zn
UNITS	ppm	ppm	ppm
DETECTION LIMIT	0.01	1	1
DIGEST	4A/	4A/	4A/
ANALYTICAL FINISH	MS	OE	OE
SAMPLE NUMBERS			
0001 GCA10610	3.47	19	402
0002 GCA10611	3.59	19	327
0003 GCA10612	3.39	17	367
0004 GCA10613	3.46	33	252
0005 GCA10614	3.33	34	205
0006 GCA10615	3.23	34	244
CHECKS			
0001 GCA10610	3.43	17	395
STANDARDS			
0001 79a 1%			
0002 GTS-2a			
0003 OREAS 24b	3.13	106	107
0004 OREAS 97.01			
0005 SARM48			
BLANKS			
0001 Control Blank	X	X	X
0002 Control Blank			
0003 Acid Blank	X	X	X
0004 Acid Blank			
0005 Se-0.1ppm			

METHOD CODE DESCRIPTION

4A/MS

Genalysis Main Laboratory

Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Mass Spectrometry.

4A/OE

Genalysis Main Laboratory

Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

FC7/SIE

Genalysis Main Laboratory

Alkaline fusion (Nickel crucible) specific for Fluorine. Analysed by Specific Ion Electrode.

FP1/OE

Genalysis Main Laboratory

Sodium peroxide fusion (Zirconia crucibles) and Hydrochloric acid to dissolve the melt. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

HG1/CV

Genalysis Main Laboratory

Low temperature Perchloric acid digest specific for Mercury. Analysed by Cold Vapour Generation Atomic Absorption Spectrometry.

SE1/MS

Genalysis Main Laboratory

Aqua-Regia digest followed by Precipitation and Concentration. Specific for Selenium. Analysed by Inductively Coupled PI

GLS Job Code 143.0/1222026

Client ON GCA1220/2



Dr G Campbell
CAMPBELL, GRAEME and ASSOCIATES PTY LTD
PO Box 247
BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1222026
No. of SAMPLES	6
CLIENT O/N	GCA1220/2
PROJECT	Bowdens
STATE	Tailings –Slurry solutions
DATE RECEIVED	21/11/2012
DATE COMPLETED	17/12/2012

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

A range of solutions were received to be analysed

The NaOH dosed samples were analysed for cyanide using APHA method codes: CN-Tot (4500-CN C E), CN-WAD (4500-CN I E), FreeCN (4500-CN D).

The Raw samples were analyzed for pH, EC and F by Genalysis method codes: pH (ENV_W001), EC (ENV_W002), F (ENV_W011) and SCN (4500-CN I E). The alkalinity was measured using APHA method code 2320B

APHA code refers to "Standard methods for the examination of water and wastewater", 21st Edition 2005

HNO₃ dosed solutions were analysed for the requested element suite by ICPOES and ICPMS Genalysis method codes (ICP_W004, ICP_W003).

Results of analysis on:

Element		CO ₃	EC	F	HCO ₃	pH	SCN
Method		/VOL	/MTR	/SIE	/VOL	/MTR	/COL
Detection		1	10	0.1	1	0.1	1
Units		mgCO ₃ /L	uS/cm	mg/l	mgHCO ₃ /L	NONE	mg/L
Sample Name							
Control Blank				X			X
GCA10610 RAW		X	558	1.5	51	7.2	25
GCA10610 RAW	check		563	1.6	51	7.2	25
GCA10611 RAW		X	433	1.5	51	6.8	26
GCA10612 RAW		X	445	1.6	59	7.5	39
GCA10613 RAW		X	690	1.6	52	7.3	26
GCA10614 RAW		X	558	1.6	48	7.2	24
GCA10615 RAW		X	579	1.7	53	7.4	40

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BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1222026

Client ON GCA1220/2

Element	CN-Tot	CN-WAD	FreeCN
Method	/COL	/COL	/COL
Detection	0.01	0.01	0.1
Units	mg/l	mg/l	mg/l
Sample Name			
Control Blank	X	X	
GCA10610 NAOH	0.53	X	X
GCA10611 NAOH	0.03	0.03	X
GCA10612 NAOH	0.33	0.21	0.1
GCA10613 NAOH	0.29	0.21	0.1
GCA10614 NAOH	0.49	0.49	0.2
GCA10615 NAOH	0.48	0.33	0.2

Element	Ag	Al	As	B	Ba	Bi	Ca	Cd
Method	/MS	/OE	/MS	/OE	/MS	/MS	/OE	/MS
Detection	0.01	0.01	0.1	0.01	0.05	0.005	0.01	0.02
Units	ug/l	mg/l	ug/l	mg/l	ug/l	ug/l	mg/l	ug/l
Sample Name								
Control Blank	0.01	X	X	X	X	0.005	X	X
GCA10610 HNO3	0.62	0.08	32.7	X	51.84	X	44.98	6.11
GCA10611 HNO3	10.01	X	39.8	X	56.41	X	31.42	1.63
GCA10612 HNO3	29.43	X	29.4	X	60.22	X	31.42	1.97
GCA10613 HNO3	11.46	0.02	63.8	0.02	41.09	X	62.32	4.59
GCA10614 HNO3	30.98	0.02	85.8	0.02	49.15	X	45.1	1.69
GCA10615 HNO3	8.39	0.04	37.7	0.02	44.78	X	44.32	1.7
Alcoa11-OES		2.02		0.97			51.02	
Alcoa18-MS	4.76		28.2		5.75	4.338		5.13

Element	Co	Cr	Cu	Fe-Sol	Hg	K	Mg	Mn
Method	/MS	/OE	/OE	/OE	/MS	/OE	/OE	/OE
Detection	0.1	0.01	0.01	0.01	0.1	0.1	0.01	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	mg/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10610 HNO3	54.1	0.02	0.17	X	X	37.1	9.47	18.57
GCA10611 HNO3	33.9	X	0.11	X	X	31.4	7.03	9.6
GCA10612 HNO3	36.8	0.01	0.94	X	X	31.4	6.99	10.39
GCA10613 HNO3	71.3	0.02	0.62	X	X	36.9	15.21	31.3
GCA10614 HNO3	48.6	0.02	0.62	X	X	31.9	11.36	17.94
GCA10615 HNO3	46.7	0.02	1.46	X	X	33.3	11.28	19.34
Alcoa11-OES		0.51	0.52	1.94		3.8	48.2	0.51
Alcoa18-MS	538.4						5.9	

Element	Mo	Na	Ni	P	Pb	S	Sb	Se
Method	/MS	/OE	/OE	/OE	/MS	/OE	/MS	/MS
Detection	0.05	0.1	0.01	0.1	0.5	0.1	0.01	0.5
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	ug/l	ug/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10610 HNO3	29.46	24.9	X	0.1	50.1	61.8	30.55	1.5
GCA10611 HNO3	67.04	25.2	X	X	2.2	43.1	35.7	1.3
GCA10612 HNO3	71.9	31.7	X	0.1	2.1	46.9	41.18	1.3
GCA10613 HNO3	55.1	27.2	0.02	0.1	2.3	89.7	20.1	1.3
GCA10614 HNO3	71.98	26.9	0.01	0.1	1.7	66	27.78	1.1
GCA10615 HNO3	82.16	34.4	X	0.1	5.9	68.4	31.71	0.9
Alcoa11-OES		250.7	0.52	1		17.1		
Alcoa18-MS			5.92			5.4		5.34

GLS Job Code 143.0/1222026

Client ON GCA1220/2

Element	Si	Sn	SO4	Sr	Th	Tl	U	V	Zn
Method	/OE	/MS	/CALC	/MS	/MS	/MS	/MS	/OE	/OE
Detection	0.05	0.1	0.3	0.02	0.005	0.01	0.005	0.01	0.01
Units	mg/l	ug/l	mg/l	ug/l	ug/l	ug/l	ug/l	mg/l	mg/l
Sample Name									
Control Blank	X	X	X	X	X	X	X	X	X
GCA10610 HNO3	7.07	X	185.1	159.27	X	1.36	0.117	X	1.09
GCA10611 HNO3	7.32	0.2	129	115.29	X	0.91	0.159	X	0.42
GCA10612 HNO3	7.26	X	140.4	115.98	X	0.98	0.241	X	0.41
GCA10613 HNO3	6.43	X	268.8	296.81	X	1.83	0.221	X	0.81
GCA10614 HNO3	6.59	X	197.6	212.73	X	1.35	0.173	X	0.4
GCA10615 HNO3	6.88	X	204.9	208.95	X	1.46	0.444	X	0.32
Alcoa11-OES	16.45		51.3					0.51	0.51
Alcoa18-MS		28.3		5.4		525.8	5.044	4.64	4.999

Notes:

The possible interference from SCN in the measurement of total CN was not found to be significant.

NATA ENDORSED DOCUMENT

Company Accreditation Number 3244

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NATA Signatory: Ann Evers

Ann Evers

Date: 17/12/2012



Accredited for compliance with ISO/IEC 17025



ANALYTICAL REPORT



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Project 1220_2
 Order Number (Not specified)
 Samples 6

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SGS Reference PE072709 R0
 Report Number 0000051150
 Date Reported 29 Nov 2012

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(898/20210).

SIGNATORIES

Leanne Orsmond
 Inorganics Coordinator

Lien Tang
 Project Manager

Michael McKay
 Inorganic Team Leader - Waters

Murray O'Neill
 Nutrients Signatory



ANALYTICAL REPORT

PE072709 R0

Parameter	Units	LOR	Sample Number	001	002	003
			Sample Matrix	Water	Water	Water
			Sample Name	GCA10610	GCA10611	GCA10612

Chloride by Discrete Analyser in Water Method: AN274

Chloride	mg/L	1.0	38	37	42
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Sulphate in water Method: AN275

Sulphate	mg/L	1.0	150	120	130
----------	------	-----	-----	-----	-----

Nitrate Nitrogen and Nitrite Nitrogen (NO_x) by FIA Method: AN258

Nitrate Nitrogen, NO ₃ as N	mg/L	0.0050	0.23	0.22	0.22
--	------	--------	------	------	------

Low Level Ammonia Nitrogen by FIA Method: AN261

Ammonia Nitrogen, NH ₃ as N	mg/L	0.0050	1.9	0.86	1.1
--	------	--------	-----	------	-----



ANALYTICAL REPORT

PE072709 R0

	Sample Number	004	005	006
	Sample Matrix	Water	Water	Water
	Sample Name	GCA10613	GCA10614	GCA10615
Parameter	Units	LOR		

Chloride by Discrete Analyser in Water Method: AN274

Chloride	mg/L	1.0	40	40	45
----------	------	-----	----	----	----

Sulphate in water Method: AN275

Sulphate	mg/L	1.0	310	160	240
----------	------	-----	-----	-----	-----

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by FIA Method: AN258

Nitrate Nitrogen, NO ₃ as N	mg/L	0.0050	0.26	0.24	0.24
--	------	--------	------	------	------

Low Level Ammonia Nitrogen by FIA Method: AN261

Ammonia Nitrogen, NH ₃ as N	mg/L	0.0050	2.0	0.94	0.83
--	------	--------	-----	------	------



QC SUMMARY

PE072709 R0

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

Chloride by Discrete Analyser in Water Method: ME-(AU)-[ENV]AN274

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Chloride	LB054458	mg/L	1.0	<1	0 - 3%	99 - 100%	76%

Low Level Ammonia Nitrogen by FIA Method: ME-(AU)-[ENV]AN261

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH ₃ as N	LB054403	mg/L	0.0050	<0.005	0 - 5%	103 - 104%

Nitrate Nitrogen and Nitrite Nitrogen (NO_x) by FIA Method: ME-(AU)-[ENV]AN258

Parameter	QC Reference	Units	LOR	MB
Nitrate Nitrogen, NO ₃ as N	LB054403	mg/L	0.0050	<0.005

Sulphate in water Method: ME-(AU)-[ENV]AN275

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Sulphate	LB054458	mg/L	1.0	<1	7 - 11%	101 - 102%	76%



METHOD SUMMARY

PE072709 R0

METHOD

METHODOLOGY SUMMARY

AN258

Nitrate and Nitrite by FIA: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Without the cadmium reduction only the original nitrite is determined. Reference APHA 4500-NO3- F.

AN261

Ammonia by Continuous Flow Analyser: Ammonium in a basic medium forms ammonia gas, which is separated from the sample matrix by diffusion through a polypropylene membrane. The ammonia is reacted with phenol and hypochlorite to form indophenol blue at an intensity proportional to the ammonia concentration. The blue colour is intensified with sodium nitroprusside and the absorbance measured at 630 nm. The sensitivity of the automated method is 10-20 times that of the macro method. Reference APHA 4500-NH3 H.

AN274

Chloride by Aquakem DA: Chloride reacts with mercuric thiocyanate forming a mercuric chloride complex. In the presence of ferric iron, highly coloured ferric thiocyanate is formed which is proportional to the chloride concentration. Reference APHA 4500Cl-

AN275

Sulphate by Aquakem DA: Sulphate is precipitated in an acidic medium with barium chloride. The resulting turbidity is measured photometrically at 405nm and compared with standard calibration solutions to determine the sulphate concentration in the sample. Reference APHA 4500-SO42-. Internal reference AN275.

FOOTNOTES

IS Insufficient sample for analysis.
 LNR Sample listed, but not received.
 * This analysis is not covered by the scope of accreditation.
 ^ Performed by outside laboratory.
 LOR Limit of Reporting
 ↑↓ Raised or Lowered Limit of Reporting

QFH QC result is above the upper tolerance
 QFL QC result is below the lower tolerance
 NA The sample was not analysed for this analyte

Samples analysed as received.
 Solid samples expressed on a dry weight basis.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here:
<http://www.sgs.com.au/pv.sgs/3/-/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf>

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Annexure 3

Details of Sampling Programs for Waste Rock, Ore and Soil Samples

(Total No. of pages including blank pages = 52)

Note: This Annexure is only available on the digital version of this document

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NOTE:

The Sampling Programme Memoranda presented in the following pages correspond to the initial main programme of testing of waste rock, ore, and soil samples carried out during 2012-2013.

Graeme Campbell & Associates Pty Ltd


Kingsgate

Consolidated Limited

MEMORANDUM

TO: Graeme Campbell
CC: Bob Markovich, Rob Corkery, Chris Dickson,
FROM: Peter Smith
DATE: 29/07/2014
SUBJECT: Bowdens Silver Project - Waste-Rock Sulphur and Manganese Data Analysis for Waste-rock Geochemistry Study

Executive Summary

Above the Early Permian Rylstone Volcanics, which host mineralisation within the Bowdens Silver Deposit (BSD), the Late Permian Snapper Point Sandstone is underlain by a thin slither of Late Permian conglomerate which is comprised of clasts from both the Sydney Basin sandstones (Snapper Point Formation??), Rylstone volcanics and older Ordovician Coomber Formation shales, siltstones and fine sandstones. Due to the complex nature of the polymictic conglomerate, alteration of Manganese (Mn) and to a lesser extent sulphur (S) appears similar to that of the volcanic units, with strong Mn alteration throughout the unit at relatively low values of Mn.

Coomber Formation units which underlay the BSD, also cut-off the mineralisation along the eastern margin of the deposit, due to N-S structural movement causing uplift of geology to the east of this structure. These units have not been reviewed in this document due to the limited occurrence within the pit boundaries and limited data on these units. A number of RC drill holes have intersected these units in the east and all have displayed low values for sulphur, manganese and zinc (Zn).

The Snapper Point Formation sandstone on the other hand, is derived from reworked silica rich sands with minimal inclusion of accessory minerals. These sandstones display little to no alteration after extraction in drill core, with minor haematite and Mn alteration along fractures occurring in-situ at the time of drilling.

Statistical assessment of sulphur values, and manganese and zinc values for $S < 0.1\%$, $S = 0.1$ to 0.3% , $S > 0.3\%$ have been undertaken. These ranges sulphur values relate to those used to distinguish between materials which are non-acid forming (NAF) and potentially acid forming (PAF).

Introduction

As part of the waste rock and tailings dam environmental studies, it has been considered necessary to identify the constraints of suitable NAF waste-rock and the impact of sulphur, manganese and zinc values limiting this material. Second to this, it was considered pertinent to review possible impacts of physical and observed properties of the lithology's on their use as NAF and PAF materials. This included a review of porosity, friability and alteration of manganese and sulphur over time.

Z:\Bowdens Data\03 Bowdens Environment\1 Government Departments\1.1 Planning\1.1.2 EIS Studies\1.1.2.6 Wasterock_Geochem

Lithology Physical and Visible Properties

During the process of analysis it was identified that the physical and visible properties of the varying lithologies may play an important part in their suitability as NAF material. For this reason a review of metallurgical test work completed as part of the Bowdens Silver Deposit (BSD) Definitive Feasibility Study (DFS) was completed. The focus for the review was centred on comminution testing which determined the resistivity of each rock-type to crushing and milling, with the belief that this will give some insight into the general physical properties of each rock-type.

As a result of this review it was identified through Bond Rod Mill Work Index (BWi), Bond Ball Mill Work Index (BBWi) (The BWi and BBWi are a measure of the resistance of the material to crushing and grinding.) and Sag mill comminution (SMC) testing that from hardest to softest the rock-types are as follows, ignimbrites are (SMC 35.4 and 36.2 hard), Volcanic breccia (SMC, 42.5 and 96.9 medium to soft) are slightly harder than the crystal tuff (SMC 53.0 and 92.1 medium to soft) which is the softest

Table 1. SMC Tests – Summary Results (Table 5.4.3 DFS Study, 5.4 Comminution tests)

Hole Id	Rock Type	A	b	A x b	ta	
BD12004	Crystal Tuff	63.9	0.83	53.0	0.55	medium
BD12009	Crystal Tuff	68.2	1.35	92.1	0.98	soft
BD12010	Breccia	64.6	1.5	96.9	1.04	soft
BD12012	Breccia	70.9	0.6	42.5	0.46	medium
BD12011	Ignimbrite	90.8	0.39	35.4	0.37	hard
BD12006	Ignimbrite	78.8	0.46	36.2	0.38	hard

The SMC tests above confirm the visible properties of drill core, with ignimbrite tending to appear harder, with relatively brittle fracture and less permeable in nature with respect to the volcanic breccia and crystal tuff. These features may play an important function in NAF suitability with crystal tuff and volcanic breccia being more friable and visibly more permeable with higher clay/silt fraction. These features also allow for more rapid transformation of manganese mineral conversion to manganese oxides and sulphates, which can be seen in the following drill-core images.

The following images are comprised of the various rock-types, with two images for each section of drill core taken. The first image of each section of core is taken shortly after the drilling process (within 1-2weeks of drilling) and the second image of each section of core is approximately 2 years after drilling. The purpose of this is to demonstrate the alteration of the core due to oxidation and reduction as a result of exposure to air of varying moisture seasonally (N.B. Core is stored undercover within a core shed with no direct exposure to sunlight or weather events.).

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Ignimbrite Characteristics

Visible evidence from the images below indicate that sulphur and zinc values do not necessarily influence the alteration and oxidation of manganese within the ignimbrite. Also evident in these images is the high competency of the ignimbrite core, maintaining full competency even after 2 years of storage after drilling.

Three trays of drill core containing ignimbrite were selected based on variation in sulphur and manganese grades. Note the strong manganese alteration in tray 12 of BD12002 containing 0.4% S and 8290ppm Mn with 291ppm Zn from 28m to 29m. However in trays 9 and 31 from holes BD12006 and BD12012 respectively, minimal evidence of Mn alteration occurs and only minor jarosite formation is evident in BD12009 which contained 1.7% S, 2460ppm Mn and 4600ppm Zn from 22m to 23m. BD12012 tray 31 displays minor yellowish brown alteration most likely due to minor Mn alteration as S values are minimal through this section, with 0.0% S, 4680ppm Mn and 133ppm Zn contained from 87m to 88m. Also identified was the lack of alteration seen in the core which had been wrapped in plastic wrap to stop oxidation in tray 31 of BD12012 (½ core under exposed ¼ core samples).



BD12012 Tray 31, 87.6m to 90.6m. Ignimbrite. 07/03/2012
(87m to 88m 0.0% S, 4680ppm Mn and 133ppm Zn)



BD12012 Tray 31, 87.6m to 90.6m. Ignimbrite. 25/07/2014



BD12002 Tray 12, 27.6m to 30.6m. Ignimbrite 07/03/2012
(28m to 29m, 0.4% S, 8290ppm Mn and 291ppm Zn)



BD12002 Tray 12, 27.6m to 30.6m. Ignimbrite 25/07/2014



BD12009 Tray 9, 21.6m to 24.6m. Ignimbrite 07/03/2012
(22m to 23m, 1.7% S, 2460ppm Mn and 4600ppm Zn)



BD12009 Tray 9, 21.6m to 24.6m. Ignimbrite 25/07/2014

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Crystal Tuff

Evidence from the images taken of intervals of crystal tuff indicate that manganese alteration occurs at much lower values and under minimal influence from sulphur values, with all three drill core trays having varying Mn values with consistent sulphur grades of 0.1% S. Note that alteration in BD12011 tray 12 has already occurred at the time of drilling, with strong iron rich zones of haematite/manganese alteration already present. Also, the later image for BD12012 Tray 14, indicates strong Mn alteration even though the Mn values are only 461ppm from 38.0m to 38.6m.

Physical evidence in the core displays the more fractured porous nature of the crystal tuff units with friable easily weathered fragments.



**BD12011 Tray 12, 30.7m to 33.7m. Crystal Tuff 02/06/2012
(33m to 34m, 0.1% S, 125ppm Mn and 40ppm Zn)**



BD12011 Tray 12, 30.7m to 33.7m. Crystal Tuff 25/07/2014



BD12012 Tray 14, 36.9m to 39.6m Crystal Tuff, 07/03/2012
(0.1% S, 461ppm Mn and 31ppm Zn)



BD12012 Tray 14, 36.9m to 39.6m Crystal Tuff, 25/07/2014



BD12012 Tray 12, 30.6m to 33.6m, Crystal Tuff, 07/03/2012
(33m to 34m, 0.1% S, 1015ppm Mn and 115ppm Zn)



BD12012 Tray 12, 30.6m to 33.6m, Crystal Tuff, 25/07/2014

Z:\Bowdens Data\03 Bowdens Environment\1 Government Departments\1.1 Planning\1.1.2 EIS
 Studies\1.1.2.6 Wasterock_Geochem

Volcanic Breccia

Visible evidence from the volcanic breccia indicate selective alteration of Mn and S within mainly crystal tuff clasts and more porous matrix flows. At lower values of Mn, alteration is constrained to minor clasts, possibly due to Mn values being constrained to specific clasts, with variation in Mn values a result of the ratio of Mn bearing clasts in the conglomerate. Also not in BD12001 Tray 15, the yellowish alteration possibly jarosite (S) formation throughout the interval displayed. This indicates that although Mn is confined to specific clasts, S tends to be more dispersed through the breccia indicating varying modes of mineralisation of S and Mn. Also note the larger proportion of Mn alteration in BD12009 Tray 25, indicating a larger portion of Mn bearing clasts, with strong selective alteration.

From the selected images, it appears that the volcanic breccia are reasonably competent rock with minimal fracture and friability. However evidence from other intervals indicate the matrix within the breccia are more friable and prone to fracture. This is most likely due to the variability of breccia and is possibly dependent on the clast and matrix composition along with silica alteration taking place after formation of these breccia units.



**BD12001 Tray 15, 39.6m to 42.6m. Volcanic Breccia, 02/02/2012
(40m to 41m, 0.5% S, 543ppm Mn and 1995ppm Zn)**



BD12001 Tray 15, 39.6m to 42.6m. Volcanic Breccia, 25/07/2014



BD12009 Tray 25, 66.8m to 69.8m. Volcanic Breccia, 29/02/2012
(67m to 68m, 1.0% S, 1050ppm Mn and 3030ppm Zn)



BD12009 Tray 25, 66.8m to 69.8m. Volcanic Breccia, 25/07/2014

Sandstone/Conglomerate

Above the Early Permian Rylstone Volcanics, the Late Permian Snapper Point Sandstone is underlain by a thin slither of Late Permian conglomerate which is comprised of clasts from both the Sydney Basin sandstones (Snapper Point Formation??), Rylstone Volcanics and older Ordovician Coomber Formation shales, siltstones and fine sandstones. Due to the complex nature of the polymictic conglomerate, alteration of Mn and to a lesser extent S appears similar to that of the volcanic units mentioned above, with strong Mn alteration throughout the unit at relatively low values of Mn, as seen in BD12012 Tray 9.

The Snapper Point Formation sandstone on the other hand, is derived from reworked silica rich sands with minimal inclusion of accessory minerals. These sandstones display little to no alteration after extraction in drill core, with minor haematite and Mn alteration along fractures occurring in-situ at the time of drilling, as evident in BD12012 Tray 8 below.

Physically these units tend to be moderately friable, relative to the crystal tuff and ignimbrite at either end of this scale. The conglomerate tends to break through and around clasts, dependent upon the derivation of the particular clast in a soft to moderately hard matrix. The sandstone is uniform in nature and therefore fracture and friability is consistent throughout the unit. It is generally competent in drill core, however is easily fractured and broken with the use of a geological hammer.

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BD12012 Tray 9, 21.6m to 24.6m. Conglomerate, 07/03/2012
(21.3m to 22m, 0.6% S, 410ppm Mn and 35ppm Zn)



BD12012 Tray 9, 21.6m to 24.6m. Conglomerate, 25/07/2014



BD12012 Tray 8, 18.6m to 21.6m. Sandstone, 07/03/2012
(0.1% S, 127ppm Mn and 19ppm Zn)



BD12012 Tray 8, 18.6m to 21.6m. Sandstone, 25/07/2014

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Geochemical Statistical Analysis for Sulphur, Manganese and Zinc

Method

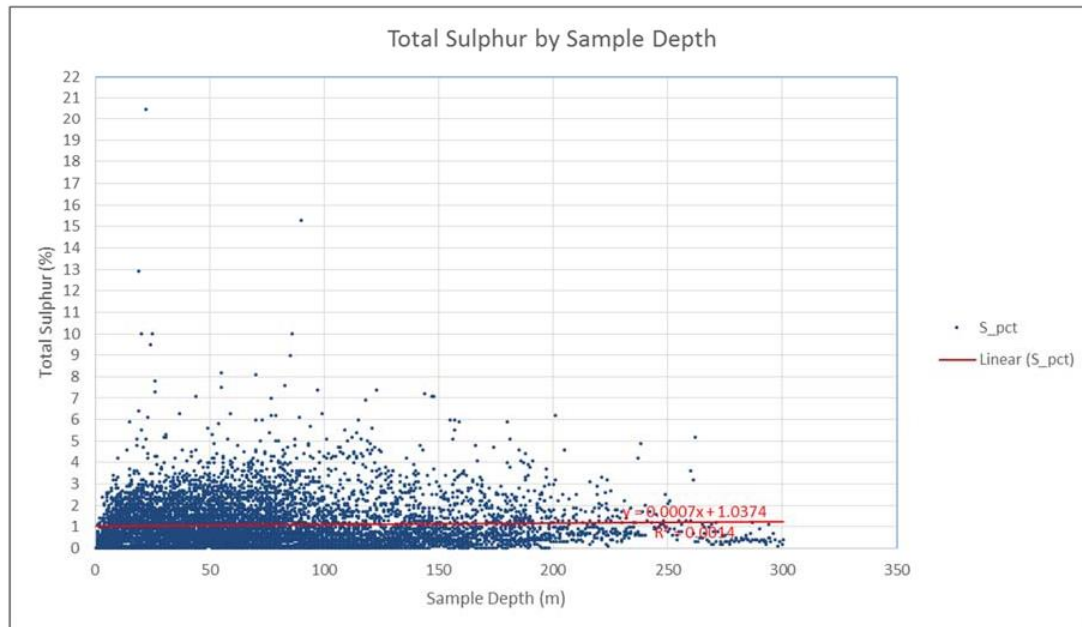
Assay data collected during several drilling programs completed by Kingsgate and historical data from previous drilling completed by Silver Standard Australia was used to create histograms S and Mn values for all samples with AgE grades below 30g/t (Minimum ore grade cut-off).

In the first instance all samples with S and Mn values were analysed globally regardless of rock type but excluding sandstone. Scatter plots for both S and Mn (for $\leq 0.3\%S$) against sample downhole depth were produced. Then histograms for S and Mn were produced from the global data for samples $<30g/t$ AgE within the pit shell.

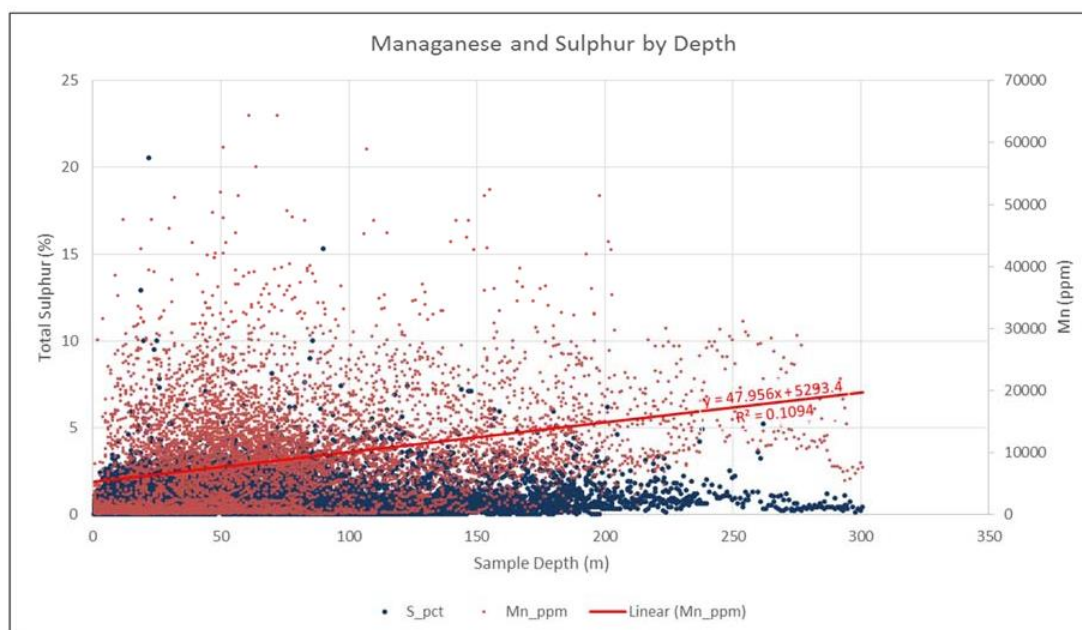
Results were then divided into rock-type and histograms produced for both S and Mn for samples $<30g/t$ AgE. Following on from this Mn histograms were produced for three separate S% ranges, $\leq 0.1\% S$, $0.1\% < S \leq 0.3\%$ and $> 0.3\% S$, for the global dataset and by lithology.

Results and Analysis

Scatterplots of assay results against depth downhole, indicate that values for sulphur remain almost constant with regard to increasing depth. This is possibly a function of sample density as the number of samples at greater depths are limited.

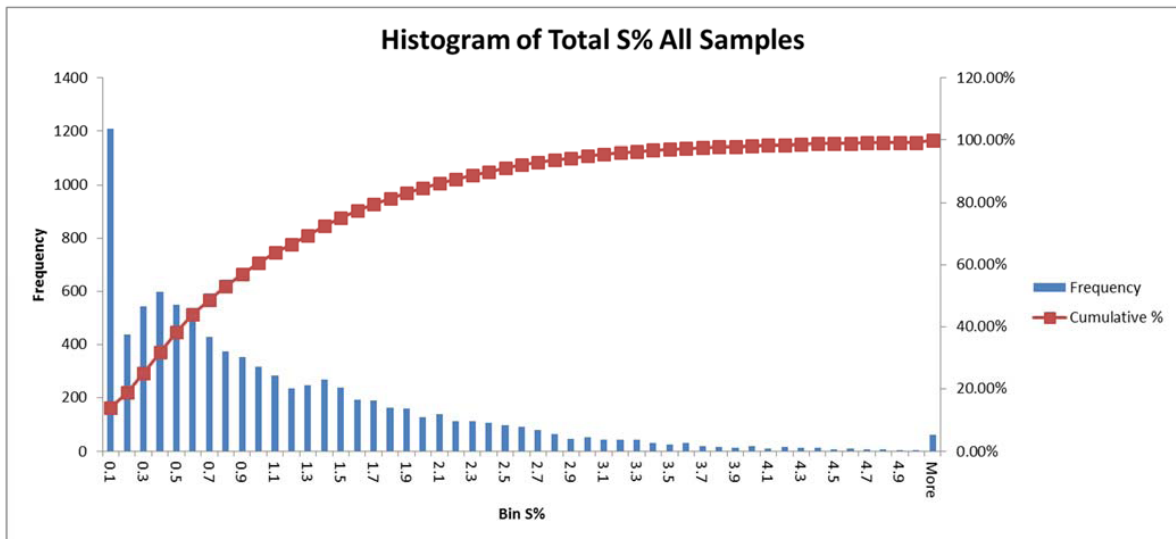


The trend line for Manganese indicates a distinct increase in Manganese values with increasing depth. This may be a result of leaching or possibly variation in lithology causing increase in values. This may also indicate that Mn within the area is associated with lithology rather than mineralisation.

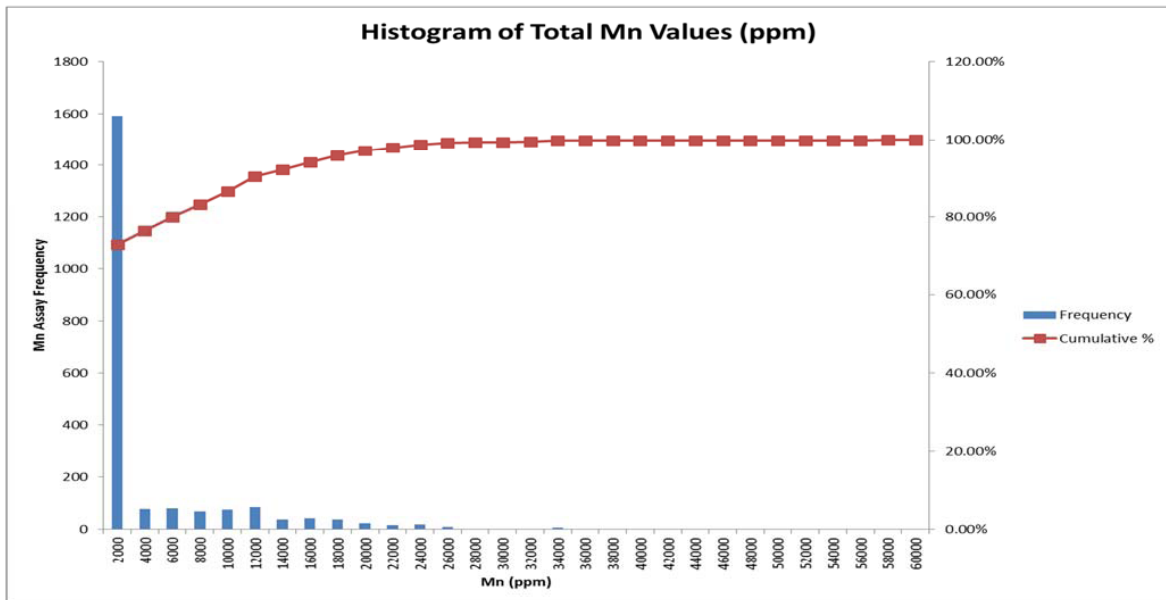


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Histogram for S% for all samples below cut-off grade of 30g/t AgE (Excluding Sandstone), indicates that 60% of S samples are $\leq 1.0\%$ S with 90% of all samples $\leq 2.4\%$ S Range, with a consistent decreasing frequency tail with increasing S grade.

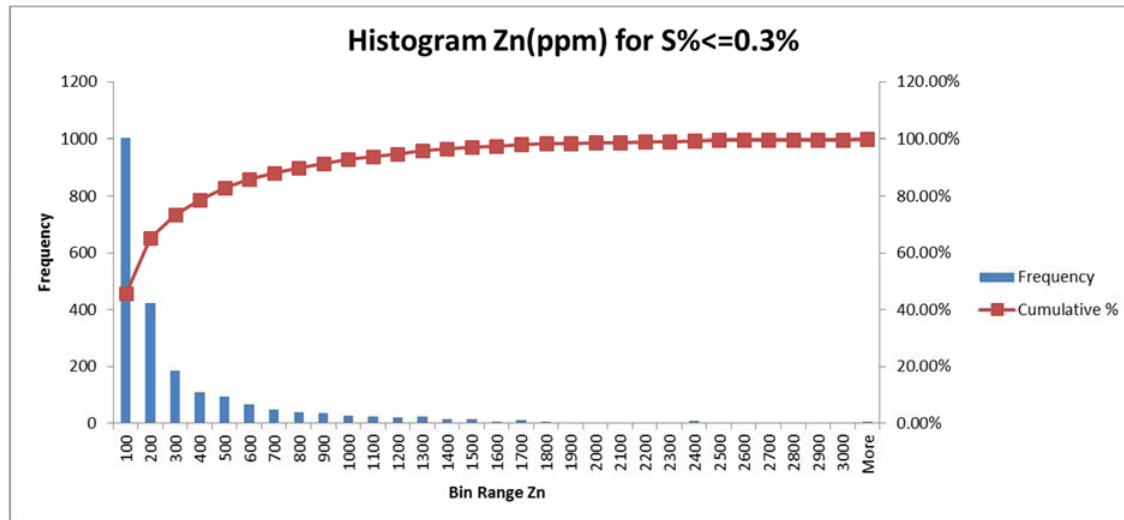


Mn values for S grades of 0.3% S or less show a distinct low end frequency, with 58.9% of all samples with values of 1000ppm Mn or less and 47.7% of all samples coming in at 500ppm or less. This suggests that all potential NAF material will be relatively low in Mn.



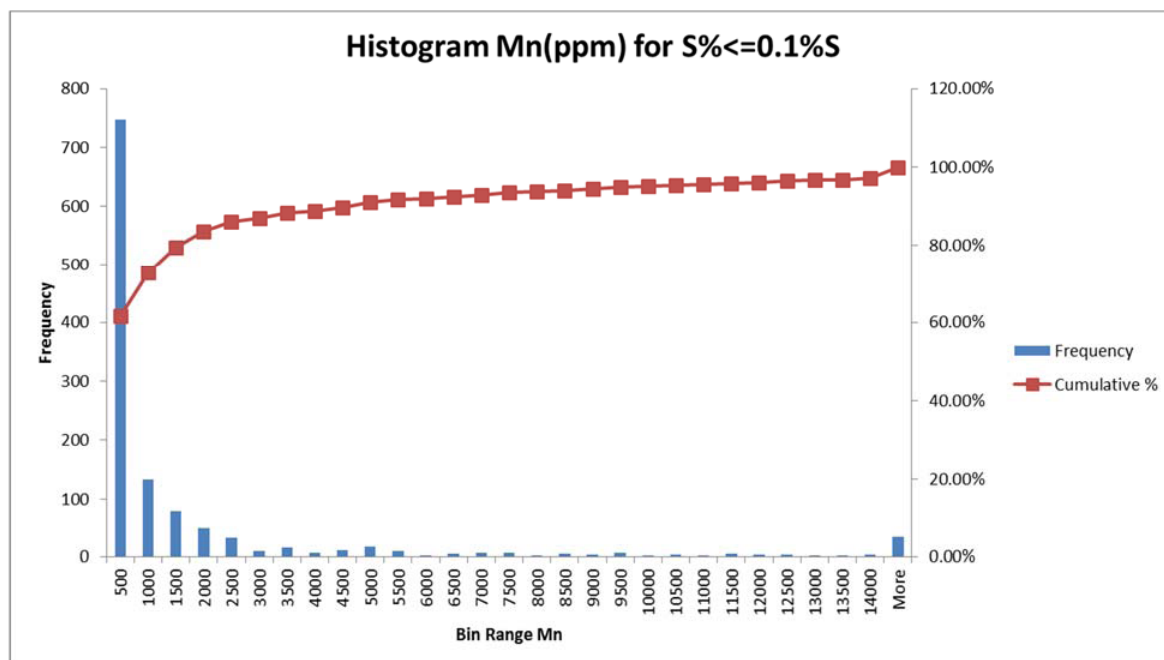
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Although the Bowdens deposit contains zinc bearing sphalerite using a S cut-off of 0.3% limits the volume of samples containing zinc sulphides. Globally, 82.8% of samples fell within the 500ppm Zn range or less for samples assayed for S within the volcanic units and further to this 45.75% of samples fell within the 100ppm or less range. This indicates the potential for zinc enrichment in NAF materials is low relative to the style of mineralisation present.



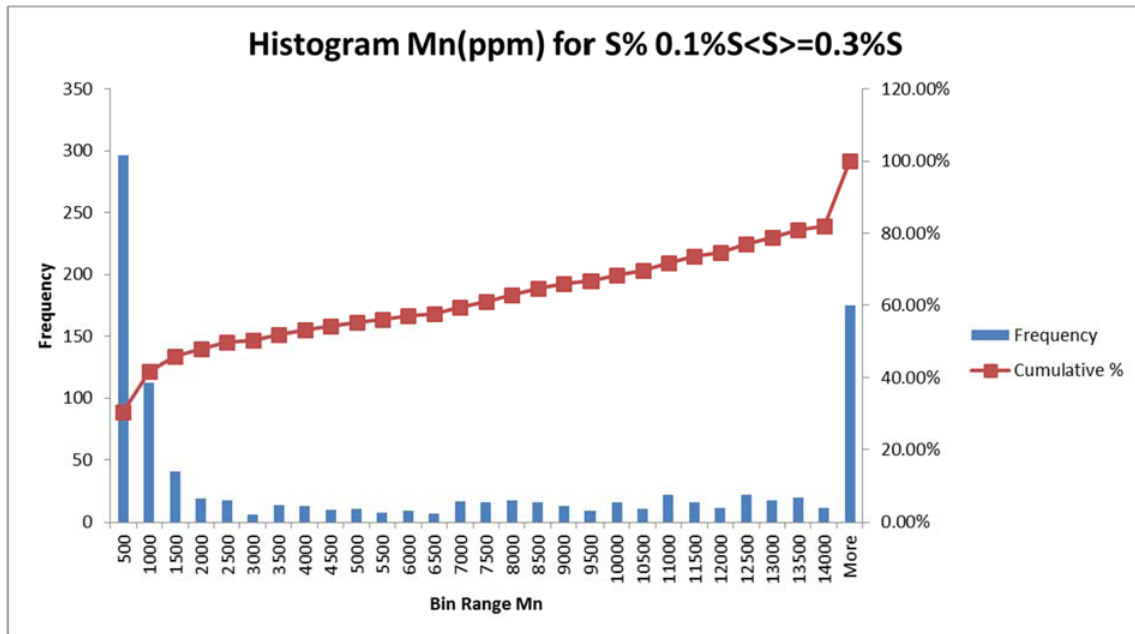
Manganese in All Volcanic Units

Refining the search parameters for Mn for best case scenario NAF materials, by using a cut-off grade of $\leq 0.1\%$ S, the following histogram demonstrates consistently low Mn values. High frequency in the 500-1000ppm range (61.7% and 72.7% of all samples respectively) and a short tail into the larger ranges gives positive indication on the potential of low S material to be used for NAF purposes.

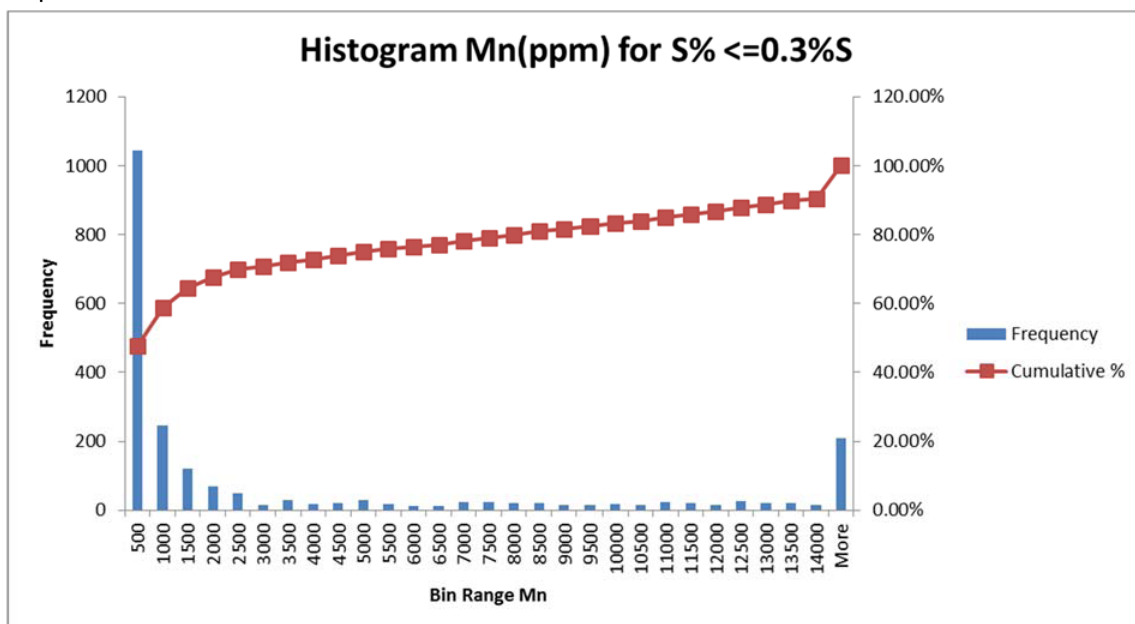


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Restricting the sample range to S values of between 0.1% S and 0.3% S which is considered the lower ideal range and upper realistic range for NAF S cut-off values, a definite increase in the upper bin ranges for Mn values is identified. Cumulative percentage of 30.3% and 41.8% within the 500ppm and 1000ppm ranges respectively, suggest materials contain larger portions of Mn, with only 50.3% results falling within the 3500ppm range or less.

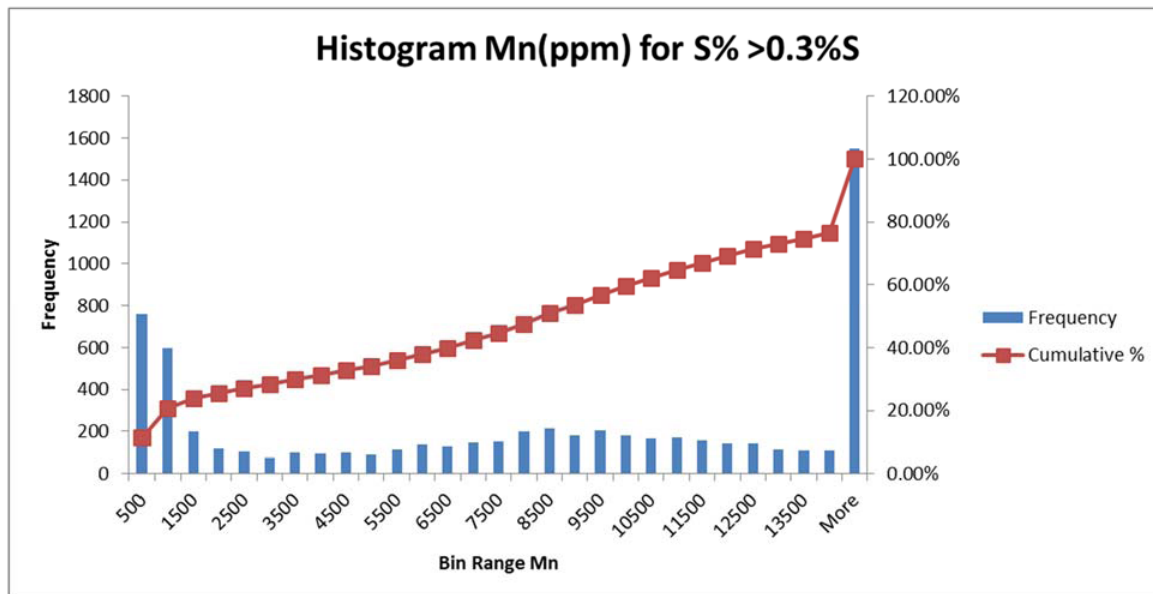


Due to a limited number of samples falling within the 0.1% to 0.3% S range of 977 samples compared with 1210 samples in the $\leq 0.1\%$ S range both discussed above and the low end frequency of the 0.1% range. When combining to the two ranges into a $\leq 0.3\%$ S range consisting of 2188 samples there is evidence of a reduced average and low end frequency indicating positive outcome as potential NAF material.



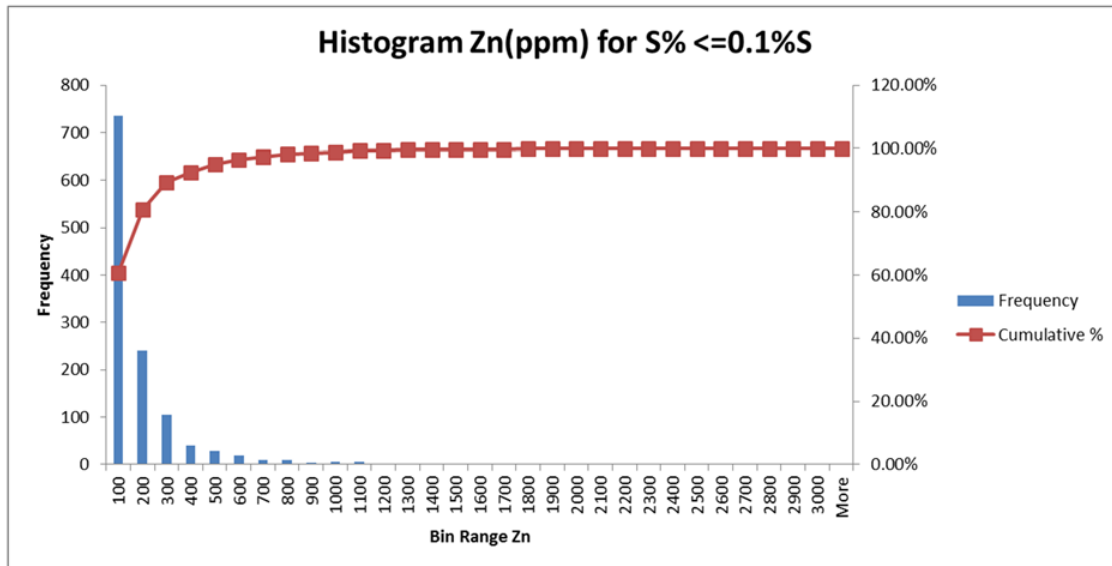
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For samples above 0.3% S there is an obvious decrease in low end frequency and increased average frequency across all bins for Mn. Cumulative percentages indicate this with 49.1% of all samples ≥ 9000 ppm Mn and only 11.6% of samples in the 500ppm Mn range.

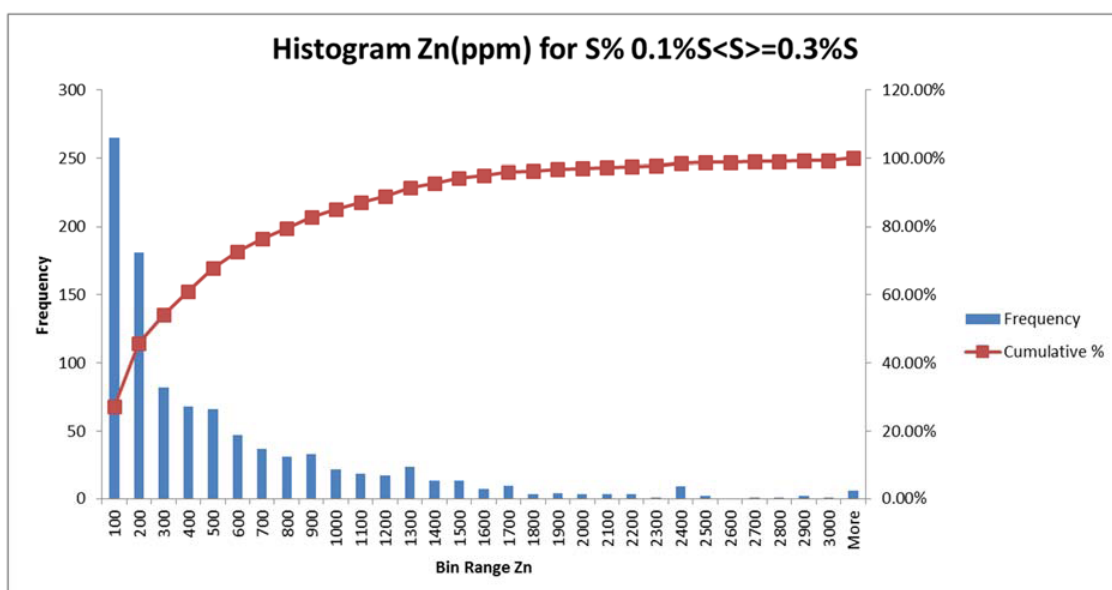


Zinc in All Volcanic Units

Similarly to Mn, Zn in the 0.1% S range displays a distinct low end frequency and short tail into higher value bins, with a total of 60.8% of all samples falling within the 100ppm Zn range. This appears to be directly related S values, as all histograms tend to display a similar trend with regard to Zn values which tend to tail out to zero values in higher ranges. On the other hand Mn values appear to extend an average value across a broad bin range indicating that there is not a direct association with S values and therefore mineralisation. However it is important to note that there is some type of secondary relationship occurring as Mn values do increase with increasing S grades.

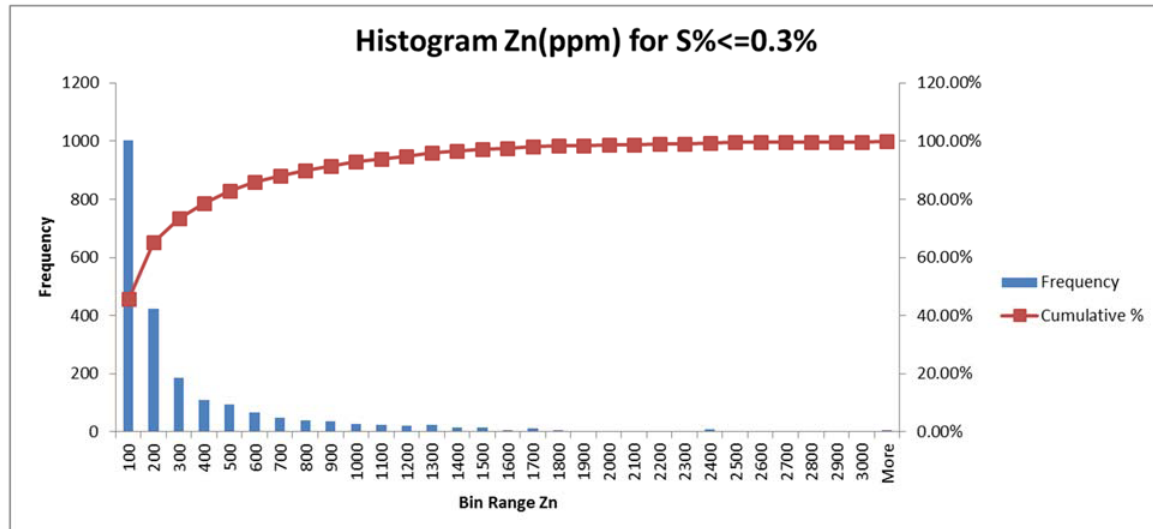


Restricting the sample range to S values of between 0.1% S and 0.3% S as previously done with Mn the data maintains a definite low end frequency, however the tail has extended into higher bin ranges. Cumulatively 54.0% of samples are contained within the 300ppm range with 520 samples of a total 977 contained within this range.

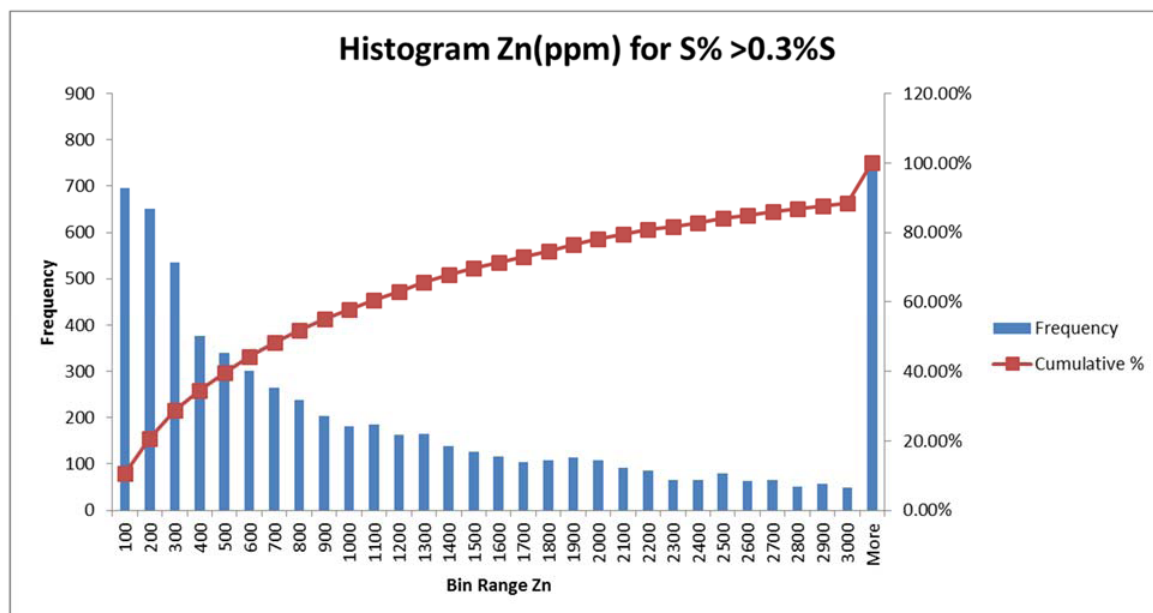


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As with the $\leq 0.3\%$ S range for Mn, combining of the 0.1% and 0.3% S cut-off a low end frequency is maintained for Zn values. Cumulatively 45.75% and 65% of samples are contained within the 100 and 200ppm ranges respectively. Indicating positive potential for use of materials in this S range for NAF materials.



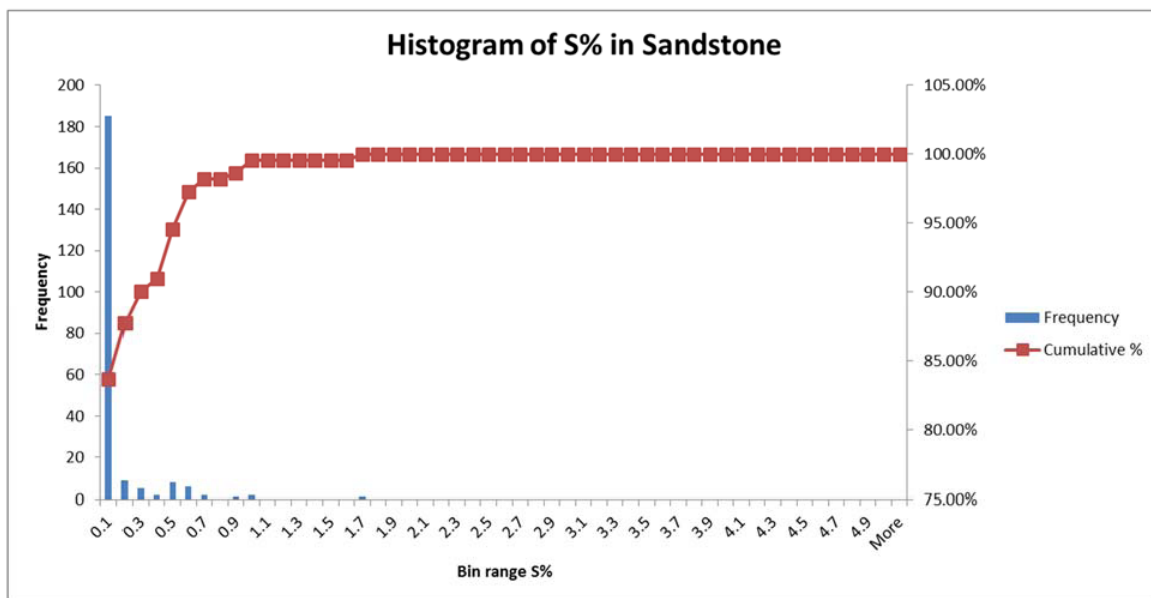
As should be expected and similarly to Mn, for S values $> 0.3\%$ Zn values display a reduction in low end frequency and higher average frequency in higher end bin ranges. Although as stated previously the relationship to S appears more direct than that with Mn, and again this possibly relates to a secondary relationship between S and Mn occurrence.



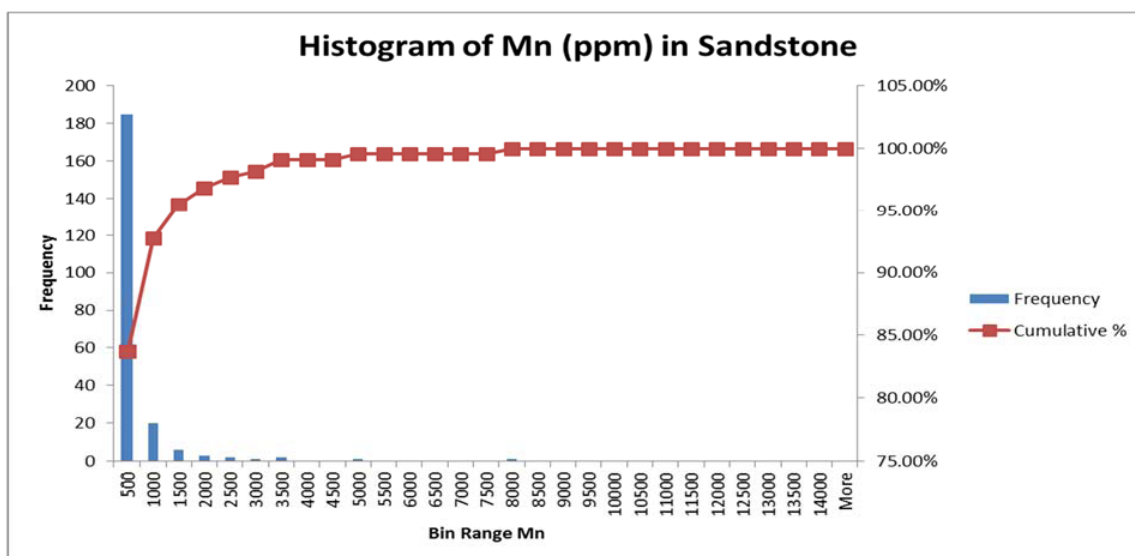
Snapper Point Sandstone

Evidence from the following histograms clearly indicates that S, Mn and Zn trends within the sandstone units have a distinct signature, unlike those seen in the volcanic units hosting the Bowdens Silver Deposit (BSD). This signature is due to the geological timing of the deposition of the Snapper Point Sandstone units being later than the deposition and mineralisation events within the older Rylstone Volcanic units.

Within the sandstone units 90% of all assayed S values contain 0.3% S or less, indicating that the majority of the sandstones are suitable NAF material.

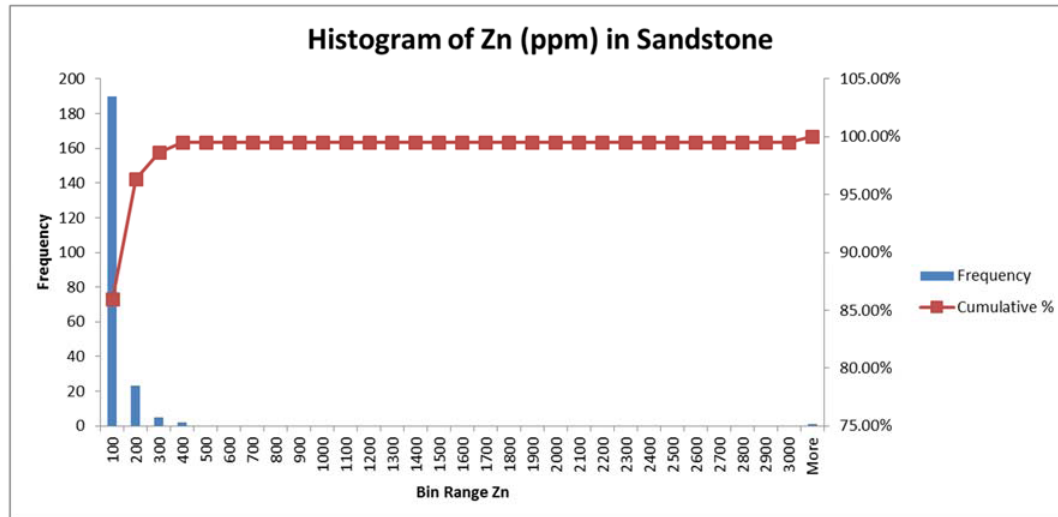


Samples for Mn within the sandstone also indicate relatively low grades with 87.7% of all samples within the sandstone containing 500ppm Mn or less.



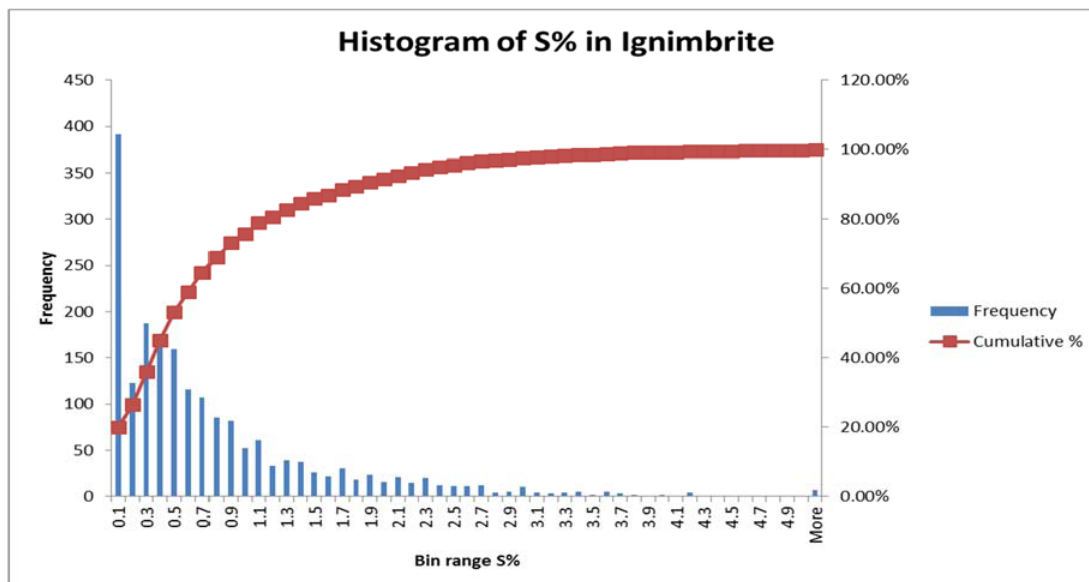
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Zn values within the sandstone display almost identical frequency regimes to those of both S and Mn, with 86.0% of all samples contained within the 100ppm Zn range. This feature indicates that both Mn and Zn values within the sandstone, have a different geochemical relationship to the contained S with regard to those seen in the volcanic units.



Ignimbrite

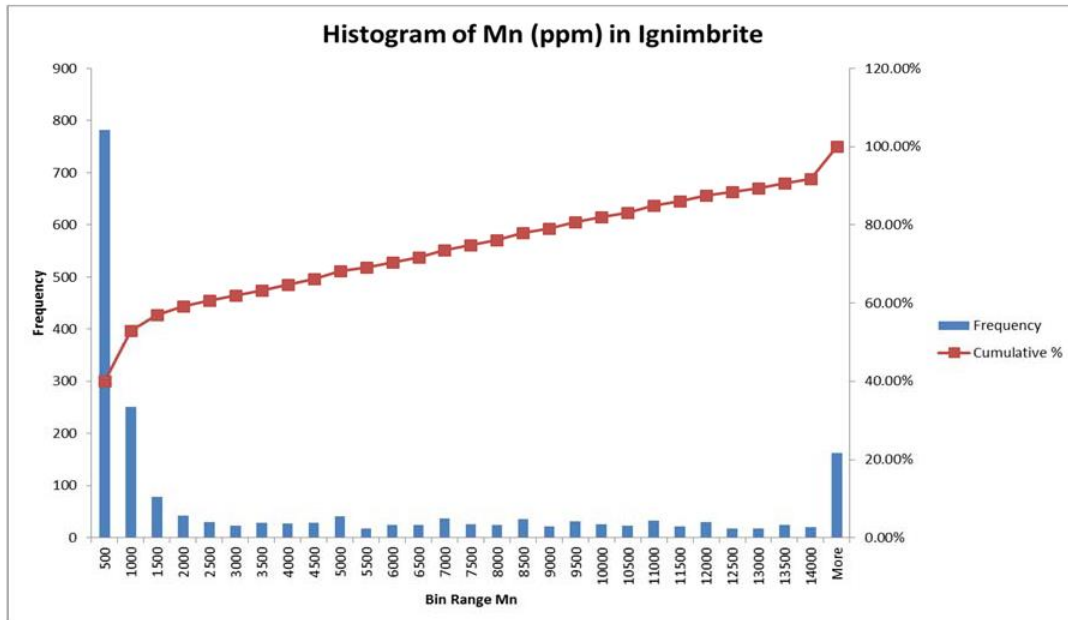
The histogram for S% in ignimbrite indicates a higher portion of samples in PAF range, with only 36.0% of samples in the 0.3% S range. A steady decreasing tail through to the 3.0% bin. Lithological characteristics of ignimbrite tend to be relatively hard, glassy and brittle, with sulphide mineralisation tending to be contained in small veins and fracture fill with very limited dissemination of sulphides.



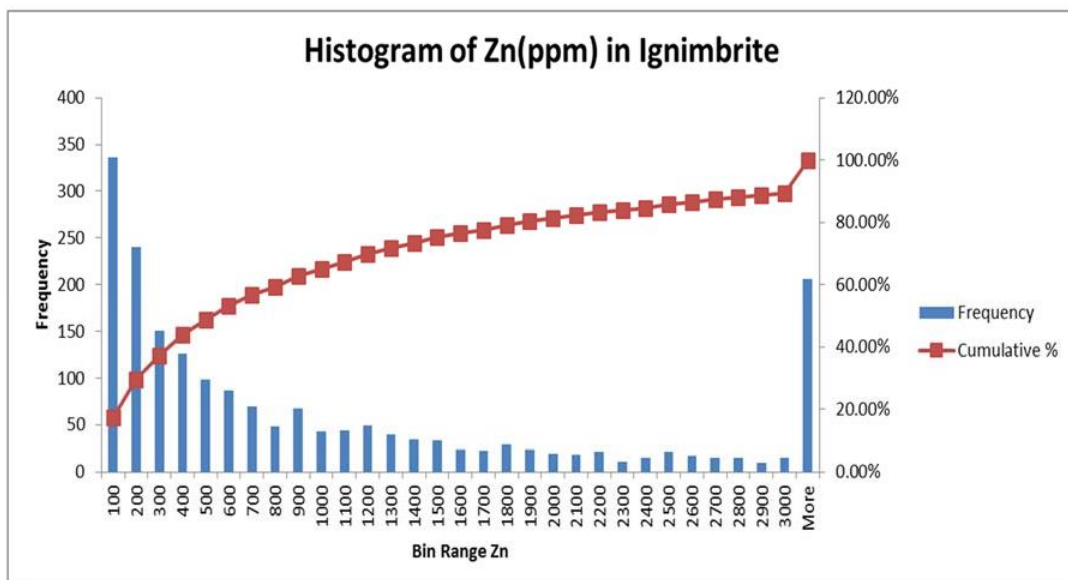
53% of all Mn values are within the 1000ppm or less range and 47.1% of all samples within the ignimbrite contain 500ppm or less. However unlike S% Mn does not appear to tail out with consistent frequency values for Mn seen throughout the range to over 14,000ppm. Again this

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indicates that Mn is a function of rock type or possible structural fluid migration process and has limited relationship to S values.



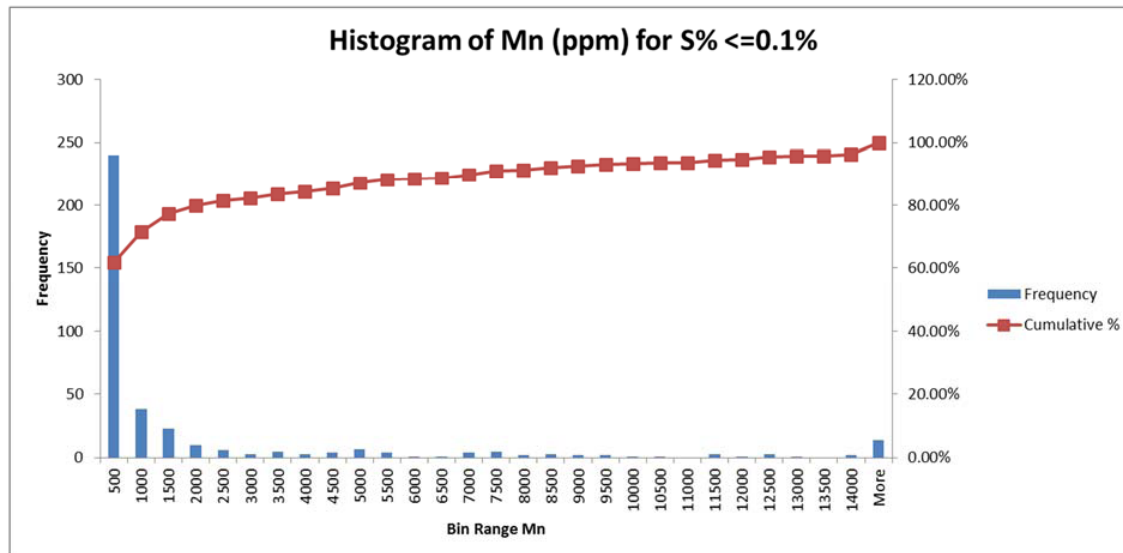
Zn values in ignimbrite show a strong low end frequency with a steadily declining tail through higher grades. 48.8% of all values fall within the 500ppm range or less. Although there are significant number of samples above 3000ppm frequencies up until this point indicate a steady decline indicating a significant relationship with S in the >30g/t AgE.



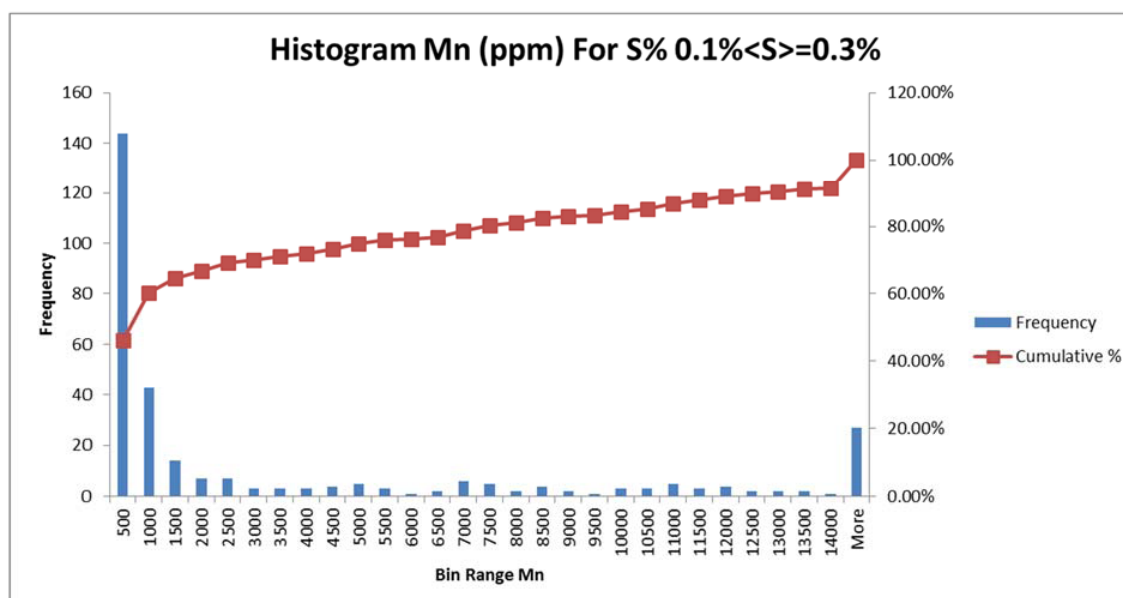
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Manganese in Ignimbrite

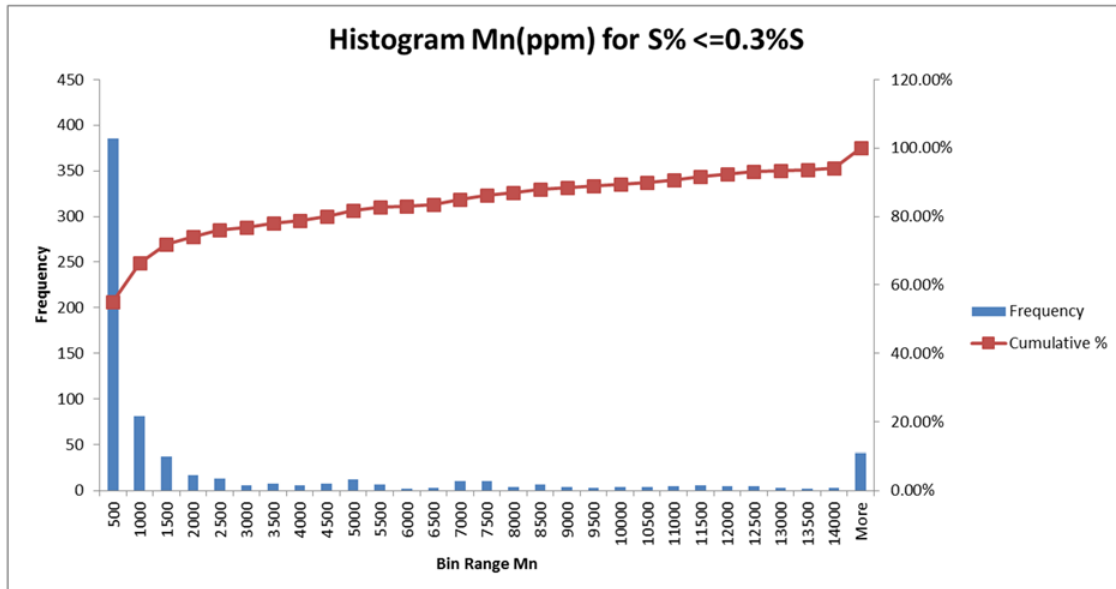
For S% <0.1% there is a distinct low end frequency with 61.7% of samples in the 500ppm bin range and very limited samples above 2000ppm range with 79.95% of samples contained within this range. The low Mn content across the majority of samples indicates high potential for NAF material, however physical characteristics of ignimbrite may be a constraining factor.



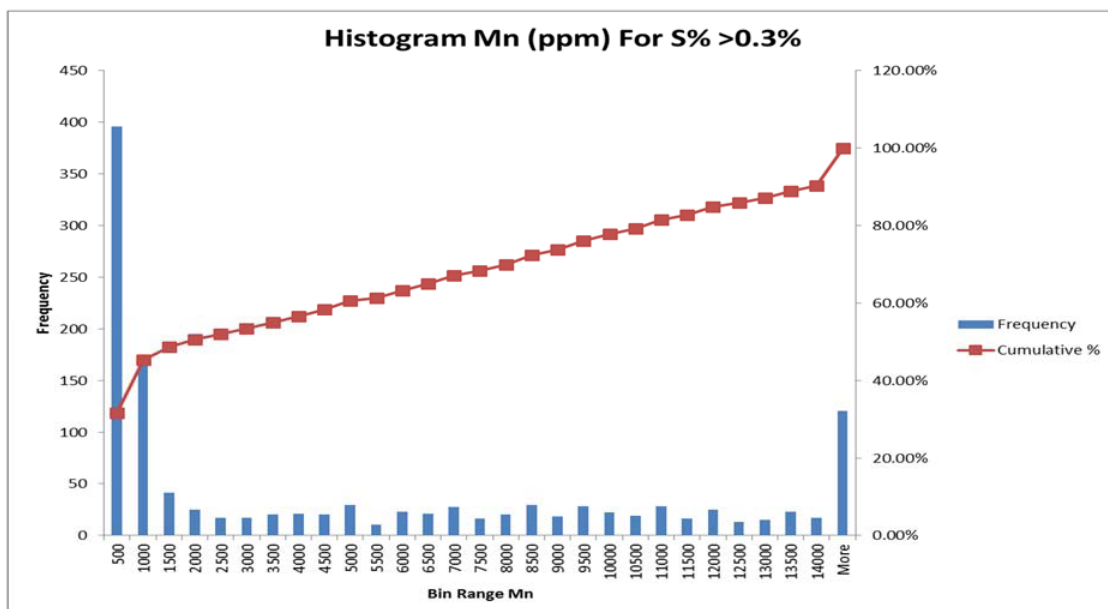
Mn values for the S% range between 0.1% S and 0.3% S show a slight increase in bin range with a larger portion of samples falling in 1000ppm range however overall 60.1% of samples are still contained within this low end range. This is most likely a result of the lower permeability of ignimbrites, reducing the infiltration of hydrothermal fluids carrying Mn, or possibly due to the original geochemical nature of the ignimbrites being Mn poor.



Combining the 0.1% and the 0.1 to 0.3% S ranges a return to increased low end frequency, with 54.9% of samples falling within the 500ppm range and 66.5% falling within the 1000ppm range from a total pool of samples of 700. Of the 700 samples, 389 were derived from the <0.1% S range and 311 from the >0.1% to 0.3% S range.



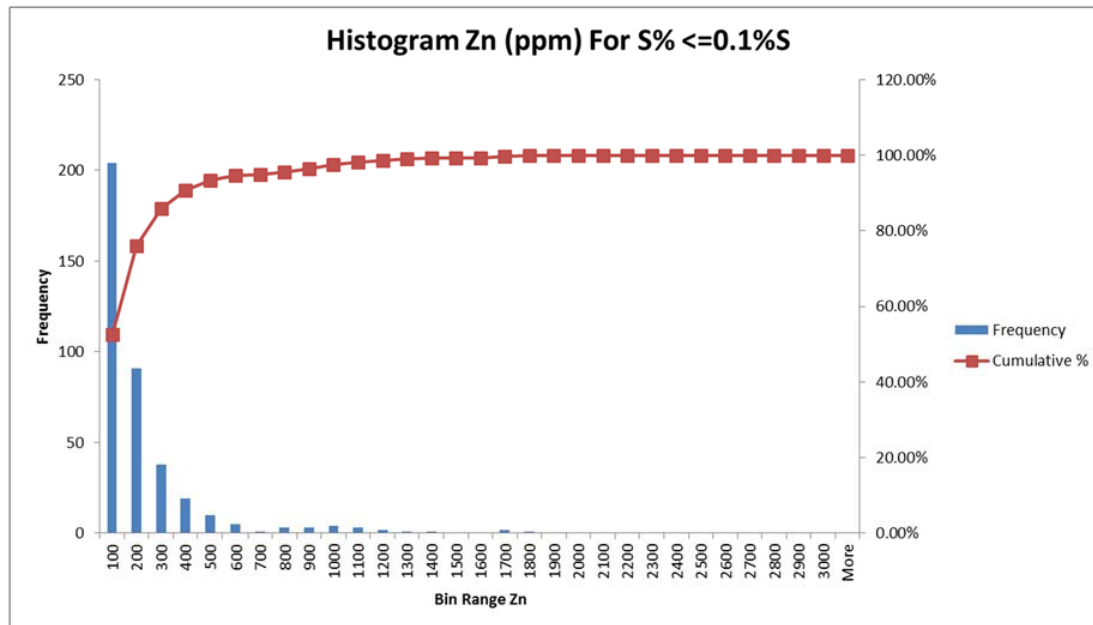
A total of 1247 samples were identified in the >0.3% S range with Mn values still displaying a low end frequency curve with 45.4% of samples contained within or below the 1000ppm range. This reiterates the limited supply of Mn within the ignimbrite units and indicates a possible secondary source of Mn infiltration into more permeable units of the volcanic suite.



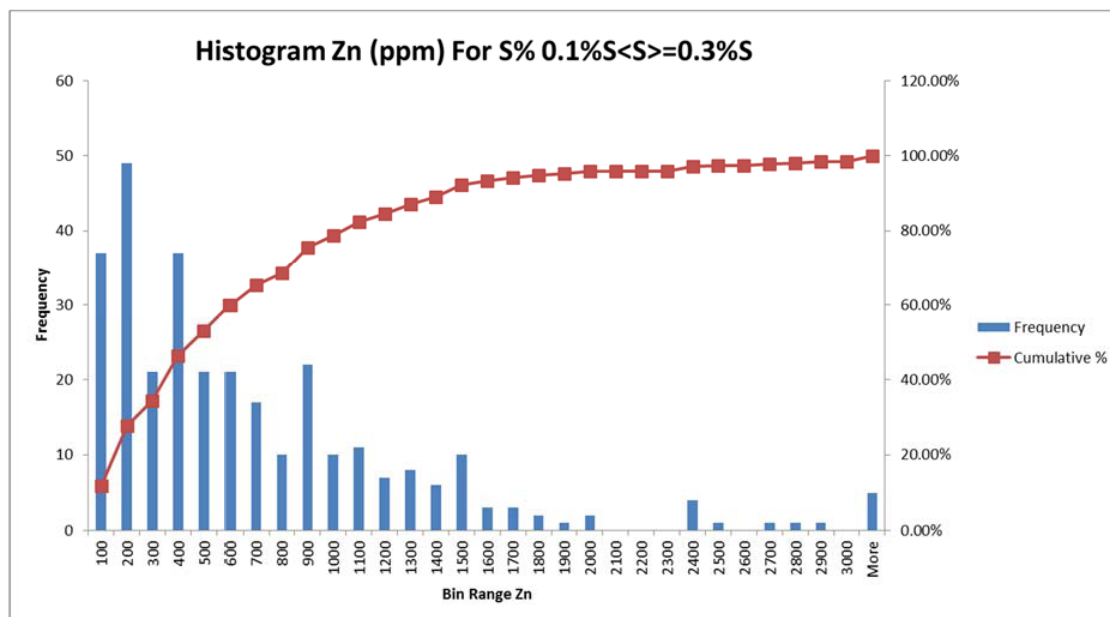
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Zinc in Ignimbrite

For S values 0.1% and below Zn values display a definite low end frequency curve with 52.6% of samples falling within the 100ppm range and cumulatively 90.7% of samples are contained within or below the 400ppm range. This again demonstrates the direct link of Zn values with S grades and limited dissemination of sulphides within ignimbrite units.

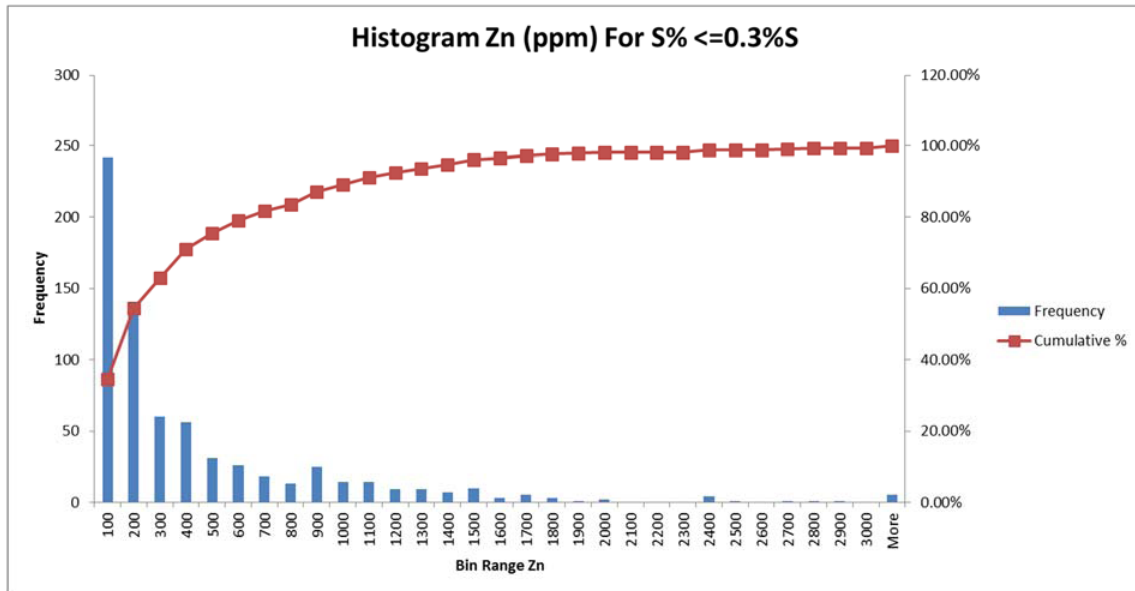


For S values between 0.1% and 0.3% S, Zn values display a more inconsistent trend with high fluctuations between bin ranges and a more disjointed frequency curve, with only 27.7% of samples falling within or below the 200ppm range. This is possibly due to the nature of mineralisation within the ignimbrites being confined to fracture fill veining creating large fluctuations in S and Zn values due to small micro-fracture fill having an impact on values at this low sulphide S range.

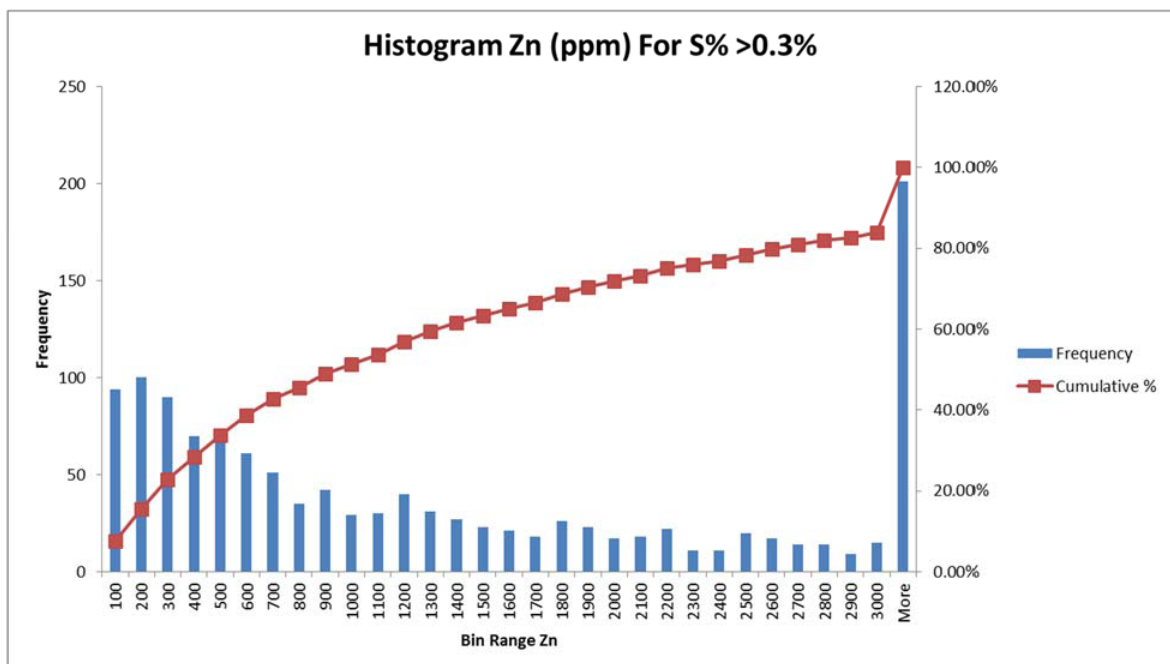


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Combining the 0.1% and the 0.1 to 0.3% S ranges a return to increased low end frequency is seen, with 54.49% of samples within 200ppm or less range. Also evident is the short tail with 89.2% of all samples falling within the 1000ppm or less range. With almost even distribution of 388 samples in the 0.1% S range and 311 in the 0.1 to 0.3% S range, indicating that overall the Zn values for this S% range in ignimbrite have a majority low end frequency.



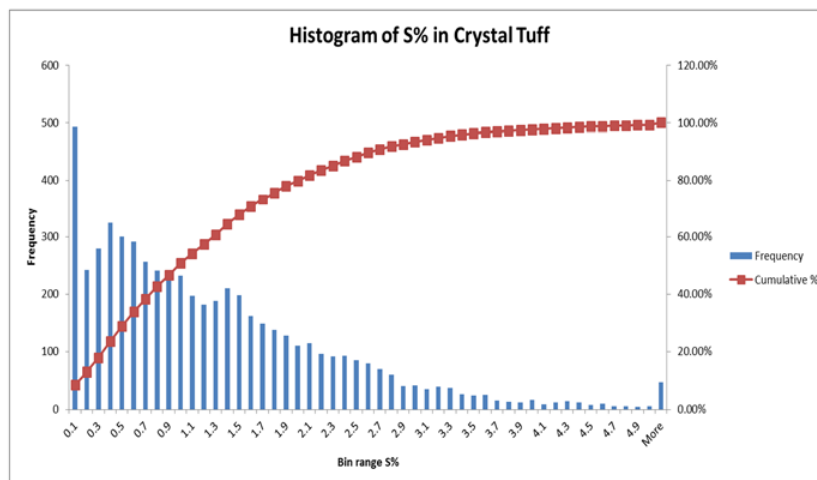
For the greater than 0.3% S range, the low end frequency is diminished with a long broad tail across all values of zinc. Only 51.2% of the 1247 sample total in the 1000ppm or less range and the 90% cumulative total not reached until the more than 3000ppm bin. This is most likely related to mineralisation at the higher end of the AgE cut-off influencing the overall waste characteristics of the ignimbrite.



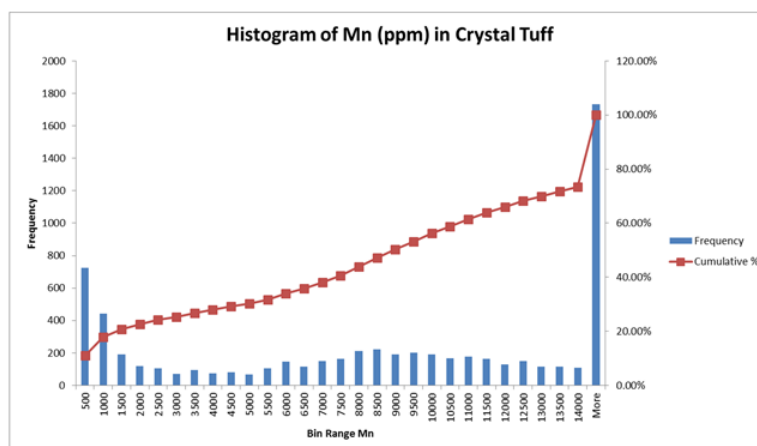
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Crystal Tuff

Within the crystal tuff units' S grades tend to have a larger dispersion across the S% ranges, with a long broader tail extending to 5% S. Only 17.8% of S grades fall within the 0.3% S or less range. This is most likely due to the more porous friable nature of the crystal tuff and extensive mineralisation in disseminated form hosted within the crystal tuff. Evidence from diamond drilling indicates that crystal tuff tends to break down faster once exposed to open air and becomes very friable within 3-6 months of exposure after drilling. This is probably due to the larger quantity of fine ash matrix within these units, with respect to ignimbrite and to a lesser extent the volcanic breccia units which become more friable after 1-3 years for ignimbrite (if at all!) and 6-12 months for the volcanic breccia.

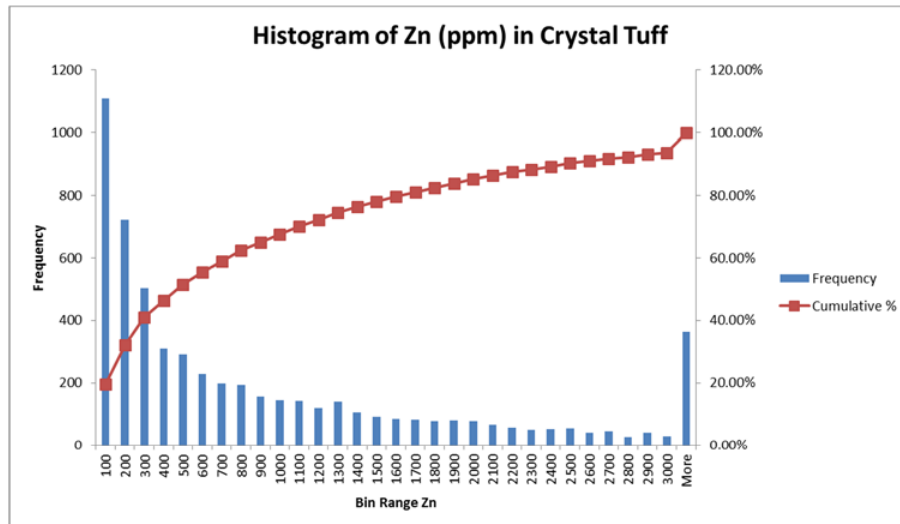


Along with S, Mn trends within the Crystal Tuff display a large dispersion across all ranges and only 17.9% fall within the 1000ppm Mn or less range. Mn values also display similar frequency features as those seen within the ignimbrite with no distinct tailing out in the frequency of Mn values. Visible indications from drill core display rapid black staining from MnO formation, most likely due to the disseminated mineralisation style and/or the more friable nature of the crystal tuff. Although previous comments indicated that Mn values are not related to mineralisation, the impact of disseminated sulphides dispersed throughout the crystal tuff may have a role in the activation of MnO formation.



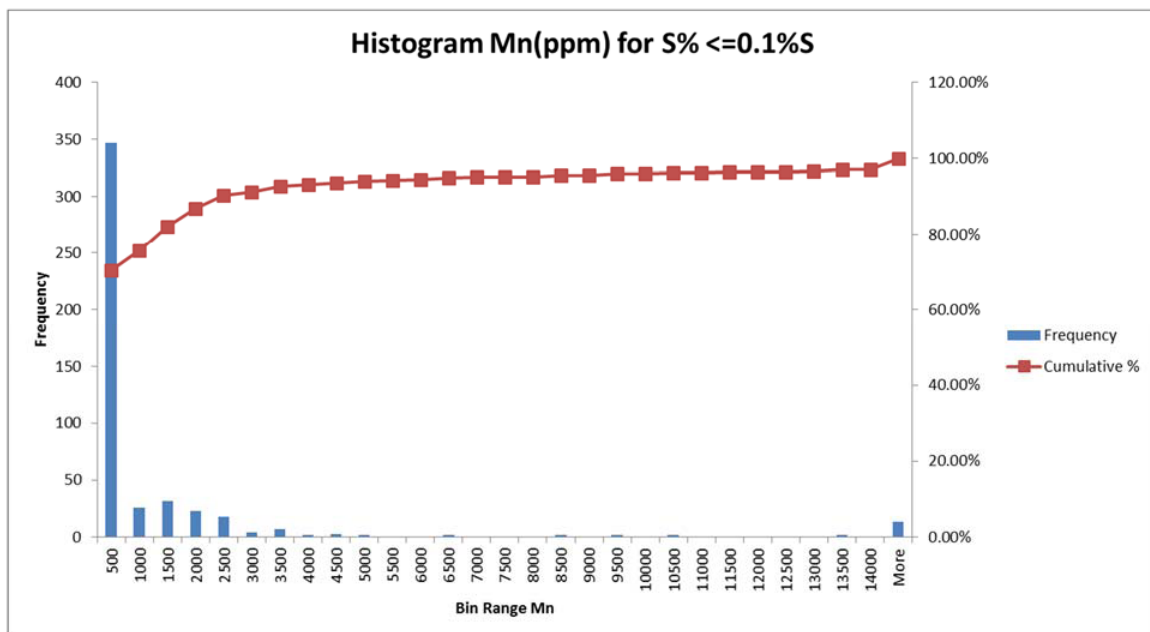
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Zn within the crystal tuff units display a definite low end frequency with a steady decrease in cumulative percentage into higher value bins. When compared to S% values there is a distinct difference at the low end bin ranges with S% displaying an upward trend before moving into a steady decline in frequency, however zinc values steadily decrease in frequency through the bin ranges, with 51.5% of all zinc values in crystal tuff falling within or below the 500ppm range.



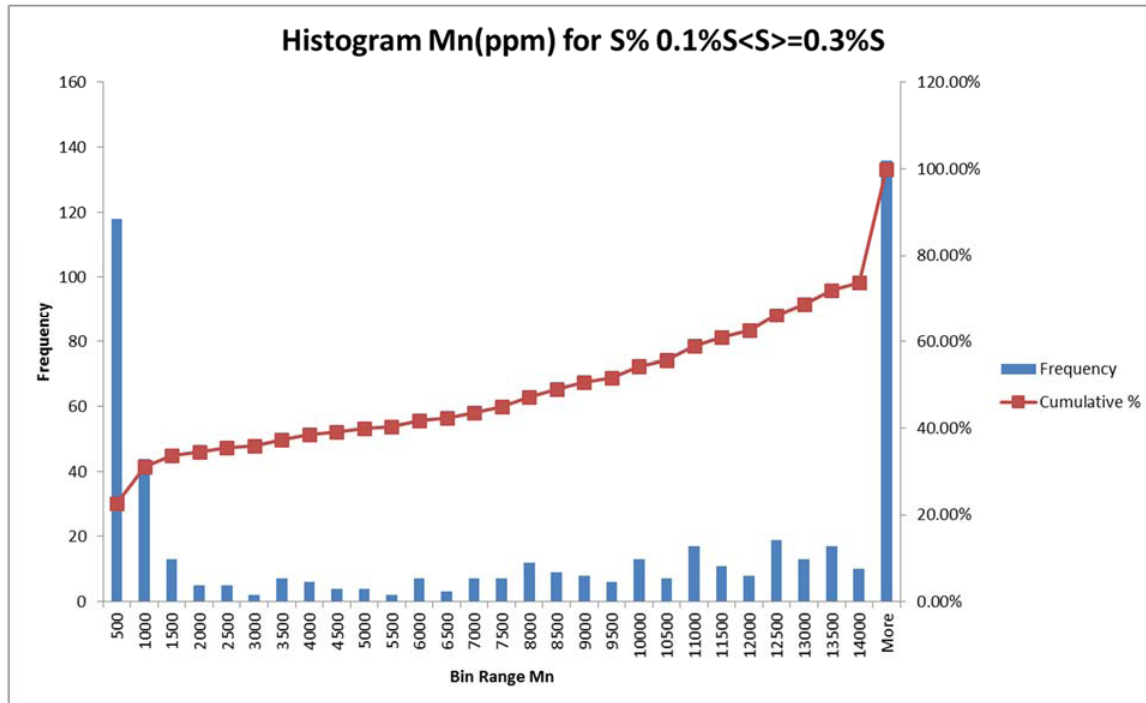
Manganese in Crystal Tuff

Manganese in the 0.1% S or less range displays a definite low end frequency, with 70.4% of samples falling within the 500ppm or less bin. Therefore crystal tuff in this low S% range has high potential as NAF material with 86.8% of samples falling within the 2000ppm or less range for Mn.

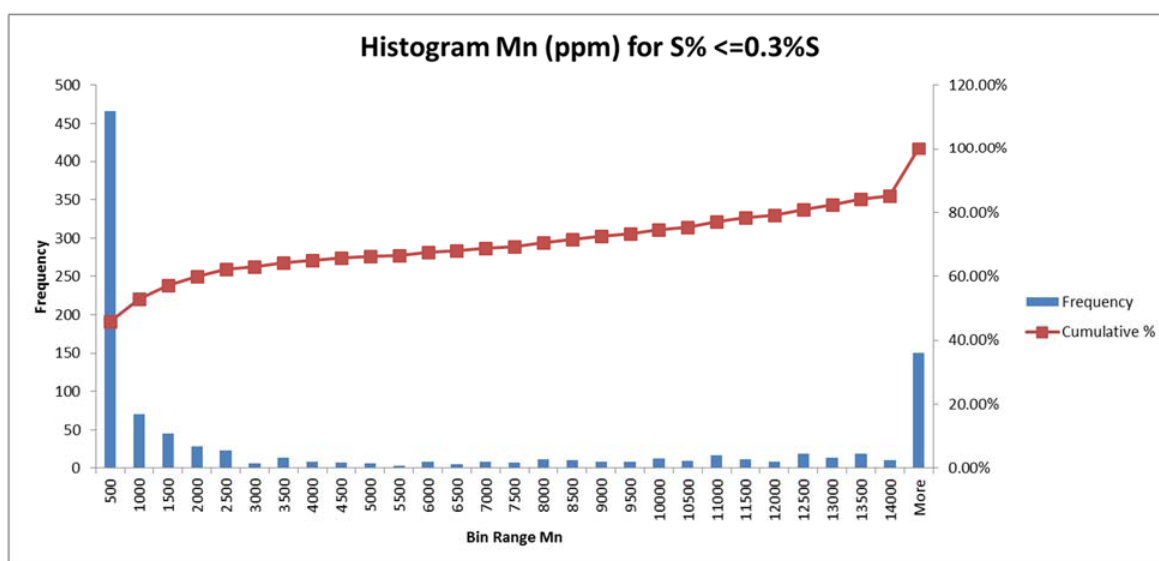


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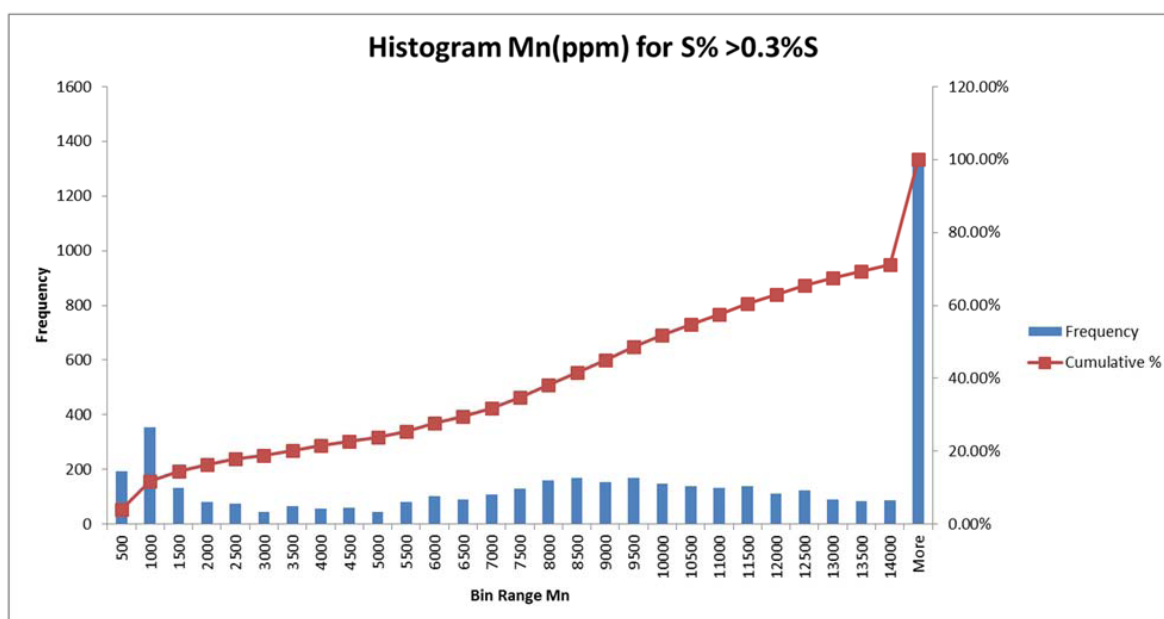
Mn values for the S% range between 0.1% S and 0.3% S show a double high with a strong low end frequency followed by a gradual increase in frequency from 6000ppm range which is maintained at a steady level throughout the upper ranges. The cumulative totals indicate that only 41.73% of samples fall within the 6000ppm range or less, leaving a total of 58.27% above this range.



Again once the 0.1% and 0.1 to 0.3% ranges are combined a distinct low end tail is returned with the combined totals at the low end totalling 52.86% in the 1000ppm range or less. Due to the strong low end frequency in 0.1% S range totalling 493 samples and 22.69% of samples in the 0.1% to 0.3% S range being within the 500ppm range the combined tables return the low end frequency producing 0.3% S material suitable overall for use as NAF material.



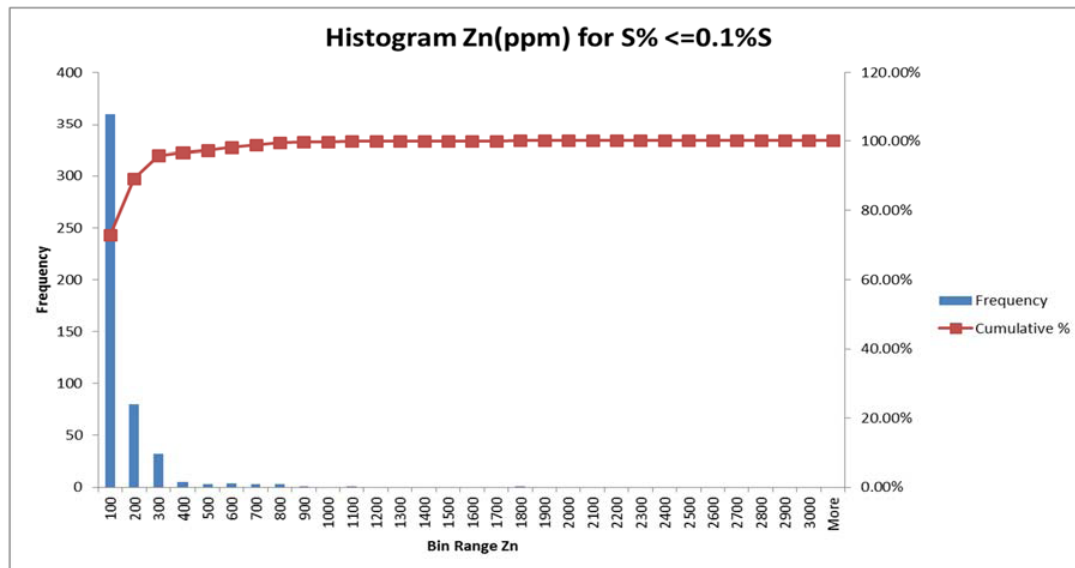
For the range of greater than 0.3% S, Mn values display minimal low end frequency and maintain a steady distribution across all bin ranges, with only 23.75% of samples falling within the 5000ppm range or less.



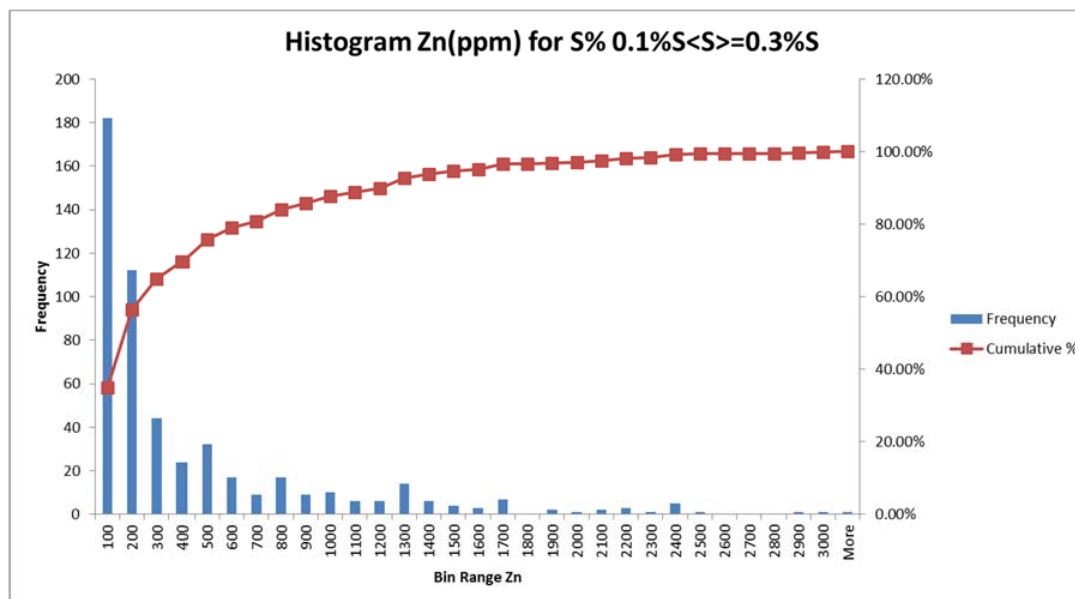
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Zinc in Crystal Tuff

For S values 0.1% and below Zn values display and definite low end frequency curve with 73.02% of samples falling within the 100ppm range and cumulatively 96.75% of samples are contained within or below the 400ppm range. This again demonstrates the direct link of Zn values with S grades and limited dissemination of sulphides within ignimbrite units compared with crystal tuff units.

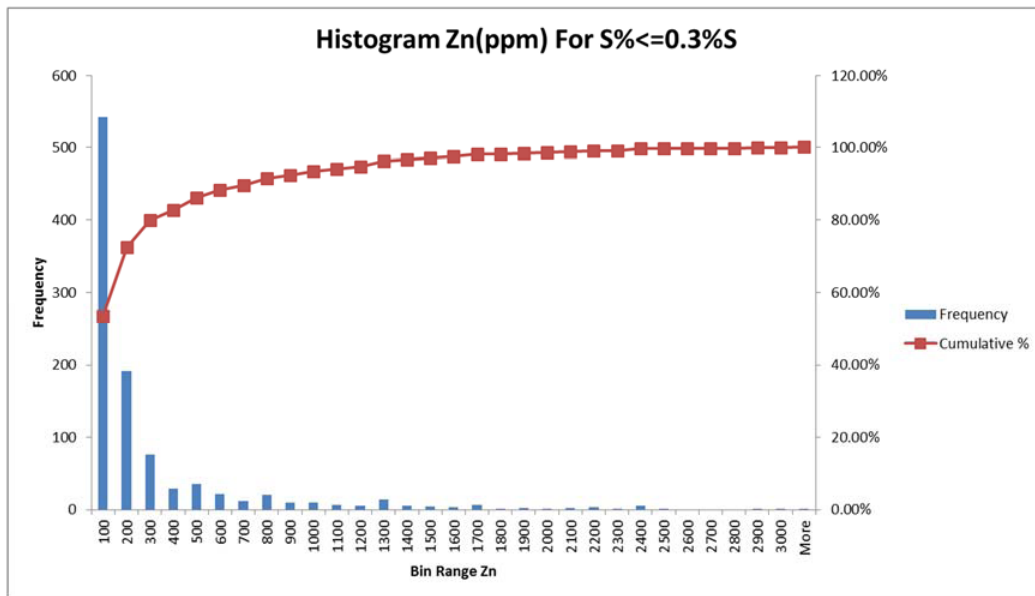


For S values between 0.1% and 0.3% S, Zn values maintain a low end frequency, with 56.54% of samples falling within or below the 200ppm range. This is possibly due to the disseminated nature of ore in the crystal tuff, producing more consistent low values of zinc and sulphur in lower grade ore regions.

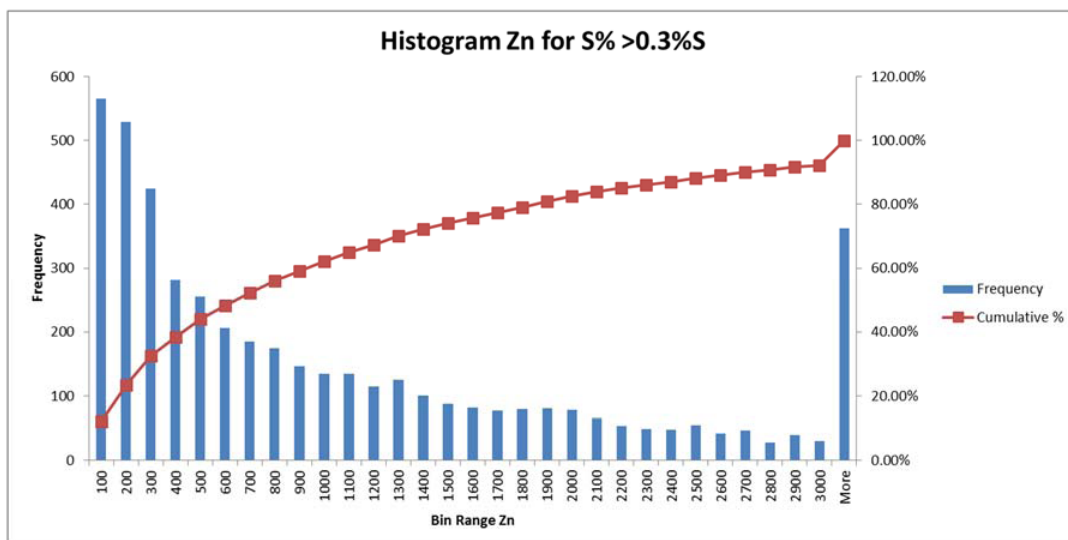


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Combining the 0.1% and the 0.1 to 0.3% S ranges low end frequency is maintained, with 53.55% of samples within 100ppm or less range. Also evident is the short tail with 86.29% of all samples falling within the 500ppm or less range. With almost even distribution of 388 samples in the 0.1% S range and 311 in the 0.1 to 0.3% S range, indicating that overall the Zn values for this S% range in crystal tuff have a majority low end frequency. Cumulative percentage confirms this with the combined totals of 388 samples in the 0.1% S range and 311 samples in the 0.1% to 0.3% S range both having low end frequency curves.



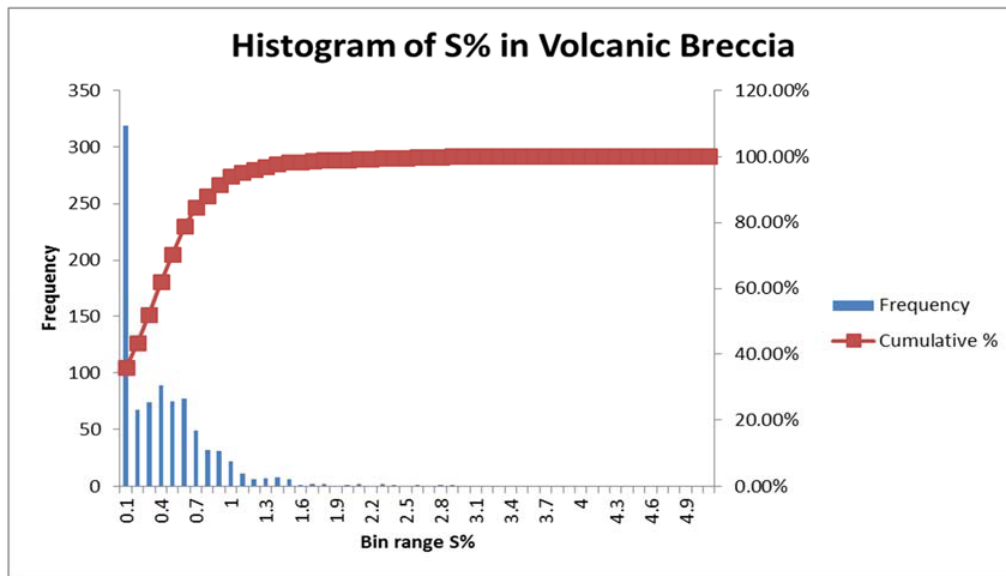
For S% values greater than 0.3% although there is a distinct low end frequency, cumulative percentage displays a steadily increasing curve throughout the entire bin range. This is possibly due to the disseminated mineralisation style within the crystal tuff producing larger zinc values at the higher end of the AgE cut-off grade of 30g/t.



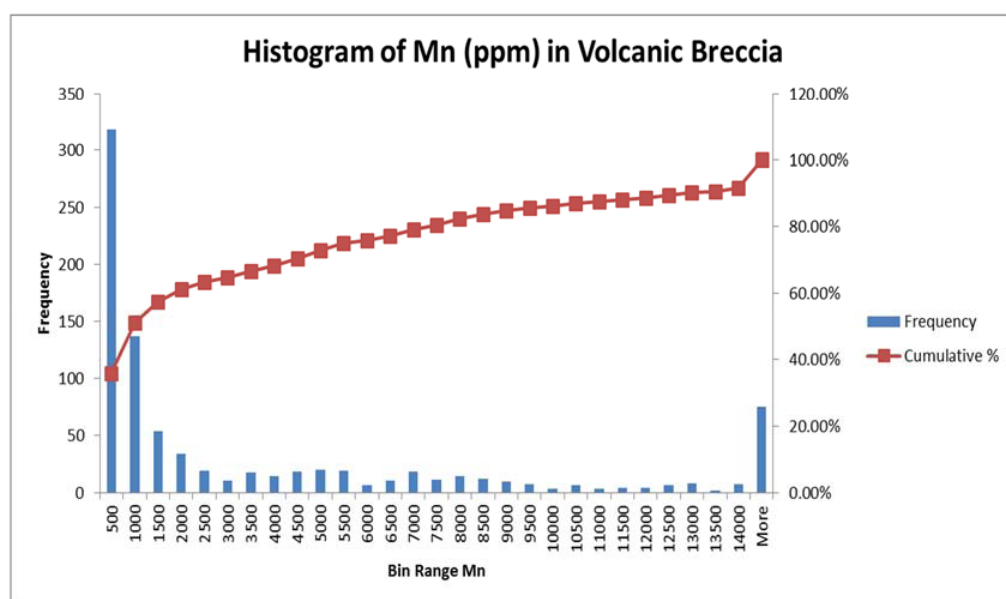
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Volcanic Breccia

51.9% of S values within the volcanic breccia units fall within the 0.3% S or less range with the histogram displaying a very short tail with 94.1% of S values within the 1.0% S or less range. Increasing the potential for larger quantities of NAF materials to be derived from this unit. Lithological indications from drill core suggest that moderate friability and hydrothermal processes may have reduced the S content through the porous matrix surrounding larger cobble to boulder size polymictic volcanic derived clasts within the breccia.

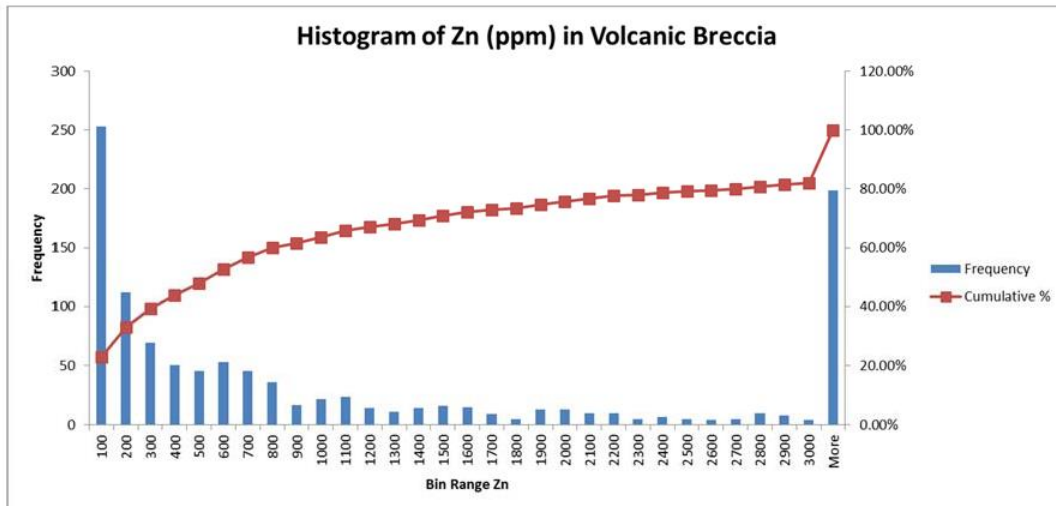


Interestingly the Mn values for the volcanic breccia display similar features to those within the ignimbrite with 51.2% of values falling within the 1000ppm Mn or less range and 35.8% of samples at 500ppm or less. There also appears to be a slight weak tail with increasing value not seen in Mn values within other units. As stated previously this may due to hydrothermal leaching of the breccia due to structural activity within these zones.



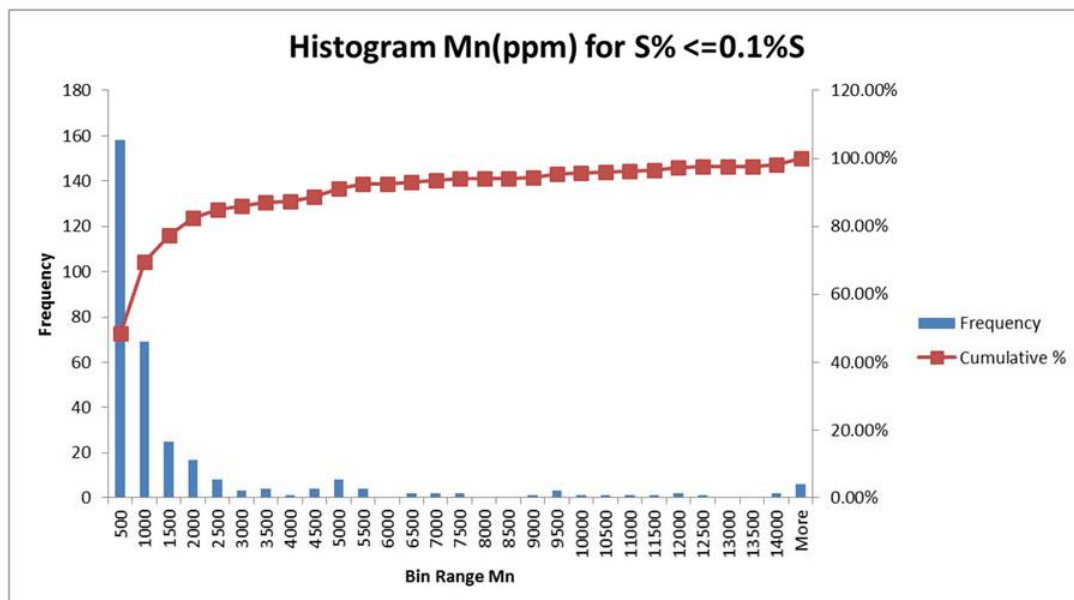
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Zn within the volcanic breccia units display a definite low end frequency with a steady decrease in cumulative percentage into higher value bins. When compared to S% values there is a distinct difference at the low end bin ranges with S% displaying an upward trend before moving into a steady decline in frequency, however zinc values steadily decrease in frequency through the bin ranges, with 47.96% of all zinc values in crystal tuff falling within or below the 500ppm range.



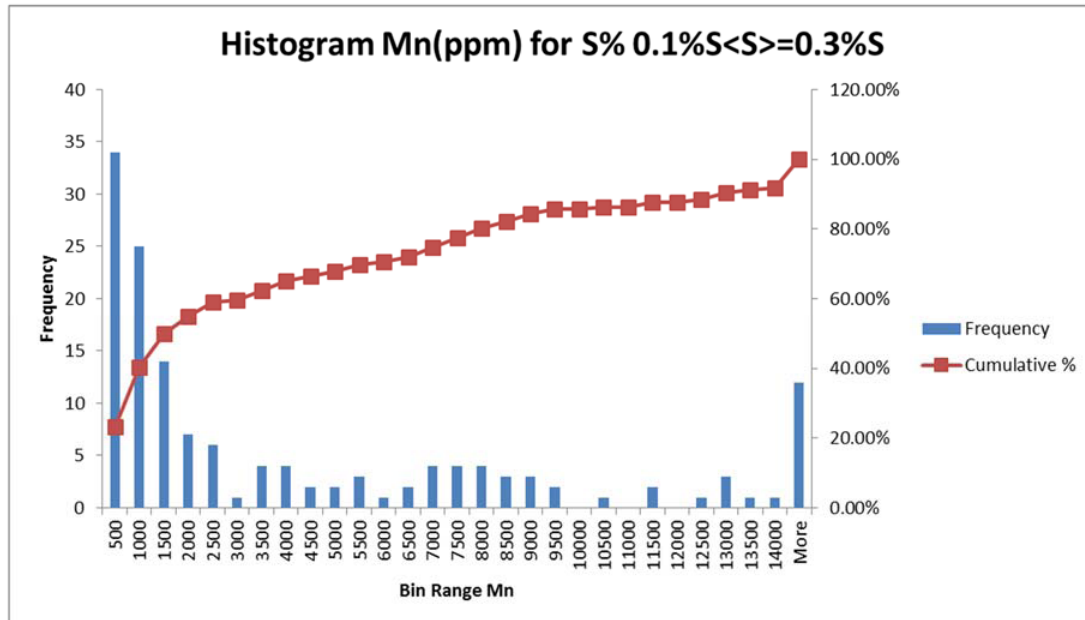
Manganese in Volcanic Breccia

Manganese in the 0.1% S or less range displays a definite low end frequency, with 69.3% of samples falling within the 1000ppm or less bin. Therefore volcanic breccia in this low S% range has high potential as NAF material with 82.5% of samples falling within the 2000ppm or less range for Mn.

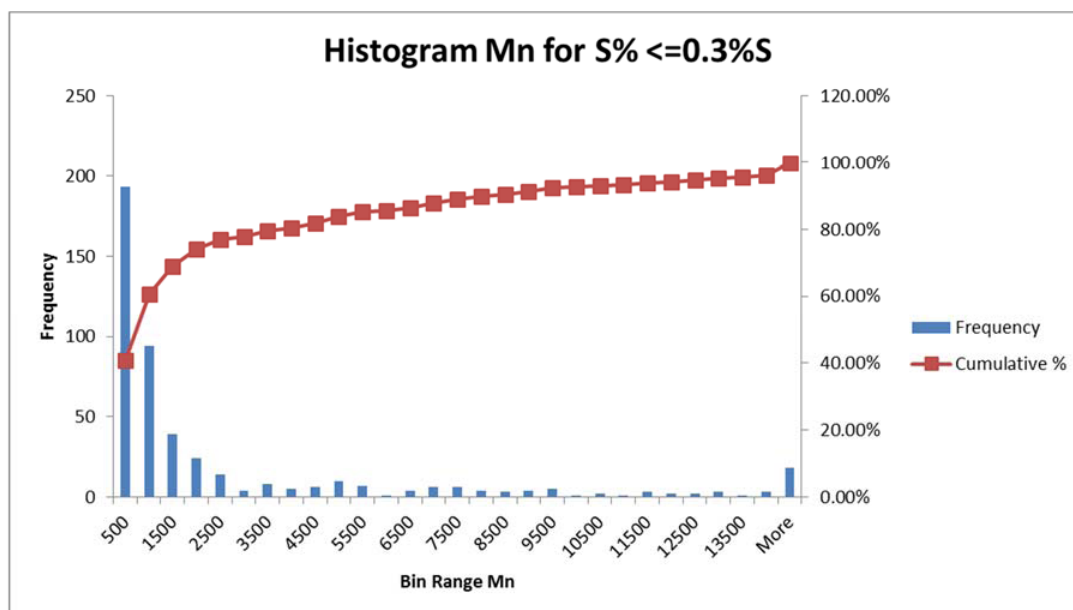


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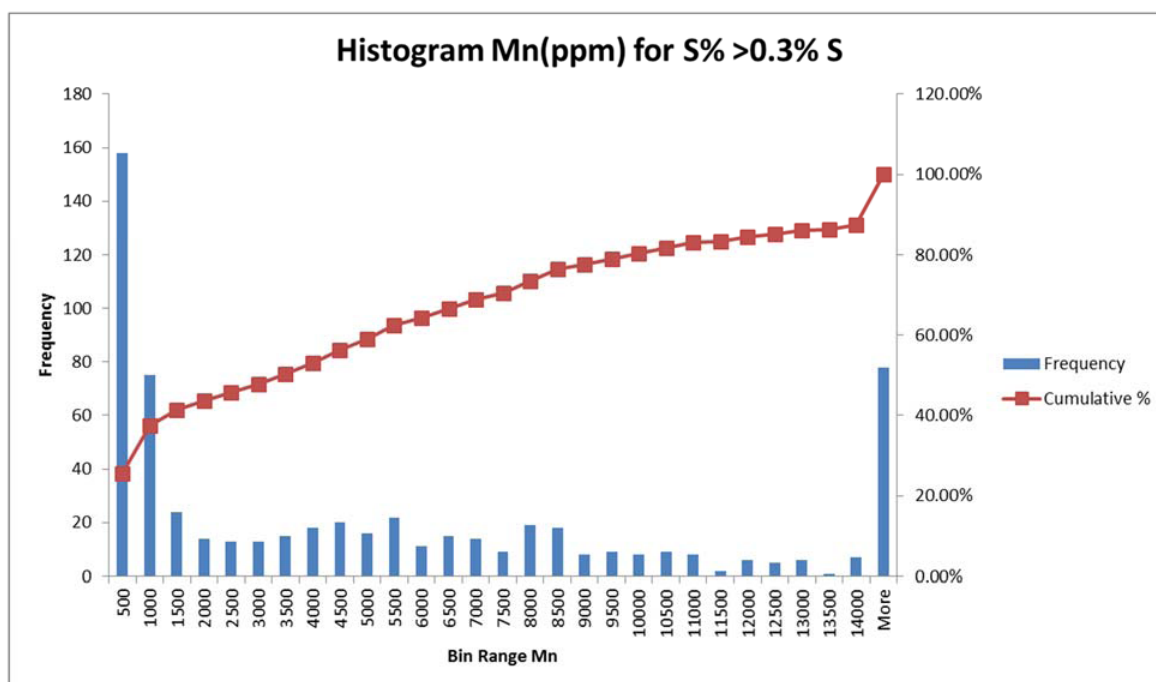
Mn values for the S% range between 0.1% S and 0.3% S show a double high with a strong low end frequency followed by a gradual increase in frequency from 6000ppm to 9500ppm range before dropping into upper ranges. The cumulative totals indicate that only 54.8% of samples fall within the 2000ppm range or less, and a total of 70.55% of samples fall within the 6000ppm or less range.



Once the 0.1% and 0.1 to 0.3% ranges are combined a distinct low end tail is returned with the combined totals at the low end totalling 60.68% in the 1000ppm range or less. Due to the strong low end frequency in 0.1% S range totalling 326 samples and 23.29% of total samples numbering 146 in the 0.1% to 0.3% S range being within the 500ppm range the combined tables return the low end frequency producing 0.3% S material suitable overall for use as NAF material.



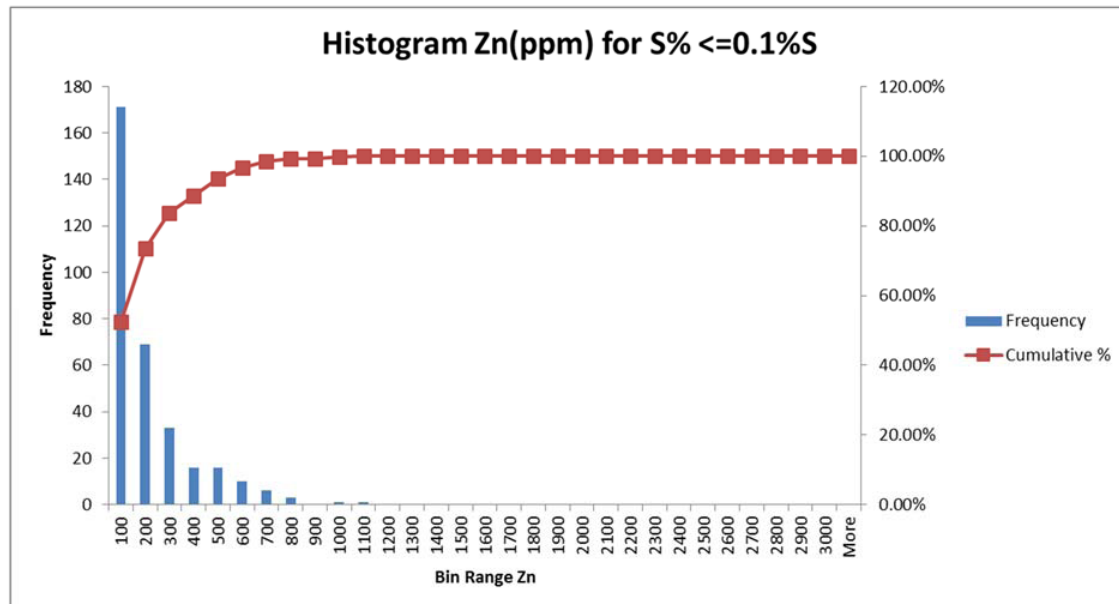
For the range of greater than 0.3% S, Mn values display a moderate low end frequency and maintain a steadily decreasing distribution across all bin ranges, with only 25.44% of samples falling within the 5000ppm range or less.



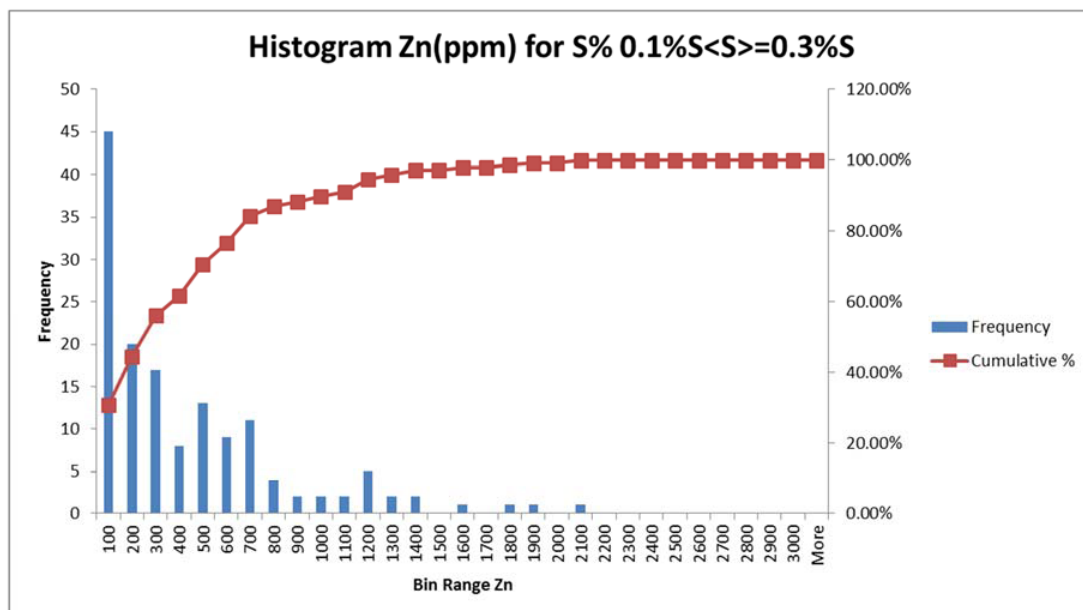
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Zinc in Volcanic Breccia

For S values 0.1% and below Zn values display and definite low end frequency curve with 52.45% of samples falling within the 100ppm range and cumulatively 93.56% of samples are contained within or below the 500ppm range. This again demonstrates the direct link of Zn values with S grades and the disseminated nature of sulphides within volcanic breccia units.

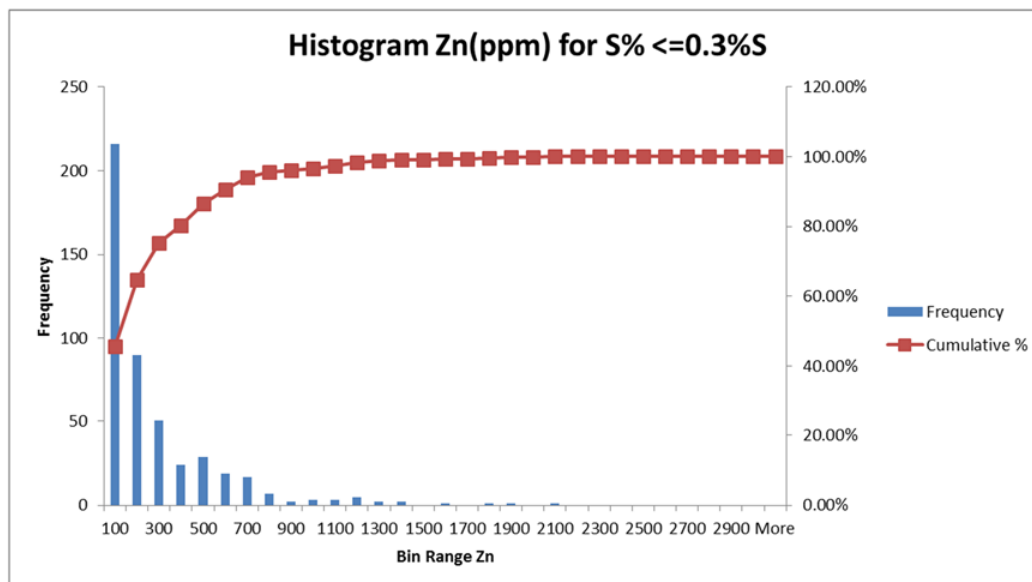


For S values between 0.1% and 0.3% S, Zn values maintain a low end frequency, with 56.16% of samples falling within or below the 300ppm range. This is possibly due to the disseminated nature of ore in the volcanic breccia, producing more consistent low values of zinc and sulphur in lower grade mineralised regions.

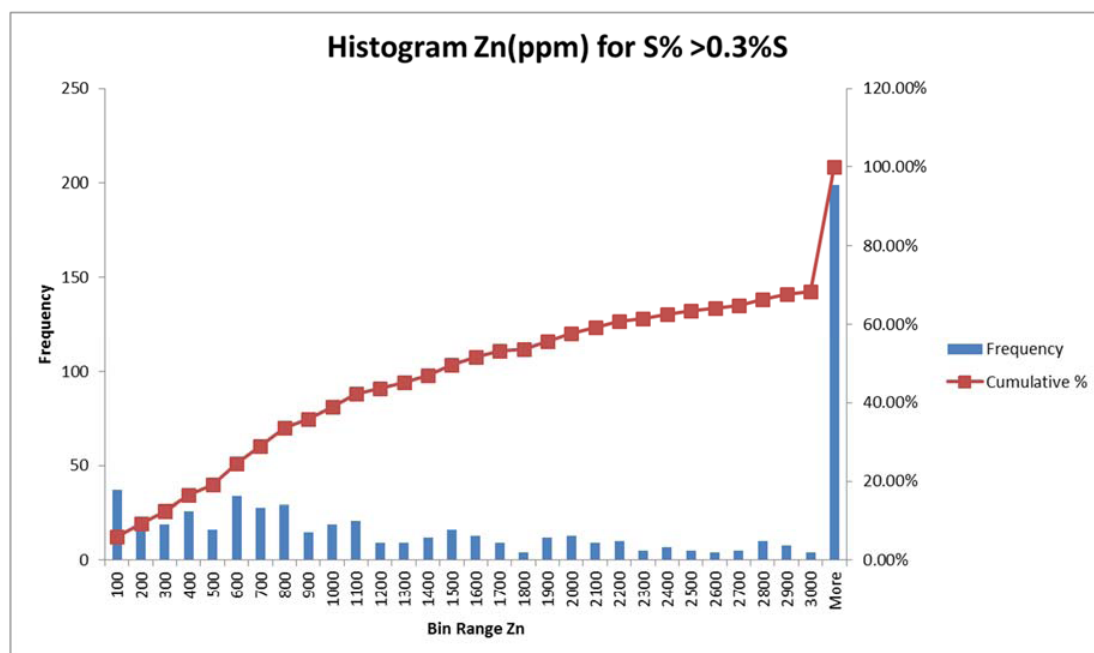


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Combining the 0.1% and the 0.1 to 0.3% S ranges low end frequency is maintained, with 45.67% of samples within 100ppm or less range. Also evident is the short tail with 86.47% of all samples falling within the 500ppm or less range. With low end sulphur distribution of 326 samples in the 0.1% S range and 146 in the 0.1 to 0.3% S range, indicating that overall the Zn values for this S% range in volcanic breccia have a majority low end frequency. Cumulative percentage confirms this with the combined totals of 326 samples in the 0.1% S range and 146 samples in the 0.1% to 0.3% S range both having low end frequency curves.



For S% values greater than 0.3% although there is a weak low end frequency, cumulative percentage displays a steadily increasing curve throughout the entire bin range. This is possibly due to the disseminated mineralisation style within the volcanic breccia producing larger zinc values at the higher end of the AgE waste cut-off grade of 30g/t.



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Kingsgate

Consolidated Limited

MEMORANDUM

TO: Graeme Campbell

CC: Bob Markovich, Rob Corkery, Chris Dickson,

FROM: Peter Smith

DATE: 29/07/2014

SUBJECT: Drill Collar Location of GCA Samples

Executive Summary

Introduction

Various samples and composite samples were collected from diamond drill-core and RC drilling along with three composite samples taken from the auger drilling program, to provide environmental analysis of waste-rock for the proposed Bowdens Silver Mine. The following images identify the collar locations for these samples and are identifiable by hole identifications with reference to the Graeme Capbell and Associates (GCA) sample tables and data.

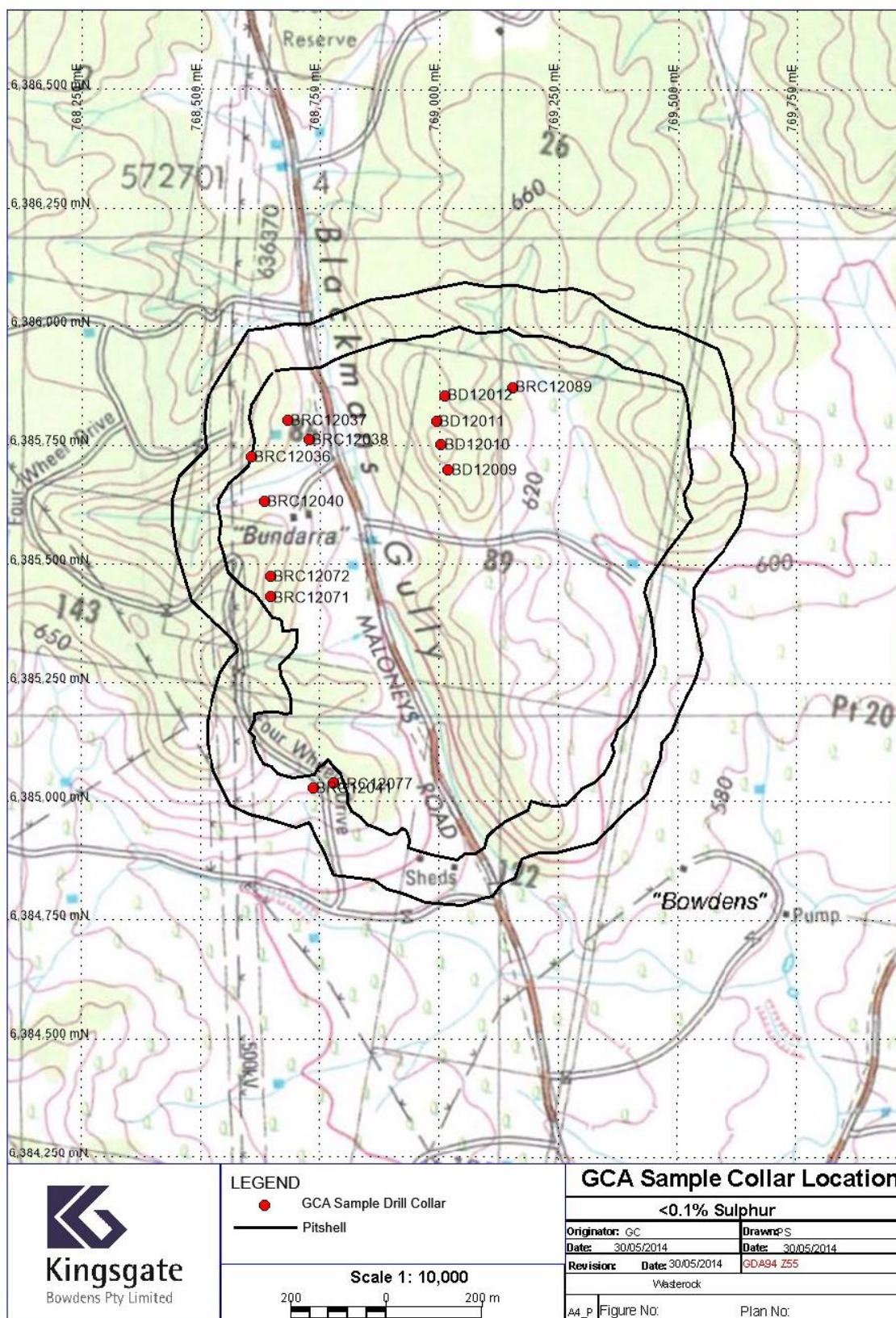


Figure 1. Table 1_A3 0.1%S Sample Collar Location

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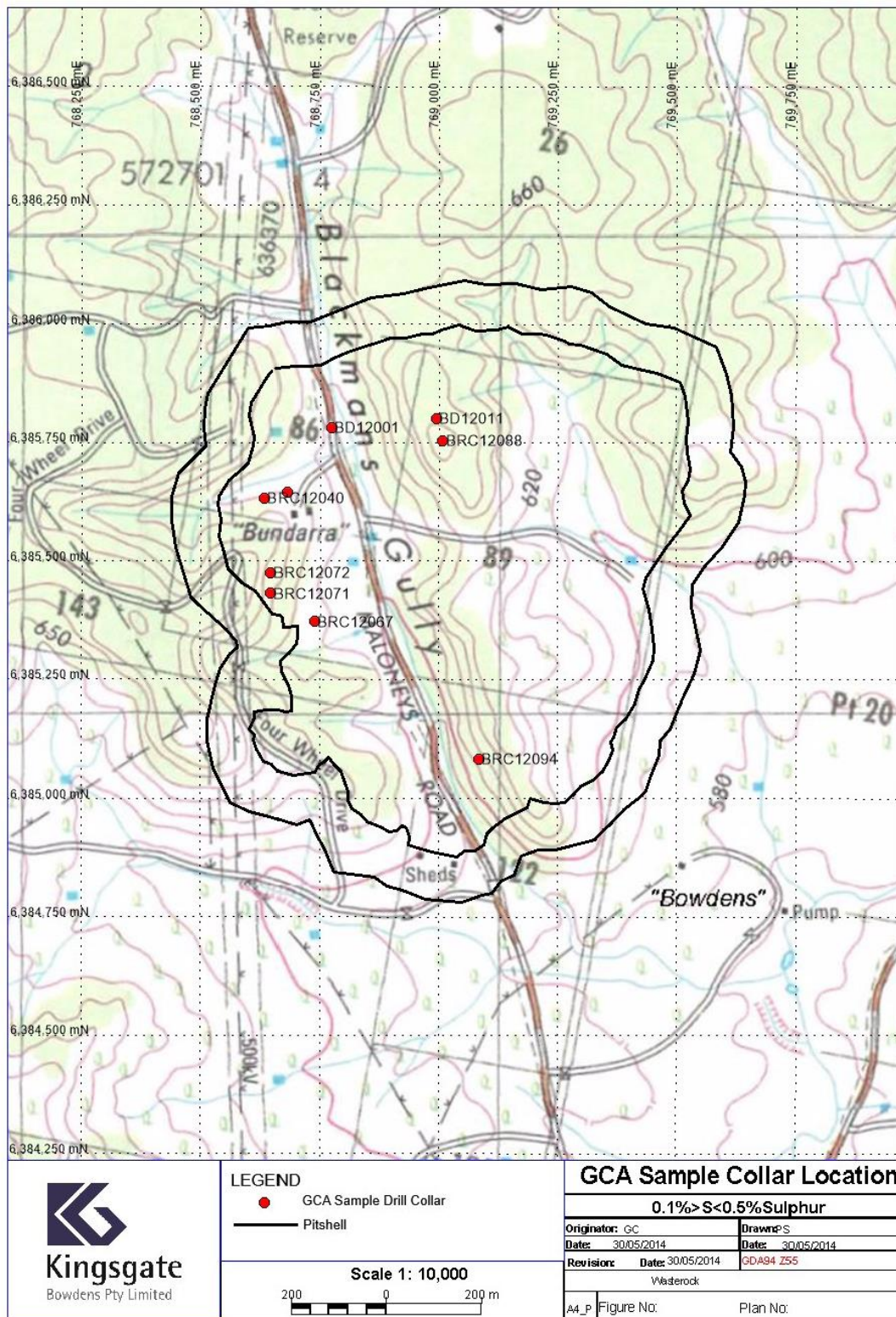


Figure 2. Table 3_A3 0.1 to 0.5% S Sample Collar Location

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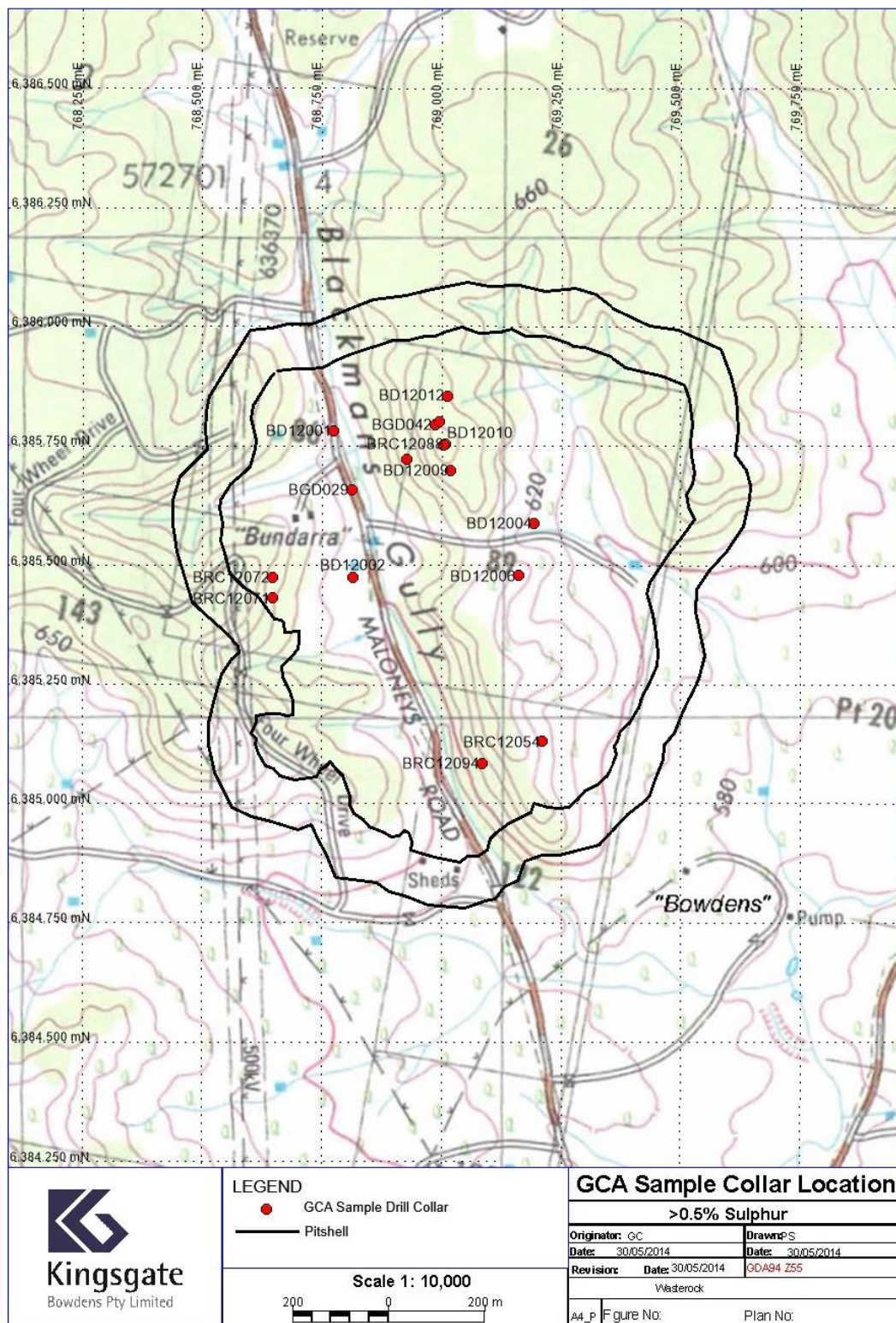


Figure 3. Table 3_A3 >0.5S Sample Collar Locations

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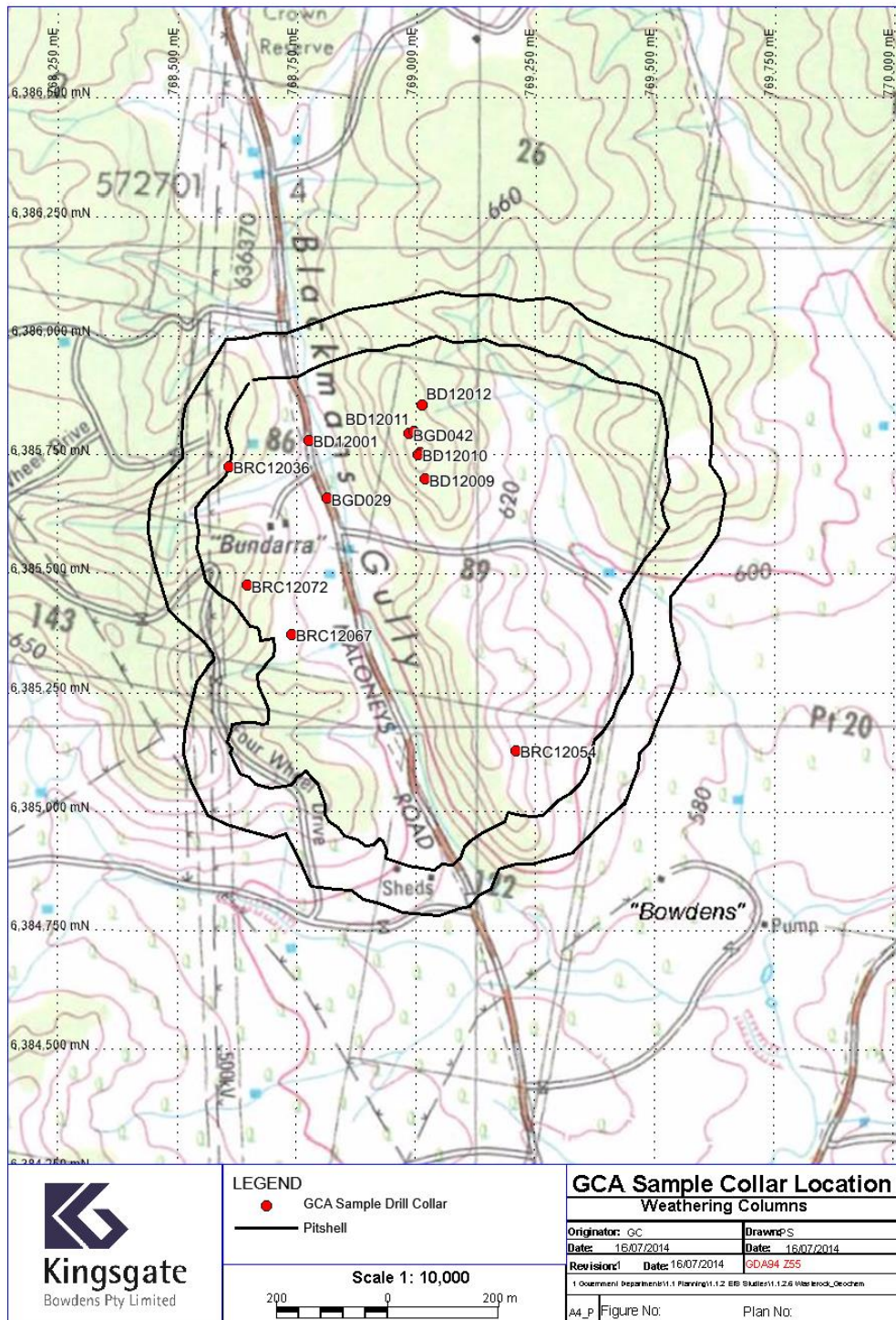


Figure 4. Weathering Column Sample Collar Locations

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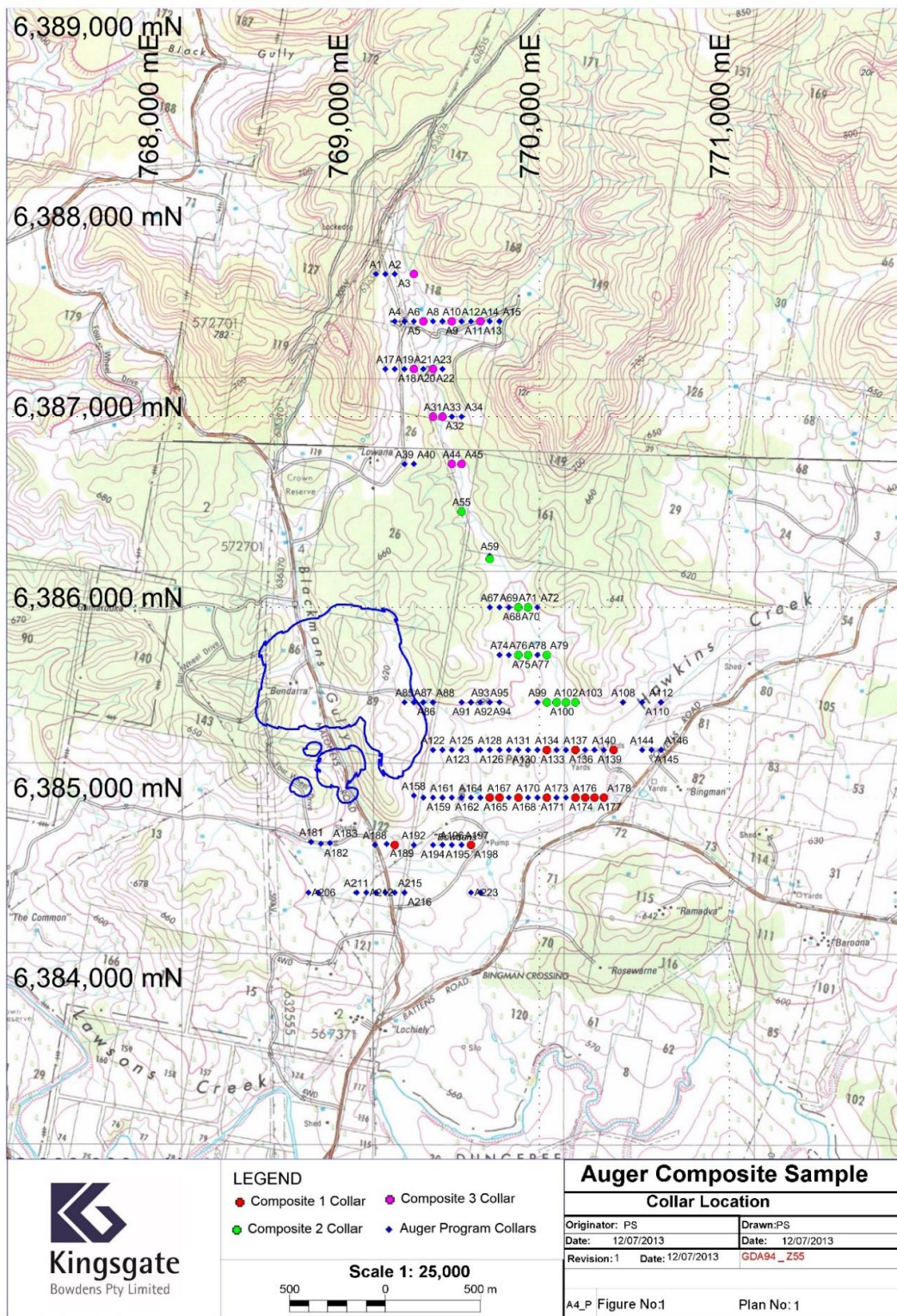


Figure 5. Auger Program and Composite Sample Collar Location

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Kingsgate
Consolidated Limited

MEMORANDUM

TO: Graeme Campbell
CC: Bob Markovich, Rob Corkery, Chris Dickson,
FROM: Peter Smith
DATE: 29/07/2014
SUBJECT: Auger Sampling Method and Analysis

Executive Summary

Introduction

As part of EIS and DFS studies it was necessary to define the depth and volume of available topsoil and subsoil available throughout the Tailings Storage Facility (TSF) and Waste Rock Emplacement (WRE). Further to this a need to provide background to the likely physical and geochemical nature of these soils was necessary to determine their best use within the proposed Bowdens Silver Mine. An auger drilling program was devised to provide this information, with a program consisting of 229 proposed auger drill-hole locations (See Figure 1). From the proposed 229 holes 127 were completed with the remainder not drilled, due to refusal due to outcrop, cultural heritage sites restricting access and/or ability to access certain areas due to terrain (See Figure 2).

Method

Using a Pioneer Engineering Rig mounted on the tray of a Nissan Patrol, equipped with a 100mm auger bit capable of drilling over 10m in depth, supplied by Colling Exploration of Cobar NSW. The program was completed on a grid of 50m spacing of drill-holes on lines 250m apart orientated east-west (Datum:GDA94 Zone55). Samples were collected at 1m intervals and comprised the entire interval, with drilling to depth at refusal of bit penetration.

The collected samples were geologically logged, based on colour, particle size and plasticity and then categorised according to these characteristics. Colour was determined by two colour codes and an intensity grading of light, medium or dark. Particle size was determined by codes and percentage of each code, with codes being, clay, silt, sand, and gravel. Plasticity was determined with a simple 1 to 4 numbering system with 1 being least plastic (i.e. Pure Sand/gravel) and 4 being very plastic (i.e. Pure Clay).

Sampling was completed in two stages, the first round consisted of three composite samples being collected for environmental testing, and comprised various drill-hole intervals from three separate areas, the first from the WRE, the second from the southern TSF and the third from the northern TSF area. These samples consisted of approximately 100-200g being taken from individual 1m intervals, and comprised both clayey and sandy gravel intervals from various holes throughout the separated areas. (See Figure 2. for details.)

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The second stage of sampling was for geochemical purposes, with the bottom of hole samples (i.e. the last 1m interval) from each drill-hole being sent to ALS laboratory for 51 element ICP-AES analysis.

Results

All samples from the geochemical analysis returned very low levels of sulphur, arsenic, zinc and lead, with the only exception to this being three samples from auger locations directly over the eastern edge of the Bowdens Silver Deposit. This fact is evident from the summary statistics displayed below with all elements displaying low means, relatively low range and kth largest and median values.

Summary Statistics Auger Drilling				
	<i>Pb(ppm)</i>	<i>Zn(ppm)</i>	<i>As(ppm)</i>	<i>S(%)</i>
Mean	84.69113	78.39355	31.90815	0.012903
Standard Error	36.45472	11.86247	9.432343	0.001419
Median	12.675	29.95	7.04	0.01
Mode	7.32	114.5	3.61	0.005
Standard Deviation	405.9426	132.0949	105.0341	0.0158
Sample Variance	164789.4	17449.05	11032.17	0.00025
Kurtosis	84.26013	12.02639	50.12772	35.28132
Skewness	8.757203	3.345197	6.912405	5.116827
Range	4144.64	799.4	848.51	0.135
Minimum	5.36	3.6	0.49	0.005
Maximum	4150	803	849	0.14
Sum	10501.7	9720.8	3956.61	1.6
Count	124	124	124	124
Largest(1)	4150	803	849	0.14
Smallest(1)	5.36	3.6	0.49	0.005
Confidence Level(95.0%)	72.15989	23.48103	18.67074	0.002809

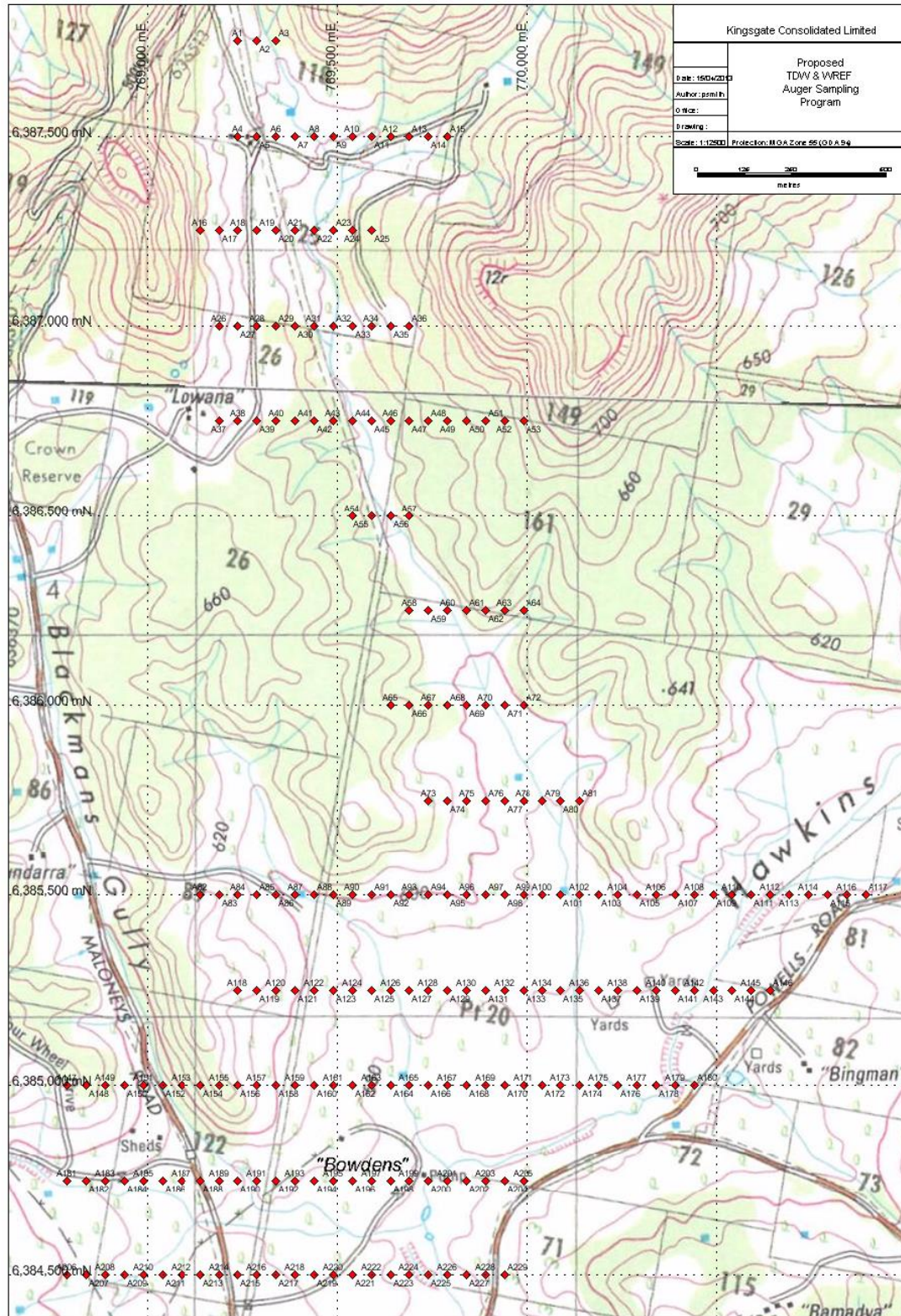


Figure 1. Proposed Auger Drilling Collar Location

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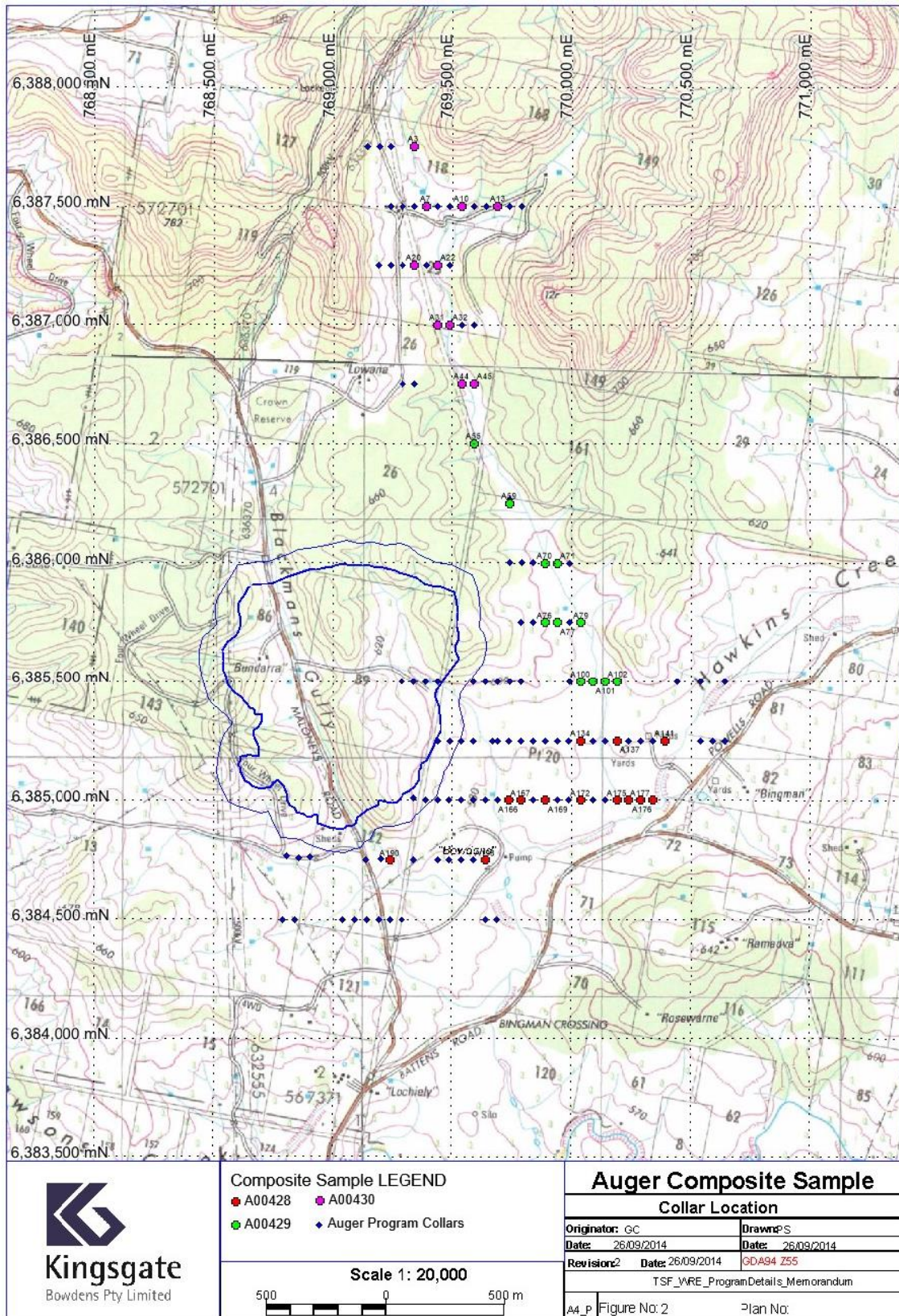


Figure 2. Auger Program and Composite Sample Collar Location

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NOTE:

The Sampling Programme Memorandum presented in the following pages correspond to the programme of testing carried out on Low-S samples of waste rock from the Fresh-Zone conducted during 2017-2018.

Graeme Campbell & Associates Pty Ltd

ADM-FORM-023



memo

Bowdens Silver Pty Ltd

To: Graeme Campbell; Paul Ryall
From: Grace Barber
CC: Tony McClure
Date: 06/03/2019
Re: Sample Selection on for Characterisation of Low-S Rock from the Fresh Rock Zone

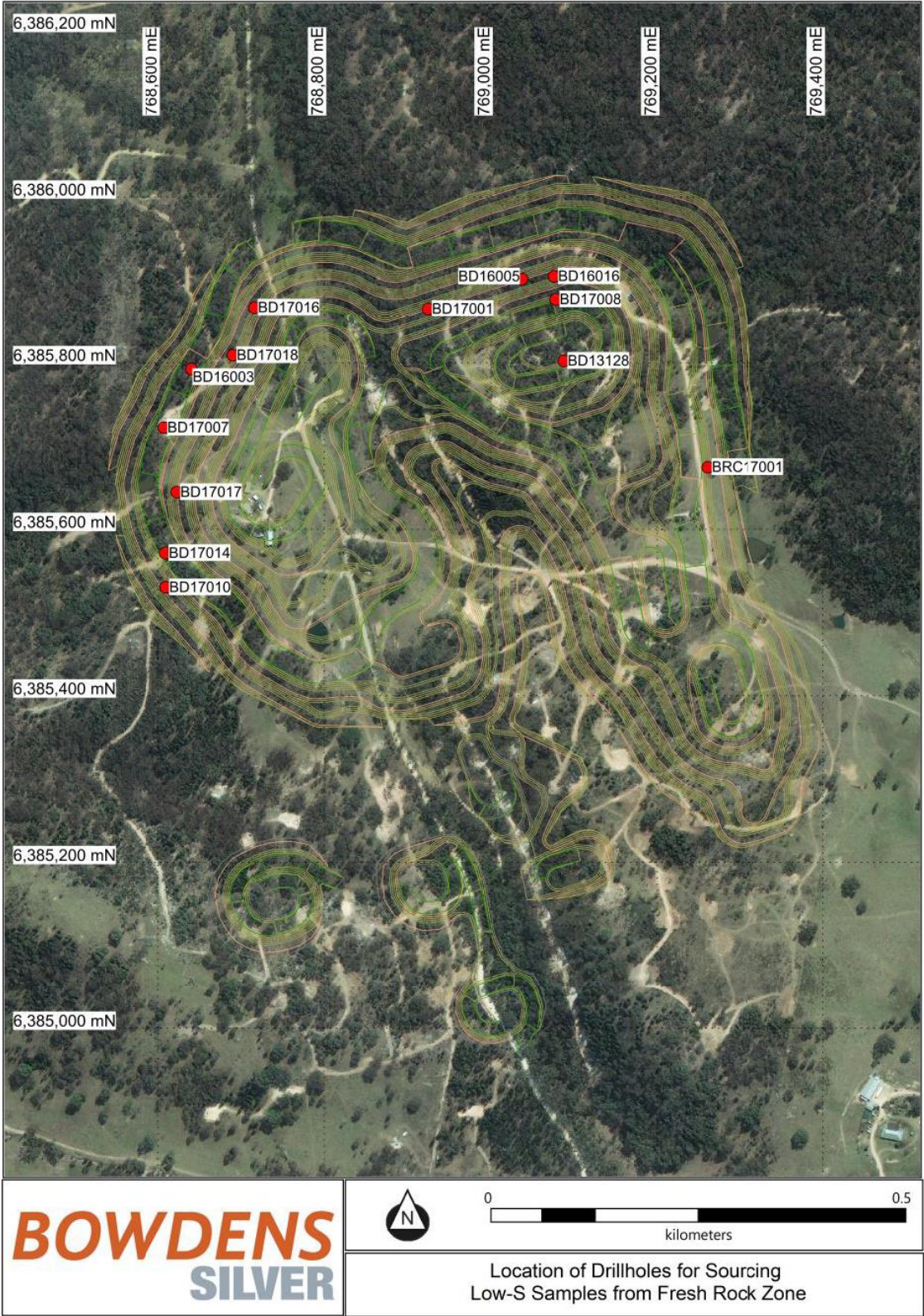
Graeme Campbell requested a memorandum on the samples selected for the waste rock characterisation study. This memo and attachments detail these samples. During October 2017 a selection of samples from the waste rock zone in the Bowdens Silver Deposit were selected and sent to ALS Orange laboratory for analyses. The samples were selected on the following criteria:

- Waste was classed using the 2017 H&S Bowdens Silver resource model where waste was less than 30g/t silver equivalent.
- Samples must be less than 0.3% sulphur content
- Samples are within the 'current' pit design, 2012 AMC Consultants Pty. Ltd. open pit design.
- Samples must be in consecutive 4 metre sequence to make composites
- Composites must be below the zone of oxidation, fresh rock.

A total of 357 samples from 13 diamond drill holes were selected to make 90 composites. Four metre interval composites were combined by ALS. Composites were a total of 40g and composited by weighted average dependent on original sample size. ME-IR08 method was used to determine the total Carbon and total Sulphur for each composite. Fizz testing was also completed by ALS and results sent to Graeme Campbell November 2017. Following discrimination of results by Graeme Campbell from the fizz testing it was shown testing was inadequate. All samples were forwarded on to the Graeme Campbell and Associates (GCA) laboratory in Bridgetown (WA) for further testing.

Following the completion of the resource and reserve estimate in May 2018 a new pit design was released by AMC Consultants Pty. Ltd. All composites were checked to ensure they were within the new pit design, all are within the 2018 AMC pit design.

From further correspondence for Stage-2 testing, 16 x 1-2 metre quarter core intervals were selected for further analyses. These samples were sent to the GCA laboratory in for further testing in July 2018.



Annexure 4

Testwork Methods

(Total No. of pages including blank pages = 8)

ANNEXURE 3

TESTWORK METHODS

The testwork methods outlined below are proven approaches to 'static-testing' within the Australian, and international mining-industries (e.g. Price 2009; Stewart *et al.* 2006; AMIRA 2002; Morin and Hutt 1997).¹ There is also the Global-Acid-Rock-Drainage- (GARD) Guide which is an INAP initiative (go to: www.gardguide.com).

Part of the acid-base-account testing, and all of the multi-element analyses, and clay-surface-chemical determinations, were carried out by Genalysis Laboratory Services Pty Ltd (Maddington).

Specialised ABA-testing, and the kinetic-testing programme, was undertaken by GCA (Bridgetown), and characterisation of rock- and clay-mineralogy was carried out by Roger Townend & Associates (Malaga).

The Cr(II)-Reducible-S determinations were performed by SGS Australia Pty Ltd, Newburn.

Samples were crushed to 2mm (nominal) in a jaw/rolls-crusher, and pulverised to 75µm (nominal), for specific tests, as required.

1.0 ACID-BASE-CHEMISTRY AND SALINITY TESTWORK

Acid-base chemistry and salinity were assessed by determining:

- pH and Electrical-Conductivity (EC) on sample slurries;
- Total-Sulphur (Total-S), and Sulphate-Sulphur (SO₄-S);
- Acid-Neutralisation-Capacity (ANC), and CO₃-C;
- Net-Acid-Producing-Potential (NAPP); and,
- Net-Acid-Generation (NAG).

Relevant details of the testwork methods employed are discussed below. Further details are presented in the laboratory reports.

1.1 pH-(1:2) and EC-(1:2) Tests

Measurements of pH and EC are performed on slurries prepared using deionised-water, and a solid:water ratio of *c.* 1:2 (w/w).

The slurries are allowed to age for *c.* 24 hours, prior to measuring pH and EC.²

¹ 'Static'-testing' corresponds to 'whole-rock' analyses and tests.

² The slurries are stirred at the beginning of the testwork, and once again immediately prior to measuring pH and EC.

pH-(1:2) and EC-(1:2) values provide a measure of the inherent acidity/alkalinity and salinity.³

1.2 Total-S and SO₄-S

Total-S is determined by Leco combustion (@ 1300 °C) with detection of evolved SO_{2(g)} by infra-red spectroscopy.

SO₄-S is determined by the Na₂CO₃-Extraction Method (Berigari and Al-Any 1994; Lenahan and Murray-Smith 1986).⁴

The difference between Total-S and SO₄-S indicates the Sulphide-S (strictly Non-Sulphate-S) value.

Where 'recalcitrant-sulphate-minerals' (e.g. alunites and jarosites) are prominent (as at Bowdens), the Chromium(II)-Reducible-S method is recommended for determining Sulphide-S samples (Schumann *et al.* 2012). This approach was followed herein.

1.3 Acid-Consuming Properties

1.3.1 ANC

ANC is determined by a procedure based on that of Sobek *et al.* (1978) which is the 'standard' ANC-testing method (AMIRA 2002; Morin and Hutt 1997).

Samples (as crushings) are reacted with dilute HCl for *c.* 2 hours at 80-90 °C, followed by back-titration with NaOH to a pH=7 end-point to determine the amount of acid consumed.⁵

1.3.2 CO₃-C

CO₃-C is the difference between the Total-C and Total-Organic-C (TOC). Total-C is measured by Leco combustion (@ 1300 °C) with detection of evolved CO_{2(g)} by infra-red spectroscopy. TOC is determined by Leco combustion on a sub-sample which had been treated with strong HCl to decompose carbonate-minerals.

³ The pH-(1:2) values approximate the "Abrasion-pH" values for identifying minerals in the field (e.g. Stevens and Carron 1948).

⁴ The Na₂CO₃-reagent extracts SO₄ which occurs as soluble sulphates, and calcium sulphates (e.g. gypsum and anhydrite). It also extracts SO₄ sorbed to the surfaces of sesquioxides, clays and primary-silicates. However, SO₄ present as barytes (BaSO₄) is not extracted, and SO₄ associated with jarositic-type and alunitic-type compounds is incompletely extracted.

⁵ A few drops of 30 % (w/w) H₂O₂ are added to the test mixtures as the pH=7 end-point is approached, so that Fe(II) forms released by the acid-attack of ferroan-carbonates (and -silicates) are oxidised to Fe(III) forms (which then hydrolyse to 'Fe(OH)₃'). This step ensures that the resulting ANC values are not unduly biased 'on-the-high-side', due to the release of Fe(II) during the acid-digestion step (AMIRA 2002), provided that the ferroan-carbonate content is not excessive (e.g. siderite-C values less than 1.5 % [Stewart *et al.* 2006]).

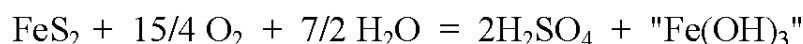
1.3.3 pH-Buffering Properties

pH-Buffering properties are determined via a Metrohm® 736 Titrino auto-titrator, and 0.05 M-H₂SO₄. Auto-titrations comprise regular addition of H₂SO₄ to decrease the pH values of the test-suspensions (prepared using pulps) to 3.0 typically over the course of c. 1 day.⁶ Despite taking up to 1 day to complete, the H₂SO₄-addition rates employed in the auto-titrations are 'orders-of-magnitude' faster than the sulphide-oxidation rates typically observed under 'ambient-weathering' conditions.

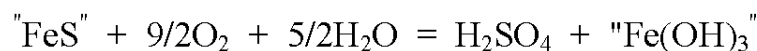
1.4 NAPP Calculations

NAPP values are usually calculated from Total-S, SO₄-S and ANC values, assuming that all of the Sulphide-S occurs in the form of pyrite, and/or pyrrhotite. NAPP values facilitate assessment of Acid-Formation Potential (AFP).

The complete-oxidation of pyrite (and/or marcasite) may be described by:



The complete-oxidation of pyrrhotite may be described by:



Since pyrrhotite is non-stoichiometric, expressing it as "FeS" is approximate (Janzen *et al.* 2000). Elemental-S may also be produced during pyrrhotite weathering (Nicholson and Scharer 1994), especially at low-pH. However, Elemental-S is ultimately oxidised to H₂SO₄.

It may be shown that, if the Sulphide-S (in %S) occurs as pyrite/pyrrhotite, then the amount of acid (in kg H₂SO₄/tonne) produced through complete-oxidation is given by 30.6 x %S. That is, the same conversion-factor of 30.6 applies for both pyrite-, and pyrrhotite-oxidation.

Note: The above treatment of oxidation-reaction stoichiometry is restricted to oxidation by 'atmospheric-O₂' which is the dominant oxidant at circum-neutral-pH. A different oxidation-stoichiometry applies under acidic conditions (e.g. pH less than 3-4) where soluble-Fe(III) forms prevail, and then function as the chief oxidant (e.g. Rimstidt and Newcomb 1993).

Mechanistic aspects of pyrite- and pyrrhotite-oxidation were reviewed by Rimstidt and Vaughan (2003), and Belzile *et al.* (2004), respectively.

⁶ In titrating to a pH=3.0 end-point, any Fe(II) released through acid attack of ferroan-carbonates and -silicates is not quantitatively oxidised to Fe(III), and subsequently hydrolysed/precipitated to 'Fe(OH)₃'. The equivalent of c. 0.5 kg H₂SO₄/tonne is generally required to decrease the pH of the "solution-only" to pH=3.0. No correction is made for this 'electrolyte-consumption' of H₂SO₄.

1.5 NAG Tests

The NAG Test is a direct measure of the potential for acid-production through sulphide-oxidation, and also provides an indication of the reactivity of the sulphide-minerals, and the availability of alkalinity-forms (AMIRA 2002; Miller *et al.* 1997, 1994). Since this test is performed on pulps, sulphide-grains are fully liberated, and available for reaction.

The sample is reacted with H₂O₂ to oxidise sulphide-minerals, and allow the produced acid to react with the acid-neutralising components (chiefly carbonate-minerals). The results from NAG testwork supplement the NAPP-based assessment of AFP (Stewart *et al.* 2006; Shaw 2005; Morin and Hutt 1997).

The NAG-testing methodology used by GCA is the 'Static-NAG Test' in its "single-addition" mode, with NaOH-titration to a pH=7 end-point (AMIRA 2002; Miller *et al.* 1994, 1997). The Start-pH of the 15 % (v/v) H₂O₂ solution (prepared from A.R.-grade H₂O₂) is adjusted to pH=4.5 using 0.1 M-NaOH. The boiling treatment to decompose residual, unreacted-H₂O₂ following overnight reaction is carried out in two stages (viz. boiling for *c.* 2 hours initially, cooling and addition of 1 mL of 0.02 M-CuSO₄, followed by boiling for a further *c.* 2 hours). The addition of Cu(II) catalyses the decomposition of unreacted-H₂O₂, and thereby prevents "positive-blank" values (McElnea and Ahern 2004; O'Shay *et al.* 1990).⁷

2.0 MULTI-ELEMENT ANALYSES

The total content of a wide range of major- and minor-elements are determined through the use of various digestion and analytical techniques. The respective detection-limits are appropriate for environmental investigations.

Element enrichments are identified using the *Geochemical Abundance Index (GAI)*.⁸ The GAI quantifies an assay result for a particular element in terms of the average-crustal-abundance of that element.⁹ The latter corresponds to the typical composition of soils, regoliths and bedrocks derived from unmineralised terrain.

The GAI (based on a log-2 scale) is expressed in 7 integer increments (viz. 0 to 6). A GAI of 0 indicates that the content of the element is less than, or similar to, the average-crustal-abundance; a GAI of 3 corresponds to a 12-fold enrichment above the average-crustal-abundance; and so forth, up to a GAI of 6 which corresponds to a 96-fold, or greater, enrichment above average-crustal-abundances.

⁷ Where samples contain sufficient Cu(II), then Cu(II) forms will be released to solution during reaction with H₂O₂, especially at low-pH.

⁸ The GAI was developed by Förstner *et al* (1993), and is defined as:

$$GAI = \log_2 [C_n / (1.5 \times B_n)]$$

where:

C_n = measured content of n-th element in the sample.

B_n = "background" content of the n-th element in the sample.

⁹ The average-crustal-abundances of the elements for the GAI calculations are based on the values listed in Bowen (1979).

3.0 MINERALOGY AND CLAY-SURFACE CHEMISTRY

The semi-quantitative mineralogy, and clay-surface chemistry (generally restricted to waste-regoliths, oxide-ores, and/or soils), are determined using methods routinely used in geology, and soil science.

Indicative abundances of mineral fall into one of the following broad classes, viz.

- | | | |
|---|-----------|-------------------|
| • | dominant | greater than 50 % |
| • | major | 20-50 % |
| • | minor | 10-20 % |
| • | accessory | 2-10 % |
| • | trace | less than 2 % |

Randomly- and preferentially-oriented specimens are prepared, and variously treated with sodium-hexametaphosphate (dispersant), ethylene-glycol, and heating, to quantify non-expansive, and expansive (e.g. smectites), varieties of clay-minerals.

The Effective-Cation-Exchange Capacity (eCEC), and suite of Exchangeable-Cations, are determined by different methods for samples (as crushings) of non-calcareous and calcareous materials (Rengasamy and Churchman 1999). In both cases, soluble-salts are initially removed via pre-washing using a 'mixed-organic-solvent' (viz. ethylene-glycol and ethanol). Method 15A2 in Rayment and Higginson (1992) is then employed for non-calcareous samples to determine eCEC, and Exchangeable-Sodium Percentage (ESP). In the case of calcareous samples, a method based on that described by Pierce and Morris (2004) is used, and prevents the dissolution of carbonate-minerals (e.g. calcites and dolomites).¹⁰ After the initial pre-washing step above, extraction is carried out with 1 M-NH₄Cl buffered at pH=8.5 in an ethanolic-aqueous solution. Without such precautions to suppress dissolution of carbonate-minerals, the eCEC is biased 'on-the-high-side', and ESP biased 'on-the-low-side'. Depending on the abundance and nature of the carbonate-minerals, the magnitude of this bias can be marked.

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¹⁰ The procedure described by Pierce and Morris (2004) is closely related to that originally developed by Tucker (1974).

-
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Annexure 5

Acid-Formation Potential (AFP): Classification Criteria

(Total No. of pages including blank pages = 4)

ANNEXURE 4

ACID-FORMATION POTENTIAL (AFP):

CLASSIFICATION CRITERIA

1.0 CALCULATED PARAMETERS

Where Maximum-Potential-Acidity (MPA) calculations were undertaken, the MPA values (in kg H₂SO₄/tonne) were calculated by multiplying either the Total-S value (in %), or the Sulphide-S value (in %), by 30.6.

The use of either Total-S or Sulphide-S in these calculations is discussed below. Where Cr(II)-Reducible-S values (Schumann *et al.* 2012) were available, these were taken as the Sulphide-S values.

The multiplication-factor of 30.6 reflects both the reaction stoichiometry for the complete-oxidation of pyrite (and/or marcasite, and/or pyrrhotite), by O₂ to "Fe(OH)₃" and H₂SO₄, and the different weight-based units of %, and kg H₂SO₄/tonne.

Net-Acid-Producing-Potential (NAPP) values (in kg H₂SO₄/tonne) are calculated from the corresponding MPA and Acid-Neutralisation-Capacity (ANC) values (i.e. NAPP = MPA - ANC).

2.0 CLASSIFICATION CRITERIA

In terms of AFP, test-samples in geochemical-characterisation investigations may be classified into one of the following categories, viz.

- Non-Acid Forming (NAF)
- Potentially-Acid Forming (PAF)

There are **no** unifying, 'standard' criteria for classifying the AFP of test-samples (e.g. Price 2009; AMIRA 2002), and reflects the diversity of sulphide- and gangue-mineral assemblages within (un)mineralised-lithotypes of varying weathering- and alteration-status. Rather, criteria for classifying AFP may need to be tailored to deposit-specific geochemistry, mineralogy, and site-specific climate.

The situation for the Bowdens Silver Project (BSP) is a case in point where the criteria adopted for AFP classification reflect deposit-specific characteristics (e.g. trace occurrence of alunites and jarosites in a groundmass variously enriched in clays [e.g. smectites and illites]). The outcomes from the kinetic-testing programme were especially relevant for setting classification criteria where Total-S < 0.3 %, especially

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for the weathered rock (chiefly sandstones) derived from the upper sections of the geologic profile where the alunite/clay mixed assemblage is common.

The criteria for AFP classification for the BSP are:

A. **Total-S < 0.1 %**

- **NAF**

B. **0.10 % ≤ Total-S ≤ 0.3 %**

- Sulphide-S < 0.1 %
- **NAF**
- 0.10 % ≤ Sulphide-S ≤ 0.30 %
- **NAF** negative-NAPP value with ANC/MPA ratio ≥ 2.0
- **PAF** either positive-NAPP value, or negative-NAPP value with ANC/MPA ratio < 2.0

(N.B.: MPA and NAPP values based on Sulphide-S)

C. **Total-S > 0.3 %**

- **NAF** negative NAPP value with ANC/MPA ratio ≥ 2.0
- **PAF** either positive-NAPP value, or negative-NAPP value with ANC/MPA ratio < 2.0

(N.B.: MPA and NAPP values based on Total-S)

Use of Total-S in the MPA and NAPP calculations for Total-S > 0.3 % is conservative, since, when expressed on a percent-S-weight basis (i.e. as %S), the dissolution of alunites and jarosites (and ensuing precipitation of Fe(III)- and Al-oxyhydroxides) is less (by about one-third) 'acid-generating' than oxidation of pyrite. However, the mineralogy of the Bowdens deposit is one where sulphide minerals (e.g. pyrite) generally dominate over alunites and jarosites for Total-S > 0.3 %.

It should be noted that the above criteria for classification of AFP for the BSP are based on the information obtained from this study, including kinetic testing and mineralogical assessment. Operational experience during the Project, as well as additional technical investigations in the future, may potentially lead to refinements of these criteria.

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3.0 REFERENCES

- AMIRA International Ltd, 2002, "ARD Test Handbook", Prepared by Ian Wark Research Institute, and Environmental Geochemistry International Pty Ltd
- Price W, 2009, "Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials", MEND Report 1.20.1
- Schumann R, Stewart W, Miller S, Kawashima N, Li J, and Smart R, 2012, "Acid-Base Accounting Assessment of Mine Wastes Using Chromium Reducible Sulfur Method", *Science of the Total Environment*, 424:289-296

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Annexure 6

Laboratory Reports

(Total No. of pages including blank pages = 302)

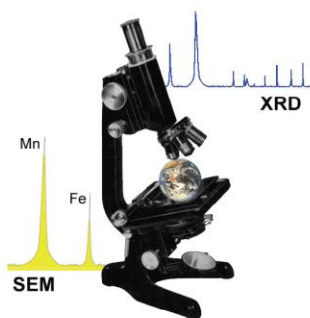
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NOTE:

The laboratory reports presented in the following pages correspond to the initial main programme of testing carried out during 2012-2013.

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GRAEME CAMPBELL AND ASSOC.

21-06-2013

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OUR REFERENCE: 23480

YOUR REFERENCE: 1220/1

FIVE MINE WASTE SAMPLES FOR XRD, SEM AND OPTICAL MINERALOGY ANALYSIS, GCA-ROCK USUAL.

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ACN 069 920 476 ABN 92 076 109 663

<GRAEME CAMPBELL>

2

Ref No <23480>

XRD PROCEDURES

XRD	PANALYTICAL XPERT PRO
DETECTOR	PIXCEL 1D
ANGULAR RANGE	5° TO 110°
DIVERGENCE SLIT	1/4°
ANTI SCATTER SLIT	1/2°
RADIATION	Co Kα 1.788965
SLIT TYPE	FIXED
GENERATOR	40Kv 40 Ma

XRD/PLM RESULTS

	GCA10039	GCA10043	GCA10044	GCA10049	GCA10053
QUARTZ	MAJOR	MAJOR	MAJOR	DOMINANT	MAJOR
K-FELDSPAR	MAJOR	MAJOR	MAJOR	ACCESSORY	MAJOR
MUSCOVITE	MINOR	MAJOR	MAJOR	ACCESSORY	ACCESSORY
PYRITE	ACCESSORY	ACCESSORY	ACCESSORY	ACCESSORY	ACCESSORY
TI-OXIDES	ACCESSORY	ACCESSORY	ACCESSORY	ACCESSORY	ACCESSORY
GALENA	TRACE	TRACE	TRACE	TRACE	TRACE
RHODOCHROSITE		ACCESSORY	ACCESSORY	ACCESSORY	ACCESSORY
SIDERITE		ACCESSORY			
SPHALERITE	TRACE	ACCESSORY	TRACE	TRACE	TRACE
MARCASITE			ACCESSORY		
ZIRCON	TRACE				TRACE
APATITE			TRACE		
ILLITE				MAJOR	MINOR

COMMENT

The mica in samples GCA10039, GCA10043 and GCA10044 is predominantly sericite, an alteration of K-feldspar phenocrysts, coarser muscovite flakes are relatively rare. PLM and XRD analysis of samples GCA10049 and GCA10053 determined the mica to be mainly of an illite nature (<2 µm).

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Ref No <23480>

SEM/EDS ANALYSES**GCA10043**

SIDERITE	A	B	C
MgO	4.0	2.7	0.7
CaO	1.9	1.7	0.3
MnO	8.1	11.0	13.6
FeO	45.9	44.6	45.3

RHODOCHROSITE	A	B
CaO	0.8	0.6
MnO	39.8	27.7
FeO	9.4	10.1
ZnO		11.6

GCA10044

RHODOCHROSITE	A	B	C
CaO	1.0	1.4	0.6
MnO	30.6	24.0	45.4
FeO	12.6	17.5	2.9
ZnO	5.3	6.3	
MgO	0.4	0.7	1.1

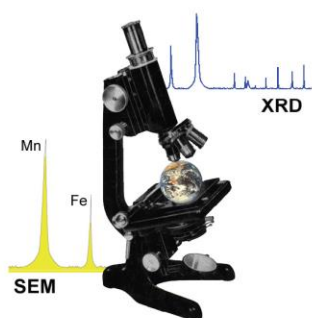
GCA10049

RHODOCHROSITE	A	B
CaO	2.1	2.7
MnO	35.6	42.8
FeO	11.9	4.1
MgO	0.4	0.5

GCA10053

RHODOCHROSITE	A	B
CaO	0.7	2.0
MnO	47.2	44.3
FeO	2.1	3.7

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03/07/2013

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OUR REFERENCE: 23481

YOUR REFERENCE: 1220/2

XRD/PLM/SEM ROCK/CLAY MINERALOGICAL ASSESSMENT OF SEVEN CRUSHINGS/PULPS
INCLUDING CLAY TREATMENTS.

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Ref No <23481>

XRD PROCEDURES

XRD	PANALYTICAL XPERT PRO
DETECTOR	PIXCEL 1D
ANGULAR RANGE	5° TO 110°
DIVERGENCE SLIT	1/4°
ANTI SCATTER SLIT	1/2°
RADIATION	Co Kα 1.788965
SLIT TYPE	FIXED
GENERATOR	40Kv 40 Ma

XRD/PLM RESULTS

	GCA10651/53	GCA10663/64	GCA10668/69	GCA10674/75
QUARTZ	MAJOR	DOMINANT	DOMINANT	MAJOR
KAOLINITE	MAJOR	ACCESSORY	MINOR	MINOR
SMECTITE/ILLITE	ACCESSORY	MINOR	ACCESSORY	MAJOR
MUSCOVITE/ILLITE	ACCESSORY	ACCESSORY		
K-FELDSPAR	ACCESSORY		ACCESSORY	ACCESSORY
TI OXIDES	ACCESSORY	ACCESSORY		
HEMATITE	TRACE	TRACE	TRACE	TRACE
SPHALERITE	TRACE			
GOETHITE		TRACE	TRACE	TRACE
TOURMALINE	TRACE	TRACE		
PYRITE			TRACE	TRACE
JAROSITE		TRACE		TRACE
ZIRCON	TRACE	TRACE		

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Ref No <23481>

	GCA10678/79	GCA10682/83	GCA10687/91
QUARTZ	MAJOR	MAJOR	MAJOR
KAOLINITE	ACCESSORY	MINOR	ACCESSORY
SMECTITE/ILLITE	MAJOR	MAJOR	MAJOR
K-FELDSPAR	ACCESSORY		MINOR
PLAGIOCLASE			ACCESSORY
TI OXIDES			TRACE
HEMATITE	TRACE	TRACE	TRACE
GOETHITE			TRACE
PYRITE		TRACE	TRACE
JAROSITE	ACCESSORY		
ZIRCON	TRACE		
CHLORITE		TRACE	
SIDERITE		ACCESSORY	TRACE?
ANKERITE			ACCESSORY

SEM/EDS ANALYSES

GCA10682/83

SIDERITE	A	B
MgO	1.3	1.2
CaO	2.3	1.4
MnO	7.5	8.8
FeO	48.9	48.5

GCA10687/91

ANKERITE	A	B
MgO	15.0	10.6
CaO	29.0	29.6
MnO	1.0	1.6
FeO	11.0	14.2

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CLAY TREATMENTS

Ten grams of each sample were weighed into a 50 mL centrifuge tube with 20 mL of DI water. The clay fraction (~2 µm) was separated using ultrasonic treatment and centrifugation. The sample was then saturated/treated using the following 4 treatments, then examined by XRD analysis:

1. MgCl₂ saturated
2. MgCl₂ saturated and Glycerol
3. KCl saturated
4. KCl saturated and heated at 550°C for 2 hours.

Only samples were chosen for clay treatments for which smectite or illite presence was indicated in the “whole sample” assessment, and/or where identifying smectite on the “whole sample” was difficult through possibly smectite peaks being obscured by peaks from clays with some overlapping d-spacings (e.g. vermiculite/chlorite).

Note. These results reflect the fraction of the mineral in the clay fraction (<2 microns).

Note. Dominant (≥50%), Major (≥20%), Minor (≥10%), Accessory (≥1%), Trace (<1%), ND (not detected).

	SMECTITE/ILLITE	CHLORITE	KAOLINITE	ILLITE	VERMICULITE
GCA10651/53	ACCESSORY	ND	DOMINANT	ACCESSORY	ND
GCA10663/64	MAJOR	ND	MAJOR	MINOR	ND
GCA10668/69	MINOR	ND	DOMINANT	ND	ND
GCA10674/75	DOMINANT	ND	MAJOR	ND	ND
GCA10678/79	DOMINANT	ND	ACCESSORY	ND	ND
GCA10682/83	DOMINANT	ND	MAJOR	ND	ND
GCA10687/89	DOMINANT	ND	ACCESSORY	ND	ND

Note. Smectite/Illite is an interstratified smectite and illite phase.

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OUR REFERENCE: 23481b

CONCENTRATION BY CLAY SEPARATION METHODS AND ADDITIONAL XRD ANALYSES (LONG CAPTURE TIMES) OF SAMPLES GCA10663/64, GCA10674/75 AND GCA10678/79, FROM JOB 23481, FOR SPECIFIC IDENTIFICATION OF ALUNITE.

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GRAEME CAMPBELL**Ref No: 23481B****XRD PROCEDURES**

XRD	PANALYTICAL XPERT PRO
DETECTOR	PIXCEL 1D
ANGULAR RANGE	30° TO 45°
DIVERGENCE SLIT	1/2°
ANTI SCATTER SLIT	1°
TIME	4 HOURS
RADIATION	Co Kα 1.788965
SLIT TYPE	FIXED
GENERATOR	40Kv 40 Ma

METHODS

Specific identification of alunite from samples GCA10663/64, GCA10674/75 and GCA10678/79, from report 23481, was requested by the client. Four hour capture time-XRD analyses were performed on the whole sample, initially, with ambiguous results. Due to the clay content of the samples, a clay separation was undertaken, to concentrate the sample. This was performed using clay dispersion/shaking methods followed by centrifugation. The 'non-clay' fraction was then analysed by XRD, with long capture times (4 hours), within a limited 2 θ range (30° to 45°), the region containing the main alunite peak.

RESULTS

	GCA10663/64	GCA10674/75	GCA10678/79
MINERAL ABUNDANCES ON "NON CLAY FRACTION" BASIS			
ALUNITE	TRACE	TRACE	TRACE
JAROSITE	ACCESSORY	ACCESSORY	ACCESSORY

10663/64: A small peak at 2.989A, albeit shared by both alunite and muscovite, suggests that alunite may be present. XRD analyses indicate jarosite is present. Optical microscopy also confirms its presence.

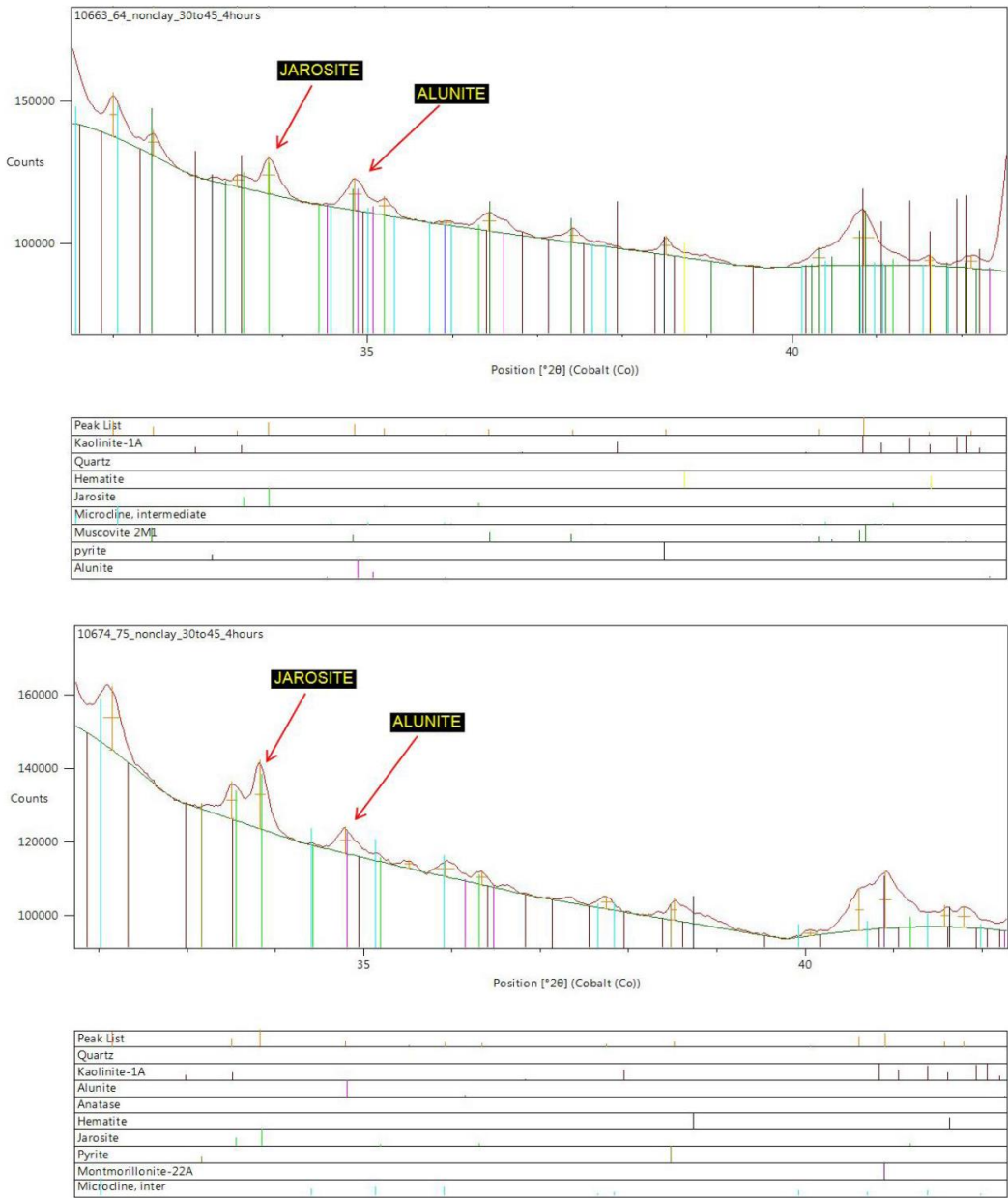
10674/75: A very small peak at 2.989A, suggests that alunite may be present. XRD analyses indicate jarosite is present. Optical microscopy also confirms its presence.

10678/79: A very small peak at 2.989A, suggests that alunite may be present. XRD analyses indicate jarosite is present. Optical microscopy also confirms its presence.

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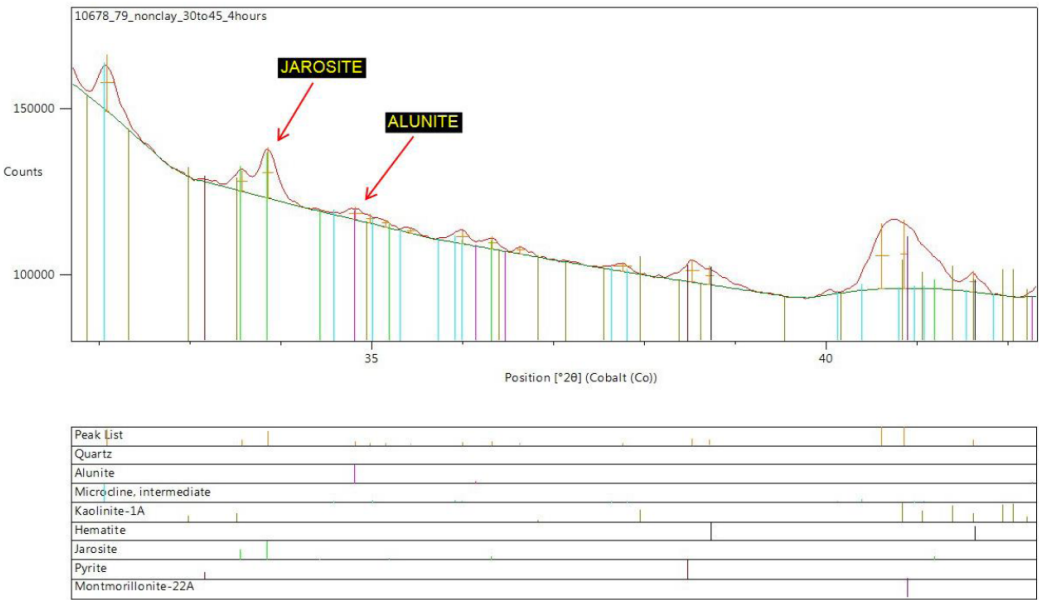
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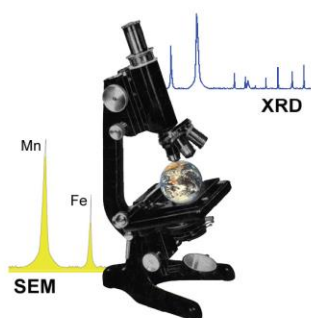
APPENDIX – XRD TRACES



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XRD/PLM/SEM ROCK/CLAY MINERALOGICAL ASSESSMENT OF FIVE CRUSHINGS/PULPS
INCLUDING CLAY TREATMENTS.

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<GRAEME CAMPBELL>

2

Ref No <23482>

XRD PROCEDURES

XRD	PANALYTICAL XPERT PRO
DETECTOR	PIXCEL 1D
ANGULAR RANGE	5° TO 110°
DIVERGENCE SLIT	1/4°
ANTI SCATTER SLIT	1/2°
RADIATION	Co Kα 1.788965
SLIT TYPE	FIXED
GENERATOR	40Kv 40 Ma

XRD/PLM RESULTS

	GCA10706/07	GCA10730/31	GCA10740/41	GCA10747/48/49	GCA10754/55
QUARTZ	MAJOR	DOMINANT	MAJOR	MAJOR	MAJOR
K-FELDSPAR	MINOR	ACCESSORY	MAJOR	MINOR	
RHODOCHROSITE	ACCESSORY		ACCESSORY	ACCESSORY	
SMECTITE/ILLITE	MAJOR		MAJOR		MAJOR
ILLITE/MUSCOVITE		MAJOR		MAJOR	
CHLORITE					ACCESSORY
KAOLINITE					MINOR
DOLOMITE					ACCESSORY
SIDERITE					ACCESSORY
JAROSITE		TRACE			
HEMATITE		TRACE			
GOETHITE		TRACE			
TI OXIDES	TRACE	TRACE	ACCESSORY	ACCESSORY	ACCESSORY
SPHALERITE			TRACE	TRACE	
PYRITE	TRACE	TRACE	TRACE	TRACE	ACCESSORY
MARCASITE	TRACE	TRACE	TRACE	TRACE	TRACE
GALENA			TRACE	TRACE	
ARSENOPYRITE			TRACE		
BARITE	TRACE				
ZIRCON				TRACE	

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<GRAEME CAMPBELL>

3

Ref No <23482>

SEM/EDS ANALYSES

GCA10706/07

RHODOCHROSITE	A	B
MgO		1.9
CaO	1.5	0.6
MnO	45.1	40.7
FeO	3.4	6.8

GCA10740/41

RHODOCHROSITE	A	B
MgO	0.2	0.6
CaO	1.2	1.0
MnO	45.3	45.8
FeO	3.3	2.6

GCA10747/48/49

RHODOCHROSITE	A	B
MgO		0.7
CaO	0.6	3.0
MnO	47.5	40.3
FeO	1.9	6.0

GCA10754/55

DOLOMITE	A	B
MgO	25.5	17.1
CaO	51.1	51.2
MnO	3.6	3.6
FeO	19.8	28.1

SIDERITE	A	B
MgO	24.7	18.3
CaO	6.9	2.9
MnO	3.9	4.7
FeO	64.5	74.1

Roger Townend and Associates

<GRAEME CAMPBELL>

4

Ref No <23482>

CLAY TREATMENTS

Ten grams of each sample were weighed into a 50 mL centrifuge tube with 20 mL of DI water. The clay fraction ($\sim 2 \mu\text{m}$) was separated using ultrasonic treatment and centrifugation. The sample was then saturated/treated using the following 4 treatments, then examined by XRD analysis:

1. MgCl_2 saturated
2. MgCl_2 saturated and Glycerol
3. KCl saturated
4. KCl saturated and heated at 550°C for 2 hours.

Only samples were chosen for clay treatments for which smectite or illite presence was indicated in the “whole sample” assessment, and/or where identifying smectite on the “whole sample” was difficult through possibly smectite peaks being obscured by peaks from clays with some overlapping d-spacings (e.g. vermiculite/chlorite).

Note. These results reflect the fraction of the mineral in the clay fraction ($<2 \mu\text{m}$).

Note. Dominant ($\geq 50\%$), Major ($\geq 20\%$), Minor ($\geq 10\%$), Accessory ($\geq 1\%$), Trace ($<1\%$), ND (not detected).

	SMECTITE/ILLITE	CHLORITE	KAOLINITE	ILLITE	VERMICULITE
GCA10706/07	DOMINANT	ND	ND	ND	ND
GCA10730/31	ND	ND	ND	DOMINANT	ND
GCA10740/41	DOMINANT	ND	ND	ND	ND
GCA10747/48/49	ND	ND	ND	DOMINANT	ND
GCA10754/55	MAJOR	ACCESSORY	MAJOR	ND	ND

Note. Smectite/Illite is an interstratified smectite and illite.

Roger Townend and Associates

GLS Job Code 143.0/1224568

Client ON GCA 1220/1



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JOB INFORMATION

JOB CODE	143/1224568
No. of SAMPLES	48
CLIENT O/N	GCA1220/1
PROJECT	Bowdens
STATE	Mine Waste
DATE RECEIVED	31/12/2012
DATE COMPLETED	31/01/2013

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

The samples were received mine wastes which were dried at 80C. The samples were crushed to a nominal 2mm a split was then taken and fine pulverised to a nominal -75um

Results of analysis on:

Element		C	C-Acinsol	C-CO3	S	S-SO4
Method		/CSA	C71/CSA	/CALC	/CSA	S72/GR
Detection		0.01	0.01	0.01	0.01	0.01
Units		%	%	%	%	%
Sample Name						
Control Blank		0.03	X	X	X	X
GCA10651		0.02	0.01	0.01	0.02	0.02
GCA10651	check	X	X	X	0.01	X
GCA10652		0.02	0.01	0.01	0.02	X
GCA10653		0.02	0.02	X	X	X
GCA10654		0.02	0.02	X	X	0.01
GCA10655		0.01	0.01	X	0.02	0.02
GCA10656		0.07	0.03	0.04	0.02	X
GCA10657		0.04	0.02	0.02	X	X
GCA10658		0.02	0.01	0.01	0.02	0.02
GCA10660		0.06	0.05	0.01	0.02	X
GCA10661		0.07	0.06	0.01	0.02	X
GCA10662		0.08	0.02	0.06	0.07	0.04
GCA10663		0.03	0.01	0.02	0.02	X
GCA10664		0.06	0.02	0.04	0.25	0.22
GCA10665		0.02	X	0.02	0.05	0.05
GCA10666		X	X	X	0.11	0.09
GCA10667		0.03	0.03	X	0.05	0.05

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GLS Job Code 143.0/1224568

Client ON GCA 1220/1

Element		C	C-Acinsol	C-CO3	S	S-SO4
Method		/CSA	C71/CSA	/CALC	/CSA	S72/GR
Detection		0.01	0.01	0.01	0.01	0.01
Units		%	%	%	%	%
Sample Name						
GCA10668		X	X	X	0.02	0.02
GCA10669		0.06	X	0.06	0.04	0.02
GCA10670		0.01	0.01	X	0.15	0.14
GCA10671		0.1	0.03	0.07	0.02	X
GCA10672		0.11	0.01	0.1	0.04	X
GCA10672	check	0.1	0.03	0.07	0.03	X
GCA10673		0.5	0.05	0.45	0.02	X
GCA10674		0.01	0.01	X	0.15	0.14
GCA10675		X	X	X	0.02	X
GCA10676		0.06	0.05	0.01	0.04	0.04
GCA10677		0.05	0.04	0.01	0.05	0.04
GCA10678		0.02	0.02	X	0.19	0.2
GCA10679		X	X	X	0.24	0.22
GCA10680		0.02	0.02	X	0.14	0.13
GCA10681		X	X	X	0.08	0.02
GCA10682		0.64	0.01	0.63	0.07	X
GCA10683		0.54	0.01	0.53	0.03	X
GCA10684		0.06	0.04	0.02	0.04	0.02
GCA10685		0.1	0.02	0.08	0.04	0.02
GCA10686		0.11	0.02	0.09	0.1	0.03
GCA10687		0.46	0.02	0.44	0.05	X
GCA10690		0.07	0.03	0.04	0.02	X
GCA10691		0.42	0.02	0.4	0.05	0.01
GCA10692		0.06	0.01	0.05	0.02	X
GCA10693		0.25	0.03	0.22	0.02	X
GCA10694		0.35	0.02	0.33	0.1	X
GCA10694	check	0.34	0.03	0.31	0.09	X
GCA10695		0.02	0.02	X	0.01	X
GCA10696		0.08	0.03	0.05	0.05	0.03
GCA10697		0.04	0.03	0.01	0.02	X
GCA10698		0.05	0.01	0.04	0.04	0.02
GCA10699		0.04	0.02	0.02	0.11	0.07
GCA10700		0.03	0.03	X	0.04	0.03
GCA10701		0.03	0.03	X	0.04	0.03
OREAS 92		0.11			0.3	
S_SO4_B-2						1.27
OREAS 501		0.28			0.37	
MA-3a		2.57		2.57	0.99	
PD-1				X		4.27
DS-1		3.17		3.17	2.6	
S_SO4_A-2						0.54

Notes

1. Total-S and Total-C were determined on the pulps
2. Total-C and Total-S was determined using an induction furnace according to Genalysis method number MPL_W043. The samples are ignited in oxygen ~1700C and the CO2 and SO2 measured by infrared detectors
3. S-SO4 was determined on the pulps by precipitation of BaSO4 according to Genalysis method number ENV_W039, after digestion with Na2CO3 (S72/GR) solution by OES.(S71/OE) Genalysis method codes:
4. C-Acinsol (acid insoluble carbon compounds) by a C&S analyser after removal of carbonates and soluble organic carbon using hot hydrochloric acid according to Genalysis method number MPL_W046.

GLS Job Code 143.0/1224568

Client ON GCA 1220/1

Results of analysis on:

sample name		Fizz Rate	volume ml	HCl M	NaOH M	Colour Change	pH Drop	ANC soln pH	ANC (kgH ₂ SO ₄ /t)
GCA10651		0	8	0.540	0.190	N		1.4	1
GCA10651	check	0	8	0.540	0.190	N		1.2	1
GCA10652		0	8	0.540	0.190	N		1.4	1
GCA10653		0	8	0.540	0.190	N		1.4	1
GCA10654		0	8	0.540	0.190	N		1.4	1
GCA10655		0	8	0.540	0.190	N		1.3	1
GCA10656		0	8	0.540	0.190	N		1.4	1
GCA10657		0	8	0.540	0.190	N		1.4	1
GCA10658		0	8	0.540	0.190	N		1.4	0
GCA10660		0	8	0.540	0.190	N		1.4	3
GCA10661		0	8	0.540	0.190	N		1.3	4
GCA10662		0	8	0.540	0.190	N		1.3	0
GCA10663		0	8	0.540	0.190	N		1.2	0
GCA10664		0	8	0.540	0.190	N		1.3	0
GCA10665		0	8	0.540	0.190	N		1.3	1
GCA10666		0	8	0.540	0.190	N		1.2	2
GCA10667		0	8	0.540	0.190	N		1.2	2
GCA10668		0	8	0.540	0.190	N		1.2	1
GCA10669		0	8	0.540	0.190	N		1.3	1
GCA10670		0	8	0.540	0.190	N		1.3	2
GCA10671		0	8	0.540	0.190	N		1.2	2
GCA10672		0	8	0.540	0.190	N	4.0	1.2	3
GCA10672	check	0	8	0.540	0.190	N		1.3	3
GCA10673		1	8	0.540	0.190	Y	2.9	1.4	10
GCA10674		0	8	0.540	0.190	N		1.3	4
GCA10675		0	8	0.540	0.190	N		1.3	6
GCA10676		0	8	0.540	0.190	N		1.3	0
GCA10677		0	8	0.540	0.190	N		1.2	1
GCA10678		0	8	0.540	0.190	N		1.3	3
GCA10679		0	8	0.540	0.190	N		1.2	4
GCA10680		0	8	0.540	0.190	N		1.3	3
GCA10681		0	8	0.540	0.190	N		1.3	7
GCA10682		0	8	0.540	0.190	Y	2.8	1.7	12
GCA10683		0	8	0.540	0.190	Y	2.8	1.6	13
GCA10684		0	8	0.540	0.190	N		1.3	2
GCA10685		0	8	0.540	0.190	N		1.3	10
GCA10686		0	8	0.540	0.190	N		1.3	6
GCA10687		0	8	0.540	0.190	N	3.3	1.4	25
GCA10690		0	8	0.540	0.190	N		1.2	5
GCA10691		0	8	0.540	0.190	Y	3.4	1.4	24
GCA10692		0	8	0.540	0.190	N		1.3	6
GCA10693		0	8	0.540	0.190	N	3.7	1.3	12
GCA10694		1	8	0.540	0.190	N	3.8	1.4	15
GCA10694	check	0	8	0.540	0.190	Y	3.8	1.4	15
GCA10695		0	8	0.540	0.190	N		1.3	4
GCA10696		0	8	0.540	0.190	N		1.2	6
GCA10697		0	8	0.540	0.190	N		1.3	1
GCA10698		0	8	0.540	0.190	N		1.2	1
GCA10699		0	8	0.540	0.190	N		1.2	1
GCA10700		0	8	0.540	0.190	N		1.2	1
GCA10701		0	8	0.540	0.190	N		1.2	1

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Client ON GCA 1220/1

Notes:

1. ANC was determined on 2g - Acid concentrations are as stated.
2. Colour change: Y indicates the appearance of a green colouration as the pH=7 endpoint was approached. N indicates no colour change. Two drops of 30 % hydrogen peroxide are added to each sample as the endpoint is approached to oxidise any ferrous iron.
3. pH drop : Result reported when the pH drops to a value below 4 on addition of peroxide
4. This "Bulk-ANC" static-testing procedure is based on AMIRA (2002), according to Genalysis method number ENV_W035

NATA ENDORSED DOCUMENT

Company Accreditation Number 3244

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 31/1/2013

GLS Job Code 143.0/1300295

Client ON GCA 1220/1



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JOB INFORMATION

JOB CODE	143/1300295
No. of SAMPLES	55
CLIENT O/N	GCA1220/1
PROJECT	Bowdens
STATE	Mine Waste
DATE RECEIVED	4/02/2013
DATE COMPLETED	21/02/2013

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

The samples were received mine wastes which were dried at 80C. The samples were crushed to a nominal 2mm a split was then taken and fine pulverised to a nominal -75um

Results of analysis on:

Element		C	C-Acinsol	C-CO3	S-SO4	S
Method		/CSA	C71/CSA	/CALC	S72/GR	/CSA
Detection		0.01	0.01	0.01	0.01	0.01
Units		%	%	%	%	%
Sample Name						
Control Blank		X	X	X	X	X
GCA10702		0.26	0.06	0.2	0.06	0.51
GCA10702	check	0.26	0.03	0.23	0.05	0.5
GCA10703		0.3	0.06	0.24	0.13	0.47
GCA10704		0.2	0.06	0.14	0.09	0.4
GCA10705		0.2	0.06	0.14	0.08	0.29
GCA10706		0.11	0.06	0.05	0.06	0.53
GCA10707		0.38	0.06	0.32	0.06	0.51
GCA10708		0.11	0.03	0.08	0.12	0.78
GCA10709		0.37	0.05	0.32	0.04	0.31
GCA10710		0.47	0.05	0.42	0.04	0.38
GCA10711		0.33	X	0.33	0.07	1.01
GCA10712		0.28	0.05	0.23	0.1	0.77
GCA10713		0.41	0.03	0.38	0.1	0.78
GCA10714		0.6	0.02	0.58	0.06	0.61
GCA10715		0.04	0.03	0.01	0.03	0.03

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BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1300295

Client ON GCA 1220/1

Element		C	C-Acinsol	C-CO3	S-SO4	S
Method		/CSA	C71/CSA	/CALC	S72/GR	/CSA
Detection		0.01	0.01	0.01	0.01	0.01
Units		%	%	%	%	%
Sample Name						
GCA10716		0.05	0.06	X	0.02	0.03
GCA10717		0.04	0.04	X	0.02	0.02
GCA10718		0.21	0.06	0.15	0.03	0.53
GCA10719		0.29	0.05	0.24	0.03	0.5
GCA10720		0.17	0.07	0.1	0.02	0.57
GCA10721		0.31	0.09	0.22	0.02	0.57
GCA10722		0.77	0.04	0.73	X	0.34
GCA10722	check	0.79	0.04	0.75	0.03	0.33
GCA10723		0.06	0.04	0.02	0.02	0.02
GCA10724		0.03	0.03	X	X	0.01
GCA10725		0.05	0.05	X	0.24	0.3
GCA10726		0.05	0.04	0.01	0.2	0.64
GCA10727		0.07	0.04	0.03	0.08	1.26
GCA10728		0.18	0.06	0.12	0.09	1.48
GCA10729		0.16	0.16	X	0.06	1.41
GCA10730		0.06	0.02	0.04	0.45	0.49
GCA10731		0.04	0.04	X	0.1	0.48
GCA10732		0.29	0.07	0.22	0.04	0.54
GCA10733		0.06	0.06	X	0.21	1.65
GCA10734		0.07	0.04	0.03	0.11	2.27
GCA10735		0.45	0.09	0.36	0.09	1.73
GCA10736		0.44	0.05	0.39	0.05	1.47
GCA10737		0.13	0.01	0.12	0.09	1.64
GCA10738		0.04	0.04	X	0.46	0.51
GCA10739		0.14	0.14	X	0.57	0.57
GCA10740		0.13	0.03	0.1	0.02	0.45
GCA10741		0.12	0.03	0.09	0.02	0.35
GCA10742		0.22	0.02	0.2	0.04	0.67
GCA10743		0.06	X	0.06	0.05	1.14
GCA10744		0.34	0.02	0.32	X	0.47
GCA10745		0.19	0.03	0.16	X	0.38
GCA10746		0.12	0.01	0.11	X	0.46
GCA10747		0.42	0.02	0.4	X	0.57
GCA10748		0.11	0.03	0.08	X	0.46
GCA10749		0.35	0.06	0.29	0.03	1.03
GCA10750		0.35	0.02	0.33	0.03	0.51
GCA10751		0.14	0.03	0.11	0.04	1
GCA10752		0.13	0.03	0.1	0.04	0.58
GCA10753		0.02	0.03	X	X	0.4
GCA10754		0.85	0.04	0.81	0.02	1.6
GCA10755		0.84	0.06	0.78	0.03	1.13
GCA10756		1.53	0.04	1.49	0.02	0.93
MA-1b		2.39				1.26
MA-3a		2.5				1.08
PD-1					4.2	
S_SO4_A-2					0.56	
MA-1b		2.37				1.25
S_SO4_B-2					1.32	

GLS Job Code 143.0/1300295

Client ON GCA 1220/1

Notes

1. Total-S and Total-C were determined on the pulps
2. Total-C and Total-S was determined using an induction furnace according to Genalysis method number MPL_W043. The samples are ignited in oxygen ~1700C and the CO2 and SO2 measured by infrared detectors
3. S-SO4 was determined on the pulps by precipitation of BaSO4 according to Genalysis method number ENV_W039, after digestion with Na2CO3 (S72/GR)
4. C-Acinsol (acid insoluble carbon) by a C&S analyser after removal of carbonates and soluble organic carbon using hot hydrochloric acid according to Genalysis method number MPL_W046.

Results of analysis on:

sample name		Fizz Rate	volume ml	HCl M	NaOH M	Colour Change	pH Drop	ANC soln pH	ANC (kgH2SO4/t)
GCA10702		0	8	0.538	0.190	N		1.5	19
GCA10702	check	0	8	0.538	0.190	N		1.5	16
GCA10703		0	8	0.538	0.190	N		1.5	10
GCA10704		0	8	0.538	0.190	N		1.5	11
GCA10705		0	8	0.538	0.190	N		1.5	15
GCA10706		0	8	0.538	0.190	N		1.5	10
GCA10707		0	8	0.538	0.190	N	3.8	1.5	19
GCA10708		0	8	0.538	0.190	N		1.5	7
GCA10709		1	8	0.538	0.190	N		1.6	23
GCA10710		0	8	0.538	0.190	N		1.6	24
GCA10711		0	8	0.538	0.190	N		1.5	12
GCA10712		0	8	0.538	0.190	N		1.5	9
GCA10713		0	8	0.538	0.190	N		1.6	20
GCA10714		0	8	0.538	0.190	N	3.9	1.7	28
GCA10715		0	8	0.538	0.190	N		1.4	3
GCA10716		0	8	0.538	0.190	N		1.4	3
GCA10717		0	8	0.538	0.190	N		1.4	7
GCA10718		0	8	0.538	0.190	N		1.5	13
GCA10719		0	8	0.538	0.190	N		1.6	21
GCA10720		0	8	0.538	0.190	N		1.4	10
GCA10721		0	8	0.538	0.190	N		1.5	22
GCA10722		0	8	0.538	0.190	N		1.8	41
GCA10722	check	0	8	0.538	0.190	N		1.8	41
GCA10723		0	8	0.538	0.190	N		1.4	4
GCA10724		0	8	0.538	0.190	N		1.4	4
GCA10725		0	8	0.538	0.190	N		1.4	<1
GCA10726		0	8	0.538	0.190	N		1.2	<1
GCA10727		0	8	0.538	0.190	N		1.4	<1
GCA10728		0	8	0.538	0.190	N		1.4	5
GCA10729		0	8	0.538	0.190	N		1.4	1
GCA10730		0	8	0.538	0.190	N		1.4	<1
GCA10731		0	8	0.538	0.190	N		1.4	<1
GCA10732		0	8	0.538	0.190	N		1.5	10
GCA10733		0	8	0.538	0.190	N		1.4	<1
GCA10734		0	8	0.538	0.190	N		1.4	<1
GCA10735		0	8	0.538	0.190	Y	3.5	1.5	9
GCA10736		0	8	0.538	0.190	Y	3.5	1.5	7
GCA10737		0	8	0.538	0.190	N		1.5	3
GCA10738		0	8	0.538	0.190	N		1.4	<1
GCA10739		0	8	0.538	0.190	N		1.4	<1
GCA10740		0	8	0.538	0.190	N		1.4	9
GCA10741		0	8	0.538	0.190	N		1.4	6

GLS Job Code 143.0/1300295

Client ON GCA 1220/1

sample name	Fizz Rate	volume ml	HCl M	NaOH M	Colour Change	pH Drop	ANC soln pH	ANC (kgH ₂ SO ₄ /t)
GCA10742	0	8	0.538	0.190	N		1.5	13
GCA10743	0	8	0.538	0.190	N		1.4	6
GCA10744	0	8	0.538	0.190	N		1.5	12
GCA10745	0	8	0.538	0.190	N		1.5	10
GCA10746	0	8	0.538	0.190	N		1.5	8
GCA10747	0	8	0.538	0.190	N		1.6	14
GCA10748	0	8	0.538	0.190	N		1.4	7
GCA10749	0	8	0.538	0.190	N		1.6	16
GCA10750	0	8	0.538	0.190	N		1.6	18
GCA10751	0	8	0.538	0.190	N		1.4	7
GCA10752	0	8	0.538	0.190	N		1.4	5
GCA10753	0	8	0.538	0.190	N		1.4	3
GCA10754	0	8	0.538	0.190	Y	2.8	1.8	29
GCA10755	0	20	0.538	0.487	Y	2.8	1.1	40
GCA10756	1	20	0.538	0.487	N	2.8	1.2	61

Notes:

1. ANC was determined on 2g -. Acid concentrations are as stated.
2. Colour change: Y indicates the appearance of a green colouration as the pH=7 endpoint was approached. N indicates no colour change. Two drops of 30 % hydrogen peroxide are added to each sample as the endpoint is approached to oxidise any ferrous iron.
3. pH drop : Result reported when the pH drops to a value below 4 on addition of peroxide
4. This "Bulk-ANC" static-testing procedure is based on AMIRA (2002), according to Genalysis method number ENV_W035

NATA ENDORSED DOCUMENT**Company Accreditation Number 3244**

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 21/02/2013

GLS Job Code 143.0/1306300

Client ON GCA 1220/1



Accredited for compliance with ISO/IEC 17025

Dr G Campbell
CAMPBELL, GRAEME and ASSOCIATES PTY LTD
PO Box 247
BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1306300
No. of SAMPLES	2
CLIENT O/N	GCA1220/1
PROJECT	Bowdens
STATE	Mine Waste
DATE RECEIVED	2/05/2013
DATE COMPLETED	20/05/2013

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

The samples were received as pulps

Results of analysis on:

Element		S
Method		/CSA
Detection		0.01
Units		%
Sample Name		
Control Blank		0.02
GCA10742		0.43
GCA10744	check	0.63
GCA10742		0.41
MA-1b		1.17

Notes

1. Total-S was determined on the pulps
2. Total-S was determined using an induction furnace according to Genalysis method number MPL_W043. The samples are ignited in oxygen ~1700C and the CO2 and SO2 measured by infrared detectors

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BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1306300

Client ON GCA 1220/1

NATA ENDORSED DOCUMENT

Company Accreditation Number 3244

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 20/05/2013

GLS Job Code 143.0/1308081

Client ON GCA 1220/1



GENALYSIS
LABORATORY SERVICES



Accredited for compliance with ISO/IEC 17025

Dr G Campbell
CAMPBELL, GRAEME and ASSOCIATES PTY LTD
PO Box 247
BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1308081
No. of SAMPLES	32
CLIENT O/N	GCA1220/1
PROJECT	Bowdens
STATE	Mine Waste
DATE RECEIVED	6/06/2013
DATE COMPLETED	9/07/2013

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

The samples were received as drill core samples of approx. 1.0-1.5 kg each with the following instructions for preparation.

1.0 SAMPLE PREPARATION

1.1 Initial Isolation of -2mm and +2mm Fractions and Labelling with "fe" and "c" suffixes, Respectively

- All samples are to be passed through the jaw/rolls-crusher with clearance set to 10-15 mm.
- The -2mm fraction is to be obtained via dry-sieving, and the weights of the -2mm and +2mm fractions forwarded to GCA for review.
- Depending on the yield of the -2mm fraction, the +2mm fraction may be re-passed through the crusher with clearance set to nominal 5-10 mm.
- Following confirmation by GCA (after reviewing weights of the above), the following suffixes are to be assigned to each sample, viz.
• -2mm fraction GCA11069fe, etc.
• +2mm fraction GCA11069c etc

1.2 Final Preparation of -2mm Crushings and -75µm Pulps

- The "fe" samples are to be thoroughly hand-mixed, and subsampled for pulping approx. 100g to nominal 75 µm.
The "c" samples are then to be re-crushed with clearance of crusher set to nominal 2mm. After hand-mixing, approx. 100g is to be pulped to nominal 75 µm.

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BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1308081

Client ON GCA 1220/1

Results of analysis on:

Element		S	S-SO4	C	C-Acinsol	C-CO3
Method		/CSA	S72/GR	/CSA	C71/CSA	/CALC
Detection		0.005	0.01	0.01	0.01	0.01
Units		%	%	%	%	%
Sample Name						
Control Blank		0.016	X	X	X	X
GCA11069fe		1.465	0.05	0.01	X	0.01
GCA11069c		1.32		X	X	X
GCA11070fe		1.286	0.03	0.29	0.03	0.26
GCA11070c		1.286		0.25	0.04	0.21
GCA11071fe		1.557	0.04	0.33	0.04	0.29
GCA11071c		1.846		0.28	0.04	0.24
GCA11072fe		1.819	0.04	0.04	0.04	0
GCA11072c		1.748		0.03	0.03	0
GCA11073fe		2.155	0.04	0.75	0.05	0.7
GCA11073c		1.937		0.59	0.05	0.54
GCA11074fe		1.098	0.03	0.21	0.03	0.18
GCA11074c		1.14		0.16	0.03	0.13
GCA11075fe		1.566	0.02	0.57	0.04	0.53
GCA11075c		1.186		0.58	0.05	0.53
GCA11076fe		1.124	0.02	0.25	0.03	0.22
GCA11076c		1.138		0.23	0.04	0.19
GCA11077fe		1.261	1.00	0.02	0.02	0
GCA11077c		1.069		0.02	0.02	0
GCA11078fe		1.891	0.11	1.11	0.04	1.07
GCA11078c		1.652		0.83	0.04	0.79
GCA11079fe		2.043	0.12	0.39	0.02	0.37
GCA11079c		1.985		0.31	0.02	0.29
GCA11080fe		1.52	0.04	0.31	0.02	0.29
GCA11080c		2.033		0.32	0.03	0.29
GCA11081fe		1.421	0.03	0.87	0.04	0.83
GCA11081c		1.567		0.71	0.04	0.67
GCA11082fe		1.079	0.02	0.66	0.03	0.63
GCA11082fe	check	1.07	0.02	0.66	0.05	0.61
GCA11082c		0.984		0.63	0.08	0.55
GCA11083fe		1.827	0.03	0.34	0.06	0.28
GCA11083c		2.195		0.27	0.05	0.22
GCA11084fe		1.445	0.04	0.32	0.08	0.24
GCA11084c		1.446		0.27	0.03	0.24
GCA11075c		1.148		0.57	0.03	0.54
MA-1b		1.184		2.48		
PD-1			4.35			
S_SO4_A-2	N		0.56			
S_SO4_B-2	N		1.10			

GLS Job Code 143.0/1308081

Client ON GCA 1220/1

Notes

1. Total-S and Total-C were determined on the pulps
2. Total-C and Total-S was determined using an induction furnace according to Genalysis method number MPL_W043. The samples are ignited in oxygen ~1700C and the CO₂ and SO₂ measured by infrared detectors
3. S-SO₄ was determined on the pulps by precipitation of BaSO₄ according to Genalysis method number ENV_W039, after digestion with Na₂CO₃ (S72/GR)
4. C-Acinsol (acid insoluble carbon) by a C&S analyser after removal of carbonates and soluble organic carbon using hot hydrochloric acid according to Genalysis method number MPL_W046.

Results of analysis on:

sample		Fizz	volume	HCl	NaOH	Colour	pH	ANC	ANC
name		Rate	ml	M	M	Change	Drop	soln pH	(kgH ₂ SO ₄ /t)
GCA11069fe		2	8	0.491	0.210	N		1.4	0
GCA11070fe		2	8	0.491	0.210	Y		1.6	12
GCA11071fe		2	8	0.491	0.210	Y		1.6	8
GCA11072fe		2	8	0.491	0.210	N		1.5	2
GCA11073fe		2	20	0.491	0.490	Y	2.6	1.0	10
GCA11074fe		2	8	0.491	0.210	Y		1.6	6
GCA11075fe		2	8	0.491	0.210	Y	3.2	1.8	16
GCA11076fe		2	8	0.491	0.210	Y		1.6	7
GCA11077fe		2	8	0.491	0.210	Y		1.6	-3
GCA11078fe		2	20	0.491	0.490	Y	2.5	1.1	24
GCA11079fe		2	8	0.491	0.210	Y	3.0	1.8	8
GCA11080fe		2	8	0.491	0.210	Y	3.3	1.6	5
GCA11081fe		2	20	0.491	0.490	Y	2.8	1.2	27
GCA11082fe		2	20	0.491	0.490	Y	2.9	1.1	13
GCA11082fe	check	2	20	0.491	0.490	Y	2.9	1.1	13
GCA11083fe		2	8	0.491	0.210	Y	3.8	1.7	10
GCA11084fe		2	8	0.491	0.210	Y		1.6	10

Notes:

1. ANC was determined on 2g -. Acid concentrations are as stated.
2. Colour change: Y indicates the appearance of a green colouration as the pH=7 endpoint was approached. N indicates no colour change. Two drops of 30 % hydrogen peroxide are added to each sample as the endpoint is approached to oxidise any ferrous iron.
3. pH drop : Result reported when the pH drops to a value below 4 on addition of peroxide
4. This "Bulk-ANC" static-testing procedure is based on AMIRA (2002), according to Genalysis method number ENV_W035

BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1308081

Client ON GCA 1220/1

Element		Ag	As	Ba	Cd	Pb
Method		4A/MS	4A/MS	4A/MS	4A/MS	4A/MS
Detection		0.05	0.5	0.1	0.02	0.5
Units		ppm	ppm	ppm	ppm	ppm
Duplicates						
Sample Name						
Control Blank		0.09	X	0.9	0.03	1.5
GCA11069fe		11.2	340.8	549.7	4.19	246.4
GCA11070fe		2.37	55.4	540.2	3.73	385.6
GCA11071fe		1.63	122.6	581.2	0.21	73
GCA11072fe		4.43	68.4	665	4.91	1565.1
GCA11073fe		0.15	21.3	406.5	0.1	38.1
GCA11074fe		1.21	30.8	594.2	0.66	40.7
GCA11075fe		11.7	115	938.5	0.53	61.4
GCA11076fe		2.8	55.9	1179.7	2.75	591.8
GCA11077fe		0.34	129.8	674.1	0.23	157
GCA11078fe	check	0.95	97.6	440.9	0.18	44.5
GCA11079fe		0.42	25.8	1336.1	0.1	23.1
GCA11080fe		1	94.3	729.3	0.32	31.6
GCA11081fe		4.06	26.7	724.7	1.9	148.2
GCA11082fe		5.26	28.3	802.1	4	294
GCA11083fe		2.03	125.4	924.4	0.89	79.7
GCA11084fe		4.09	81.4	1324.7	4.85	277.2
GCA11082fe		5.37	27.5	811.1	4.07	303.1
GTS-2a		0.39	124.6	189.9	0.45	23.1
OREAS 97.01						
Control Blank		0.12	2.4	5	0.04	2.1
Control Blank						
Acid Blank		0.11	1.8	1.1	X	1

Element		Sb	Cu	Mn	Zn	Se
Method		4A/MS	4A/OE	4A/OE	4A/OE	SE1/MS
Detection		0.05	1	1	1	0.01
Units		ppm	ppm	ppm	ppm	ppm
Duplicates						
Sample Name						
Control Blank		0.06	X	2	X	X
GCA11069fe		24.16	6	3510	850	0.03
GCA11070fe		9.56	4	11241	1136	0.01
GCA11071fe		6.4	3	11293	150	0.01
GCA11072fe		7.9	4	1283	1292	0.1
GCA11073fe		8.27	20	9981	152	0.01
GCA11074fe		6.39	3	5797	147	0.06
GCA11075fe		6.44	5	17267	295	0.05
GCA11076fe		6.25	4	8645	915	0.07
GCA11077fe		30.78	26	2382	156	0.13
GCA11078fe	check	16.45	14	24707	211	0.04
GCA11079fe		9.23	15	8663	169	0.05
GCA11080fe		5.61	2	7645	217	0.03
GCA11081fe		9.19	15	23093	643	0.05
GCA11082fe		2.01	2	15353	956	X
GCA11083fe		5.94	3	11684	324	0.01
GCA11084fe		7.79	18	11089	1165	0.01
GCA11082fe		2.01	2	15211	919	X
GTS-2a		1.23	91	1566	198	
OREAS 97.01						0.65
Control Blank		0.07	X	X	1	
Control Blank						X
Acid Blank		X	X	X	X	

GLS Job Code 143.0/1308081

Client ON GCA 1220/1

Notes:

The results have been determined according to Genalysis methods codes:

Digestions : MPL_W002 (4A) and MPL_W005 (SE1)

Analytical Finishes: ICP_W004 (/OE) and ICP_W003 (/MS)

The results included the assay of blanks and international reference standards:

GTS-2a

and Genalysis in-house standards:

OREAS 97.01

The results are expressed as parts per million or percent by mass in the dried and prepared material.

NATA ENDORSED DOCUMENT

Company Accreditation Number 3244

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 09/07/2013



ANALYTICAL REPORT



CLIENT DETAILS

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Project **GCA Job No 1220 1_ Total S and CRS**
 Order Number **GCA-Job-No. 1220/1**
 Samples 29

LABORATORY DETAILS

Manager Ros Ma
 Laboratory SGS Newburn Environmental
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SGS Reference PE077220 R0
 Report Number 0000060883
 Date Reported 10 May 2013

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(898/20210).

SIGNATORIES

Ros Ma
 Laboratory Manager

Sonam Tashi
 Chemist



ANALYTICAL REPORT

PE077220 R0

	Sample Number	001	002	003
	Sample Matrix	Pulp	Pulp	Pulp
	Sample Name	GCA10703	GCA10704	GCA10705
Parameter	Units	LOR		

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur	%w/w	0.0050	0.45	0.41	0.29
--------------	------	--------	------	------	------

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.0050	0.23	0.24	0.21
Chromium Reducible Sulphur (Scr)	moles H+/T	5.0	145	152	128
Chromium Reducible Sulphur (Scr)	kg H2SO4/T	0.250	7.1	7.5	6.3

	Sample Number	004	005	006
	Sample Matrix	Pulp	Pulp	Pulp
	Sample Name	GCA10707	GCA10708	GCA10743
Parameter	Units	LOR		

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur	%w/w	0.0050	0.47	0.72	1.1
--------------	------	--------	------	------	-----

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.0050	0.32	0.50	0.80
Chromium Reducible Sulphur (Scr)	moles H+/T	5.0	199	311	499
Chromium Reducible Sulphur (Scr)	kg H2SO4/T	0.250	9.8	15	24



ANALYTICAL REPORT

PE077220 R0

	Sample Number	007	008	009
	Sample Matrix	Pulp	Pulp	Pulp
	Sample Name	GCA10744	GCA10745	GCA10750
Parameter	Units	LOR		

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur	%w/w	0.0050	0.71	0.38	0.49
--------------	------	--------	------	------	------

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.0050	0.45	0.29	0.39
Chromium Reducible Sulphur (Scr)	moles H+/T	5.0	278	178	246
Chromium Reducible Sulphur (Scr)	kg H2SO4/T	0.250	14	8.7	12
	Sample Number	010	011	012	
	Sample Matrix	Pulp	Pulp	Pulp	
	Sample Name	GCA10751	GCA10753	GCA10719	
Parameter	Units	LOR			

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur	%w/w	0.0050	0.84	0.38	0.51
--------------	------	--------	------	------	------

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.0050	0.71	0.29	0.39
Chromium Reducible Sulphur (Scr)	moles H+/T	5.0	441	178	244
Chromium Reducible Sulphur (Scr)	kg H2SO4/T	0.250	22	8.7	12



ANALYTICAL REPORT

PE077220 R0

	Sample Number	013	014	015
	Sample Matrix	Pulp	Pulp	Pulp
	Sample Name	GCA10721	GCA10730	GCA10740
Parameter	Units	LOR		

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur	%w/w	0.0050	0.54	0.49	0.45
--------------	------	--------	------	------	------

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.0050	0.39	<0.005	0.34
Chromium Reducible Sulphur (Scr)	moles H+/T	5.0	241	<5	213
Chromium Reducible Sulphur (Scr)	kg H2SO4/T	0.250	12	<0.25	10

	Sample Number	016	017	018
	Sample Matrix	Pulp	Pulp	Pulp
	Sample Name	GCA10741	GCA10742	GCA10709
Parameter	Units	LOR		

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur	%w/w	0.0050	0.37	0.42	0.30
--------------	------	--------	------	------	------

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.0050	0.071	0.34	0.23
Chromium Reducible Sulphur (Scr)	moles H+/T	5.0	44	211	145
Chromium Reducible Sulphur (Scr)	kg H2SO4/T	0.250	2.2	10	7.1



ANALYTICAL REPORT

PE077220 R0

	Sample Number	019	020	021
	Sample Matrix	Pulp	Pulp	Pulp
	Sample Name	GCA10710	GCA10725	GCA10726
Parameter	Units	LOR		

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur	%w/w	0.0050	0.37	0.33	0.60
--------------	------	--------	------	------	------

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.0050	0.30	0.060	0.33
Chromium Reducible Sulphur (Scr)	moles H+/T	5.0	184	38	209
Chromium Reducible Sulphur (Scr)	kg H ₂ SO ₄ /T	0.250	9.1	1.8	10

	Sample Number	022	023	024
	Sample Matrix	Pulp	Pulp	Pulp
	Sample Name	GCA10738	GCA10733	GCA10734
Parameter	Units	LOR		

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur	%w/w	0.0050	0.53	1.9	2.5
--------------	------	--------	------	-----	-----

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.0050	0.028	1.1	1.4
Chromium Reducible Sulphur (Scr)	moles H+/T	5.0	18	663	853
Chromium Reducible Sulphur (Scr)	kg H ₂ SO ₄ /T	0.250	0.87	33	42



ANALYTICAL REPORT

PE077220 R0

	Sample Number	025	026	027
	Sample Matrix	Pulp	Pulp	Pulp
	Sample Name	GCA10754	GCA10756	GCA10727
Parameter	Units	LOR		

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur	%w/w	0.0050	1.7	0.80	1.4
--------------	------	--------	-----	------	-----

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.0050	1.1	0.052	0.83
Chromium Reducible Sulphur (Scr)	moles H+/T	5.0	676	32	518
Chromium Reducible Sulphur (Scr)	kg H2SO4/T	0.250	33	1.6	25

	Sample Number	028	029
	Sample Matrix	Pulp	Pulp
	Sample Name	GCA10728	GCA10739
Parameter	Units	LOR	

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur	%w/w	0.0050	1.5	0.39
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Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.0050	0.96	0.008
Chromium Reducible Sulphur (Scr)	moles H+/T	5.0	602	5
Chromium Reducible Sulphur (Scr)	kg H2SO4/T	0.250	30	0.26



QC SUMMARY

PE077220 R0

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

Chromium Reducible Sulphur (CRS) Method: ME-(AU)-[ENV]AN217

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS % Recovery
Chromium Reducible Sulphur (Scr)	LB063673	%	0.0050		0 - 4%	109%
	LB063759	%	0.0050	<0.005	1 - 9%	98%
	LB063771	%	0.0050	<0.005	2 - 8%	90%
Chromium Reducible Sulphur (Scr)	LB063759	moles	5.0	<5		
	LB063771	moles	5.0	<5		
Chromium Reducible Sulphur (Scr)	LB063759	kg	0.250	<0.25		
	LB063771	kg	0.250	<0.25		

Total Sulfur by LECO Furnace Method: ME-(AU)-[ENV]AN202

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS % Recovery
Total Sulfur	LB063663	%w/w	0.0050	<0.005	0 - 5%	99%



METHOD SUMMARY

PE077220 R0

METHOD

METHODOLOGY SUMMARY

AN202	The sulphur is oxidised to sulphur dioxide gas in a tube furnace using oxygen to aid the oxidation process. The evolved sulphur dioxide is measure by an infra red cell. The infra red cell output is calibrated against the value of a known standard sample to provide the total sulphur value of the unknown sample.
AN202	Maximum Potential Acidity (MPA) of the sample is a calculation that expresses the total sulphur result as kg of H ₂ SO ₄ /tonne. Neutralisation potential ratio (NPR) is calculated as the sample ANC divided by the MPA.
AN217	Dried pulped sample is mixed with acid and chromium metal in a rapid distillation unit to produce hydrogen sulphide (H ₂ S) which is collected and titrated with iodine (I ₂ (aq)) to measure SCR.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	This analysis is not covered by the scope of accreditation.	QFH	QC result is above the upper tolerance
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
^	Performed by outside laboratory.	NA	The sample was not analysed for this analyte

Samples analysed as received.
Solid samples expressed on a dry weight basis.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here:
<http://www.sgs.com.au/pv.sgs/3/-/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf>

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ANALYTICAL REPORT



Accreditation No. 2562

CLIENT DETAILS

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Project **GCA Job No 1220/1**
 Order Number **1220/1**
 Samples 6

LABORATORY DETAILS

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SGS Reference PE089791 R0
 Report Number 0000088237
 Date Reported 19 Jun 2014
 Date Received 12 Jun 2014

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(898/20210).

SIGNATORIES

Michael McKay
 Soils Section Leader

Ros Ma
 Laboratory Manager



ANALYTICAL REPORT

PE089791 R0

	Sample Number	001	002
	Sample Matrix	Rock	Rock
	Sample Name	GCA10044	GCA10049
Parameter	Units	LOR	

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.005	1.8	0.94
Chromium Reducible Sulphur (Scr)	moles H+/T	5	1100	590
Chromium Reducible Sulphur (Scr)	kg H ₂ SO ₄ /T	0.25	55	29

	Sample Number	003	004
	Sample Matrix	Rock	Rock
	Sample Name	GCA10053	GCA10039
Parameter	Units	LOR	

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.005	0.58	1.1
Chromium Reducible Sulphur (Scr)	moles H+/T	5	360	680
Chromium Reducible Sulphur (Scr)	kg H ₂ SO ₄ /T	0.25	18	34



ANALYTICAL REPORT

PE089791 R0

	Sample Number	005	006
	Sample Matrix	Rock	Rock
	Sample Name	GCA10043	GCA10729/52
Parameter	Units	LOR	

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.005	1.4	0.73
Chromium Reducible Sulphur (Scr)	moles H ⁺ /T	5	880	450
Chromium Reducible Sulphur (Scr)	kg H ₂ SO ₄ /T	0.25	43	22



QC SUMMARY

PE089791 R0

MB blank results are compared to the Limit of Reporting.
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

Chromium Reducible Sulphur (CRS) Method: ME-(AU)-JENVJAN217

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS % Recovery
Chromium Reducible Sulphur (Scr)	LB086717	%	0.005	<0.005	0%	94%
Chromium Reducible Sulphur (Scr)	LB086717	moles	5	<5		
Chromium Reducible Sulphur (Scr)	LB086717	kg	0.25	<0.25		



METHOD SUMMARY

PE089791 R0

METHOD

AN217

METHODOLOGY SUMMARY

Dried pulped sample is mixed with acid and chromium metal in a rapid distillation unit to produce hydrogen sulphide (H₂S) which is collected and titrated with iodine (I₂(aq)) to measure SCR.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	This analysis is not covered by the scope of accreditation.	QFH	QC result is above the upper tolerance
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
^	Performed by outside laboratory.	NA	The sample was not analysed for this analyte

Samples analysed as received.
Solid samples expressed on a dry weight basis.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here:
<http://www.sgs.com.au/pv.sgs/3/~media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf>

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ANALYTICAL REPORT

Dr G. CAMPBELL
CAMPBELL, GRAEME and ASSOCIATES
PO Box 247
BRIDGETOWN, W.A. 6255
AUSTRALIA

JOB INFORMATION

JOB CODE : 143.0/1305654
No. of SAMPLES : 118
No. of ELEMENTS : 9
CLIENT O/N : GCA1220/1 (Job 1 of 1)
SAMPLE SUBMISSION No. :
PROJECT : BOWDENS
STATE : Ex-Pulp
DATE RECEIVED : 17/04/2013
DATE COMPLETED : 14/05/2013
DATE PRINTED : 14/05/2013
ANALYSING LABORATORY : Intertek Genalysis Perth

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method
OV = Value over-range for Package

Accredited for compliance with ISO/IEC 17025
Company Accreditation Number 3244

SAMPLE DETAILS

DISCLAIMER

Intertek Genalysis wishes to make the following disclaimer pertaining to the accompanying analytical results.

All work is performed in accordance with the Intertek Minerals Standard Terms and Conditions of work <http://www.intertek.com/terms/>

This report relates specifically to the sample(s) that were drawn and/or provided by the client or their nominated third party. The reported result(s) provide no warranty or verification on the sample(s) representing any specific goods and/or shipment and only relate to the sample(s) as received and tested. This report was prepared solely for the use of the client named in this report. Intertek accepts no responsibility for any loss, damage or liability suffered by a third party as a result of any reliance upon or use of this report.

SIGNIFICANT FIGURES

It is common practice to report data derived from analytical instrumentation to a maximum of two or three significant figures. Some data reported herein may show more figures than this. The reporting of more than two or three figures in no way implies that the third, fourth and subsequent figures may be real or significant.

Intertek Genalysis accepts no responsibility whatsoever for any interpretation by any party of any data where more than two or three significant figures have been reported.

SAMPLE STORAGE DETAILS

GENERAL CONDITIONS

SAMPLE STORAGE OF SOLIDS

Bulk Residues and Pulps will be stored for 60 DAYS without charge. After this time all Bulk Residues and Pulps will be stored at a rate of \$3.30 per cubic metre per day until your written advice regarding collection or disposal is received. Expenses related to the return or disposal of samples will be charged to you at cost. Current disposal cost is charged at \$100.00 per cubic metre.

SAMPLE STORAGE OF SOLUTIONS

Samples received as liquids, waters or solutions will be held for 60 DAYS free of charge then disposed of, unless written advice for return or collection is received.

NOTES
NATA ENDORSED DOCUMENT
Company Accreditation Number 3244
Analysing Laboratory: Intertek Genalysis Perth

The contents of this report have been prepared in accordance with the terms of NATA accreditation and as such should only be reproduced in full.

The analysis results reported herein have been obtained using the following methods and conditions:

The samples as listed were received as expulp 1224568 1300295 which had been pulverised in a zirconia bowl

The results have been determined according to Genalysis methods codes :
Digestions : MPL_W002 (4A/) and MPL_W003 (4AH/)

Analytical Finishes: ICP_W004 (/OE), ICP_W003 (/MS) and AAS_W008 (/AA).

The results included the assay of blanks and international reference standards:
GTS-2a, OREAS 24b, WGB-1, AMISO167, BCS381 and GBM399-5

and Genalysis in-house standard:
MPL-5

The results are expressed as parts per million or percent by mass in the dried and prepared material.

Intertek Genalysis signatory
Ann Patricia EVERS
Chief Chemist



Date: 14-May-2013

This document is issued in accordance with NATA's accreditation requirements.

143.0/1305654 (14/05/2013) CLIENT O/N: GCA1220/1

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Part 1/2

ANALYSIS

ELEMENTS	Ag	As	As-Rp1	Ba	Cd	Cu	Mn	Mn-Rp1	Pb	Pb-Rp1
UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%
DETECTION LIMIT	0.05	0.5	50	0.1	0.02	1	1	10	0.5	0.01
DIGEST	4A/	4A/	4AH/	4A/	4A/	4A/	4A/	4AH/	4A/	4AH/
ANALYTICAL FINISH	MS	MS	OE	MS	MS	OE	OE	OE	MS	AA
SAMPLE NUMBERS										
0001 GCA10039	9.05	210.7		1009.9	3.37	8	462			0.39
0002 GCA10040	8.57	962.0		790.1	23.09	17	1796		895.1	
0003 GCA10041	7.76	96.5		889.5	4.00	8	1.17%			0.31
0004 GCA10042	8.96	103.7		1008.8	4.79	22	1.25%			0.36
0005 GCA10043	5.69	86.6		898.2	2.79	7	1.23%		1490.4	
0006 GCA10044	10.42	171.0		705.1	3.80	18	9187		1440.2	
0007 GCA10045	2.32	180.4		664.8	0.13	3	1.16%		93.7	
0008 GCA10046	5.70	117.8		1176.8	4.05	5	8071		1824.9	
0009 GCA10047	7.11	36.9		1036.5	0.76	8	7795		156.2	
0010 GCA10048	4.75	76.2		480.5	10.19	5	1.17%		1779.0	
0011 GCA10049	24.39	50.7		261.8	2.85	6	1.51%		1661.9	
0012 GCA10050	3.95	40.1		458.6	2.53	12	1.05%		261.5	
0013 GCA10051	3.56	32.7		515.4	1.50	6	7541		75.8	
0014 GCA10052	5.26	31.5		592.3	2.29	5	8638		230.5	
0015 GCA10053	2.64	43.2		540.8	2.79	3	9605		146.0	
0016 GCA10651	0.11	30.0		369.6	0.04	4	111		11.4	
0017 GCA10652	0.21	52.1		551.0	0.04	5	229		11.4	
0018 GCA10653	0.06	74.9		572.6	X	8	17		17.4	
0019 GCA10654	0.06	35.0		173.9	X	4	12		12.2	
0020 GCA10655	0.07	53.5		399.8	X	3	38		10.5	
0021 GCA10656	0.08	95.2		403.6	0.05	5	15		15.1	
0022 GCA10657	0.15	23.3		283.2	0.03	3	9		12.8	
0023 GCA10658	0.09	45.6		222.6	0.02	9	9		24.2	
0024 GCA10660	0.12	3.4		280.5	0.11	2	125		37.1	
0025 GCA10661	1.38	4.2		559.7	0.08	2	187		45.4	
0026 GCA10662	0.09	48.0		421.8	0.02	14	17		18.9	
0027 GCA10663	X	19.3		244.2	0.05	3	31		16.4	
0028 GCA10664	0.07	100.5		288.7	0.12	8	145		25.9	
0029 GCA10665	0.06	97.9		281.2	0.14	10	1513		25.4	
0030 GCA10666	0.22	16.2		850.1	0.13	20	2145		18.9	
0031 GCA10667	0.09	12.0		932.7	0.20	29	1659		26.2	
0032 GCA10668	0.08	8.7		156.2	0.18	7	144		25.2	
0033 GCA10669	0.10	17.8		488.2	0.03	3	49		21.5	
0034 GCA10670	X	46.2		657.6	0.07	17	128		22.8	
0035 GCA10671	1.26	3.3		91.4	0.05	1	551		33.9	
0036 GCA10672	1.05	8.6		202.2	0.05	3	776		57.0	
0037 GCA10673	0.59	4.4		180.2	0.12	4	5344		66.9	
0038 GCA10674	0.06	5.0		95.3	0.02	2	717		31.2	
0039 GCA10675	X	3.7		119.4	0.04	2	809		11.3	
0040 GCA10676	0.05	30.1		212.2	0.10	10	505		21.8	

143.0/1305654 (14/05/2013) CLIENT O/N: GCA1220/1

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 Part 2/2

ANALYSIS

ELEMENTS	Sr	Zn
UNITS	ppm	ppm
DETECTION LIMIT	0.05	1
DIGEST	4A/	4A/
ANALYTICAL FINISH	MS	OE
SAMPLE NUMBERS		
0001 GCA10039	218.97	618
0002 GCA10040	150.86	4936
0003 GCA10041	252.23	2274
0004 GCA10042	350.93	2228
0005 GCA10043	266.76	1938
0006 GCA10044	217.69	2082
0007 GCA10045	203.78	2860
0008 GCA10046	364.84	1459
0009 GCA10047	360.80	219
0010 GCA10048	322.10	2545
0011 GCA10049	204.94	710
0012 GCA10050	186.77	591
0013 GCA10051	184.45	333
0014 GCA10052	147.79	580
0015 GCA10053	168.32	716
0016 GCA10651	298.59	27
0017 GCA10652	376.18	38
0018 GCA10653	488.12	33
0019 GCA10654	262.09	13
0020 GCA10655	384.36	10
0021 GCA10656	410.21	32
0022 GCA10657	327.38	16
0023 GCA10658	606.72	17
0024 GCA10660	35.73	94
0025 GCA10661	75.98	101
0026 GCA10662	440.22	67
0027 GCA10663	359.86	12
0028 GCA10664	504.14	29
0029 GCA10665	486.69	133
0030 GCA10666	510.79	299
0031 GCA10667	544.06	161
0032 GCA10668	205.75	33
0033 GCA10669	742.44	13
0034 GCA10670	627.86	39
0035 GCA10671	46.08	79
0036 GCA10672	85.93	103
0037 GCA10673	104.11	184
0038 GCA10674	80.98	73
0039 GCA10675	59.30	85
0040 GCA10676	125.62	60

143.0/1305654 (14/05/2013) CLIENT O/N: GCA1220/1

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Part 1/2

ANALYSIS

ELEMENTS	Ag	As	As-Rp1	Ba	Cd	Cu	Mn	Mn-Rp1	Pb	Pb-Rp1
UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%
DETECTION LIMIT	0.05	0.5	50	0.1	0.02	1	1	10	0.5	0.01
DIGEST	4A/	4A/	4AH/	4A/	4A/	4A/	4A/	4AH/	4A/	4AH/
ANALYTICAL FINISH	MS	MS	OE	MS	MS	OE	OE	OE	MS	AA
SAMPLE NUMBERS										
0041 GCA10677	0.23	23.7		264.2	0.21	9	1066		24.2	
0042 GCA10678	0.10	38.0		329.7	0.25	4	1288		24.2	
0043 GCA10679	0.10	23.6		136.8	0.28	3	1597		26.8	
0044 GCA10680	0.08	9.5		115.2	0.17	2	977		35.6	
0045 GCA10681	X	4.4		86.8	0.02	1	334		31.1	
0046 GCA10682	0.19	3.7		55.1	0.06	2	3275		43.6	
0047 GCA10683	0.10	4.8		59.6	X	1	3556		26.8	
0048 GCA10684	0.33	15.5		550.8	0.09	3	337		18.3	
0049 GCA10685	0.57	9.8		1302.9	0.10	2	2227		20.4	
0050 GCA10686	0.19	11.6		305.8	0.38	3	450		92.3	
0051 GCA10687	0.10	9.0		285.0	0.19	2	627		52.3	
0052 GCA10690	0.10	5.8		576.3	0.19	2	1359		27.4	
0053 GCA10691	0.07	4.7		621.8	0.11	2	579		45.5	
0054 GCA10692	2.38	19.8		747.5	0.54	2	640		200.9	
0055 GCA10693	0.06	3.4		483.3	0.24	2	615		22.6	
0056 GCA10694	0.07	6.2		306.9	6.43	3	3503		226.2	
0057 GCA10695	0.09	9.3		560.3	0.12	3	681		25.7	
0058 GCA10696	0.44	20.3		1245.8	0.23	3	345		43.5	
0059 GCA10697	4.79	165.3		544.7	1.20	2	109		112.9	
0060 GCA10698	5.82	197.6		535.6	2.00	7	69		211.5	
0061 GCA10699	43.71	440.0		483.0	15.87	4	78		559.7	
0062 GCA10700	15.93	896.7		553.3	5.02	5	93		355.2	
0063 GCA10701	9.08	467.0		563.0	2.54	4	122		295.0	
0064 GCA10702	0.33	23.9		566.3	1.53	2	420		44.8	
0065 GCA10703	0.74	44.8		957.3	0.32	2	2661		108.6	
0066 GCA10704	0.20	33.8		456.3	0.53	2	782		53.0	
0067 GCA10705	0.07	29.0		400.4	0.40	2	524		36.2	
0068 GCA10706	0.16	29.2		647.4	0.51	2	679		37.6	
0069 GCA10707	0.17	19.1		416.3	0.41	2	4006		63.6	
0070 GCA10708	4.71	136.6		809.2	1.84	2	3365		121.4	
0071 GCA10709	0.15	23.6		483.2	0.53	2	4932		43.0	
0072 GCA10710	1.02	65.8		461.9	1.40	2	1.15%		74.6	
0073 GCA10711	31.85	575.9		563.2	8.55	4	1.16%		743.3	
0074 GCA10712	9.53	153.0		543.6	0.97	5	1.06%		135.9	
0075 GCA10713	6.87	72.6		714.1	4.06	5	1.51%		143.3	
0076 GCA10714	21.45	78.2		685.7	9.46	3		2.14%	661.4	
0077 GCA10715	0.19	14.4		762.3	0.12	3	195		34.3	
0078 GCA10716	0.41	36.2		504.4	0.22	2	364		43.3	
0079 GCA10717	0.46	22.8		491.4	0.67	9	3027		55.5	
0080 GCA10718	1.53	37.5		484.4	2.68	2	297		119.3	

143.0/1305654 (14/05/2013) CLIENT O/N: GCA1220/1

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 Part 2/2

ANALYSIS

ELEMENTS	Sr	Zn
UNITS	ppm	ppm
DETECTION LIMIT	0.05	1
DIGEST	4A/	4A/
ANALYTICAL FINISH	MS	OE
SAMPLE NUMBERS		
0041 GCA10677	210.16	191
0042 GCA10678	143.32	105
0043 GCA10679	96.35	106
0044 GCA10680	108.87	89
0045 GCA10681	63.40	53
0046 GCA10682	43.50	102
0047 GCA10683	75.51	123
0048 GCA10684	134.87	79
0049 GCA10685	64.02	93
0050 GCA10686	118.35	411
0051 GCA10687	155.11	449
0052 GCA10690	98.55	76
0053 GCA10691	124.10	73
0054 GCA10692	92.65	156
0055 GCA10693	103.06	49
0056 GCA10694	83.23	517
0057 GCA10695	170.52	64
0058 GCA10696	80.83	79
0059 GCA10697	137.76	30
0060 GCA10698	84.84	26
0061 GCA10699	85.30	307
0062 GCA10700	118.29	61
0063 GCA10701	118.37	113
0064 GCA10702	223.15	343
0065 GCA10703	214.32	187
0066 GCA10704	122.16	184
0067 GCA10705	201.68	71
0068 GCA10706	221.52	163
0069 GCA10707	147.23	192
0070 GCA10708	158.89	485
0071 GCA10709	182.71	213
0072 GCA10710	182.83	340
0073 GCA10711	209.24	1628
0074 GCA10712	172.99	185
0075 GCA10713	220.93	1007
0076 GCA10714	264.27	1678
0077 GCA10715	48.66	75
0078 GCA10716	47.18	82
0079 GCA10717	527.89	207
0080 GCA10718	292.52	627

143.0/1305654 (14/05/2013) CLIENT O/N: GCA1220/1

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Part 1/2

ANALYSIS

ELEMENTS	Ag	As	As-Rp1	Ba	Cd	Cu	Mn	Mn-Rp1	Pb	Pb-Rp1
UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%
DETECTION LIMIT	0.05	0.5	50	0.1	0.02	1	1	10	0.5	0.01
DIGEST	4A/	4A/	4AH/	4A/	4A/	4A/	4A/	4AH/	4A/	4AH/
ANALYTICAL FINISH	MS	MS	OE	MS	MS	OE	OE	OE	MS	AA
SAMPLE NUMBERS										
0081 GCA10719	4.05	30.3		386.8	0.82	2	3723		96.3	
0082 GCA10720	0.93	39.6		438.6	0.17	1	3710		29.9	
0083 GCA10721	0.54	51.0		461.1	0.05	2	7959		21.6	
0084 GCA10722	8.15	211.9		437.0	5.21	4		2.84%	272.1	
0085 GCA10723	0.16	4.0		383.9	0.26	3	1216		28.2	
0086 GCA10724	0.15	7.8		584.2	0.20	2	1787		25.9	
0087 GCA10725	2.30	180.2		621.2	0.28	2	722		99.6	
0088 GCA10726	1.25	90.2		735.0	1.08	2	475		36.1	
0089 GCA10727	2.15	147.9		675.6	1.92	2	2528		45.9	
0090 GCA10728	2.83	142.6		628.0	0.45	3	7211		121.9	
0091 GCA10729	69.81		4945	655.1	11.09	11	359		457.7	
0092 GCA10730	1.19	68.3		286.4	0.07	2	853		43.7	
0093 GCA10731	0.42	62.0		342.1	0.97	1	714		23.9	
0094 GCA10732	0.52	76.0		364.0	0.21	1	1.03%		25.4	
0095 GCA10733	11.63	155.1		1271.0	1.14	6	552		111.8	
0096 GCA10734	53.40	206.1		1413.0	2.83	13	1398		348.4	
0097 GCA10735	20.17	189.3		982.2	1.77	13	1.29%		157.4	
0098 GCA10736	17.36	241.3		1113.1	2.45	11	1.36%		340.2	
0099 GCA10737	34.49	255.6		1099.0	4.56	14	4097		578.3	
0100 GCA10738	0.24	28.5		640.1	0.09	11	242		19.9	
0101 GCA10739	0.18	17.4		629.3	0.05	8	569		18.6	
0102 GCA10740	2.59	66.7		298.0	7.66	3	4342		353.8	
0103 GCA10741	1.77	58.6		206.9	10.85	2	3785		618.0	
0104 GCA10742	0.98	46.0		632.3	1.83	1	5462		151.7	
0105 GCA10743	5.19	87.2		572.6	5.73	4	752		799.1	
0106 GCA10744	4.93	42.5		245.4	21.07	4	1.15%		1496.1	
0107 GCA10745	1.22	31.7		449.5	2.25	1	5494		132.6	
0108 GCA10746	2.01	59.7		656.4	4.03	4	3232		241.0	
0109 GCA10747	11.89	267.5		465.3	17.00	7	1.48%		726.5	
0110 GCA10748	2.96	221.3		419.4	4.45	3	3888		180.1	
0111 GCA10749	4.96	250.0		363.7	7.15	5	1.35%		296.9	
0112 GCA10750	4.86	101.2		384.9	8.86	5	1.36%		559.9	
0113 GCA10751	17.14	50.7		448.0	5.67	9	4581		614.9	
0114 GCA10752	41.06	59.6		416.0	9.75	13	3956		729.1	
0115 GCA10753	11.23	38.0		416.5	7.05	5	617		456.5	
0116 GCA10754	0.19	29.8		115.6	0.11	17	1220		26.2	
0117 GCA10755	0.18	32.9		184.9	0.13	10	991		21.8	
0118 GCA10756	0.14	28.6		310.7	0.53	19	1922		18.1	

143.0/1305654 (14/05/2013) CLIENT O/N: GCA1220/1

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 Part 2/2

ANALYSIS

ELEMENTS	Sr	Zn
UNITS	ppm	ppm
DETECTION LIMIT	0.05	1
DIGEST	4A/	4A/
ANALYTICAL FINISH	MS	OE
SAMPLE NUMBERS		
0081 GCA10719	212.46	234
0082 GCA10720	197.21	45
0083 GCA10721	316.61	25
0084 GCA10722	238.99	1046
0085 GCA10723	59.63	98
0086 GCA10724	135.73	65
0087 GCA10725	138.77	50
0088 GCA10726	137.55	57
0089 GCA10727	112.37	214
0090 GCA10728	140.64	310
0091 GCA10729	220.59	2758
0092 GCA10730	175.09	48
0093 GCA10731	155.50	86
0094 GCA10732	146.49	171
0095 GCA10733	729.69	473
0096 GCA10734	789.02	1123
0097 GCA10735	483.21	633
0098 GCA10736	448.82	822
0099 GCA10737	457.13	1450
0100 GCA10738	367.03	25
0101 GCA10739	236.50	36
0102 GCA10740	109.74	1526
0103 GCA10741	128.17	1999
0104 GCA10742	166.33	538
0105 GCA10743	107.49	1220
0106 GCA10744	107.93	4072
0107 GCA10745	108.48	486
0108 GCA10746	125.56	745
0109 GCA10747	113.97	2765
0110 GCA10748	132.56	863
0111 GCA10749	149.18	1559
0112 GCA10750	192.67	1556
0113 GCA10751	170.61	1103
0114 GCA10752	114.40	1516
0115 GCA10753	111.50	1030
0116 GCA10754	504.19	135
0117 GCA10755	710.99	74
0118 GCA10756	921.48	135

143.0/1305654 (14/05/2013) CLIENT O/N: GCA1220/1

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Part 1/2**ANALYSIS**

ELEMENTS	Ag	As	As-Rp1	Ba	Cd	Cu	Mn	Mn-Rp1	Pb	Pb-Rp1
UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%
DETECTION LIMIT	0.05	0.5	50	0.1	0.02	1	1	10	0.5	0.01
DIGEST	4A/	4A/	4AH/	4A/	4A/	4A/	4A/	4AH/	4A/	4AH/
ANALYTICAL FINISH	MS	MS	OE	MS	MS	OE	OE	OE	MS	AA
CHECKS										
0001 GCA10039	8.50	212.4		977.1	3.48	7	450			
0002 GCA10656	0.07	93.2		392.7	X	5	14		18.5	
0003 GCA10677	0.19	21.6		249.6	0.18	9	1164		22.0	
0004 GCA10699	42.52	426.8		469.7	15.86	4	77		544.9	
0005 GCA10719	4.35	30.1		375.1	0.89	2	3632		138.0	
0006 GCA10739	0.16	17.7		629.1	0.04	8	556		19.4	
STANDARDS										
0001 WGB-1	0.05	2.0		871.8	0.11	108	1097		7.7	
0002 AMIS0167	0.93	158.3		84.4	0.44	61	170		246.5	
0003 GTS-2a	0.30	125.0		190.9	0.44	87	1506		19.9	
0004 MPL-5	27.84	981.6		580.4	3.03	1881	2276		1989.8	
0005 OREAS 24b	0.08	9.3		728.6	0.04	38	435		22.4	
0006 BCS381			X					2.39%		X
0007 GBM399-5			322					290		2.17
0008 MPL-5			1024					2301		0.22
BLANKS										
0001 Control Blank	X	X		X	X	X	X	X	X	X

143.0/1305654 (14/05/2013) CLIENT O/N: GCA1220/1

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ANALYSIS

ELEMENTS	Sr	Zn
UNITS	ppm	ppm
DETECTION LIMIT	0.05	1
DIGEST	4A/	4A/
ANALYTICAL FINISH	MS	OE
CHECKS		
0001 GCA10039	207.41	627
0002 GCA10656	398.01	33
0003 GCA10677	204.16	191
0004 GCA10699	82.96	303
0005 GCA10719	209.28	229
0006 GCA10739	241.55	37
STANDARDS		
0001 WGB-1	116.87	29
0002 AMIS0167	19.60	159
0003 GTS-2a	93.25	196
0004 MPL-5	417.59	1220
0005 OREAS 24b	122.83	95
0006 BCS381		
0007 GBM399-5		
0008 MPL-5		
BLANKS		
0001 Control Blank	X	X

METHOD CODE DESCRIPTION

<u>Method Code</u>	<u>Analysing Laboratory</u>	<u>NATA document</u>
4A/MS Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Mass Spectrometry.	Intertek Genalysis Perth	4A/ : MPL_W002, MS : ICP_W003
4A/OE Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.	Intertek Genalysis Perth	4A/ : MPL_W002, OE : ICP_W004
4AH/AA Modified (for higher precision) multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids. Analysed by Flame Atomic Absorption Spectrometry.	Intertek Genalysis Perth	4AH/ : MPL_W003, AA : AAS_W008
4AH/OE Modified (for higher precision) multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.	Intertek Genalysis Perth	4AH/ : MPL_W003, OE : ICP_W004



ANALYTICAL REPORT

Dr G. CAMPBELL
CAMPBELL, GRAEME and ASSOCIATES
PO Box 247
BRIDGETOWN, W.A. 6255
AUSTRALIA

JOB INFORMATION

JOB CODE : 143.0/1305750
No. of SAMPLES : 18
No. of ELEMENTS : 33
CLIENT O/N : GCA1219/1 (Job 1 of 1)
SAMPLE SUBMISSION No. :
PROJECT : BOWDENS
STATE : Pulp
DATE RECEIVED : 22/04/2013
DATE COMPLETED : 10/05/2013
DATE PRINTED : 10/05/2013
ANALYSING LABORATORY : Intertek Genalysis Perth

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method
OV = Value over-range for Package

Accredited for compliance with ISO/IEC 17025
Company Accreditation Number 3244

SAMPLE DETAILS

DISCLAIMER

Intertek Genalysis wishes to make the following disclaimer pertaining to the accompanying analytical results.

All work is performed in accordance with the Intertek Minerals Standard Terms and Conditions of work <http://www.intertek.com/terms/>

This report relates specifically to the sample(s) that were drawn and/or provided by the client or their nominated third party. The reported result(s) provide no warranty or verification on the sample(s) representing any specific goods and/or shipment and only relate to the sample(s) as received and tested. This report was prepared solely for the use of the client named in this report. Intertek accepts no responsibility for any loss, damage or liability suffered by a third party as a result of any reliance upon or use of this report.

SIGNIFICANT FIGURES

It is common practice to report data derived from analytical instrumentation to a maximum of two or three significant figures. Some data reported herein may show more figures than this. The reporting of more than two or three figures in no way implies that the third, fourth and subsequent figures may be real or significant.

Intertek Genalysis accepts no responsibility whatsoever for any interpretation by any party of any data where more than two or three significant figures have been reported.

SAMPLE STORAGE DETAILS

GENERAL CONDITIONS

SAMPLE STORAGE OF SOLIDS

Bulk Residues and Pulps will be stored for 60 DAYS without charge. After this time all Bulk Residues and Pulps will be stored at a rate of \$3.30 per cubic metre per day until your written advice regarding collection or disposal is received. Expenses related to the return or disposal of samples will be charged to you at cost. Current disposal cost is charged at \$100.00 per cubic metre.

SAMPLE STORAGE OF SOLUTIONS

Samples received as liquids, waters or solutions will be held for 60 DAYS free of charge then disposed of, unless written advice for return or collection is received.

NOTES
NATA ENDORSED DOCUMENT
Company Accreditation Number 3244
Analysing Laboratory: Intertek Genalysis Perth

The contents of this report have been prepared in accordance with the terms of NATA accreditation and as such should only be reproduced in full.

The analysis results reported herein have been obtained using the following methods and conditions:

The samples as listed were received, dried and pulverised in a zirconia bowl.

The results have been determined according to Genalysis methods codes :
Digestions : MPL_W002 (4A/), MPL_W005 (SE1/), ENV_W012 (FC7/SIE), MPL_W011 (FP1/),
MPL_W008 (HG1/)

Analytical Finishes: ICP_W004 (/OE), ICP_W003 (/MS), and AAS_W004 (/CV).

The results included the assay of blanks and international reference standards:
79a 1% and CRM No. 782-1

and Genalysis in-house standards:
OREAS 97.01, MPL-5 and HgSTD-5

The results are expressed as parts per million or percent by mass in the dried and prepared material.

Intertek Genalysis signatory
Ann Patricia EVERS
Chief Chemist



Date: 09-May-2013

This document is issued in accordance with NATA's accreditation requirements.

143.0/1305750 (10/05/2013) CLIENT O/N: GCA1219/1

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Part 1/4

ANALYSIS

ELEMENTS	Ag	Al	As	B	Ba	Bi	Ca	Cd	Co	Cr
UNITS	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.01	0.5	50	0.1	0.01	0.1	0.02	0.1	50
DIGEST	4A/	FP1/	4A/	FP1/	4A/	4A/	FP1/	4A/	4A/	FP1/
ANALYTICAL FINISH	MS	OE	MS	OE	MS	MS	OE	MS	MS	OE
SAMPLE NUMBERS										
0001 GCA10706/07	0.18	7.94	21.0	X	474.9	0.30	0.6	0.32	0.9	X
0002 GCA10730/31	0.43	6.83	64.5	X	319.4	0.02	0.2	0.49	0.8	X
0003 GCA10740/41	2.27	6.62	79.0	X	241.9	0.38	0.3	6.92	0.7	X
0004 GCA10747/48/49	5.38	6.71	211.8	X	411.6	0.45	0.3	8.27	1.8	X
0005 GCA10752/53	16.24	6.77	51.9	X	413.5	0.42	0.2	7.95	0.4	X
0006 GCA10754/55	0.18	7.65	30.2	X	143.5	0.42	1.0	0.10	7.0	X
0007 GCA10651/53	0.09	6.91	216.8	X	536.7	0.19	0.2	0.02	0.9	X
0008 GCA10663/64	0.05	5.32	61.8	X	264.8	0.11	0.2	0.07	1.6	X
0009 GCA10668/69	0.44	6.72	12.2	X	267.2	0.43	0.2	0.10	1.3	X
0010 GCA10674/75	0.03	8.91	3.8	X	105.3	0.51	0.3	X	6.4	X
0011 GCA10678/79	0.10	7.54	36.5	X	254.7	0.29	0.3	0.33	10.8	X
0012 GCA10682/83	0.18	8.84	4.6	X	58.3	0.75	0.5	0.03	11.2	X
0013 GCA10687/91	0.08	7.85	7.3	X	427.1	0.32	0.8	0.13	1.4	X
0014 GCA10039	9.13	6.18	222.6	X	1040.2	0.05	0.2	3.50	4.2	X
0015 GCA10049	25.27	5.81	52.9	X	267.5	0.09	0.4	3.06	1.0	X
0016 GCA10053	2.70	5.95	44.1	X	543.9	0.02	0.3	2.86	0.8	X
0017 GCA10043	6.22	7.11	88.9	X	918.9	0.80	0.3	2.77	6.7	X
0018 GCA10044	10.85	6.58	173.0	X	728.6	0.08	0.3	3.99	21.3	X

CHECKS

0001 GCA10706/07	0.16	7.96	20.3	X	492.1	0.28	0.6	0.30	0.9	60
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STANDARDS

0001 79a 1%										
0002 CRM No. 782-1		0.04		X			21.6			X
0003 HgSTD-5										
0004 MPL-5	28.95		1034.6		608.9	38.14		3.05	136.9	
0005 OREAS 97.01										
0006 Se-0.1ppm										
0007 Se-1.0ppm										

BLANKS

0001 Control Blank	X	X	X	X	X	X	X	X	X	X
0002 Control Blank	0.03		0.8		0.4	0.03		X	X	
0003 Control Blank		X		X			0.2			62
0004 Control Blank										
0005 Acid Blank	0.01		X		0.3	X		X	X	
0006 Acid Blank		X		X			X			X

143.0/1305750 (10/05/2013) CLIENT O/N: GCA1219/1

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Part 2/4

ANALYSIS

ELEMENTS	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni
UNITS	ppm	ppm	%	ppm	%	%	ppm	ppm	ppm	ppm
DETECTION LIMIT	1	50	0.01	0.01	0.05	0.01	1	0.1	20	1
DIGEST	4A/	FC7/	FP1/	HG1/	FP1/	FP1/	4A/	4A/	4A/	4A/
ANALYTICAL FINISH	OE	SIE	OE	CV	OE	OE	OE	MS	OE	OE
SAMPLE NUMBERS										
0001 GCA10706/07	1	676	0.86	X	3.57	0.26	2377	2.0	529	2
0002 GCA10730/31	1	956	0.79	0.07	3.27	0.18	815	2.7	638	X
0003 GCA10740/41	3	817	0.66	0.03	4.00	0.16	2957	2.2	458	X
0004 GCA10747/48/49	3	979	0.99	0.03	4.73	0.19	8873	2.2	667	X
0005 GCA10752/53	7	1195	0.82	0.02	5.53	0.17	1383	2.0	525	X
0006 GCA10754/55	11	809	3.40	0.01	1.90	0.59	1155	0.6	273	6
0007 GCA10651/53	15	674	0.59	0.01	1.23	0.12	68	8.4	364	2
0008 GCA10663/64	4	642	0.89	0.11	1.60	0.11	115	4.6	277	3
0009 GCA10668/69	4	842	0.73	0.02	1.43	0.05	88	0.4	381	3
0010 GCA10674/75	X	3369	1.12	0.02	2.56	0.46	847	0.6	250	10
0011 GCA10678/79	2	695	0.93	0.03	2.68	0.18	1551	1.3	257	15
0012 GCA10682/83	X	844	3.01	X	2.29	0.24	4823	0.3	218	13
0013 GCA10687/91	1	1025	0.81	0.06	4.02	0.43	626	0.7	3289	2
0014 GCA10039	5	559	1.62	0.02	6.16	0.08	528	4.7	993	X
0015 GCA10049	5	1240	1.56	0.02	3.44	0.17	1.33%	3.9	375	X
0016 GCA10053	2	947	0.99	0.02	4.92	0.12	8881	9.2	695	X
0017 GCA10043	6	681	4.37	0.01	6.35	0.17	1.10%	1.4	775	X
0018 GCA10044	15	584	2.91	0.03	5.94	0.10	8440	3.3	649	4

CHECKS

0001 GCA10706/07	1	712	0.91	X	3.60	0.26	2081	1.9	493	X
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STANDARDS

0001 79a 1%		4275								
0002 CRM No. 782-1			0.33		0.20	12.29				
0003 HgSTD-5				0.77						
0004 MPL-5	1875						2226	21.3	5611	2300
0005 OREAS 97.01										
0006 Se-0.1ppm										
0007 Se-1.0ppm										

BLANKS

0001 Control Blank	X	100	0.01	X	0.07	X	6	X	X	X
0002 Control Blank	X						3	X	X	2
0003 Control Blank			0.02		0.15	X				
0004 Control Blank				X						
0005 Acid Blank	1						10	X	X	X
0006 Acid Blank			X		X	X				

143.0/1305750 (10/05/2013) CLIENT O/N: GCA1219/1

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Part 3/4

ANALYSIS

ELEMENTS	P	Pb	S	Sb	Se	Si	Sn	Sr	Th	Tl
UNITS	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
DETECTION LIMIT	10	0.5	50	0.05	0.01	0.1	0.1	0.05	0.01	0.02
DIGEST	4A/	4A/	4A/	4A/	SE1/	FP1/	4A/	4A/	4A/	4A/
ANALYTICAL FINISH	OE	MS	OE	MS	MS	OE	MS	MS	MS	MS
SAMPLE NUMBERS										
0001 GCA10706/07	208	39.0	4558	5.22	X	31.0	2.7	211.09	15.36	2.99
0002 GCA10730/31	217	29.0	4111	8.27	0.01	33.7	2.0	160.21	12.97	3.41
0003 GCA10740/41	131	897.3	3514	14.52	0.06	30.9	2.5	126.29	16.01	3.93
0004 GCA10747/48/49	123	290.7	6754	24.43	X	32.2	3.1	105.74	11.85	4.61
0005 GCA10752/53	127	511.0	4092	12.51	0.10	32.7	2.9	108.99	13.79	4.92
0006 GCA10754/55	455	25.5	1.07%	3.61	0.20	29.8	2.9	596.66	13.51	1.65
0007 GCA10651/53	625	21.7	280	2.00	0.18	30.2	2.3	452.59	13.63	0.87
0008 GCA10663/64	407	21.9	1536	3.65	0.11	31.7	2.0	451.95	9.06	6.67
0009 GCA10668/69	432	22.2	279	2.46	0.05	32.9	3.1	409.77	18.44	2.06
0010 GCA10674/75	82	27.5	1314	0.72	X	29.4	4.2	72.94	22.67	1.58
0011 GCA10678/79	115	44.2	3621	1.69	0.03	32.3	2.8	110.84	10.79	2.90
0012 GCA10682/83	95	61.3	540	0.83	X	29.9	3.8	112.35	25.77	1.20
0013 GCA10687/91	99	40.5	521	1.02	X	30.9	2.9	143.72	17.20	2.40
0014 GCA10039	204	3911.9	1.59%	11.75	0.02	28.9	3.3	216.07	10.33	5.18
0015 GCA10049	235	1777.5	1.12%	9.25	X	32.8	1.6	204.74	10.84	3.06
0016 GCA10053	190	154.3	6635	3.83	X	32.5	1.5	173.58	11.25	4.09
0017 GCA10043	459	1608.4	1.83%	4.97	X	29.2	3.9	272.06	7.97	4.01
0018 GCA10044	416	1532.2	2.36%	14.45	0.03	31.9	4.5	221.84	6.70	5.27

CHECKS

0001 GCA10706/07	179	42.1	4240	4.71	X	31.7	2.9	176.61	14.98	3.02
------------------	-----	------	------	------	---	------	-----	--------	-------	------

STANDARDS

0001 79a 1%										
0002 CRM No. 782-1						0.2				
0003 HgSTD-5										
0004 MPL-5	738	2115.2	1.09%	350.58			9.3	440.96	96.34	6.43
0005 OREAS 97.01					0.69					
0006 Se-0.1ppm					0.10					
0007 Se-1.0ppm					0.96					

BLANKS

0001 Control Blank	X	X	X	X	X	X	0.1	X	X	X
0002 Control Blank	X	1.2	X	0.14			0.4	0.19	0.04	X
0003 Control Blank						X				
0004 Control Blank										
0005 Acid Blank	X	0.5	X	X			0.1	0.08	X	X
0006 Acid Blank						X				

143.0/1305750 (10/05/2013) CLIENT O/N: GCA1219/1

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ANALYSIS

ELEMENTS	U	V	Zn
UNITS	ppm	ppm	ppm
DETECTION LIMIT	0.01	1	1
DIGEST	4A/	4A/	4A/
ANALYTICAL FINISH	MS	OE	OE
SAMPLE NUMBERS			
0001 GCA10706/07	7.10	11	123
0002 GCA10730/31	3.50	10	80
0003 GCA10740/41	3.75	9	1358
0004 GCA10747/48/49	5.29	18	1570
0005 GCA10752/53	4.37	6	1260
0006 GCA10754/55	3.00	90	103
0007 GCA10651/53	3.38	79	32
0008 GCA10663/64	3.04	49	21
0009 GCA10668/69	3.04	14	23
0010 GCA10674/75	2.23	6	86
0011 GCA10678/79	3.24	18	117
0012 GCA10682/83	4.41	9	137
0013 GCA10687/91	5.66	11	255
0014 GCA10039	3.63	17	638
0015 GCA10049	2.38	9	715
0016 GCA10053	4.31	11	729
0017 GCA10043	2.06	52	1934
0018 GCA10044	2.02	41	2089
CHECKS			
0001 GCA10706/07	7.60	11	122
STANDARDS			
0001 79a 1%			
0002 CRM No. 782-1			
0003 HgSTD-5			
0004 MPL-5	11.74	189	1270
0005 OREAS 97.01			
0006 Se-0.1ppm			
0007 Se-1.0ppm			
BLANKS			
0001 Control Blank	X	X	X
0002 Control Blank	X	X	X
0003 Control Blank			
0004 Control Blank			
0005 Acid Blank	X	X	X
0006 Acid Blank			

METHOD CODE DESCRIPTION

<u>Method Code</u>	<u>Analysing Laboratory</u>	<u>NATA document</u>
4A/MS	Intertek Genalysis Perth	4A/ : MPL_W002, MS : ICP_W003
	Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Mass Spectrometry.	
4A/OE	Intertek Genalysis Perth	4A/ : MPL_W002, OE : ICP_W004
	Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.	
FC7/SIE	Intertek Genalysis Perth	ENV_W012, SIE : ENV_W012
	Alkaline fusion (Nickel crucible) specific for Fluorine. Analysed by Specific Ion Electrode.	
FP1/OE	Intertek Genalysis Perth	FP1/ : MPL_W011, OE : ICP_W004
	Sodium peroxide fusion (Zirconia crucibles) and Hydrochloric acid to dissolve the melt. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.	
HG1/CV	Intertek Genalysis Perth	
	Low temperature Perchloric acid digest specific for Mercury. Analysed by Cold Vapour Generation Atomic Absorption Spectrometry.	
SE1/MS	Intertek Genalysis Perth	
	Aqua-Regia digest followed by Precipitation and Concentration. Specific for Selenium. Analysed by Inductively Coupled PI	

GLS Job Code 143.0/1308118

Client ON GCA 1220/1



Accredited for compliance with ISO/IEC 17025

Dr G Campbell
CAMPBELL, GRAEME and ASSOCIATES PTY LTD
PO Box 247
BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1308118
No. of SAMPLES	7
CLIENT O/N	GCA1220/1
PROJECT	Bowdens
STATE	Mine Waste
DATE RECEIVED	23/05/2013
DATE COMPLETED	19/06/2013

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

The samples were received as ex pulp 1305750

Results of analysis on:

Element		S	S-SO ₄	C	C-Acinsol	C-CO ₃
Method		/CSA	S72/GR	/CSA	C71/CSA	/CALC
Detection		0.01	0.01	0.01	0.01	0.01
Units		%	%	%	%	%
Sample Name						
Control Blank		0.02	()	0.02	X	X
GCA10651/53		0.03	0.02	0.01	0.01	0
GCA10651/53	check	0.02	X	0.02	0.02	0
GCA10663/64		0.13	0.12	0.04	0.03	0.01
GCA10668/69		0.03	0.02	X	X	X
GCA10674/75		0.1	0.1	0.01	X	0.01
GCA10678/79		0.18	0.16	0.03	X	0.03
GCA10682/83		0.07	0.01	0.66	0.03	0.63
GCA10687/91		0.07	0.02	0.38	0.03	0.35
OREAS 45e		0.05		0.48		
PD-1			4.35			
S_SO4_A-2	N		0.57			
S_SO4_B-2	N		1.12			

Notes

1. Total-S and Total-C were determined on the pulps
2. Total-C and Total-S was determined using an induction furnace according to Genalysis method number MPL_W043. The samples are ignited in oxygen ~1700C and the CO₂ and SO₂ measured by infrared detectors

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GLS Job Code 143.0/1308118

Client ON GCA 1220/1

3. S-SO₄ was determined on the pulps by precipitation of BaSO₄ according to Genalysis method number ENV_W039, after digestion with Na₂CO₃ (S72/GR)
4. C-Acinsol (acid insoluble carbon) by a C&S analyser after removal of carbonates and soluble organic carbon using hot hydrochloric acid according to Genalysis method number MPL_W046.

Results of analysis on:

sample		Fizz	volume	HCl	NaOH	Colour	pH	ANC	ANC
name		Rate	ml	M	M	Change	Drop	soln pH	(kgH ₂ SO ₄ /t)
GCA10651/53		0	8	0.491	0.208	N		1.4	0
GCA10651/53	check	0	8	0.491	0.208	N		1.5	2
GCA10663/64		0	8	0.491	0.208	N		1.5	-1
GCA10668/69		0	8	0.491	0.208	N		1.6	-1
GCA10674/75		0	8	0.491	0.208	N		1.6	0
GCA10678/79		0	8	0.491	0.208	N		1.6	2
GCA10682/83		0	20	0.494	0.490	Y	2.8	1.3	8
GCA10687/91		0	8	0.491	0.208	Y	3.9	1.8	22

Notes:

1. ANC was determined on 2g - Acid concentrations are as stated.
2. Colour change: Y indicates the appearance of a green colouration as the pH=7 endpoint was approached. N indicates no colour change. Two drops of 30 % hydrogen peroxide are added to each sample as the endpoint is approached to oxidise any ferrous iron.
3. pH drop : Result reported when the pH drops to a value below 4 on addition of peroxide
4. This "Bulk-ANC" static-testing procedure is based on AMIRA (2002), according to Genalysis method number ENV_W035

NATA ENDORSED DOCUMENT**Company Accreditation Number 3244**

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 19/06/2013

GLS Job Code 143.0/1308119

Client ON GCA 1220/1



Accredited for compliance with ISO/IEC 17025

Dr G Campbell
CAMPBELL, GRAEME and ASSOCIATES PTY LTD
PO Box 247
BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1308119
No. of SAMPLES	5
CLIENT O/N	GCA1220/1
PROJECT	Bowdens
STATE	Mine Waste
DATE RECEIVED	23/05/2013
DATE COMPLETED	19/06/2013

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

The samples were received as ex pulp 1305750

Results of analysis on:

Element		S	S-SO4	C	C-Acinsol	C-CO3
Method		/CSA	S72/GR	/CSA	C71/CSA	/CALC
Detection		0.01	0.01	0.01	0.01	0.01
Units		%	%	%	%	%
Sample Name						
Control Blank		0.02	X	X	X	X
GCA10706/07		0.49	0.05	0.24	0.06	0.18
GCA10706/07	check	0.51	0.05	0.21	0.05	0.16
GCA10730/31		0.45	0.26	0.04	0.04	0
GCA10740/41		0.43	0.03	0.12	0.05	0.07
GCA10747/48/49		0.65	0.02	0.25	0.09	0.16
GCA10754/55		1.46	0.03	0.75	0.03	0.72
MA-3a		1		2.39		
PD-1			4.47			
S_SO4_A-2			0.55			
S_SO4_B-2			1.1			

Notes

1. Total-S and Total-C were determined on the pulps
2. Total-C and Total-S was determined using an induction furnace according to Genalysis method number MPL_W043. The samples are ignited in oxygen ~1700C and the CO2 and SO2 measured by infrared detectors
3. S-SO4 was determined on the pulps by precipitation of BaSO4 according to Genalysis method number ENV_W039, after digestion with Na2CO3 (S72/GR)
4. C-Acinsol (acid insoluble carbon) by a C&S analyser after removal of carbonates and soluble organic carbon using hot hydrochloric acid according to Genalysis method number MPL_W046.

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GLS Job Code 143.0/1308119

Client ON GCA 1220/1

Results of analysis on:

sample		Fizz	volume	HCl	NaOH	Colour	pH	ANC	ANC
name		Rate	ml	M	M	Change	Drop	soln pH	(kgH ₂ SO ₄ /t)
GCA10706/07		0	8	0.488	0.208	N		1.7	13
GCA10706/07	check	0	8	0.488	0.208	N		1.7	11
GCA10730/31		0	8	0.488	0.208	N		1.5	-2
GCA10740/41		0	8	0.488	0.208	N		1.6	8
GCA10747/48/49		0	8	0.488	0.208	N		1.6	12
GCA10754/55		1	20	0.494	0.490	Y	3	1.3	30

Notes:

1. ANC was determined on 2g -. Acid concentrations are as stated.
2. Colour change: Y indicates the appearance of a green colouration as the pH=7 endpoint was approached. N indicates no colour change. Two drops of 30 % hydrogen peroxide are added to each sample as the endpoint is approached to oxidise any ferrous iron.
3. pH drop : Result reported when the pH drops to a value below 4 on addition of peroxide
4. This "Bulk-ANC" static-testing procedure is based on AMIRA (2002), according to Genalysis method number ENV_W035

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 19/06/2013

GLS Job Code 143.0/1307942

Client ON GCA 1220/1



Accredited for compliance with ISO/IEC 17025

Dr G Campbell
CAMPBELL, GRAEME and ASSOCIATES PTY LTD
PO Box 247
BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1307942
No. of SAMPLES	1
CLIENT O/N	GCA1220/1
PROJECT	Bowdens
STATE	Mine Waste
DATE RECEIVED	31/05/2013
DATE COMPLETED	27/06/2013

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

The samples were received mine wastes which were dried at 80C.
The samples were crushed to a nominal 2mm a split was then taken and fine pulverised to a nominal -75um in a zirconia bowl.

Results of analysis on:

Element		S	S-SO4	C	C-Acinsol	C-CO3
Method		/CSA	S72/GR	/CSA	C71/CSA	/CALC
Detection		0.01	0.01	0.01	0.01	0.01
Units		%	%	%	%	%
Sample Name						
Control Blank		0.02	X	X	X	X
GCA10729/52		0.99	0.02	0.11	0.11	0
GCA10729/52	check	0.97	0.03	0.12	0.1	0.02
MA-3a		0.98		2.4		
PD-1			4.43			
S_SO4_A-2	N		0.57			
S_SO4_B-2	N		1.12			

Notes

1. Total-S and Total-C were determined on the pulps
2. Total-C and Total-S was determined using an induction furnace according to Genalysis method number MPL_W043. The samples are ignited in oxygen ~1700C and the CO2 and SO2 measured by infrared detectors
3. S-SO4 was determined on the pulps by precipitation of BaSO4 according to Genalysis method number ENV_W039, after digestion with Na2CO3 (S72/GR)
4. C-Acinsol (acid insoluble carbon) by a C&S analyser after removal of carbonates and soluble organic carbon using hot hydrochloric acid according to Genalysis method number MPL_W046.

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GLS Job Code 143.0/1307942

Client ON GCA 1220/1

Results of analysis on:

sample		Fizz	volume	HCl	NaOH	Colour	pH	ANC	ANC
name		Rate	ml	M	M	Change	Drop	soln pH	(kgH ₂ SO ₄ /t)
GCA10729/52		1	8	0.488	0.208	N		1.5	1
GCA10729/52	check	1	8	0.488	0.208	N		1.5	2

Notes:

1. ANC was determined on 2g -. Acid concentrations are as stated.
2. Colour change: Y indicates the appearance of a green colouration as the pH=7 endpoint was approached. N indicates no colour change. Two drops of 30 % hydrogen peroxide are added to each sample as the endpoint is approached to oxidise any ferrous iron.
3. pH drop : Result reported when the pH drops to a value below 4 on addition of peroxide
4. This "Bulk-ANC" static-testing procedure is based on AMIRA (2002), according to Genalysis method number ENV_W035

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 27/06/2013



ANALYTICAL REPORT

Dr G. CAMPBELL
CAMPBELL, GRAEME and ASSOCIATES
PO Box 247
BRIDGETOWN, W.A. 6255
AUSTRALIA

JOB INFORMATION

JOB CODE : 143.0/1307943
No. of SAMPLES : 1
No. of ELEMENTS : 33
CLIENT O/N : GCA1220/1 (Job 1 of 1)
SAMPLE SUBMISSION No. :
PROJECT : BOWDENS
STATE : Ex-Pulp
DATE RECEIVED : 31/05/2013
DATE COMPLETED : 10/07/2013
DATE PRINTED : 10/07/2013
ANALYSING LABORATORY: Intertek Genalysis Perth

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method
OV = Value over-range for Package

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SAMPLE DETAILS

DISCLAIMER

Intertek Genalysis wishes to make the following disclaimer pertaining to the accompanying analytical results.

All work is performed in accordance with the Intertek Minerals Standard Terms and Conditions of work <http://www.intertek.com/terms/>

This report relates specifically to the sample(s) that were drawn and/or provided by the client or their nominated third party. The reported result(s) provide no warranty or verification on the sample(s) representing any specific goods and/or shipment and only relate to the sample(s) as received and tested. This report was prepared solely for the use of the client named in this report. Intertek accepts no responsibility for any loss, damage or liability suffered by a third party as a result of any reliance upon or use of this report.

SIGNIFICANT FIGURES

It is common practice to report data derived from analytical instrumentation to a maximum of two or three significant figures. Some data reported herein may show more figures than this. The reporting of more than two or three figures in no way implies that the third, fourth and subsequent figures may be real or significant.

Intertek Genalysis accepts no responsibility whatsoever for any interpretation by any party of any data where more than two or three significant figures have been reported.

SAMPLE STORAGE DETAILS

GENERAL CONDITIONS

SAMPLE STORAGE OF SOLIDS

Bulk Residues and Pulps will be stored for 60 DAYS without charge. After this time all Bulk Residues and Pulps will be stored at a rate of \$3.30 per cubic metre per day until your written advice regarding collection or disposal is received. Expenses related to the return or disposal of samples will be charged to you at cost. Current disposal cost is charged at \$100.00 per cubic metre.

SAMPLE STORAGE OF SOLUTIONS

Samples received as liquids, waters or solutions will be held for 60 DAYS free of charge then disposed of, unless written advice for return or collection is received.

NOTES
NATA ENDORSED DOCUMENT
Company Accreditation Number 3244
Analysing Laboratory: Intertek Genalysis Perth

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The analysis results reported herein have been obtained using the following methods and conditions:

The samples as listed were received, dried and pulverised in a zirconia bowl ex pulp 1307942.

The results have been determined according to Genalysis methods codes :
Digestions : MPL_W002 (4A/), MPL_W005 (SE1/), ENV_W012 (FC7/SIE), MPL_W011 (FP1/),
MPL_W008 (HG1/)

Analytical Finishes: ICP_W004 (/OE), ICP_W003 (/MS), and AAS_W004 (/CV).

The results included the assay of blanks and international reference standards:
OREAS 45d, STSD-1 and SARM4

and Genalysis in-house standards:
OREAS 97.01 and HgSTD-5

The results are expressed as parts per million or percent by mass in the dried and prepared material.

Ann Evers

Intertek Genalysis signatory
Ann Patricia EVERS
Chief Chemist

Date: 09-Jul-2013

143.0/1307943 (10/07/2013) CLIENT O/N: GCA1220/1

ANALYSIS

ELEMENTS	Ag	Al	As	B	Ba	Bi	Ca	Cd	Co	Cr
UNITS	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.01	0.5	50	0.1	0.01	0.1	0.02	0.1	50
DIGEST	4A/	FP1/	4A/	FP1/	4A/	4A/	FP1/	4A/	4A/	FP1/
ANALYTICAL FINISH	MS	OE	MS	OE	MS	MS	OE	MS	MS	OE
SAMPLE NUMBERS										
0001 GCA10729/52	62.92	6.25	2917.8	X	621.9	0.29	0.3	11.86	1.2	X
CHECKS										
0001 GCA10729/52	58.59	4.79	2585.4	X	559.8	0.25	0.2	10.94	1.1	X
STANDARDS										
0001 HgSTD-5										
0002 OREAS 45d	0.32		19.9		194.6	0.32		0.05	31.0	
0003 OREAS 97.01										
0004 SARM4	8.38			X		8.2				64
0005 STSD-1										
BLANKS										
0001 Control Blank	X	X	X	X	0.4	X	0.1	X	X	60
0002 Control Blank	0.03		2.5		1.2	X		X	X	
0003 Control Blank		X		X			0.1			X
0004 Control Blank										
0005 Control Blank										
0006 Acid Blank	0.01		1.2		0.6	X		X	X	
0007 Acid Blank		X		X			X			X
0008 Se - 0.1ppm										

143.0/1307943 (10/07/2013) CLIENT O/N: GCA1220/1

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Part 2/4

ANALYSIS

ELEMENTS	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni
UNITS	ppm	ppm	%	ppm	%	%	ppm	ppm	ppm	ppm
DETECTION LIMIT	1	50	0.01	0.01	0.05	0.01	1	0.1	20	1
DIGEST	4A/	FC7/	FP1/	HG1/	FP1/	FP1/	4A/	4A/	4A/	4A/
ANALYTICAL FINISH	OE	SIE	OE	CV	OE	OE	OE	MS	OE	OE
SAMPLE NUMBERS										
0001 GCA10729/52	13	578	1.22	0.05	5.98	0.10	1746	7.9	766	2

CHECKS

0001 GCA10729/52	12	585	0.95	0.03	4.55	0.07	1683	8.0	719	2
------------------	----	-----	------	------	------	------	------	-----	-----	---

STANDARDS

0001 HgSTD-5				0.80						
0002 OREAS 45d	386						525	2.8	1018	231
0003 OREAS 97.01										
0004 SARM4			6.27		0.28	4.40				
0005 STSD-1		1078								

BLANKS

0001 Control Blank	X	X	0.08	X	X	X	10	0.3	X	X
0002 Control Blank	X						X	0.3	X	X
0003 Control Blank			0.02		X	X				
0004 Control Blank				X						
0005 Control Blank										
0006 Acid Blank	X						3	0.3	X	X
0007 Acid Blank			X		X	X				
0008 Se - 0.1ppm										

143.0/1307943 (10/07/2013) CLIENT O/N: GCA1220/1

ANALYSIS

ELEMENTS	P	Pb	S	Sb	Se	Si	Sn	Sr	Th	Ti
UNITS	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
DETECTION LIMIT	10	0.5	50	0.05	0.01	0.1	0.1	0.05	0.01	0.02
DIGEST	4A/	4A/	4A/	4A/	SE1/	FP1/	4A/	4A/	4A/	4A/
ANALYTICAL FINISH	OE	MS	OE	MS	MS	OE	MS	MS	MS	MS
SAMPLE NUMBERS										
0001 GCA10729/52	139	667.1	1.07%	17.20	0.17	31.8	2.5	201.34	13.80	7.70
CHECKS										
0001 GCA10729/52	134	579.1	1.01%	15.65	0.17	24.8	2.3	177.03	12.11	6.72
STANDARDS										
0001 HgSTD-5										
0002 OREAS 45d	382	22.1	487	0.90			2.8	33.51	14.31	0.27
0003 OREAS 97.01					0.65					
0004 SARM4						24.2				
0005 STSD-1										
BLANKS										
0001 Control Blank	X	0.5	X	X	X	X	0.1	0.14	X	X
0002 Control Blank	X	1.0	X	X			X	0.34	0.03	0.03
0003 Control Blank						X				
0004 Control Blank										
0005 Control Blank					X					
0006 Acid Blank	X	0.5	X	X			X	0.18	0.01	X
0007 Acid Blank						X				
0008 Se - 0.1ppm					0.09					

143.0/1307943 (10/07/2013) CLIENT O/N: GCA1220/1

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Part 4/4

ANALYSIS

ELEMENTS	U	V	Zn
UNITS	ppm	ppm	ppm
DETECTION LIMIT	0.01	1	1
DIGEST	4A/	4A/	4A/
ANALYTICAL FINISH	MS	OE	OE
SAMPLE NUMBERS			
0001 GCA10729/52	5.34	8	2370
CHECKS			
0001 GCA10729/52	4.64	7	2260
STANDARDS			
0001 HgSTD-5			
0002 OREAS 45d	2.72	235	46
0003 OREAS 97.01			
0004 SARM4			
0005 STSD-1			
BLANKS			
0001 Control Blank	0.02	X	1
0002 Control Blank	0.02	X	X
0003 Control Blank			
0004 Control Blank			
0005 Control Blank			
0006 Acid Blank	X	X	X
0007 Acid Blank			
0008 Se - 0.1ppm			

METHOD CODE DESCRIPTION

<u>Method Code</u>	<u>Analysing Laboratory</u>	<u>NATA document</u>
4A/MS	Intertek Genalysis Perth	4A/ : MPL_W002, MS : ICP_W003
	Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Mass Spectrometry.	
4A/OE	Intertek Genalysis Perth	4A/ : MPL_W002, OE : ICP_W004
	Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.	
FC7/SIE	Intertek Genalysis Perth	ENV_W012, SIE : ENV_W012
	Alkaline fusion (Nickel crucible) specific for Fluorine. Analysed by Specific Ion Electrode.	
FP1/OE	Intertek Genalysis Perth	FP1/ : MPL_W011, OE : ICP_W004
	Sodium peroxide fusion (Zirconia crucibles) and Hydrochloric acid to dissolve the melt. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.	
HG1/CV	Intertek Genalysis Perth	
	Low temperature Perchloric acid digest specific for Mercury. Analysed by Cold Vapour Generation Atomic Absorption Spectrometry.	
SE1/MS	Intertek Genalysis Perth	
	Aqua-Regia digest followed by Precipitation and Concentration. Specific for Selenium. Analysed by Inductively Coupled PI	



ANALYTICAL REPORT



Accreditation No. 2562

CLIENT DETAILS

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Project **GCA 1220/1**
Order Number **GCA1220/1**
Samples 1

LABORATORY DETAILS

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SGS Reference PE079981 R0
Report Number 0000067006
Date Reported 05 Aug 2013
Date Received 25 Jul 2013

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(898/20210).

SIGNATORIES

Michael McKay
Inorganic Team Leader - Waters

Ros Ma
Laboratory Manager



ANALYTICAL REPORT

PE079981 R0

Sample Number	001
Sample Matrix	Pulp
Sample Name	GCA10729/52

Parameter

Units

LOR

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.005	0.43
Chromium Reducible Sulphur (Scr)	moles H+/T	5	270
Chromium Reducible Sulphur (Scr)	kg H2SO4/T	0.25	13



QC SUMMARY

PE079981 R0

MB blank results are compared to the Limit of Reporting.
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

Chromium Reducible Sulphur (CRS) Method: ME-(AU)-JENVJAN217

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS % Recovery
Chromium Reducible Sulphur (Scr)	LB068900	%	0.005	<0.005	0%	85%
Chromium Reducible Sulphur (Scr)	LB068900	moles	5	<5		
Chromium Reducible Sulphur (Scr)	LB068900	kg	0.25	<0.25		



METHOD SUMMARY

PE079981 R0

METHOD

AN217

METHODOLOGY SUMMARY

Dried pulped sample is mixed with acid and chromium metal in a rapid distillation unit to produce hydrogen sulphide (H₂S) which is collected and titrated with iodine (I₂(aq)) to measure SCR.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	This analysis is not covered by the scope of accreditation.	QFH	QC result is above the upper tolerance
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
^	Performed by outside laboratory.	NA	The sample was not analysed for this analyte

Samples analysed as received.
Solid samples expressed on a dry weight basis.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here:
<http://www.sgs.com.au/pv.sgs.v3/~media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf>

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GLS Job Code 143.0/1309817

Client ON GCA 1220/1



Dr G Campbell
CAMPBELL, GRAEME and ASSOCIATES PTY LTD
PO Box 247
BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143.0/1309817
No. of SAMPLES	7
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Mine Waste
DATE RECEIVED	8/07/2013
DATE COMPLETED	19/07/2013

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

The samples were received as ex pulp 1305750

GCA10682/83, GCA10687/91 are "calcareous" samples. The rest are "non calcareous" samples
Mn was also included in the analysis and calculations. This inclusion falls outside the scope of the referenced procedures as requested by Dr Graeme Campbell

The digest AmCl7 was used as follows for the non calcareous samples:

2g of each of the samples were weighed into a centrifuge tube and pre-washed with 2x 25ml 10 % (v/v) deionised ethylene glycol in 90 % (v/v) ethanol which has been previously deionised by passing through Amberlite resin

After the centrifuge stage there may be finely dispersed material in suspension. If this is the case a few drops of PVA may be necessary. The PVA aqueous solution is 0.05 % (w/v) polyvinyl alcohol. No additions.

Extraction step for Exchangeable cations

After decanting following completion of the 2nd pre-wash, the residue in centrifuge tube is subjected to 2 x 30-minute extractions via end-over-end tumbling at approx. 10 rpm. Each extraction uses 20 ml of 1 M-NH₄Cl buffered at pH 7.0 using ammonia solution 28 % (w/w). At the completion of each extraction, the suspensions are centrifuged and the supernatants decanted and collected into a communal extract. The final communal extract is brought to 50 ml with 4 M-HCl.
Sample analysed for Ca,Mg,K,Mn and Na by OES.

Reference:

Based on procedure 15B2 Soil Chemical Methods – Australasia; George E. Rayment & David J. Lyons CSIRO Publishing 2011.

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Page 1 of 3

GLS Job Code 143.0/1309817

Client ON GCA 1220/1

Results of analysis on:

Element	Method	Units	GCA10651/53	GCA10651/53	GCA10663/64
				check	
Ca	AmCl7/OE	cmol(+)/kg	0.4	0.4	0.4
K	AmCl7/OE	cmol(+)/kg	0.9	0.9	1.3
Mg	AmCl7/OE	cmol(+)/kg	2.1	2	1
Na	AmCl7/OE	cmol(+)/kg	0.8	0.8	0.1
Mn	AmCl7/OE	cmol(+)/kg	0.2	0.2	0.4
eCEC		cmol(+)/kg	4.4	4.3	3.2
Ca	exch	%	9.1	9	12.3
K	exch	%	20	20.2	40.6
Mg	exch	%	47	47.1	31.8
Na	exch(ESP)	%	18.6	18.3	3.3
Mn	exch	%	5.4	5.3	12

Element	Method	Units	GCA10668/69	GCA10674/75	GCA10678/79	ASPAC-33
Ca	AmCl7/OE	cmol(+)/kg	0.6	5	8.1	41.5
K	AmCl7/OE	cmol(+)/kg	1.2	2.1	2.3	1.6
Mg	AmCl7/OE	cmol(+)/kg	1.3	12.1	9.8	35.9
Na	AmCl7/OE	cmol(+)/kg	0	0.1	0	1.8
Mn	AmCl7/OE	cmol(+)/kg	0.1	2.9	5.6	0
eCEC		cmol(+)/kg	3.2	22.3	25.8	80.9
Ca	exch	%	19.6	22.7	31.3	51.3
K	exch	%	37.6	9.6	9	2
Mg	exch	%	39.1	54.6	38	44.4
Na	exch(ESP)	%	0	0.3	0.2	2.3
Mn	exch	%	3.7	12.9	21.5	0

The digest AmCl was used as follows for the calcareous samples:

2g of each of the samples were weighed into a centrifuge tube and pre-washed with 2x 25ml 10 % (v/v) deionised ethylene glycol in 90 % (v/v) ethanol which has been previously deionised by passing through Amberlite resin. After the centrifuge stage there may be finely dispersed material in suspension. If this is the case a few drops of PVA may be necessary. The PVA aqueous solution is 0.05 % (w/v) polyvinyl alcohol.

Extraction step for Exchangeable cations

After decanting following completion of the 2nd pre-wash, the residue in centrifuge tube is subjected to 4 x 30-minute extractions via end-over-end tumbling at approx. 10 rpm. Each extraction uses 20 mL of alcoholic (60 % w/w) 1 M-NH₄Cl buffered at pH 8.5 using ammonia solution 28 % (w/w). At the completion of each extraction, the suspensions are centrifuged and the supernatants decanted and collected into a communal extract. The final communal extract is brought to 100 mL with 4 M-HCl.

Sample analysed for Ca, Mg, K, Mn and Na by OES

Reference: Comparison of extraction techniques for measuring exchangeable cations in calcareous soils.

C. G. Pierce and S. Morris Australian Journal of Soil Research, 2004, 42,301-311

(Based on B.M. Tucker (1974) Laboratory procedures for cation exchange measurements on soils. CSIRO Australia, Division of soils Technical paper No 23)

GLS Job Code 143.0/1309817

Client ON GCA 1220/1

Results of analysis on:

Element	Method	Units	GCA10682/83	GCA10687/91	ASPAC-33
Ca	AmCl/OE	cmol(+)/kg	10.2	8.6	41.17
K	AmCl/OE	cmol(+)/kg	1.03	1.66	1.6
Mg	AmCl/OE	cmol(+)/kg	8.08	8.52	36.91
Na	AmCl/OE	cmol(+)/kg	0.05	0.43	1.92
Mn	AmCl/OE	cmol(+)/kg	0.33	0.03	0
eCEC		cmol(+)/kg	19.68	19.24	81.59
Ca	exch	%	51.82	44.7	50.46
K	exch	%	5.21	8.63	1.96
Mg	exch	%	41.04	44.28	45.23
Na	exch (ESP)	%	0.24	2.21	2.35
Mn	exch		1.68	0.17	0

Ann Evers

19/07/2013



ANALYTICAL REPORT



Accreditation No. 2562

CLIENT DETAILS

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Project **GCA-Job-No. 1220/1**
 Order Number **GCA 1220/1**
 Samples 17

LABORATORY DETAILS

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SGS Reference PE078942 R0
 Report Number 0000066034
 Date Reported 22 Jul 2013
 Date Received 24 Jun 2013

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(898/20210).

CRS: #1 could not be analysed due to insufficient sample.

SIGNATORIES

Michael McKay
 Inorganic Team Leader - Waters

Ros Ma
 Laboratory Manager



ANALYTICAL REPORT

PE078942 R0

	Sample Number	001	002
	Sample Matrix	Pulp	Pulp
	Sample Name	GCA10039	GCA10043
Parameter	Units	LOR	

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.005	-	1.4
Chromium Reducible Sulphur (Scr)	moles H+/T	5	-	865
Chromium Reducible Sulphur (Scr)	kg H ₂ SO ₄ /T	0.25	-	42

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur	%w/w	0.005	1.9	2.1
Maximum Potential Acidity*	kg H ₂ SO ₄ /T	0.1	57	64
Neutralisation Potential Ratio (NPR) - calculation*	No unit	0.1	-	-

	Sample Number	003	004
	Sample Matrix	Pulp	Pulp
	Sample Name	GCA10044	GCA10049
Parameter	Units	LOR	

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.005	1.4	0.88
Chromium Reducible Sulphur (Scr)	moles H+/T	5	896	552
Chromium Reducible Sulphur (Scr)	kg H ₂ SO ₄ /T	0.25	44	27



ANALYTICAL REPORT

PE078942 R0

	Sample Number	003	004
	Sample Matrix	Pulp	Pulp
	Sample Name	GCA10044	GCA10049
Parameter	Units	LOR	

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur	%w/w	0.005	2.7	1.3
Maximum Potential Acidity*	kg H ₂ SO ₄ /T	0.1	81	39
Neutralisation Potential Ratio (NPR) - calculation*	No unit	0.1	-	-

	Sample Number	005	006
	Sample Matrix	Pulp	Pulp
	Sample Name	GCA10053	GCA10651/53
Parameter	Units	LOR	

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.005	0.47	<0.005
Chromium Reducible Sulphur (Scr)	moles H ⁺ /T	5	294	<5
Chromium Reducible Sulphur (Scr)	kg H ₂ SO ₄ /T	0.25	14	<0.25

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur	%w/w	0.005	0.73	<0.005
Maximum Potential Acidity*	kg H ₂ SO ₄ /T	0.1	22	<0.10
Neutralisation Potential Ratio (NPR) - calculation*	No unit	0.1	-	-



ANALYTICAL REPORT

PE078942 R0

	Sample Number	007	008
	Sample Matrix	Pulp	Pulp
	Sample Name	GCA10663/64	GCA10668/69
Parameter	Units	LOR	

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.005	<0.005	0.005
Chromium Reducible Sulphur (Scr)	moles H+/T	5	<5	<5
Chromium Reducible Sulphur (Scr)	kg H ₂ SO ₄ /T	0.25	<0.25	<0.25

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur	%w/w	0.005	0.11	0.007
Maximum Potential Acidity*	kg H ₂ SO ₄ /T	0.1	3.2	0.21
Neutralisation Potential Ratio (NPR) - calculation*	No unit	0.1	-	-

	Sample Number	009	010
	Sample Matrix	Pulp	Pulp
	Sample Name	GCA10674/75	GCA10678/79
Parameter	Units	LOR	

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.005	<0.005	<0.005
Chromium Reducible Sulphur (Scr)	moles H+/T	5	<5	<5
Chromium Reducible Sulphur (Scr)	kg H ₂ SO ₄ /T	0.25	<0.25	<0.25



ANALYTICAL REPORT

PE078942 R0

	Sample Number	009	010
	Sample Matrix	Pulp	Pulp
	Sample Name	GCA10674/75	GCA10678/79
Parameter	Units	LOR	

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur	%w/w	0.005	0.083	0.16
Maximum Potential Acidity*	kg H ₂ SO ₄ /T	0.1	2.6	4.8
Neutralisation Potential Ratio (NPR) - calculation*	No unit	0.1	-	-

	Sample Number	011	012
	Sample Matrix	Pulp	Pulp
	Sample Name	GCA10682/83	GCA10687/91
Parameter	Units	LOR	

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.005	0.032	0.034
Chromium Reducible Sulphur (Scr)	moles H ⁺ /T	5	20	21
Chromium Reducible Sulphur (Scr)	kg H ₂ SO ₄ /T	0.25	0.97	1.0

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur	%w/w	0.005	0.037	<0.005
Maximum Potential Acidity*	kg H ₂ SO ₄ /T	0.1	1.1	0.14
Neutralisation Potential Ratio (NPR) - calculation*	No unit	0.1	-	-



ANALYTICAL REPORT

PE078942 R0

	Sample Number	013	014
	Sample Matrix	Pulp	Pulp
	Sample Name	GCA10706/07	GCA10730/31
Parameter	Units	LOR	

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.005	0.33	0.13
Chromium Reducible Sulphur (Scr)	moles H+/T	5	208	83
Chromium Reducible Sulphur (Scr)	kg H ₂ SO ₄ /T	0.25	10	4.1

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur	%w/w	0.005	0.49	0.45
Maximum Potential Acidity*	kg H ₂ SO ₄ /T	0.1	15	14
Neutralisation Potential Ratio (NPR) - calculation*	No unit	0.1	-	-

	Sample Number	015	016
	Sample Matrix	Pulp	Pulp
	Sample Name	GCA10740/41	GCA10747/48/49
Parameter	Units	LOR	

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.005	0.23	0.26
Chromium Reducible Sulphur (Scr)	moles H+/T	5	145	162
Chromium Reducible Sulphur (Scr)	kg H ₂ SO ₄ /T	0.25	7.1	8.0



ANALYTICAL REPORT

PE078942 R0

	Sample Number	015	016
	Sample Matrix	Pulp	Pulp
	Sample Name	GCA10740/41	GCA10747/48/49
Parameter	Units	LOR	

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur	%w/w	0.005	0.42	0.67
Maximum Potential Acidity*	kg H ₂ SO ₄ /T	0.1	13	20
Neutralisation Potential Ratio (NPR) - calculation*	No unit	0.1	-	-

	Sample Number	017
	Sample Matrix	Pulp
	Sample Name	GCA10754/55
Parameter	Units	LOR

Chromium Reducible Sulphur (CRS) Method: AN217

Chromium Reducible Sulphur (Scr)	%	0.005	1.1
Chromium Reducible Sulphur (Scr)	moles H ⁺ /T	5	700
Chromium Reducible Sulphur (Scr)	kg H ₂ SO ₄ /T	0.25	34

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur	%w/w	0.005	1.6
Maximum Potential Acidity*	kg H ₂ SO ₄ /T	0.1	50
Neutralisation Potential Ratio (NPR) - calculation*	No unit	0.1	-



QC SUMMARY

PE078942 R0

MB blank results are compared to the Limit of Reporting.
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared to the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

Chromium Reducible Sulphur (CRS) Method: ME-(AU)-[ENV]AN217

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS % Recovery
Chromium Reducible Sulphur (Scr)	LB066949	%	0.005	<0.005	14 - 15%	96%
	LB067074	%	0.005	<0.005	0%	96%
Chromium Reducible Sulphur (Scr)	LB066949	moles	5	<5		
	LB067074	moles	5	<5		
Chromium Reducible Sulphur (Scr)	LB066949	kg	0.25	<0.25		
	LB067074	kg	0.25	<0.25		

Total Sulfur by LECO Furnace Method: ME-(AU)-[ENV]AN202

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS % Recovery
Total Sulfur	LB066925	%w/w	0.005	<0.005	1%	101%
Maximum Potential Acidity*	LB066925	kg	0.1	<0.10		



METHOD SUMMARY

PE078942 R0

METHOD

METHODOLOGY SUMMARY

AN202	The sulphur is oxidised to sulphur dioxide gas in a tube furnace using oxygen to aid the oxidation process. The evolved sulphur dioxide is measure by an infra red cell. The infra red cell output is calibrated against the value of a known standard sample to provide the total sulphur value of the unknown sample.
AN202	Maximum Potential Acidity (MPA) of the sample is a calculation that expresses the total sulphur result as kg of H ₂ SO ₄ /tonne. Neutralisation potential ratio (NPR) is calculated as the sample ANC divided by the MPA.
AN217	Dried pulped sample is mixed with acid and chromium metal in a rapid distillation unit to produce hydrogen sulphide (H ₂ S) which is collected and titrated with iodine (I ₂ (aq)) to measure SCR.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	This analysis is not covered by the scope of accreditation.	QFH	QC result is above the upper tolerance
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
^	Performed by outside laboratory.	NA	The sample was not analysed for this analyte

Samples analysed as received.
 Solid samples expressed on a dry weight basis.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here:
<http://www.sgs.com.au/pv.sgs/3/~media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf>

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Graeme Campbell & Associates Pty Ltd

Laboratory Report

NET-ACID-GENERATION (NAG) TESTWORK

Sample Number	Sample Weight (g)	Comments	pH of Test Mixture Before Boiling Step	Test Mixture After Boiling Step		Titre (mL) (0.1 M-NaOH)		NAG (kg H ₂ SO ₄ /tonne)		
				pH	EC (µS/cm)	To pH 4.5	pH 4.5 to pH 7.0	To pH 4.5	pH 4.5 to pH 7.0	To pH 7.0
GCA10651/53	3.0	Reaction peaked overnight	5.5	5.6	25	-	0.50	<0.5	0.9	0.9
GCA10663/64	3.0	Reaction peaked overnight	5.0	4.2	59	0.20	1.00	<0.5	1.7	1.7
GCA10668/69	3.0	Reaction peaked overnight	5.2	5.2	28	-	1.50	<0.5	2.5	2.5
GCA10674/75	3.0	Reaction peaked overnight	5.2	5.2	63	-	1.10	<0.5	1.8	1.8
GCA10678/79	3.0	Reaction peaked overnight	4.9	5.1	89	-	0.40	<0.5	0.7	0.7
GCA10682/83	3.0	Reaction peaked overnight	6.5	7.3	60	-	-	<0.5	<0.5	<0.5
GCA10687/91	3.0	Reaction peaked overnight	7.2	8.9	78	-	-	<0.5	<0.5	<0.5
GCA10687/91-1	3.0	Reaction peaked overnight	7.2	8.9	79	-	-	<0.5	<0.5	<0.5
BLANK1	3.0	Reaction peaked overnight	5.8	6.8	35	-	-	<0.5	<0.5	<0.5

Notes: Test conditions based on those described by Miller *et al.* (1997), and AMIRA (2002) for the 'Static-NAG-Test' in its 'Single-Addition-Mode'. The pH of the 15 % (v/v) H₂O₂ solution was adjusted to 4.5 using 0.1 M-NaOH prior to commencing the NAG Tests. Following an overnight-reaction period, the test-mixtures were boiled for c. 2 hours. Then, after allowing the test-mixtures to cool, c. 1.0 mL of 0.016 M-CuSO₄ solution was added, and the test-mixtures again boiled for c. 2 hours. The addition of Cu(II) catalyses the decomposition of any residual, unreacted-H₂O₂ in the test-mixtures (McElnea and Ahern 2004; O'Shay *et al.* 1990). K-Feldspar was employed for the Blank.

Dr GD Campbell
7th June 2013

Graeme Campbell & Associates Pty Ltd

Laboratory Report

NET-ACID-GENERATION (NAG) TESTWORK

Sample Number	Sample Weight (g)	Comments	pH of Test Mixture Before Boiling Step	Test Mixture After Boiling Step		Titre (mL) (0.1 M-NaOH)		NAG (kg H ₂ SO ₄ /tonne)		
				pH	EC (µS/cm)	To pH 4.5	pH 4.5 to pH 7.0	To pH 4.5	pH 4.5 to pH 7.0	To pH 7.0
GCA10706/07	3.0	Reaction peaked overnight	4.7	6.9	230	-	-	<0.5	<0.5	<0.5
GCA10730/31	3.0	Reaction peaked overnight	3.3	3.5	220	1.50	1.80	2.5	3.0	5.5
GCA10740/41	3.0	Reaction peaked overnight	3.7	5.0	190	-	1.80	<0.5	3.0	3.0
GCA10747/48/49	3.0	Reaction peaked overnight	4.2	5.5	300	-	0.70	<0.5	1.2	1.2
GCA10754/55	3.0	Reaction peaked overnight	4.2	3.3	750	2.90	1.60	4.8	2.7	7.5
GCA10754/55-1	3.0	Reaction peaked overnight	4.1	3.3	760	3.20	1.10	5.3	1.8	7.1
BLANK1	3.0	Reaction peaked overnight	5.9	6.8	37	-	-	<0.5	<0.5	<0.5

Notes: Test conditions based on those described by Miller *et al.* (1997), and AMIRA (2002) for the 'Static-NAG-Test' in its 'Single-Addition-Mode'. The pH of the 15 % (v/v) H₂O₂ solution was adjusted to 4.5 using 0.1 M-NaOH prior to commencing the NAG Tests. Following an overnight-reaction period, the test-mixtures were boiled for c. 2 hours. Then, after allowing the test-mixtures to cool, c. 1.0 mL of 0.016 M-CuSO₄ solution was added, and the test-mixtures again boiled for c. 2 hours. The addition of Cu(II) catalyses the decomposition of any residual, unreacted-H₂O₂ in the test-mixtures (McElnea and Ahern 2004, O'Shay *et al.* 1990). K-Feldspar was employed for the Blank.

Dr GD Campbell
7th June 2013

Graeme Campbell & Associates Pty Ltd

Laboratory Report

NET-ACID-GENERATION (NAG) TESTWORK

Sample Number	Sample Weight (g)	Comments	pH of Test Mixture Before Boiling Step	Test Mixture After Boiling Step		Titre [0.1 M-NaOH] (mL)	NAG (kg H ₂ SO ₄ /tonne)
				pH	EC (µS/cm)		
GCA10702	3.0	Reaction peaked overnight	7.0	7.5	530	-	<0.5
GCA10706	3.0	Reaction peaked overnight	4.1	4.1	280	3.00	4.9
GCA10744	3.0	Reaction peaked overnight	5.4	4.8	330	0.90	1.5
GCA10746	3.0	Reaction peaked overnight	5.3	6.0	240	0.10	<0.5
GCA10747	3.0	Reaction peaked overnight	6.1	6.7	210	-	<0.5
GCA10748	3.0	Reaction peaked overnight	4.7	4.6	260	1.50	1.7
GCA10749	3.0	Reaction peaked overnight	4.4	5.3	510	1.20	2.0
GCA10711	3.0	Reaction peaked overnight	3.6	4.6	560	2.20	3.6
GCA10712	3.0	Reaction peaked overnight	4.0	5.7	500	1.10	1.8
GCA10713	3.0	Reaction peaked overnight	4.5	6.6	390	0.70	1.2
GCA10720	3.0	Reaction peaked overnight	5.2	4.1	330	1.70	2.8
GCA10732	3.0	Reaction peaked overnight	4.5	6.5	300	-	<0.5
GCA10742	3.0	Reaction peaked overnight	6.4	6.9	240	0.70	1.2
GCA10718	3.0	Reaction peaked overnight	5.9	5.4	330	-	<0.5
GCA10755	3.0	Reaction peaked overnight	8.7	8.5	360	-	<0.5
GCA10755-1	3.0	Reaction peaked overnight	8.9	8.7	300	-	<0.5
BLANK1	3.0	Reaction peaked overnight	5.7	7.1	70	-	<0.5

Notes: Test conditions based on those described by Miller *et al.* (1997), and AMIRA (2002) for the 'Static-NAG-Test' in its 'Single-Addition-Mode'. The pH of the 15 % (v/v) H₂O₂ solution was adjusted to 4.5 using 0.1 M-NaOH prior to commencing the NAG Tests. Following an overnight-reaction period, the test-mixtures were boiled for c. 2 hours. Then, after allowing the test-mixtures to cool, c. 1.0 mL of 0.016 M-CuSO₄ solution was added, and the test-mixtures again boiled for c. 2 hours. The addition of Cu(II) catalyses the decomposition of any residual, unreacted-H₂O₂ in the test-mixtures (McElnea and Ahern 2004; O'Shay *et al.* 1990). K-Feldspar was employed for the Blank.

Dr GD Campbell
12th April 2013

Graeme Campbell & Associates Pty Ltd

Laboratory Report

NET-ACID-GENERATION (NAG) TESTWORK

Sample Number	Sample Weight (g)	Comments	pH of Test Mixture Before Boiling Step	Test Mixture After Boiling Step		Titre [0.1 M- NaOH] (mL)	NAG (kg H ₂ SO ₄ / tonne)
				pH	EC (µS/cm)		
GCA10651	3.0	Reaction peaked overnight	5.8	6.6	26	0.40	0.7
GCA10652	3.0	Reaction peaked overnight	5.6	6.5	26	0.20	<0.5
GCA10653	3.0	Reaction peaked overnight	5.7	6.2	24	0.50	0.9
GCA10654	3.0	Reaction peaked overnight	5.6	6.0	24	0.50	0.9
GCA10655	3.0	Reaction peaked overnight	5.5	5.8	23	0.50	0.9
GCA10656	3.0	Reaction peaked overnight	5.3	5.6	19	0.40	0.7
GCA10657	3.0	Reaction peaked overnight	5.4	5.7	21	0.40	0.7
GCA10658	3.0	Reaction peaked overnight	5.4	5.4	25	0.60	1.0
GCA10660	3.0	Reaction peaked overnight	5.7	6.3	33	0.50	0.9
GCA10661	3.0	Reaction peaked overnight	5.6	6.1	38	0.60	1.0
GCA10662	3.0	Reaction peaked overnight	4.5	4.6	66	0.90	1.5
GCA10663	3.0	Reaction peaked overnight	4.9	4.8	28	0.80	1.4
GCA10664	3.0	Reaction peaked overnight	4.6	4.2	83	1.40	2.3
GCA10665	3.0	Reaction peaked overnight	4.8	5.0	44	0.70	1.2
GCA10666	3.0	Reaction peaked overnight	4.7	4.9	70	0.70	1.2
GCA10667	3.0	Reaction peaked overnight	5.1	5.3	47	0.40	0.7
GCA10668	3.0	Reaction peaked overnight	5.0	5.1	27	0.90	1.5
GCA10668-1	3.0	Reaction peaked overnight	5.0	5.1	28	0.70	1.2
BLANK1	3.0	Reaction peaked overnight	5.6	7.1	80	-	<0.5

Notes: Test conditions based on those described by Miller *et al.* (1997), and AMIRA (2002) for the 'Static-NAG-Test' in its 'Single-Addition-Mode'. The pH of the 15 % (v/v) H₂O₂ solution was adjusted to 4.5 using 0.1 M-NaOH prior to commencing the NAG Tests. Following an overnight-reaction period, the test-mixtures were boiled for c. 2 hours. Then, after allowing the test-mixtures to cool, c. 1.0 mL of 0.016 M-CuSO₄ solution was added, and the test-mixtures again boiled for c. 2 hours. The addition of Cu(II) catalyses the decomposition of any residual, unreacted-H₂O₂ in the test-mixtures (McElnea and Ahern 2004; O'Shay *et al.* 1990). K-Feldspar was employed for the Blank.

Dr GD Campbell
28th February 2013

Graeme Campbell & Associates Pty Ltd

Laboratory Report

NET-ACID-GENERATION (NAG) TESTWORK

Sample Number	Sample Weight (g)	Comments	pH of Test Mixture Before Boiling Step	Test Mixture After Boiling Step		Titre [0.1 M-NaOH] (mL)	NAG (kg H ₂ SO ₄ /tonne)
				pH	EC (µS/cm)		
GCA10669	3.0	Reaction peaked overnight	4.8	4.9	35	0.70	1.2
GCA10670	3.0	Reaction peaked overnight	4.5	4.5	63	1.30	2.2
GCA10671	3.0	Reaction peaked overnight	5.2	5.9	38	0.30	<0.5
GCA10672	3.0	Reaction peaked overnight	5.1	5.9	50	0.40	0.7
GCA10673	3.0	Reaction peaked overnight	7.1	7.3	42	-	<0.5
GCA10674	3.0	Reaction peaked overnight	5.2	4.7	91	1.00	1.7
GCA10675	3.0	No apparent reaction	5.4	5.8	35	0.40	0.7
GCA10676	3.0	No apparent reaction	5.2	5.5	40	0.40	0.7
GCA10677	3.0	Reaction peaked overnight	6.0	5.8	45	0.20	<0.5
GCA10678	3.0	Reaction peaked overnight	4.7	4.6	110	0.80	1.4
GCA10679	3.0	No apparent reaction	4.8	4.7	120	0.70	1.2
GCA10680	3.0	No apparent reaction	4.5	4.9	89	0.50	0.9
GCA10681	3.0	Reaction peaked overnight	4.3	4.6	89	0.20	<0.5
GCA10682	3.0	Reaction peaked overnight	6.0	6.7	78	0.20	<0.5
GCA10683	3.0	Reaction peaked overnight	7.0	7.1	51	-	<0.5
GCA10684	3.0	Reaction peaked overnight	5.3	5.7	52	0.40	0.7
GCA10685	3.0	Reaction peaked overnight	8.5	8.1	56	-	<0.5
GCA10686	3.0	Reaction peaked overnight	4.8	5.7	97	0.50	0.9
GCA10686-1	3.0	Reaction peaked overnight	4.7	5.7	83	0.10	<0.5
BLANK2	3.0	Reaction peaked overnight	5.7	7.0	72	-	<0.5

Notes: Test conditions based on those described by Miller *et al.* (1997), and AMIRA (2002) for the 'Static-NAG-Test' in its 'Single-Addition-Mode'. The pH of the 15 % (v/v) H₂O₂ solution was adjusted to 4.5 using 0.1 M-NaOH prior to commencing the NAG Tests. Following an overnight-reaction period, the test-mixtures were boiled for c. 2 hours. Then, after allowing the test-mixtures to cool, c. 1.0 mL of 0.016 M-CuSO₄ solution was added, and the test-mixtures again boiled for c. 2 hours. The addition of Cu(II) catalyses the decomposition of any residual, unreacted-H₂O₂ in the test-mixtures (McElnea and Ahern 2004; O'Shay *et al.* 1990). K-Feldspar was employed for the Blank.

Dr GD Campbell
28th February 2013

Graeme Campbell & Associates Pty Ltd

Laboratory Report

NET-ACID-GENERATION (NAG) TESTWORK

Sample Number	Sample Weight (g)	Comments	pH of Test Mixture Before Boiling Step	Test Mixture After Boiling Step		Titre [0.1 M-NaOH] (mL)	NAG (kg H ₂ SO ₄ /tonne)
				pH	EC (µS/cm)		
GCA10687	3.0	Reaction peaked overnight	7.4	8.7	89	-	<0.5
GCA10690	3.0	Reaction peaked overnight	8.4	7.0	32	-	<0.5
GCA10691	3.0	Reaction peaked overnight	7.2	9.1	89	-	<0.5
GCA10692	3.0	Reaction peaked overnight	6.7	7.0	36	-	<0.5
GCA10693	3.0	Reaction peaked overnight	7.0	8.4	46	-	<0.5
GCA10694	3.0	Reaction peaked overnight	9.0	8.7	85	-	<0.5
GCA10695	3.0	Reaction peaked overnight	6.0	6.8	27	0.20	<0.5
GCA10696	3.0	Reaction peaked overnight	5.7	6.5	40	0.20	<0.5
GCA10697	3.0	Reaction peaked overnight	5.7	6.8	26	0.10	<0.5
GCA10698	3.0	Reaction peaked overnight	5.5	6.6	32	0.30	<0.5
GCA10699	3.0	Reaction peaked overnight	4.4	4.6	64	0.80	1.4
GCA10700	3.0	No apparent reaction	5.3	5.8	23	0.20	<0.5
GCA10701	3.0	No apparent reaction	5.3	5.8	30	0.20	<0.5
GCA10701-1	3.0	No apparent reaction	5.3	5.8	28	0.50	0.9
BLANK3	3.0	Reaction peaked overnight	5.7	7.1	71	-	<0.5

Notes: Test conditions based on those described by Miller *et al.* (1997), and AMIRA (2002) for the 'Static-NAG-Test' in its 'Single-Addition-Mode'. The pH of the 15 % (v/v) H₂O₂ solution was adjusted to 4.5 using 0.1 M-NaOH prior to commencing the NAG Tests. Following an overnight-reaction period, the test-mixtures were boiled for c. 2 hours. Then, after allowing the test-mixtures to cool, c. 1.0 mL of 0.016 M-CuSO₄ solution was added, and the test-mixtures again boiled for c. 2 hours. The addition of Cu(II) catalyses the decomposition of any residual, unreacted-H₂O₂ in the test-mixtures (McElnea and Ahern 2004; O'Shay *et al.* 1990). K-Feldspar was employed for the Blank.

Dr GD Campbell
4th March 2013

Graeme Campbell & Associates Pty Ltd

Laboratory Report

NET-ACID-GENERATION (NAG) TESTWORK

Sample Number	Sample Weight (g)	Comments	pH of Test Mixture Before Boiling Step	Test Mixture After Boiling Step		Titre [0.1 M-NaOH] (mL)	NAG (kg H ₂ SO ₄ /tonne)
				pH	EC (µS/cm)		
GCA10702	3.0	Reaction peaked overnight	7.8	7.3	400	-	<0.5
GCA10703	3.0	Reaction peaked overnight	7.3	7.2	240	-	<0.5
GCA10704	3.0	Reaction peaked overnight	4.7	5.6	230	0.10	<0.5
GCA10705	3.0	Reaction peaked overnight	6.3	6.9	210	-	<0.5
GCA10706	3.0	Reaction peaked overnight	4.2	4.3	310	3.70	6.1
GCA10707	3.0	Reaction peaked overnight	7.9	7.3	220	-	<0.5
GCA10708	3.0	Reaction peaked overnight	3.5	3.7	410	5.50	9.0
GCA10709	3.0	Reaction peaked within 3 hours	8.5	7.7	150	-	<0.5
GCA10710	3.0	Reaction peaked within 3 hours	8.5	8.3	150	-	<0.5
GCA10711	3.0	Reaction peaked overnight	3.8	4.9	470	2.50	4.1
GCA10712	3.0	Reaction peaked overnight	4.2	5.7	380	0.30	<0.5
GCA10713	3.0	Reaction peaked overnight	4.9	6.5	380	0.10	<0.5
GCA10714	3.0	Reaction peaked overnight	6.7	7.2	210	-	<0.5
GCA10715	3.0	Reaction peaked overnight	5.8	6.6	62	0.20	<0.5
GCA10716	3.0	Reaction peaked overnight	5.9	6.3	54	0.20	<0.5
GCA10717	3.0	Reaction peaked within 30 minutes	8.4	7.0	44	-	<0.5
GCA10718	3.0	Reaction peaked overnight	6.0	5.5	250	0.30	<0.5
GCA10719	3.0	Reaction peaked within 4 hours	8.8	7.9	130	-	<0.5
GCA10719-1	3.0	Reaction peaked within 4 hours	8.8	8.1	110	-	<0.5
BLANK1	3.0	Reaction peaked overnight	5.8	7.1	41	-	<0.5

Notes: Test conditions based on those described by Miller *et al.* (1997), and AMIRA (2002) for the 'Static-NAG-Test' in its 'Single-Addition-Mode'. The pH of the 15 % (v/v) H₂O₂ solution was adjusted to 4.5 using 0.1 M-NaOH prior to commencing the NAG Tests. Following an overnight-reaction period, the test-mixtures were boiled for c. 2 hours. Then, after allowing the test-mixtures to cool, c. 1.0 mL of 0.016 M-CuSO₄ solution was added, and the test-mixtures again boiled for c. 2 hours. The addition of Cu(II) catalyses the decomposition of any residual, unreacted-H₂O₂ in the test-mixtures (McElnea and Ahern 2004; O'Shay *et al.* 1990). K-Feldspar was employed for the Blank.

Dr GD Campbell
4th March 2013

Graeme Campbell & Associates Pty Ltd

Laboratory Report

NET-ACID-GENERATION (NAG) TESTWORK

Sample Number	Sample Weight (g)	Comments	pH of Test Mixture Before Boiling Step	Test Mixture After Boiling Step		Titre [0.1 M-NaOH] (mL)	NAG (kg H ₂ SO ₄ /tonne)
				pH	EC (µS/cm)		
GCA10720	3.0	Reaction peaked overnight	5.1	4.5	340	1.90	3.2
GCA10721	3.0	Reaction peaked overnight	8.6	8.3	140	-	<0.5
GCA10722	3.0	Reaction peaked overnight	8.2	8.4	110	-	<0.5
GCA10723	3.0	Reaction peaked overnight	7.1	7.1	45	-	<0.5
GCA10724	3.0	Reaction peaked overnight	7.9	7.8	37	-	<0.5
GCA10725	3.0	Reaction peaked overnight	4.8	4.5	120	1.10	1.8
GCA10726	3.0	Reaction peaked overnight	3.2	3.4	330	5.80	9.5
GCA10727	3.0	Reaction peaked overnight	2.6	2.7	1,500	23.50	39
GCA10728	3.0	Reaction peaked overnight	2.7	2.8	1,300	15.30	25
GCA10729	3.0	Reaction peaked within 4 hours	2.4	2.6	1,900	22.70	38
GCA10730	3.0	Reaction peaked overnight	5.6	5.0	120	0.30	<0.5
GCA10731	3.0	Reaction peaked overnight	3.2	3.3	340	5.00	8.2
GCA10732	3.0	Reaction peaked overnight	4.7	6.4	260	0.20	<0.5
GCA10733	3.0	Reaction peaked overnight	2.4	2.7	1,500	23.80	38
GCA10734	3.0	Reaction peaked within 2 hours	2.3	2.5	2,200	33.70	56
GCA10735	3.0	Reaction peaked overnight	2.8	2.9	1,300	14.90	25
GCA10736	3.0	Reaction peaked overnight	3.0	3.2	820	8.60	15
GCA10737	3.0	Reaction peaked overnight	2.4	2.6	1,600	22.10	37
GCA10737-1	3.0	Reaction peaked overnight	2.4	2.6	1,600	23.10	38
BLANK2	3.0	Reaction peaked overnight	5.7	7.2	49	-	<0.5

Notes: Test conditions based on those described by Miller *et al.* (1997), and AMIRA (2002) for the 'Static-NAG-Test' in its 'Single-Addition-Mode'. The pH of the 15 % (v/v) H₂O₂ solution was adjusted to 4.5 using 0.1 M-NaOH prior to commencing the NAG Tests. Following an overnight-reaction period, the test-mixtures were boiled for c. 2 hours. Then, after allowing the test-mixtures to cool, c. 1.0 mL of 0.016 M-CuSO₄ solution was added, and the test-mixtures again boiled for c. 2 hours. The addition of Cu(II) catalyses the decomposition of any residual, unreacted-H₂O₂ in the test-mixtures (McElnea and Ahern 2004; O'Shay *et al.* 1990). K-Feldspar was employed for the Blank.

Dr GD Campbell
4th March 2013

Graeme Campbell & Associates Pty Ltd

Laboratory Report

NET-ACID-GENERATION (NAG) TESTWORK

Sample Number	Sample Weight (g)	Comments	pH of Test Mixture Before Boiling Step	Test Mixture After Boiling Step		Titre [0.1 M-NaOH] (mL)	NAG (kg H ₂ SO ₄ /tonne)
				pH	EC (µS/cm)		
GCA10738	3.0	Reaction peaked overnight	4.8	4.5	340	1.40	2.3
GCA10739	3.0	Reaction peaked overnight	4.9	4.7	98	1.10	1.8
GCA10740	3.0	Reaction peaked overnight	4.3	5.6	230	0.70	1.2
GCA10741	3.0	Reaction peaked overnight	4.7	5.6	200	0.60	1.0
GCA10742	3.0	Reaction peaked overnight	6.5	6.8	160	0.10	<0.5
GCA10743	3.0	Reaction peaked overnight	2.6	2.9	780	11.70	20
GCA10744	3.0	Reaction peaked overnight	5.0	4.7	320	0.80	1.4
GCA10745	3.0	Reaction peaked overnight	6.2	7.1	470	-	<0.5
GCA10746	3.0	Reaction peaked overnight	5.3	6.2	290	0.40	0.7
GCA10747	3.0	Reaction peaked overnight	6.3	7.1	210	-	<0.5
GCA10748	3.0	Reaction peaked overnight	4.7	4.7	230	1.20	2.0
GCA10749	3.0	Reaction peaked overnight	4.4	5.5	470	0.90	1.5
GCA10750	3.0	Reaction peaked overnight	6.9	7.1	180	-	<0.5
GCA10751	3.0	Reaction peaked overnight	3.9	3.4	470	5.30	8.7
GCA10752	3.0	Reaction peaked overnight	4.9	4.5	290	1.70	2.8
GCA10753	3.0	Reaction peaked overnight	4.3	3.7	260	3.80	6.3
GCA10754	3.0	Reaction peaked overnight	2.9	3.1	830	6.80	12
GCA10755	3.0	Reaction peaked overnight	4.8	5.4	580	0.20	<0.5
GCA10755-1	3.0	Reaction peaked overnight	4.5	5.1	630	0.60	1.0
BLANK3	3.0	Reaction peaked overnight	5.9	7.2	73	-	<0.5

Notes: Test conditions based on those described by Miller *et al.* (1997), and AMIRA (2002) for the 'Static-NAG-Test' in its 'Single-Addition-Mode'. The pH of the 15 % (v/v) H₂O₂ solution was adjusted to 4.5 using 0.1 M-NaOH prior to commencing the NAG Tests. Following an overnight-reaction period, the test-mixtures were boiled for c. 2 hours. Then, after allowing the test-mixtures to cool, c. 1.0 mL of 0.016 M-CuSO₄ solution was added, and the test-mixtures again boiled for c. 2 hours. The addition of Cu(II) catalyses the decomposition of any residual, unreacted-H₂O₂ in the test-mixtures (McElnea and Ahern 2004; O'Shay *et al.* 1990). K-Feldspar was employed for the Blank.

Dr GD Campbell
7th March 2013

Graeme Campbell & Associates Pty Ltd

Laboratory Report

NET-ACID-GENERATION (NAG) TESTWORK

Sample Number	Sample Weight (g)	Comments	pH of Test Mixture Before Boiling Step	Test Mixture After Boiling Step		Titre [0.1 M-NaOH] (mL)	NAG (kg H ₂ SO ₄ /tonne)
				pH	EC (µS/cm)		
GCA10756	3.0	Reaction peaked overnight	9.0	8.7	140	-	<0.5
GCA10756-1	3.0	Reaction peaked overnight	9.0	8.7	130	-	<0.5
BLANK4	3.0	Reaction peaked overnight	5.8	7.1	69	-	<0.5

Notes: Test conditions based on those described by Miller *et al.* (1997), and AMIRA (2002) for the 'Static-NAG-Test' in its 'Single-Addition-Mode'. The pH of the 15 % (v/v) H₂O₂ solution was adjusted to 4.5 using 0.1 M-NaOH prior to commencing the NAG Tests. Following an overnight-reaction period, the test-mixtures were boiled for c. 2 hours. Then, after allowing the test-mixtures to cool, c. 1.0 mL of 0.016 M-CuSO₄ solution was added, and the test-mixtures again boiled for c. 2 hours. The addition of Cu(II) catalyses the decomposition of any residual, unreacted-H₂O₂ in the test-mixtures (McElnea and Ahern 2004; O'Shay *et al.* 1990). K-Feldspar was employed for the Blank.

Dr GD Campbell
7th March 2013

Graeme Campbell & Associates Pty Ltd

Laboratory Report

NET-ACID-GENERATION (NAG) TESTWORK

Sample Number	Sample Weight (g)	Comments	pH of Test Mixture Before Boiling Step	Test Mixture After Boiling Step		Titre (mL) (0.1 M-NaOH)		NAG (kg H ₂ SO ₄ /tonne)	
				pH	EC (µS/cm)	To pH 4.5	pH 4.5 to pH 7.0	To pH 4.5	To pH 4.5 to pH 7.0
GCA11069fe	3.0	Reaction peaked within 2hrs	2.3	2.4	2,400	21.25	4.20	34.8	6.9
GCA11070fe	3.0	Reaction peaked overnight	2.6	2.9	1,200	7.70	3.20	12.6	5.3
GCA11071fe	3.0	Reaction peaked overnight	2.5	2.7	1,600	14.10	2.80	23.1	4.6
GCA11072fe	3.0	Reaction peaked within 2hrs	2.3	2.4	2,300	24.40	4.10	39.9	6.7
GCA11073fe	3.0	Reaction peaked overnight	2.5	2.7	1,700	14.00	5.50	22.9	9.0
GCA11074fe	3.0	Reaction peaked overnight	2.6	2.8	1,200	9.30	3.50	15.2	5.8
GCA11075fe	3.0	Reaction peaked within 2hrs	2.7	3.1	1,100	4.50	3.40	7.4	5.6
GCA11076fe	3.0	Reaction peaked overnight	2.7	2.9	1,100	7.80	4.60	12.7	7.6
GCA11077fe	3.0	Reaction peaked overnight	2.9	3.0	850	4.30	2.40	7.1	4.0
GCA11078fe	3.0	Reaction peaked within 2hrs	3.3	3.4	1,100	2.30	3.60	3.8	5.9
GCA11079fe	3.0	Reaction peaked within 2hrs	2.4	2.5	2,400	20.30	4.90	33.2	8.1
GCA11080fe	3.0	Reaction peaked overnight	2.4	2.6	1,900	16.90	1.90	27.7	3.2
GCA11081fe	3.0	Reaction peaked overnight	3.0	4.1	770	0.30	3.20	<0.5	5.3
GCA11082fe	3.0	Reaction peaked overnight	3.2	5.0	580	-	1.40	<0.5	2.3
GCA11083fe	3.0	Reaction peaked within 2hrs	2.5	2.6	1,800	14.70	4.00	24.1	6.6
GCA11084fe	3.0	Reaction peaked overnight	2.7	2.9	1,200	6.90	4.90	11.3	8.1
GCA11084fe-1	3.0	Reaction peaked overnight	2.6	2.8	1,400	8.30	4.20	13.6	6.9
Blank	3.0	No apparent reaction	5.3	6.7	64	-	-	<0.5	<0.5

Notes: Test conditions based on those described by Miller *et al.* (1997), and AMIRA (2002) for the 'Static-NAG-Test' in its 'Single-Addition-Mode'. The pH of the 15 % (v/v) H₂O₂ solution was adjusted to 4.5 using 0.1 M-NaOH prior to commencing the NAG Tests. Following an overnight-reaction period, the test-mixtures were boiled for c. 2 hours. Then, after allowing the test-mixtures to cool, c. 1.0 mL of 0.010 M-CuSO₄ solution was added, and the test-mixtures again boiled for c. 2 hours. The addition of Cu(II) catalyses the decomposition of any residual, unreacted-H₂O₂ in the test-mixtures (McElnea and Ahern 2004; O'Shay *et al.* 1990). K-Feldspar was employed for the Blank.

Dr GD Campbell
7th June 2013

Graeme Campbell & Associates Pty Ltd

Laboratory Report

NET-ACID-GENERATION (NAG) TESTWORK

Sample Number	Sample Weight (g)	Comments	pH of Test Mixture Before Boiling Step	Test Mixture After Boiling Step		Titre (mL) (0.1 M-NaOH)		NAG (kg H ₂ SO ₄ /tonne)		
				pH	EC (µS/cm)	To pH 4.5	pH 4.5 to pH 7.0	To pH 4.5	pH 4.5 to pH 7.0	To pH 7.0
GCA10729/52	3.0	Reaction peaked overnight	2.7	2.8	1,100	10.10	5.70	16.5	9.3	25.8
GCA10729/52-1	3.0	Reaction peaked overnight	2.7	2.7	1,300	10.90	3.50	17.9	5.8	23.7
Blank	3.0	Reaction peaked overnight	5.3	6.7	64	-	-	<0.5	<0.5	<0.5

Notes: Test conditions based on those described by Miller *et al.* (1997), and AMIRA (2002) for the 'Static-NAG-Test' in its 'Single-Addition-Mode'. The pH of the 15 % (v/v) H₂O₂ solution was adjusted to 4.5 using 0.1 M-NaOH prior to commencing the NAG Tests. Following an overnight-reaction period, the test-mixtures were boiled for c. 2 hours. Then, after allowing the test-mixtures to cool, c. 1.0 mL of 0.016 M-CuSO₄ solution was added, and the test-mixtures again boiled for c. 2 hours. The addition of Cu(II) catalyses the decomposition of any residual, unreacted-H₂O₂ in the test-mixtures (McElnea and Ahern 2004; O'Shay *et al.* 1990). K-Feldspar was employed for the Blank.

Dr GD Campbell
7th June 2013

Graeme Campbell & Associates Pty Ltd

Laboratory Report

pH-(1:2) & EC-(1:2) TESTWORK

SAMPLE NO.	SAMPLE WEIGHT (g)	SAMPLE + DEION.-W WEIGHT (g)	pH-(1:2)	EC-(1:2) (µS/cm)
GCA10651/53	30.0	60.0	5.5	160
GCA10663/64	30.0	60.0	4.5	150
GCA10668/69	30.0	60.0	4.8	110
GCA10674/75	30.0	60.0	4.8	240
GCA10678/79	30.0	60.0	4.5	1,200
GCA10682/83	30.0	60.0	6.3	210
GCA10687/91	30.0	60.0	8.2	200
GCA10687/91-1	30.0	60.0	8.3	230

Note: EC = Electrical-Conductivity.

Testwork performed on the as-supplied 'pulp' samples (nominal -75 µm).

pH-(1:2) and EC-(1:2) values correspond to pH and EC values of suspensions with a solid:solution ratio of c. 1:2 (w/w) prepared using deionised-water.

Drift in pH-glass-electrode less than 0.1 pH unit between commencement, and completion, of testwork.

Drift in EC-electrode less than 5 µS/cm between commencement, and completion, of testwork.

Testwork performed in a constant-temperature room (viz. 21 +/- 2-3 °C).

Dr GD Campbell
27th May 2013

*Graeme Campbell & Associates Pty Ltd**Laboratory Report***pH-(1:2) & EC-(1:2) TESTWORK**

SAMPLE NO.	SAMPLE WEIGHT (g)	SAMPLE + DEION.-W WEIGHT (g)	pH-(1:2)	EC-(1:2) (µS/cm)
GCA10706/07	30.0	60.0	6.8	410
GCA10730/31	30.0	60.0	4.5	340
GCA10740/41	30.0	60.0	6.5	350
GCA10747/48/49	30.0	60.0	6.7	160
GCA10754/55	30.0	60.0	7.5	330
GCA10754/55-1	30.0	60.0	7.5	320

Note: EC = Electrical-Conductivity.

Testwork performed on the as-supplied 'pulp' samples (nominal -75 µm).

pH-(1:2) and EC-(1:2) values correspond to pH and EC values of suspensions with a solid:solution ratio of c. 1:2 (w/w) prepared using deionised-water.

Drift in pH-glass-electrode less than 0.1 pH unit between commencement, and completion, of testwork.

Drift in EC-electrode less than 5 µS/cm between commencement, and completion, of testwork.

Testwork performed in a constant-temperature room (viz. 21 +/- 2-3 °C).

Dr GD Campbell

27th May 2013

Graeme Campbell & Associates Pty Ltd

Laboratory Report

pH-(1:2) & EC-(1:2) TESTWORK

SAMPLE NO.	SAMPLE WEIGHT (g)	SAMPLE + DEION.-W WEIGHT (g)	pH-(1:2)	EC-(1:2) (μS/cm)
GCA11069fe	30.0	60.0	4.0	740
GCA11070fe	30.0	60.0	5.6	480
GCA11071fe	30.0	60.0	5.6	510
GCA11072fe	30.0	60.0	4.7	470
GCA11073fe	30.0	60.0	5.8	680
GCA11074fe	30.0	60.0	6.1	470
GCA11075fe	30.0	60.0	6.1	500
GCA11076fe	30.0	60.0	6.1	290
GCA11077fe	30.0	60.0	3.8	1,700
GCA11078fe	30.0	60.0	5.7	1,400
GCA11079fe	30.0	60.0	5.1	1,400
GCA11080fe	30.0	60.0	5.4	440
GCA11081fe	30.0	60.0	6.2	540
GCA11082fe	30.0	60.0	7.5	160
GCA11083fe	30.0	60.0	6.8	420
GCA11084fe	30.0	60.0	6.4	590
GCA11084fe-1	30.0	60.0	6.3	530
GCA10729/52	30.0	60.0	5.0	99

Note: EC = Electrical-Conductivity.

Testwork performed on the as-supplied 'pulp' samples (nominal -75 μm).

pH-(1:2) and EC-(1:2) values correspond to pH and EC values of suspensions with a solid:solution ratio of c. 1:2 (w/w) prepared using deionised-water.

Drift in pH-glass-electrode less than 0.1 pH unit between commencement, and completion, of testwork.

Drift in EC-electrode less than 5 μS/cm between commencement, and completion, of testwork.

Testwork performed in a constant-temperature room (viz. 21 +/- 2-3 °C).

Dr GD Campbell
8th June 2013

Graeme Campbell & Associates Pty Ltd

Laboratory Report

pH-(1:2) & EC-(1:2) TESTWORK

SAMPLE NO.	SAMPLE WEIGHT (g)	SAMPLE + DEION.-W WEIGHT (g)	pH-(1:2)	EC-(1:2) (µS/cm)
GCA10651	30.0	60.0	5.3	110
GCA10652	30.0	60.0	5.0	92
GCA10653	30.0	60.0	5.2	54
GCA10654	30.0	60.0	4.9	100
GCA10655	30.0	60.0	4.6	82
GCA10656	30.0	60.0	4.6	27
GCA10657	30.0	60.0	4.6	73
GCA10658	30.0	60.0	4.3	68
GCA10660	30.0	60.0	4.8	150
GCA10661	30.0	60.0	4.8	170
GCA10661-1	30.0	60.0	4.8	170
GCA10662	30.0	60.0	4.3	150
GCA10663	30.0	60.0	4.1	85
GCA10664	30.0	60.0	4.1	110
GCA10665	30.0	60.0	4.1	250
GCA10666	30.0	60.0	4.2	460
GCA10667	30.0	60.0	4.4	190
GCA10668	30.0	60.0	4.5	96
GCA10669	30.0	60.0	4.8	45
GCA10670	30.0	60.0	4.0	130
GCA10671	30.0	60.0	5.5	84
GCA10671-1	30.0	60.0	5.6	96
GCA10672	30.0	60.0	5.3	140
GCA10673	30.0	60.0	6.3	76
GCA10674	30.0	60.0	4.3	230
GCA10675	30.0	60.0	5.0	140
GCA10676	30.0	60.0	4.6	270
GCA10677	30.0	60.0	4.4	230
GCA10678	30.0	60.0	4.3	800
GCA10679	30.0	60.0	4.4	1,300
GCA10680	30.0	60.0	4.5	750
GCA10681	30.0	60.0	4.7	120
GCA10681-1	30.0	60.0	4.7	130
GCA10682	30.0	60.0	5.7	110
GCA10683	30.0	60.0	6.1	130
GCA10684	30.0	60.0	5.4	270
GCA10685	30.0	60.0	7.7	420
GCA10686	30.0	60.0	6.5	300
GCA10687	30.0	60.0	7.8	220

Note: EC = Electrical-Conductivity.

Testwork performed on the as-supplied 'pulp' samples (nominal -75 µm).

pH-(1:2) and EC-(1:2) values correspond to pH and EC values of suspensions with a solid:solution ratio of c. 1:2 (w/w) prepared using deionised-water.

Drift in pH-glass-electrode less than 0.1 pH unit between commencement, and completion, of testwork.

Drift in EC-electrode less than 5 µS/cm between commencement, and completion, of testwork.

Testwork performed in a constant-temperature room (viz. 21 +/- 2-3 °C).

Dr GD Campbell

22nd February 2013

Graeme Campbell & Associates Pty Ltd

Laboratory Report

pH-(1:2) & EC-(1:2) TESTWORK

SAMPLE NO.	SAMPLE WEIGHT (g)	SAMPLE + DEION.-W WEIGHT (g)	pH-(1:2)	EC-(1:2) (μS/cm)
GCA10690	30.0	60.0	7.4	97
GCA10691	30.0	60.0	7.9	150
GCA10691-1	30.0	60.0	7.9	140
GCA10692	30.0	60.0	7.4	99
GCA10693	30.0	60.0	7.9	97
GCA10694	30.0	60.0	7.6	150
GCA10695	30.0	60.0	5.8	86
GCA10696	30.0	60.0	6.2	190
GCA10697	30.0	60.0	6.5	33
GCA10698	30.0	60.0	6.5	49
GCA10699	30.0	60.0	5.8	97
GCA10700	30.0	60.0	5.7	32
GCA10701	30.0	60.0	5.8	62
GCA10701-1	30.0	60.0	5.7	57

Note: EC = Electrical-Conductivity.

Testwork performed on the as-supplied 'pulp' samples (nominal -75 μm).

pH-(1:2) and EC-(1:2) values correspond to pH and EC values of suspensions with a solid:solution ratio of c. 1:2 (w/w) prepared using deionised-water.

Drift in pH-glass-electrode less than 0.1 pH unit between commencement, and completion, of testwork.

Drift in EC-electrode less than 5 μS/cm between commencement, and completion, of testwork.

Testwork performed in a constant-temperature room (viz. 21 +/- 2-3 °C).

Dr GD Campbell
23rd February 2013

Graeme Campbell & Associates Pty Ltd

Laboratory Report

pH-(1:2) & EC-(1:2) TESTWORK

SAMPLE NO.	SAMPLE WEIGHT (g)	SAMPLE + DEION.-W WEIGHT (g)	pH-(1:2)	EC-(1:2) (µS/cm)
GCA10702	30.0	60.0	6.8	460
GCA10703	30.0	60.0	6.1	600
GCA10704	30.0	60.0	6.1	1,200
GCA10705	30.0	60.0	6.7	1,100
GCA10706	30.0	60.0	6.5	560
GCA10707	30.0	60.0	7.1	590
GCA10708	30.0	60.0	4.6	720
GCA10709	30.0	60.0	7.5	560
GCA10710	30.0	60.0	7.8	510
GCA10711	30.0	60.0	6.2	1,200
GCA10712	30.0	60.0	5.4	1,500
GCA10712-1	30.0	60.0	5.4	1,500
GCA10713	30.0	60.0	6.0	700
GCA10714	30.0	60.0	6.6	850
GCA10715	30.0	60.0	5.1	830
GCA10716	30.0	60.0	5.1	410
GCA10717	30.0	60.0	6.5	340
GCA10718	30.0	60.0	7.4	410
GCA10719	30.0	60.0	7.8	330
GCA10720	30.0	60.0	7.5	250
GCA10721	30.0	60.0	8.0	230
GCA10722	30.0	60.0	7.9	280
GCA10722-1	30.0	60.0	7.9	190
GCA10723	30.0	60.0	5.1	130
GCA10724	30.0	60.0	5.8	120
GCA10725	30.0	60.0	4.6	150
GCA10726	30.0	60.0	3.7	340
GCA10727	30.0	60.0	4.1	540
GCA10728	30.0	60.0	5.2	700
GCA10729	30.0	60.0	4.6	430
GCA10730	30.0	60.0	4.9	210
GCA10731	30.0	60.0	3.7	610
GCA10732	30.0	60.0	5.8	440
GCA10732-1	30.0	60.0	5.8	440
GCA10733	30.0	60.0	3.6	340
GCA10734	30.0	60.0	3.5	350
GCA10735	30.0	60.0	5.3	690
GCA10736	30.0	60.0	5.6	820
GCA10737	30.0	60.0	4.9	1,100
GCA10738	30.0	60.0	4.8	110
GCA10739	30.0	60.0	4.1	380
GCA10740	30.0	60.0	5.9	310
GCA10741	30.0	60.0	7.0	160
GCA10742	30.0	60.0	7.9	190
GCA10742-1	30.0	60.0	8.1	180
GCA10743	30.0	60.0	5.0	460

Note: EC = Electrical-Conductivity.

Testwork performed on the as-supplied 'pulp' samples (nominal -75 µm).

pH-(1:2) and EC-(1:2) values correspond to pH and EC values of suspensions with a solid:solution ratio of c. 1:2 (w/w) prepared using deionised-water.

Drift in pH-glass-electrode less than 0.1 pH unit between commencement, and completion, of testwork.

Drift in EC-electrode less than 5 µS/cm between commencement, and completion, of testwork.

Testwork performed in a constant-temperature room (viz. 21 +/- 2-3 °C).

Dr GD Campbell 27th February 2013

Graeme Campbell & Associates Pty Ltd

Laboratory Report

pH-(1:2) & EC-(1:2) TESTWORK

SAMPLE NO.	SAMPLE WEIGHT (g)	SAMPLE + DEION.-W WEIGHT (g)	pH-(1:2)	EC-(1:2) (µS/cm)
GCA10744	30.0	60.0	6.6	550
GCA10745	30.0	60.0	6.7	360
GCA10746	30.0	60.0	6.7	200
GCA10747	30.0	60.0	7.9	160
GCA10748	30.0	60.0	7.2	170
GCA10749	30.0	60.0	7.3	160
GCA10750	30.0	60.0	7.3	160
GCA10751	30.0	60.0	6.7	180
GCA10752	30.0	60.0	6.5	240
GCA10752-1	30.0	60.0	6.4	220
GCA10753	30.0	60.0	6.3	210
GCA10754	30.0	60.0	7.6	210
GCA10755	30.0	60.0	7.6	240
GCA10756	30.0	60.0	8.2	140
GCA10756-1	30.0	60.0	8.2	140

Note: EC = Electrical-Conductivity.

Testwork performed on the as-supplied 'pulp' samples (nominal -75 µm).

pH-(1:2) and EC-(1:2) values correspond to pH and EC values of suspensions with a solid:solution ratio of c. 1:2 (w/w) prepared using deionised-water.

Drift in pH-glass-electrode less than 0.1 pH unit between commencement, and completion, of testwork.

Drift in EC-electrode less than 5 µS/cm between commencement, and completion, of testwork.

Testwork performed in a constant-temperature room (viz. 21 +/- 2-3 °C).

Dr GD Campbell
27th February 2013

*Graeme Campbell & Associates Pty Ltd**Laboratory Report***pH-BUFFERING TESTWORK (GCA10782/83)**

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH
0.00	0.0	6.9
0.40	0.4	5.5
0.80	0.8	4.9
1.20	1.2	4.4
1.60	1.6	4.0
2.00	2.0	3.8
2.40	2.4	3.6
2.80	2.7	3.4
3.20	3.1	3.3
3.60	3.5	3.2
4.00	3.9	3.1
4.40	4.3	3.0

Note: Titration performed using a Metrohm® 736 Titrino auto-titrator, and 0.05 M-H₂SO₄. Equilibration time between titrant additions was 15 minutes. 5.00 g of pulped sample initially dispersed in 150 mL of deionised-water. Test mixture in contact with air, at ambient temperature, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = 2 mV (pH=7.00); slope-point = 174 mV (pH=4.00); 95.5 % of Nernstian response for 25 °C.

Immediately following titration: pH=7.00 buffer read pH=7.02 and pH=4.00 buffer read pH=4.03. These discrepancies represent drift in pH-Glass electrode response during course of auto-titration.

Dr GD Campbell
23rd March 2014

Graeme Campbell & Associates Pty Ltd

Laboratory Report

pH-BUFFERING TESTWORK (GCA10710)

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH
0.00	0.0	8.3
0.40	2.0	6.7
0.80	3.9	6.2
1.20	5.9	5.9
1.60	7.8	5.6
2.00	10	5.3
2.40	12	5.1
2.80	14	4.9
3.20	16	4.7
3.60	18	4.4
4.00	20	4.2
4.40	22	3.9
4.80	24	3.7
5.20	25	3.5
5.60	27	3.4
6.00	29	3.3
6.40	31	3.2
6.80	33	3.1
7.20	35	3.0
7.60	37	3.0

Note: Titration performed using a Metrohm® 736 Titrino auto-titrator, and 0.05 M-H₂SO₄. Equilibration time between titrant additions was 15 minutes. 1.00 g of pulped sample initially dispersed in 150 mL of deionised-water. Test mixture in contact with air, at ambient temperature, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = 9 mV (pH=7.00); slope-point = 178 mV (pH=4.00); 95.2 % of Nernstian response for 25 °C.

Immediately following titration: pH=7.00 buffer read pH=7.02 and pH=4.00 buffer read pH=4.03. These discrepancies represent drift in pH-Glass electrode response during course of auto-titration.

Dr GD Campbell
23rd January 2014

*Graeme Campbell & Associates Pty Ltd**Laboratory Report***pH-BUFFERING TESTWORK (GCA10714)**

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH
0.00	0.0	7.5
0.40	2.0	6.0
0.80	3.9	5.4
1.20	5.9	5.0
1.60	7.8	4.7
2.00	10	4.4
2.40	12	4.1
2.80	14	3.8
3.20	16	3.7
3.60	18	3.5
4.00	20	3.4
4.40	22	3.3
4.80	24	3.2
5.20	25	3.1
5.60	27	3.1
6.00	29	3.0

Note: Titration performed using a Metrohm® 736 Titrino auto-titrator, and 0.05 M-H₂SO₄. Equilibration time between titrant additions was 15 minutes. 1.00 g of pulped sample initially dispersed in 150 mL of deionised-water. Test mixture in contact with air, at ambient temperature, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = 9 mV (pH=7.00); slope-point = 178 mV (pH=4.00); 95.1 % of Nernstian response for 25 °C.

Immediately following titration: pH=7.00 buffer read pH=7.02 and pH=4.00 buffer read pH=4.03. These discrepancies represent drift in pH-Glass electrode response during course of auto-titration.

Dr GD Campbell
23rd January 2014

Graeme Campbell & Associates Pty Ltd

Laboratory Report

pH-BUFFERING TESTWORK (GCA10722)

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH
0.00	0.0	8.3
0.40	2.0	6.6
0.80	3.9	6.0
1.20	5.9	5.6
1.60	7.8	5.3
2.00	10	5.0
2.40	12	4.8
2.80	14	4.6
3.20	16	4.4
3.60	18	4.2
4.00	20	4.0
4.40	22	3.9
4.80	24	3.7
5.20	25	3.6
5.60	27	3.5
6.00	29	3.4
6.40	31	3.3
6.80	33	3.3
7.20	35	3.2
7.60	37	3.1
8.00	39	3.1
8.40	41	3.0
8.80	43	3.0

Note: Titration performed using a Metrohm[®] 736 Titrino auto-titrator, and 0.05 M-H₂SO₄. Equilibration time between titrant additions was 15 minutes. 1.00 g of pulped sample initially dispersed in 150 mL of deionised-water. Test mixture in contact with air, at ambient temperature, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = 10 mV (pH=7.00); slope-point = 179 mV (pH=4.00); 94.8 % of Nernstian response for 25 °C.

Immediately following titration: pH=7.00 buffer read pH=7.02 and pH=4.00 buffer read pH=4.03. These discrepancies represent drift in pH-Glass electrode response during course of auto-titration.

Dr GD Campbell
23rd January 2014

Graeme Campbell & Associates Pty Ltd

Laboratory Report

pH-BUFFERING TESTWORK (GCA10736)

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH	Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH
0.00	0.0	7.5	16.80	16	3.5
0.40	0.4	6.8	17.20	17	3.5
0.80	0.8	6.4	17.60	17	3.5
1.20	1.2	6.2	18.00	18	3.4
1.60	1.6	6.0	18.40	18	3.4
2.00	2.0	5.8	18.80	18	3.4
2.40	2.4	5.6	19.20	19	3.4
2.80	2.7	5.5	19.60	19	3.3
3.20	3.1	5.3	20.00	20	3.3
3.60	3.5	5.2	20.40	20	3.3
4.00	3.9	5.1	20.80	20	3.3
4.40	4.3	4.9	21.20	21	3.3
4.80	4.7	4.8	21.60	21	3.2
5.20	5.1	4.7	22.00	22	3.2
5.60	5.5	4.7	22.40	22	3.2
6.00	5.9	4.6	22.80	22	3.2
6.40	6.3	4.5	23.20	23	3.1
6.80	6.7	4.5	23.60	23	3.1
7.20	7.1	4.4	24.00	24	3.1
7.60	7.4	4.3	24.40	24	3.1
8.00	7.8	4.3	24.80	24	3.1
8.40	8.2	4.3	25.20	25	3.1
8.80	8.6	4.2	25.60	25	3.0
9.20	9.0	4.2	26.00	25	3.0
9.60	9.4	4.1			
10.00	9.8	4.1			
10.40	10	4.1			
10.80	11	4.0			
11.20	11	4.0			
11.60	11	4.0			
12.00	12	3.9			
12.40	12	3.9			
12.80	13	3.8			
13.20	13	3.8			
13.60	13	3.8			
14.00	14	3.7			
14.40	14	3.7			
14.80	15	3.7			
15.20	15	3.6			
15.60	15	3.6			
16.00	16	3.6			
16.40	16	3.6			

Note: Titration performed using a Metrohm® 736 Titrino auto-titrator, and 0.05 M-H₂SO₄. Equilibration time between titrant additions was 15 minutes. 5.00 g of pulped sample initially dispersed in 150 mL of deionised-water. Test mixture in contact with air, at ambient temperature, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = 9 mV (pH=7.00); slope-point = 178 mV (pH=4.00); 95.2 % of Nernstian response for 25 °C.

Immediately following titration: pH=7.00 buffer read pH=7.02 and pH=4.00 buffer read pH=4.03. These discrepancies represent drift in pH-Glass electrode response during course of auto-titration.

Dr GD Campbell
24th January 2014

Graeme Campbell & Associates Pty Ltd

Laboratory Report

pH-BUFFERING TESTWORK (GCA10747)

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH	Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH
0.00	0.0	8.7	16.80	16	3.6
0.40	0.4	7.4	17.20	17	3.6
0.80	0.8	6.8	17.60	17	3.5
1.20	1.2	6.5	18.00	18	3.5
1.60	1.6	6.2	18.40	18	3.5
2.00	2.0	6.0	18.80	18	3.4
2.40	2.4	5.8	19.20	19	3.4
2.80	2.7	5.7	19.60	19	3.4
3.20	3.1	5.5	20.00	20	3.3
3.60	3.5	5.4	20.40	20	3.3
4.00	3.9	5.3	20.80	20	3.3
4.40	4.3	5.2	21.20	21	3.2
4.80	4.7	5.1	21.60	21	3.2
5.20	5.1	5.0	22.00	22	3.2
5.60	5.5	4.9	22.40	22	3.1
6.00	5.9	4.9	22.80	22	3.1
6.40	6.3	4.8	23.20	23	3.1
6.80	6.7	4.7	23.60	23	3.1
7.20	7.1	4.7	24.00	24	3.0
7.60	7.4	4.6	24.40	24	3.0
8.00	7.8	4.6			
8.40	8.2	4.5			
8.80	8.6	4.4			
9.20	9.0	4.4			
9.60	9.4	4.3			
10.00	9.8	4.3			
10.40	10	4.3			
10.80	11	4.2			
11.20	11	4.2			
11.60	11	4.1			
12.00	12	4.1			
12.40	12	4.0			
12.80	13	4.0			
13.20	13	4.0			
13.60	13	3.9			
14.00	14	3.9			
14.40	14	3.8			
14.80	15	3.8			
15.20	15	3.7			
15.60	15	3.7			
16.00	16	3.7			
16.40	16	3.6			

Note: Titration performed using a Metrohm® 736 Titrino auto-titrator, and 0.05 M-H₂SO₄. Equilibration time between titrant additions was 15 minutes. 5.00 g of pulped sample initially dispersed in 150 mL of deionised-water. Test mixture in contact with air, at ambient temperature, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = 9 mV (pH=7.00); slope-point = 177 mV (pH=4.00); 95.4 % of Nernstian response for 25 °C.

Immediately following titration: pH=7.00 buffer read pH=7.02 and pH=4.00 buffer read pH=4.03. These discrepancies represent drift in pH-Glass electrode response during course of auto-titration.

Dr GD Campbell
23rd January 2014

Graeme Campbell & Associates Pty Ltd

Laboratory Report

pH-BUFFERING TESTWORK (GCA10754/55)

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH	Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH
0.00	0.0	8.3	13.60	13	5.0
0.40	0.4	7.2	14.00	14	5.0
0.80	0.8	6.8	14.40	14	4.9
1.20	1.2	6.6	14.80	15	4.9
1.60	1.6	6.5	15.20	15	4.8
2.00	2.0	6.4	15.60	15	4.8
2.40	2.4	6.4	16.00	16	4.7
2.80	2.7	6.3	16.40	16	4.7
3.20	3.1	6.2	16.80	16	4.7
3.60	3.5	6.2	17.20	17	4.6
4.00	3.9	6.1	17.60	17	4.6
4.40	4.3	6.1	18.00	18	4.5
4.80	4.7	6.0	18.40	18	4.5
5.20	5.1	6.0	18.80	18	4.4
5.60	5.5	5.9	19.20	19	4.4
6.00	5.9	5.9	19.60	19	4.3
6.40	6.3	5.8	20.00	20	4.2
6.80	6.7	5.8	20.40	20	4.2
7.20	7.1	5.7	20.80	20	4.1
7.60	7.4	5.7	21.20	21	4.0
8.00	7.8	5.6			
8.40	8.2	5.6			
8.80	8.6	5.5			
9.20	9.0	5.5			
9.60	9.4	5.4			
10.00	9.8	5.4			
10.40	10	5.3			
10.80	11	5.3			
11.20	11	5.2			
11.60	11	5.2			
12.00	12	5.2			
12.40	12	5.1			
12.80	13	5.1			
13.20	13	5.0			

Note: Titration performed using a Metrohm® 736 Titrino auto-titrator, and 0.05 M-H₂SO₄. Equilibration time between titrant additions was 15 minutes. 5.00 g of pulped sample initially dispersed in 150 mL of deionised-water. Test mixture in contact with air, at ambient temperature, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = 2 mV (pH=7.00); slope-point = 171 mV (pH=4.00); 95.1 % of Nernstian response for 25 °C.

Immediately following titration: pH=7.00 buffer read pH=7.02 and pH=4.00 buffer read pH=4.03. These discrepancies represent drift in pH-Glass electrode response during course of auto-titration.

Dr GD Campbell
21nd March 2014

Graeme Campbell & Associates Pty Ltd

Laboratory Report

pH-BUFFERING TESTWORK (GCA10754)

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH
0.00	0.0	8.0
0.40	2.0	6.5
0.80	3.9	6.0
1.20	5.9	5.6
1.60	7.8	5.4
2.00	10	5.2
2.40	12	5.0
2.80	14	4.7
3.20	16	4.6
3.60	18	4.2
4.00	20	4.0
4.40	22	3.7
4.80	24	3.5
5.20	25	3.4
5.60	27	3.3
6.00	29	3.2
6.40	31	3.1
6.80	33	3.0

Note: Titration performed using a Metrohm® 736 Titrino auto-titrator, and 0.05 M-H₂SO₄. Equilibration time between titrant additions was 15 minutes. 1.00 g of pulped sample initially dispersed in 150 mL of deionised-water. Test mixture in contact with air, at ambient temperature, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = 9 mV (pH=7.00); slope-point = 178 mV (pH=4.00); 95.0 % of Nernstian response for 25 °C.

Immediately following titration: pH=7.00 buffer read pH=7.02 and pH=4.00 buffer read pH=4.03. These discrepancies represent drift in pH-Glass electrode response during course of auto-titration.

Dr GD Campbell
23rd January 2014

*Graeme Campbell & Associates Pty Ltd**Laboratory Report***pH-BUFFERING TESTWORK (GCA10755)**

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH
0.00	0.0	8.4
0.40	2.0	7.1
0.80	3.9	6.7
1.20	5.9	6.5
1.60	7.8	6.3
2.00	10	6.2
2.40	12	6.0
2.80	14	5.9
3.20	16	5.7
3.60	18	5.6
4.00	20	5.4
4.40	22	5.2
4.80	24	5.0
5.20	25	4.8
5.60	27	4.6
6.00	29	4.2
6.40	31	3.9
6.80	33	3.6
7.20	35	3.4
7.60	37	3.3
8.00	39	3.2
8.40	41	3.1
8.80	43	3.0

Note: Titration performed using a Metrohm® 736 Titrino auto-titrator, and 0.05 M-H₂SO₄. Equilibration time between titrant additions was 15 minutes. 1.00 g of pulped sample initially dispersed in 150 mL of deionised-water. Test mixture in contact with air, at ambient temperature, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = 10 mV (pH=7.00); slope-point = 178 mV (pH=4.00); 94.4 % of Nernstian response for 25 °C.

Immediately following titration: pH=7.00 buffer read pH=7.02 and pH=4.00 buffer read pH=4.03. These discrepancies represent drift in pH-Glass electrode response during course of auto-titration.

Dr GD Campbell
22nd January 2014

Graeme Campbell & Associates Pty Ltd

Laboratory Report

pH-BUFFERING TESTWORK (GCA10756)

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH
0.00	0.0	8.9
0.40	2.0	7.5
0.80	3.9	7.0
1.20	5.9	6.8
1.60	7.8	6.7
2.00	10	6.6
2.40	12	6.4
2.80	14	6.4
3.20	16	6.3
3.60	18	6.2
4.00	20	6.2
4.40	22	6.1
4.80	24	6.1
5.20	25	6.0
5.60	27	6.0
6.00	29	5.9
6.40	31	5.8
6.80	33	5.8
7.20	35	5.7
7.60	37	5.7
8.00	39	5.6
8.40	41	5.5
8.80	43	5.4
9.20	45	5.3
9.60	47	5.3
10.00	49	5.2
10.40	51	5.1
10.80	53	5.0
11.20	55	4.9
11.60	57	4.8
12.00	59	4.7
12.40	61	4.7
12.80	63	4.6
13.20	65	4.5
13.60	67	4.4
14.00	69	4.3
14.40	71	4.1
14.80	73	4.0
15.20	74	3.9
15.60	76	3.8
16.00	78	3.6
16.40	80	3.5
16.80	82	3.4
17.20	84	3.4
17.60	86	3.3
18.00	88	3.2
18.40	90	3.1
18.80	92	3.1
19.20	94	3.0
19.60	96	3.0

Note: Titration performed using a Metrohm® 736 Titrino auto-titrator, and 0.05 M-H₂SO₄. Equilibration time between titrant additions was 15 minutes. 1.00 g of pulped sample initially dispersed in 150 mL of deionised-water. Test mixture in contact with air, at ambient temperature, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = 10 mV (pH=7.00); slope-point = 178 mV (pH=4.00); 95.1 % of Nernstian response for 25 °C.

Immediately following titration: pH=7.00 buffer read pH=7.02 and pH=4.00 buffer read pH=4.03. These discrepancies represent drift in pH-Glass electrode response during course of auto-titration.

Dr GD Campbell
21st January 2014

Graeme Campbell & Associates Pty Ltd

Laboratory Report

pH-BUFFERING TESTWORK (GCA10787/91)

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH	Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH
0.00	0.0	8.5	13.60	13	4.3
0.40	0.4	7.1	14.00	14	4.3
0.80	0.8	6.6	14.40	14	4.2
1.20	1.2	6.4	14.80	15	4.1
1.60	1.6	6.3	15.20	15	4.0
2.00	2.0	6.1	15.60	15	4.0
2.40	2.4	6.0	16.00	16	3.9
2.80	2.7	5.9	16.40	16	3.8
3.20	3.1	5.8	16.80	16	3.7
3.60	3.5	5.8	17.20	17	3.7
4.00	3.9	5.7	17.60	17	3.6
4.40	4.3	5.6	18.00	18	3.5
4.80	4.7	5.5	18.40	18	3.5
5.20	5.1	5.5	18.80	18	3.4
5.60	5.5	5.4	19.20	19	3.3
6.00	5.9	5.3	19.60	19	3.3
6.40	6.3	5.3	20.00	20	3.2
6.80	6.7	5.2	20.40	20	3.2
7.20	7.1	5.2	20.80	20	3.1
7.60	7.4	5.1	21.20	21	3.1
8.00	7.8	5.1	21.60	21	3.0
8.40	8.2	5.0			
8.80	8.6	5.0			
9.20	9.0	4.9			
9.60	9.4	4.9			
10.00	9.8	4.8			
10.40	10	4.8			
10.80	11	4.7			
11.20	11	4.7			
11.60	11	4.6			
12.00	12	4.6			
12.40	12	4.5			
12.80	13	4.4			
13.20	13	4.3			

Note: Titration performed using a Metrohm® 736 Titrino auto-titrator, and 0.05 M-H₂SO₄. Equilibration time between titrant additions was 15 minutes. 5.00 g of pulped sample initially dispersed in 150 mL of deionised-water. Test mixture in contact with air, at ambient temperature, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = 2 mV (pH=7.00); slope-point = 171 mV (pH=4.00); 95.4 % of Nernstian response for 25 °C.

Immediately following titration: pH=7.00 buffer read pH=7.02 and pH=4.00 buffer read pH=4.03. These discrepancies represent drift in pH-Glass electrode response during course of auto-titration.

Dr GD Campbell
22nd March 2014

GLS Job Code 143.0/1300615

Client ON GCA 1220/1



GENALYSIS
LABORATORY SERVICES



Accredited for compliance with ISO/IEC 17025

Dr G Campbell
CAMPBELL, GRAEME and ASSOCIATES PTY LTD
PO Box 247
BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1300615
No. of SAMPLES	20
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates
DATE RECEIVED	14/01/2013
DATE COMPLETED	28/02/2013

LEGEND

X = Less than Detection Limit
NR = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

A range of solutions were received to be analysed. EC and pH were measured on the raw samples Genalysis method codes: ENV_W002 (EC), ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for HCO₃ and any sample with a pH less than 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 21st Edition 2005

The HNO₃ dosed solutions which were also analysed for the requested element suite by ICPOES and ICPMS Genalysis method code: ICP_W004 (OES) ICP_W003 (MS)

Results of analysis on:

Element		pH	Acidity	HCO ₃	EC
Method		/MTR	/VOL	/VOL	/MTR
Detection		0.1	1	1	10
Units		NONE	mgH ₂ SO ₄ /L	mgHCO ₃ /L	uS/cm
Sample Name					
Control Blank		5.4			
GCA10039-0 RAW		3.3	219		1180
GCA10039-0 RAW	check	3.3	227		1187
GCA10039-2 RAW		3.6	110		639
GCA10043-0 RAW		6.6		8	579
GCA10043-2 RAW		5	26	2	479
GCA10044-0 RAW		5.4	93		1036
GCA10044-2 RAW		7.2		3	1038
GCA10049-0 RAW		6.9		20	538
GCA10049-2 RAW		4.8		10	368
GCA10053-0 RAW		5	24	1	844
GCA10053-2 RAW		4.4	25		792

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BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1300615

Client ON GCA 1220/1

Element	Al	As	Cd	Cu	Fe-Sol	Mn	Pb	S	Zn
Method	/OE	/MS	/MS	/OE	/OE	/OE	/MS	/OE	/OE
Detection	0.01	0.1	0.02	0.01	0.01	0.01	0.5	0.1	0.01
Units	mg/l	ug/l	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l
Sample Name									
Control Blank	X	X	X	X	X	X	X	0.1	X
GCA10039-0 HNO3	14.93	907	247	0.08	9.19	35.1	2295	178.7	41.24
GCA10039-2 HNO3	3.15	398	121	X	7.89	29.5	1497	85.6	31.14
GCA10043-0 HNO3	0.04	1.6	0.32	X	0.03	31.9	4.7	82.1	6.42
GCA10043-2 HNO3	0.06	0.9	0.18	X	0.32	28.6	39.8	69.7	5.02
GCA10044-0 HNO3	0.68	9.1	3.94	0.02	4.02	112.8	142.8	179.7	30.05
GCA10044-2 HNO3	0.26	6.4	3.49	X	0.14	130.7	83.4	201.1	30.53
GCA10049-0 HNO3	X	1.8	0.12	X	X	3.5	1	72.2	0.16
GCA10049-2 HNO3	0.01	1.5	0.09	X	0.02	2.2	1.6	50	0.05
GCA10053-0 HNO3	0.52	10.3	4.36	X	1.64	45.0	41.6	134.9	2.81
GCA10053-2 HNO3	0.14	5.8	3.94	X	0.41	58.2	17.7	133.4	2.33
AlcoaHi3-OES	51.66			2.66	97.65	19.8		249.8	20.01
Alcoa-High5-MS		104.7	19.63				19.3		
SOLN-001		1055							
SOLN-002							1001		

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 28/02/2013

GLS Job Code 143.0/1301318

Client ON GCA 1220/1



GENALYSIS
LABORATORY SERVICES



Accredited for compliance with ISO/IEC 17025

Dr G Campbell
CAMPBELL, GRAEME and ASSOCIATES PTY LTD
PO Box 247
BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1301318
No. of SAMPLES	24
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates
DATE RECEIVED	31/01/2013
DATE COMPLETED	28/02/2013

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

A range of solutions were received to be analysed. EC and pH were measured on the raw samples Genalysis method codes: ENV_W002 (EC), ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for HCO₃ and any sample with a pH less than 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 21st Edition 2005

The HNO₃ dosed solutions which were also analysed for the requested element suite by ICPOES and ICPMS Genalysis method code: ICP_W004 (OES) ICP_W003 (MS)

Results of analysis on:

Element		Acidy	EC	HCO ₃	pH
Method		/VOL	/MTR	/VOL	/MTR
Detection		1	0.01	1	0.1
Units		mgH ₂ SO ₄ /L	mS/cm	mgHCO ₃ /L	NONE
Sample Name					
Control Blank				2	
GCA10039-4 RAW		121	0.62		3.6
GCA10039-4 RAW	check	126	0.61		3.6
GCA10039-6 RAW		125	0.57		3.5
GCA10043-4 RAW			0.55	4	5.8
GCA10043-6 RAW			0.38	3	5.8
GCA10044-4 RAW			1.07	2	5.2
GCA10044-6 RAW			0.9	2	5.0
GCA10049-4 RAW			0.22	10	6.6
GCA10049-6 RAW			0.18	11	6.8
GCA10053-4 RAW			0.69	2	5.0
GCA10053-6 RAW			0.5	2	5.4

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BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1301318

Client ON GCA 1220/1

Element	Al	As	Cd	Cu	Fe-Sol	Mn	Pb	S	Zn
Method	/OE	/MS	/MS	/OE	/OE	/OE	/MS	/OE	/OE
Detection	0.01	0.10	0.02	0.01	0.01	0.01	0.50	0.10	0.01
Units	mg/l	ug/l	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l
Sample Name									
Control Blank	X	X	X	X	X	X	X	X	X
GCA10039-4 HNO3	3.12	300.7	111.6	X	11.42	30.5	984.1	80.8	31.7
GCA10039-6 HNO3	3.32	263.1	91.0	0.01	13.94	27.0	759.8	71.0	28.1
GCA10043-4 HNO3	0.07	1.30	0.28	X	0.03	36.1	28.0	79.1	6.0
GCA10043-6 HNO3	0.05	0.70	0.28	X	0.06	25.0	28.2	51.9	4.4
GCA10044-4 HNO3	0.31	1.30	3.90	X	0.23	153.3	354.5	191.0	38.0
GCA10044-6 HNO3	0.28	1.30	3.93	X	0.27	145.3	524.1	156.7	36.2
GCA10049-4 HNO3	0.02	1.90	0.13	X	X	1.33	3.30	25.80	0.09
GCA10049-6 HNO3	X	1.70	0.07	X	X	1.03	4.00	20.30	0.07
GCA10053-4 HNO3	0.10	3.40	3.64	X	0.17	61.5	14.9	106.8	1.94
GCA10053-6 HNO3	0.09	2.20	2.86	X	0.04	48.6	12.4	74.0	1.37
DW-4 HNO3	X	0.50	0.17	X	X	X	X	X	0.03
DW-4 HNO3	X	X	X	X	X	X	X	X	0.03
DW-6 HNO3	0.01	1.30	0.66	X	X	X	X	X	0.02
Blank-4 HNO3	0.03	0.40	0.13	X	X	X	2.60	0.10	0.03
Blank-6 HNO3	X	X	X	X	X	X	X	X	0.01
Alcoa12-OES	2.01			0.51	2.04	0.50		19.30	0.50
Alcoa18-MS		26.20	5.16				5.80		

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 28/02//2013

GLS Job Code 143.0/1302741

Client ON GCA 1220/1



GENALYSIS
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JOB INFORMATION

JOB CODE	143/1302741
No. of SAMPLES	24
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates
DATE RECEIVED	27/02/2013
DATE COMPLETED	20/03/2013

LEGEND

X = Less than Detection Limit
NR = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

A range of solutions were received to be analysed. EC and pH were measured on the raw samples Genalysis method codes: ENV_W002 (EC), ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for HCO₃ and any sample with a pH less than 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 21st Edition 2005

The HNO₃ dosed solutions which were also analysed for the requested element suite by ICPOES and ICPMS Genalysis method code: ICP_W004 (OES) ICP_W003 (MS)

Results of analysis on:

Element		Acidy	EC	HCO ₃	pH
Method		/VOL	/MTR	/VOL	/MTR
Detection		1	10	1	0.1
Units		mgH ₂ SO ₄ /L	uS/cm	mgHCO ₃ /L	NONE
Sample Name					
Control Blank					
GCA10039-8 RAW		142	597		3.3
GCA10039-8 RAW	check	144	603		3.3
GCA10039-10 RAW		146	618		3.2
GCA10043-8 RAW			345	4	5.9
GCA10043-10 RAW			278	4	5.8
GCA10044-8 RAW			836	3	5.1
GCA10044-10 RAW		93	767		5.0
GCA10049-8 RAW			166	13	6.6
GCA10049-10 RAW			137	18	6.9
GCA10053-8 RAW			442	3	5.5
GCA10053-10 RAW			402	3	5.5

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BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1302741

Client ON GCA 1220/1

Element	Al	As	Cd	Cu	Fe-Sol	Mn	Pb	S	Zn
Method	/OE	/MS	/MS	/OE	/OE	/OE	/MS	/OE	/OE
Detection	0.01	0.1	0.02	0.01	0.01	0.01	0.5	0.1	0.01
Units	mg/l	ug/l	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l
Sample Name									
Control Blank	X	0.1	0.04	X	0.02	0.02	X	0.1	0.02
GCA10039-8 HNO3	3.67	275	78.8	0.01	18.3	25.5	855.6	65.9	27.89
GCA10039-10 HNO3	4.42	242	67	0.03	18.6	21.2	589.9	60.7	23.32
GCA10043-8 HNO3	0.03	0.8	0.35	X	0.06	24.9	27.5	44.6	4.63
GCA10043-10 HNO3	0.03	0.5	0.21	X	0.04	20.6	26.5	34.6	3.84
GCA10044-8 HNO3	0.21	1.6	3.52	X	0.44	138.3	571.8	133	37
GCA10044-10 HNO3	0.21	2	3.68	X	0.46	140.2	558.8	126	37
GCA10049-8 HNO3	0.05	1.9	0.07	X	X	0.82	9.4	17.1	0.03
GCA10049-10 HNO3	0.02	1.7	0.06	X	X	0.7	5.6	12.4	0.04
GCA10053-8 HNO3	0.06	3.1	2.71	X	0.1	46.11	14.8	63.3	1.3
GCA10053-10 HNO3	0.06	2.7	2.72	X	0.1	46.06	17.1	56.4	1.24
DW-8 HNO3	X	X	X	X	X	X	X	X	0.01
DW-10 HNO3	X	X	X	X	X	X	X	X	X
Blank-8 HNO3	X	0.1	X	X	X	X	X	X	X
Blank-10 HNO3	X	0.4	X	0.01	X	X	X	X	X
Alcoa12-OES	2.05			0.51	2	0.5		20	0.51
Alcoa18-MS		29.6	4.91				5.6		

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 20/03/2013

GLS Job Code 143.0/1305336

Client ON GCA 1220/1



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JOB INFORMATION

JOB CODE	143/1305336
No. of SAMPLES	12
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates
DATE RECEIVED	16/04/2013
DATE COMPLETED	30/04/2013

LEGEND

X = Less than Detection Limit
NR = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

A range of solutions were received to be analysed. pH was measured on the raw samples Genalysis method code: ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 21st Edition 2005

The HNO₃ dosed solutions which were also analysed for the requested element suite by ICPOES and ICPMS Genalysis method code: ICP_W004 (OES) ICP_W003 (MS)

Results of analysis on:

Element		Acidy	EC	HCO ₃	pH
Method		/VOL	/MTR	/VOL	/MTR
Detection		1	10	1	0.1
Units		mgH ₂ SO ₄ /L	uS/cm	mgHCO ₃ /L	NONE
Sample Name					
GCA10039-12 RAW		201	772		2.9
GCA10039-12 RAW	check	201	773		2.9
GCA10043-12 RAW			248	4	6.1
GCA10044-12 RAW			714	2	5.1
GCA10049-12 RAW			120	15	7
GCA10053-12 RAW			366	3	5.6

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BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1305336

Client ON GCA 1220/1

Element	As	Cd	Pb
Method	/MS	/MS	/MS
Detection	0.1	0.02	0.5
Units	ug/l	ug/l	ug/l
Sample Name			
Control Blank	X	X	X
GCA10039-12 HNO3	228.6	75.62	613.2
GCA10043-12 HNO3	0.6	0.35	20.2
GCA10044-12 HNO3	1.7	3.95	521.6
GCA10049-12 HNO3	1.2	0.07	4.1
GCA10053-12 HNO3	2.3	2.91	18.3
DW-12 HNO3	X	X	X
Blank-12 HNO3	0.1	X	X
Alcoa18-MS	26.7	5.17	5.5

Element	Al	Ca	Cu	Fe-Sol	K	Mg
Method	/OE	/OE	/OE	/OE	/OE	/OE
Detection	0.01	0.01	0.01	0.01	0.1	0.01
Units	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Sample Name						
Control Blank	X	X	X	X	X	X
GCA10039-12 HNO3	6.92	5.66	0.06	28.66	4.7	5.02
GCA10043-12 HNO3	0.05	14.37	X	0.05	7.4	5.9
GCA10044-12 HNO3	0.23	26.12	X	0.19	7.6	8.23
GCA10049-12 HNO3	0.04	9.29	X	X	6.7	3.37
GCA10053-12 HNO3	0.12	21.8	X	0.02	9	6.61
DW-12 HNO3	X	0.02	X	X	X	X
Blank-12 HNO3	0.01	0.02	0.02	X	X	0.04
Alcoa12-OES	1.99	49.83	0.51	2.03	4	49.5

Element	Mn	Na	S	Si	Zn
Method	/OE	/OE	/OE	/OE	/OE
Detection	0.01	0.1	0.1	0.05	0.01
Units	mg/l	mg/l	mg/l	mg/l	mg/l
Sample Name					
Control Blank	X	X	X	X	X
GCA10039-12 HNO3	22.22	1.1	77.8	5.84	24.92
GCA10043-12 HNO3	20.14	1.2	33.8	1.03	3.85
GCA10044-12 HNO3	141.85	0.9	130	2.05	36.29
GCA10049-12 HNO3	0.92	1.7	12.1	1.41	0.13
GCA10053-12 HNO3	47.41	0.7	54.8	2.63	1.29
DW-12 HNO3	X	X	X	X	0.02
Blank-12 HNO3	X	0.2	X	X	0.05
Alcoa12-OES	0.5	248.3	20.5	19.18	0.49

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 30/04/2013

GLS Job Code 143.0/1305130

Client ON GCA 1220/1



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JOB INFORMATION

JOB CODE	143/1305130
No. of SAMPLES	12
CLIENT O/N	GCA 1220/1
PROJECT	BOWDENS
STATE	Column leachates
DATE RECEIVED	12/04/2013
DATE COMPLETED	2/05/2013

LEGEND

X = Less than Detection Limit
NR = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

A range of solutions were received to be analysed. EC and pH were measured on the raw samples Genalysis method codes: ENV_W002 (EC), ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 21st Edition 2005

The HNO₃ dosed solutions which were also analysed for the requested element suite by ICPOES and ICPMS Genalysis method code: ICP_W004 (OES) ICP_W003 (MS)

Results of analysis on:

Element		Acidity	EC	HCO ₃	pH
Method		/VOL	/MTR	/VOL	/MTR
Detection		1	10	0.2	0.1
Units		mgH ₂ SO ₄ /L	uS/cm	mgHCO ₃ /L	NONE
Sample Name					
Control Blank					
GCA10039-16 RAW		325	1021		2.7
GCA10039-16 RAW	check	324	1019		2.7
GCA10043-16 RAW			323	3.3	5.9
GCA10044-16 RAW		123	953		4.9
GCA10049-16 RAW			121	10.8	6.9
GCA10053-16 RAW			517	2.7	5.4

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BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1305130

Client ON GCA 1220/1

Element	As	Cd	Pb
Method	/MS	/MS	/MS
Detection	0.1	0.02	0.5
Units	ug/l	ug/l	ug/l
Sample Name			
Control Blank	0.1	0.05	X
GCA10039-16 HNO3	201	97.9	366.6
GCA10043-16 HNO3	0.8	0.56	41.3
GCA10044-16 HNO3	2.9	6.61	580.9
GCA10049-16 HNO3	1	0.09	4.3
GCA10053-16 HNO3	3.1	5.17	40.5
DW-16 HNO3	0.1	X	X
Blank-16 HNO3	0.5	0.09	X
Alcoa18-MS	27.7	5.22	5.8

Element	Al	Ca	Cu	Fe-Sol	K	Mg
Method	/OE	/OE	/OE	/OE	/OE	/OE
Detection	0.01	0.01	0.01	0.01	0.1	0.01
Units	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Sample Name						
Control Blank	X	X	X	X	X	0.01
GCA10039-16 HNO3	15.11	5.04	0.14	46.74	3.8	4.45
GCA10043-16 HNO3	0.08	18.05	X	0.09	7.9	7.41
GCA10044-16 HNO3	0.47	31.3	X	0.25	7.8	9.7
GCA10049-16 HNO3	X	10.05	X	X	5.5	3.63
GCA10053-16 HNO3	0.12	30.66	X	0.08	9.4	9.03
DW-16 HNO3	X	0.03	X	X	X	X
Blank-16 HNO3	0.01	0.04	X	X	X	0.02
Alcoa12-OES	2.02	50.33	0.51	2.03	4	50.32

Element	Mn	Na	S	Si	Zn
Method	/OE	/OE	/OE	/OE	/OE
Detection	0.01	0.1	0.1	0.05	0.01
Units	mg/l	mg/l	mg/l	mg/l	mg/l
Sample Name					
Control Blank	X	X	X	X	X
GCA10039-16 HNO3	27.56	0.9	119	7.82	33.89
GCA10043-16 HNO3	29.58	1.1	44	1.04	5.8
GCA10044-16 HNO3	227.58	0.8	189	2.18	56.55
GCA10049-16 HNO3	0.88	1	13	0.98	0.13
GCA10053-16 HNO3	83.09	0.6	85	2.81	2.16
DW-16 HNO3	0.03	X	0.1	X	0.01
Blank-16 HNO3	X	X	X	X	0.02
Alcoa12-OES	0.51	254	20.3	19.38	0.5

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 2/05/2013

GLS Job Code 143.0/1306604

Client ON GCA 1220/1



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JOB INFORMATION

JOB CODE	143/1306604
No. of SAMPLES	12
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates
DATE RECEIVED	9/05/2013
DATE COMPLETED	28/05/2013

LEGEND

X	= Less than Detection Limit
NR	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

A range of solutions were received to be analysed. F, Cl, EC and pH were measured on the raw samples Genalysis method codes: ENV_W011 (F), ENV_W013 (Cl), ENV_W002 (EC) and ENV_W001 (pH). Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS: Genalysis method codes; (ICP_W004, ICPOES, ICP_W003, ICPMS)

The charge balance was calculated as requested and was found to be +/- 5%. (except for GCA10039-19 RAW the only sample containing significant levels of Fe). The concentrations of metal ions Fe and Mn are sufficiently high to affect the balance and are included

Results of analysis on:

Element		Acidy	Cl	EC	F	HCO ₃	pH
Method		/VOL	/COL	/MTR	/SIE	/VOL	/MTR
Detection		1	2	10	0.1	1	0.1
Units		mgH ₂ SO ₄ /L	mg/l	uS/cm	mg/l	mgHCO ₃ /L	NONE
Sample Name							
Control Blank			X		X		
GCA10039-19 RAW		327	X	1010	0.4		2.8
GCA10039-19 RAW	check	326	X	1007	0.4		2.8
GCA10044-19 RAW		98	X	772	X		4.9
GCA10043-20 RAW			X	310	0.2	4	6.2
GCA10049-20 RAW			X	90	0.2	10	6.9
GCA10053-20 RAW			X	484	0.1	2	5.4
GWS		78					

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GLS Job Code 143.0/1306604

Client ON GCA 1220/1

Element	Ag	Al	As	B	Ba	Bi	Ca	Cd
Method	/MS	/OE	/MS	/OE	/MS	/MS	/OE	/MS
Detection	0.01	0.01	0.1	0.01	0.05	0.005	0.01	0.02
Units	ug/l	mg/l	ug/l	mg/l	ug/l	ug/l	mg/l	ug/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10039-19 HNO3	0.08	12	176.7	X	3.57	0.006	3.12	74.97
GCA10044-19 HNO3	0.02	0.34	1.6	X	4.39	X	21.98	5.9
GCA10043-20 HNO3	X	X	0.3	X	8.33	X	17.6	0.59
GCA10049-20 HNO3	0.01	X	0.4	X	2.98	X	7.36	0.08
GCA10053-20 HNO3	0.02	0.17	2.3	X	10.56	X	26.78	5.02
DW-20 HNO3	X	X	X	X	X	X	X	X
Blank-20 HNO3	X	X	0.1	0.61	0.08	X	0.01	0.03
Alcoa12-OES		1.99		0.99			50.88	
Alcoa18-MS	5.06		27.6		5.45	4.749		5.07

Element	Co	Cr	Cu	Fe-Sol	Hg	K	Mg	Mn
Method	/MS	/OE	/OE	/OE	/MS	/OE	/OE	/OE
Detection	0.1	0.01	0.01	0.01	0.1	0.1	0.01	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	mg/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10039-19 HNO3	106.3	0.02	0.12	56.3	X	3.8	2.98	21.87
GCA10044-19 HNO3	230.5	0.15	0.01	0.15	X	7.1	7.08	181.13
GCA10043-20 HNO3	30.8	0.03	X	0.01	X	8	7.33	31.38
GCA10049-20 HNO3	0.5	X	X	X	X	4.2	2.64	0.61
GCA10053-20 HNO3	15.7	0.06	X	0.1	X	8	7.94	80.61
DW-20 HNO3	X	X	X	X	X	X	X	X
Blank-20 HNO3	X	X	0.01	X	X	X	X	X
Alcoa12-OES		0.51	0.52	2.03		4.1	51.24	0.51
Alcoa18-MS	507.4				5.1			

Element	Mo	Na	Ni	P	Pb	S	SO4	Sb
Method	/MS	/OE	/OE	/OE	/MS	/OE	/CALC	/MS
Detection	0.05	0.1	0.01	0.1	0.5	0.1	1	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	ug/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10039-19 HNO3	0.4	0.7	0.05	X	482.4	109.7	329	2.29
GCA10044-19 HNO3	0.05	0.6	0.14	X	563.4	152.6	457	0.16
GCA10043-20 HNO3	0.08	0.9	X	X	84	45.7	137	0.31
GCA10049-20 HNO3	2.81	0.8	X	X	3	9.3	28	0.84
GCA10053-20 HNO3	0.12	0.6	0.01	X	59.3	79.3	238	0.35
DW-20 HNO3	X	X	X	X	X	0.1	X	X
Blank-20 HNO3	X	0.2	X	X	X	X	X	0.02
Alcoa12-OES		252.7	0.52	1		20.5	61	
Alcoa18-MS	5.41				5.6			5.55

GLS Job Code 143.0/1306604

Client ON GCA 1220/1

Element	Se	Si	Sn	Sr	Th	Ti	U	V	Zn
Method	/MS	/OE	/MS	/MS	/MS	/MS	/MS	/OE	/OE
Detection	0.5	0.05	0.1	0.02	0.005	0.01	0.005	0.01	0.01
Units	ug/l	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l	mg/l	mg/l
Sample Name									
Control Blank	X	X	X	X	X	X	X	X	X
GCA10039-19 HNO3	X	8.57	0.1	21.02	0.231	1.73	5.426	X	27.35
GCA10044-19 HNO3	X	1.97	X	172.55	X	2.61	1.1	X	47
GCA10043-20 HNO3	X	0.93	X	188.28	X	0.57	0.012	X	7.14
GCA10049-20 HNO3	X	0.41	X	66.36	X	0.17	0.025	X	0.1
GCA10053-20 HNO3	X	2.5	X	323.06	X	0.74	0.303	X	2.22
DW-20 HNO3	X	X	X	0.09	X	0.01	X	X	X
Blank-20 HNO3	X	1.61	X	0.18	X	X	X	X	0.02
Alcoa12-OES		19.33						0.5	0.48
Alcoa18-MS	25.3		5.3	511.06	5.316	4.79	5.44		

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 28/05//2013

GLS Job Code 143.0/1307273

Client ON GCA 1220/1


GENALYSIS
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Dr G Campbell

CAMPBELL, GRAEME and ASSOCIATES PTY LTD

PO Box 247

BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1307273
No. of SAMPLES	12
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates
DATE RECEIVED	23/05/2013
DATE COMPLETED	10/06/2013

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

A range of solutions were received to be analysed. F, EC and pH were measured on the raw samples

Genalysis method codes: ENV_W011 (F), ENV_W002 (EC) and ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS: Genalysis method codes; (ICP_W004, ICPOES, ICP_W003, ICPMS)

Results of analysis on:

Element		Acidy	EC	F	HCO ₃	pH
Method		/VOL	/MTR	/SIE	/VOL	/MTR
Detection		1	10	0.1	1	0.1
Units		mgH ₂ SO ₄ /L	uS/cm	mg/l	mgHCO ₃ /L	NONE
Sample Name						
Control Blank				X		
GCA10039-22 RAW		149	563	X		3.1
GCA10039-22 RAW	check	149	565	X		3.1
GCA10044-22 RAW			531	X	2.3	5.4
GCA10043-22 RAW			230	0.2	3.2	6
GCA10049-22 RAW			106	0.3	8.6	6.7
GCA10053-22 RAW			338	X	2.6	5.7
SOLN-001				1.1		
pH5-feed		80				

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Page 1 of 2

GLS Job Code 143.0/1307273

Client ON GCA 1220/1

Element	Al	As	Cd	Co	Cu	Fe-Sol
Method	/OE	/MS	/MS	/MS	/OE	/OE
Detection	0.01	0.1	0.02	0.1	0.01	0.01
Units	mg/l	ug/l	ug/l	ug/l	mg/l	mg/l
Sample Name						
Control Blank	X	X	X	X	X	X
GCA10039-22 HNO3	4.02	71.7	28.63	44.3	0.04	28.95
GCA10044-22 HNO3	X	3.8	3.31	130	0.01	0.02
GCA10043-22 HNO3	0.01	0.4	0.42	20.3	X	0.04
GCA10049-22 HNO3	0.04	0.7	0.06	1.3	0.01	0.02
GCA10053-22 HNO3	0.03	1.2	3.26	9.9	X	0.03
DW-22 HNO3	X	X	X	X	X	X
Blank-22 HNO3	X	1.1	X	1.2	0.01	X
Alcoa12-OES	1.98				0.51	2.01
Alcoa18-MS		29.2	4.95	533.4		

Element	Mn	Pb	S	SO4	Zn
Method	/OE	/MS	/OE	/CALC	/OE
Detection	0.01	0.5	0.1	1	0.01
Units	mg/l	ug/l	mg/l	mg/l	mg/l
Sample Name					
Control Blank	X	X	X	X	X
GCA10039-22 HNO3	9.33	447.8	46.2	139	10.88
GCA10044-22 HNO3	105.5	413.3	82.9	248	24.71
GCA10043-22 HNO3	21.25	39	28.2	85	4.19
GCA10049-22 HNO3	0.43	2.1	10.4	31	0.04
GCA10053-22 HNO3	50.59	22	46.9	140	1.29
DW-22 HNO3	0.03	X	0.2	1	0.02
Blank-22 HNO3	X	X	0.2	1	0.02
Alcoa12-OES	0.51		20.2	60	0.5
Alcoa18-MS		5.3			

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Company Accreditation Number 3244

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 10/06/2013

GLS Job Code 143.0/1308067

Client ON GCA 1220/1


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Dr G Campbell

CAMPBELL, GRAEME and ASSOCIATES PTY LTD

PO Box 247

BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1308067
No. of SAMPLES	12
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates set C
DATE RECEIVED	05/06/2013
DATE COMPLETED	24/06/2013

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

A range of solutions were received to be analysed. F, EC and pH were measured on the raw samples
 Genalysis method codes: ENV_W011 (F), ENV_W002 (EC) and ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than or equal to 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS:
 Genalysis method codes; (ICP_W004, ICPOES, ICP_W003, ICPMS)

Results of analysis on:

Element		Acidity	EC	F	HCO ₃	pH
Method		/VOL	/MTR	/SIE	/VOL	/MTR
Detection		1	10	0.1	1	0.1
Units		mgH ₂ SO ₄ /L	uS/cm	mg/l	mgHCO ₃ /L	NONE
Sample Name						
Control Blank				X		
GCA10039-24 RAW		166	631	X		3.1
GCA10039-24 RAW	check	166	633	X		3.1
GCA10044-24 RAW			564	X		5.4
GCA10043-24 RAW			196	0.2	4	6.3
GCA10049-24 RAW			82	0.2	9	6.8
GCA10053-24 RAW			314	X	3	5.8
SOLN-001				1.2		

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GLS Job Code 143.0/1308067

Client ON GCA 1220/1

Element	Al	As	Cd	Co	Cu	Fe-Sol
Method	/OE	/MS	/MS	/MS	/OE	/OE
Detection	0.01	0.1	0.02	0.1	0.01	0.01
Units	mg/l	ug/l	ug/l	ug/l	mg/l	mg/l
Sample Name						
Control Blank	X	X	X	X	X	X
GCA10039-24 HNO3	5.1	62.7	31.0	45.5	0.05	32.4
GCA10044-24 HNO3	0.16	1.5	3.52	131.7	X	0.02
GCA10043-24 HNO3	0.02	0.5	0.39	15.9	X	X
GCA10049-24 HNO3	X	0.7	0.07	1	X	X
GCA10053-24 HNO3	0.07	1.3	2.84	8	X	X
DW-24 HNO3	X	X	X	X	X	X
Blank-24 HNO3	X	1.2	X	0.2	X	X
Alcoa12-OES	1.98				0.54	2.03
Alcoa18-MS		29.7	5.47	528.7		

Element	Mn	Pb	S	SO4	Zn
Method	/OE	/MS	/OE	/CALC	/OE
Detection	0.01	0.5	0.1	1	0.01
Units	mg/l	ug/l	mg/l	mg/l	mg/l
Sample Name					
Control Blank	X	X	X	X	X
GCA10039-24 HNO3	9.3	398	52.9	158	11.91
GCA10044-24 HNO3	109	438	85	255	25.69
GCA10043-24 HNO3	17.1	29.9	22.7	68	3.49
GCA10049-24 HNO3	1.01	4.4	7.6	23	0.2
GCA10053-24 HNO3	44.2	19	41	123	1.16
DW-24 HNO3	X	X	X	X	X
Blank-24 HNO3	X	0.6	X	X	0.01
Alcoa12-OES	0.51		20.5	61	0.48
Alcoa18-MS		5.5			

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 24/06//2013

GLS Job Code 143.0/1309656

Client ON GCA 1220/1


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Dr G Campbell

CAMPBELL, GRAEME and ASSOCIATES PTY LTD

PO Box 247

BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1309656
No. of SAMPLES	20
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates set C
DATE RECEIVED	03/07/2013
DATE COMPLETED	17/07/2013

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

A range of solutions were received to be analysed. F, EC and pH were measured on the raw samples

Genalysis method codes: ENV_W011 (F), ENV_W013, (EC) and ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than or equal to 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS:

Genalysis method codes; (ICP_W004, ICPOES, ICP_W003, ICPMS)

Results of analysis on:

Element		Acidity	EC	F	HCO ₃	pH
Method		/VOL	/MTR	/SIE	/VOL	/MTR
Detection		1	10	0.1	1	0.1
Units		mgH ₂ SO ₄ /L	uS/cm	mg/l	mgHCO ₃ /L	NONE
Sample Name						
Control Blank				X		
GCA10039-26 RAW		246	872	X		2.9
GCA10039-26 RAW	check	250	869	X		2.9
GCA10039-28 RAW		253	911	X		2.8
GCA10044-26 RAW			549	X	2	5.2
GCA10044-28 RAW			517	X	2	5.2
GCA10043-26 RAW			160	0.1	4	6.2
GCA10043-28 RAW			138	0.1	3	6
GCA10049-26 RAW			71	0.2	9	6.8
GCA10049-28 RAW			51	0.1	8	6.6
GCA10053-26 RAW			248	0.1	3	5.6
GCA10053-28 RAW			228	0.1	3	5.7
SOLN-001				1		

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GLS Job Code 143.0/1309656

Client ON GCA 1220/1

Element	Al	As	Cd	Co	Cu	Fe-Sol
Method	/OE	/MS	/MS	/MS	/OE	/OE
Detection	0.01	0.1	0.02	0.1	0.01	0.01
Units	mg/l	ug/l	ug/l	ug/l	mg/l	mg/l
Sample Name						
Control Blank	X	X	X	X	X	X
GCA10039-26 HNO3	7.78	89.7	39.91	58.8	0.07	47.61
GCA10039-28 HNO3	7.76	94.9	31.72	49.2	0.09	46.09
GCA10044-26 HNO3	0.15	1.2	3.69	133.3	X	X
GCA10044-28 HNO3	0.15	1.2	3.47	127.3	X	X
GCA10043-26 HNO3	X	0.4	0.36	14.2	X	X
GCA10043-28 HNO3	X	0.9	0.41	11.7	X	0.1
GCA10049-26 HNO3	0.02	0.4	0.04	0.3	X	X
GCA10049-28 HNO3	X	0.5	0.04	X	X	X
GCA10053-26 HNO3	0.03	0.8	2.29	6.8	X	X
GCA10053-28 HNO3	0.04	0.9	2.22	6.4	X	X
Alcoa12-OES	1.94				0.51	1.97
Alcoa18-MS		28.4	5.29	518.6		

Element	Mn	Pb	S	SO4	Zn
Method	/OE	/MS	/OE	/CALC	/OE
Detection	0.01	0.5	0.1	1	0.01
Units	mg/l	ug/l	mg/l	mg/l	mg/l
Sample Name					
Control Blank	0.02	X	X	X	X
GCA10039-26 HNO3	10.89	476.7	70.9	212	14.58
GCA10039-28 HNO3	8.04	373	68.9	207	11.33
GCA10044-26 HNO3	111.48	475	82.4	247	25.73
GCA10044-28 HNO3	105.96	477.7	75.7	227	24.01
GCA10043-26 HNO3	14.99	29.1	18.9	57	3.08
GCA10043-28 HNO3	12.89	26.5	16	48	2.67
GCA10049-26 HNO3	0.27	2.6	6.1	18	0.01
GCA10049-28 HNO3	0.15	1.1	4.3	13	X
GCA10053-26 HNO3	37.35	18.7	31.4	94	0.93
GCA10053-28 HNO3	35.29	15.7	29.8	89	0.89
Alcoa12-OES	0.5		19	57	0.49
Alcoa18-MS		6.2			

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 17/07/2013

GLS Job Code 143.0/1310480

Client ON GCA1220/1


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Dr G Campbell

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PO Box 247

BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1310480
No. of SAMPLES	10
CLIENT O/N	GCA1220/1
PROJECT	Bowdens
STATE	Column leachates set C
DATE RECEIVED	23/07/2013
DATE COMPLETED	14/08/2013

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

A range of solutions were received to be analysed. EC and pH were measured on the raw samples Genalysis method codes: ENV_W002 (EC) and ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than or equal to 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS: Genalysis method codes; (ICP_W004, ICPOES, ICP_W003, ICPMS)

Results of analysis on:

Element		Acid	EC	HCO ₃	pH
Method		/VOL	/MTR	/VOL	/MTR
Detection		1	10	1	0.1
Units		mgH ₂ SO ₄ /L	uS/cm	mgHCO ₃ /L	NONE
Sample Name					
Control Blank		X	X	X	X
GCA10039-30 RAW		347	1093		2.7
GCA10039-30 RAW	Check	346	1099		2.7
GCA10043-30 RAW			134	4	6.1
GCA10044-30 RAW			521	2	5.1
GCA10049-30 RAW			76	11	6.9
GCA10053-30 RAW			257	3	5.6
GWS				118	

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GLS Job Code 143.0/1310480

Client ON GCA1220/1

Element	As	Cd	Mn	Pb	S	SO4
Method	/MS	/MS	/OE	/MS	/OE	/CALC
Detection	0.1	0.02	0.01	0.5	0.1	1
Units	ug/l	ug/l	mg/l	ug/l	mg/l	mg/l
Sample Name						
Control Blank	X	X	X	X	X	X
GCA10039-30 HNO3	114	40.83	9.71	425.8	94.4	283
GCA10043-30 HNO3	0.3	0.29	13.4	26.2	16	48
GCA10044-30 HNO3	1.1	3.58	109.7	449.9	79.5	238
GCA10049-30 HNO3	0.6	0.04	0.27	2	7.1	21
GCA10053-30 HNO3	0.8	2.59	40.84	18.8	34.4	103
Alcoa12-OES			0.53		20.4	61
Alcoa18-MS	29	5.05		5.3		

Element	Sb	Si	Tl	Zn
Method	/MS	/OE	/MS	/OE
Detection	0.01	0.05	0.01	0.01
Units	ug/l	mg/l	ug/l	mg/l
Sample Name				
Control Blank	X	X	X	X
GCA10039-30 HNO3	1.34	8.83	1.3	15.11
GCA10043-30 HNO3	0.17	0.63	0.27	2.83
GCA10044-30 HNO3	0.08	1.29	1.42	25.7
GCA10049-30 HNO3	0.57	0.57	0.11	0.05
GCA10053-30 HNO3	0.21	1.65	0.39	1.07
Alcoa12-OES		19.56		0.47
Alcoa18-MS	5.85		4.7	

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 14/08/2013

GLS Job Code 143.0/1313903

Client ON GCA 1220/1


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Dr G Campbell

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PO Box 247

BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1313903
No. of SAMPLES	20
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates
DATE RECEIVED	27/09/2013
DATE COMPLETED	18/10/2013

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

A range of solutions were received to be analysed. F, Cl, EC and pH were measured on the raw samples

Genalysis method codes: ENV_W011 (F), ENV_W013 (Cl), ENV_W002 (EC) and ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than or equal to 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS:

Genalysis method codes; (ICP_W004, ICPOES, ICP_W003, ICPMS)

Results of analysis on:

Element		Acidy	Cl	EC	F	HCO ₃	pH
Method		/VOL	/COL	/MTR	/SIE	/VOL	/MTR
Detection		1	2	0.01	0.1	0.2	0.1
Units		mgH ₂ SO ₄ /L	mg/l	mS/cm	mg/l	mgHCO ₃ /L	NONE
Sample Name							
Control Blank					X		
GCA10039-32 RAW		350	X	1.28	X		2.5
GCA10039-32 RAW	check	353	X	1.30	X		2.5
GCA10039-34 RAW		349	X	1.18	X		2.6
GCA10043-32 RAW			X	0.14	0.1	2.5	6.1
GCA10043-34 RAW			X	0.13	0.1	4.5	6.2
GCA10044-32 RAW		28	X	0.51	X		5
GCA10044-34 RAW		23	X	0.50	X		4.9
GCA10049-32 RAW			X	0.11	0.3	20	7
GCA10049-34 RAW			X	0.10	0.3	25	7.2
GCA10053-32 RAW			X	0.24	X	2.6	5.8
GCA10053-34 RAW			X	0.25	X	3.0	6
SOLN-001					1		

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GLS Job Code 143.0/1313903

Client ON GCA 1220/1

Element	Ag	Al	As	B	Ba	Bi	Ca	Cd
Method	/MS	/OE	/MS	/OE	/MS	/MS	/OE	/MS
Detection	0.01	0.01	0.1	0.01	0.05	0.005	0.01	0.02
Units	ug/l	mg/l	ug/l	mg/l	ug/l	ug/l	mg/l	ug/l
Sample Name								
Control Blank	X	X	X	0.06	X	X	X	X
GCA10039-32 HNO3			126.4					38.29
GCA10039-34 HNO3	1.32	10.55	162.7	X	3.56	0.006	0.56	37.02
GCA10043-32 HNO3			0.4					0.36
GCA10043-34 HNO3	0.01	X	0.3	X	11.14	X	5.47	0.47
GCA10044-32 HNO3			1					3.41
GCA10044-34 HNO3	0.06	0.26	1.5	0.11	7.31	X	6.83	3.51
GCA10049-32 HNO3			0.6					0.04
GCA10049-34 HNO3	0.25	0.02	0.9	0.01	8.8	X	9.91	0.09
GCA10053-32 HNO3			0.7					2.27
GCA10053-34 HNO3	0.01	0.04	1.7	X	7.19	X	9.37	2.45
Alcoa18-MS	4.95		28.1		5.46	4.781		5.07
Alcoa12-OES		2		0.96			47.98	

Element	Co	Cr	Cu	Fe-Sol	Hg	K	Mg	Mn
Method	/MS	/OE	/OE	/OE	/MS	/OE	/OE	/OE
Detection	0.1	0.01	0.01	0.01	0.1	0.1	0.01	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	mg/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10039-32 HNO3								9.62
GCA10039-34 HNO3	57.9	X	0.23	71.91	X	3.9	0.52	9.57
GCA10043-32 HNO3								13.31
GCA10043-34 HNO3	11	X	X	X	X	3.8	2.48	13.57
GCA10044-32 HNO3								108.78
GCA10044-34 HNO3	121.6	0.01	0.03	0.04	X	3.8	2.58	108.27
GCA10049-32 HNO3								0.3
GCA10049-34 HNO3	0.2	X	X	X	X	4.4	3.54	0.24
GCA10053-32 HNO3								39.76
GCA10053-34 HNO3	7.1	0.02	X	X	X	3.7	2.91	43.95
Alcoa18-MS	521.1				5			
Alcoa12-OES		0.51	0.51	2.02		4.2	47.55	0.5

Element	Mo	Na	Ni	P	Pb	S	SO4	Sb
Method	/MS	/OE	/OE	/OE	/MS	/OE	/CALC	/MS
Detection	0.05	0.1	0.01	0.1	0.5	0.1	0.3	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	ug/l
Sample Name								
Control Blank	X	0.3	X	X	X	0.1	0.4	X
GCA10039-32 HNO3					497.5	108.5	325	1.57
GCA10039-34 HNO3	0.45	0.3	0.02	X	459.7	110.8	332	1.97
GCA10043-32 HNO3					25.5	16.2	48.5	0.17
GCA10043-34 HNO3	0.09	0.3	0.02	0.1	24.3	16.4	49.1	0.17
GCA10044-32 HNO3					488.6	80.6	241.5	0.09
GCA10044-34 HNO3	X	0.3	0.03	X	507.6	82.5	247.1	0.07
GCA10049-32 HNO3					1.9	9.8	29.4	0.77
GCA10049-34 HNO3	11.79	0.4	X	X	1.6	7.9	23.6	0.97
GCA10053-32 HNO3					15.8	32.7	98.1	0.18
GCA10053-34 HNO3	0.16	0.2	0.02	X	13.1	36.6	109.8	0.23
Alcoa18-MS	5.78				5.3			5.42
Alcoa12-OES		231.7	0.49	1.1		19.9	59.7	

GLS Job Code 143.0/1313903

Client ON GCA 1220/1

Element	Se	Si	Sn	Sr	Th	Tl	U	V	Zn
Method	/MS	/OE	/MS	/MS	/MS	/MS	/MS	/OE	/OE
Detection	0.5	0.05	0.1	0.02	0.005	0.01	0.005	0.01	0.01
Units	ug/l	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l	mg/l	mg/l
Sample Name									
Control Blank	X	X	X	X	X	X	0.007	X	X
GCA10039-32 HNO3		10.1				1.46			14.77
GCA10039-34 HNO3	X	11.78	0.1	9.3	0.435	1.6	1.849	0.01	14.79
GCA10043-32 HNO3		0.59				0.26			2.68
GCA10043-34 HNO3	X	0.62	X	58.33	X	0.3	0.006	X	2.7
GCA10044-32 HNO3		0.96				1.57			24.73
GCA10044-34 HNO3	X	0.83	0.2	70.73	X	1.7	0.276	X	24.45
GCA10049-32 HNO3		0.88				0.12			0.06
GCA10049-34 HNO3	X	1.03	X	81.99	X	0.14	0.072	X	0.04
GCA10053-32 HNO3		1.46				0.35			0.98
GCA10053-34 HNO3	X	1.69	X	118.52	X	0.39	0.036	X	1.07
Alcoa18-MS	28		5.3	525.16	5.026	4.91	4.876		
Alcoa12-OES		18.43						0.5	0.51

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 18/10/2013

GLS Job Code 143.0/1306572

Client ON GCA 1220/1



GENALYSIS
LABORATORY SERVICES



Accredited for compliance with ISO/IEC 17025

Dr G Campbell
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JOB INFORMATION

JOB CODE	143/1306572
No. of SAMPLES	48
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates
DATE RECEIVED	9/05/2013
DATE COMPLETED	28/05/2013

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

A range of solutions were received to be analysed. F, Cl, EC and pH were measured on the raw samples
Genalysis method codes: ENV_W011 (F), ENV_W013 (Cl), ENV_W002 (EC) and ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS:
Genalysis method codes; (ICP_W004, ICPOES, ICP_W003, ICPMS)

The charge balance was calculated as requested and was found to be +/- 5%. The concentrations of metal ions Fe and Mn are sufficiently high to affect the balance and are included

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Page 1 of 6

GLS Job Code 143.0/1306572

Client ON GCA 1220/1

Results of analysis on:

Element		Acidy	Cl	EC	F	pH	HCO3
Method		/VOL	/COL	/MTR	/SIE	/MTR	/VOL
Detection		1	2	10	0.1	0.1	1
Units		mgH2SO4/L	mg/l	uS/cm	mg/l	NONE	mgHCO3/L
Sample Name							
Control Blank			0				
GCA10651/53-0a RAW			63	952	0.2	5.9	8
GCA10651/53-0a RAW	check		65	980	0.2	6	8
GCA10651/53-0b RAW			4	195	0.1	6.5	6
GCA10663/64-0a RAW		37	42	816	0	4.7	
GCA10663/64-0b RAW		17	5	496	0.1	5	
GCA10663/64-0c RAW			0	191	0	5.4	3
GCA10668/69-0a RAW			6	248	0	5.4	5
GCA10668/69-0b RAW		10	2	260	0.1	5	2
GCA10668/69-0c RAW			0	128	0	5.1	2
GCA10674/75-0a RAW		43	16	1383	0.4	5	
GCA10674/75-0b RAW			0	365	0.2	5.6	4
GCA10674/75-0c RAW			0	109	0.1	5.5	3
GCA10678/79-0a RAW		121	7	3030	0.5	4.2	
GCA10678/79-0b RAW		42	0	1351	0	4.6	
GCA10678/79-0c RAW		21	0	812	0	4.8	
GCA10678/79-0d RAW		29	0	1020	0	4.7	
GCA10678/79-0e RAW		27	0	1005	0	4.8	
GCA10682/83-0a RAW			14	942	0.3	7.1	56
GCA10682/83-0b RAW			4	189	0.5	7.2	37
GCA10687/91-0a RAW			80	1464	2.6	7.3	231
GCA10687/91-0b RAW			2	392	2.9	7.6	168
GCA10687/91-0c RAW			0	268	2.7	8	134
GCA10687/91-0c RAW	check		0	272	2.6	8	134
pH5-feed		78					

GLS Job Code 143.0/1306572

Client ON GCA 1220/1

Element		Ag	Al	As	B	Ba	Bi	Ca	Cd
Method		/MS	/OE	/MS	/OE	/MS	/MS	/OE	/MS
Detection		0.01	0.01	0.1	0.01	0.05	0.005	0.01	0.02
Units		ug/l	mg/l	ug/l	mg/l	ug/l	ug/l	mg/l	ug/l
Sample Name									
Control Blank		0.01	0	0	0	0	0	0	0
GCA10651/53-0a HNO3		0	0.27	1.8	0.02	10	0	28.6	0.8
GCA10651/53-0b HNO3		0	0.08	1.4	0.02	2.58	0	6.4	0.02
GCA10663/64-0a HNO3		0	4.24	1.2	0	37.06	0	66.3	7.15
GCA10663/64-0b HNO3		0	1.17	1.2	0.02	20.38	0	42.3	4.25
GCA10663/64-0c HNO3		0	0.11	2.1	0.02	22.53	0	12.1	1.55
GCA10668/69-0a HNO3		0	0.16	1.1	0	37.49	0	6.7	2.63
GCA10668/69-0b HNO3		0	0.29	0.4	0	20.71	0	7.6	3.55
GCA10668/69-0c HNO3		0	0.13	0.3	0.01	14.47	0	3.0	1.52
GCA10674/75-0a HNO3		0	2.06	0.7	0	16.18	0	86.0	1.98
GCA10674/75-0b HNO3		0	0.14	0.8	0	10.93	0	13.8	0.25
GCA10674/75-0c HNO3		0	0.07	0.4	0	5.11	0	2.7	0.05
GCA10678/79-0a HNO3		0.01	8.68	1.7	0	29.38	0	280.9	72.8
GCA10678/79-0b HNO3		0	1.94	0.8	0	9.45	0	87.0	21.98
GCA10678/79-0c HNO3		0	0.83	0.5	0	7.53	0	49.8	10.1
GCA10678/79-0d HNO3		0	1.17	0.8	0	11.36	0	68.9	14.27
GCA10678/79-0e HNO3		0	1.28	1.4	0	11.11	0	69.3	13.69
GCA10682/83-0a HNO3		0	0.08	0.5	0	12.43	0	102.9	0.35
GCA10682/83-0b HNO3		0	0.05	0.4	0	2.4	0	13.0	0.08
GCA10687/91-0a HNO3		0	0.07	7	0	27.24	0	145.6	0.03
GCA10687/91-0b HNO3		0	0.02	5.9	0	40.52	0	17.7	0
GCA10687/91-0b HNO3	check	0	0.05	5.9	0	39.38	0	17.9	0
GCA10687/91-0c HNO3		0	0.02	4.9	0	50.9	0	11.5	0
DW-0a HNO3		0	0	0	0	0.06	0	0	0.02
DW-0b HNO3		0	0	0	0	0	0	0	0.04
DW-0c HNO3		0	0	0	0	0.05	0	0	0
Blank-0a HNO3		0	0.02	0.2	0	0.08	0	0	0
Blank-0b HNO3		0.03	0	0.2	0	0.12	0.007	0	0
Blank-0c HNO3		0	0	0	0	0.12	0	0	0
Alcoa12-OES			1.99		1.06			49.9	
Alcoa18-MS		4.97		27.2		5.32	4.703		5.22
AlcoaHi4-OES									

BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1306572

Client ON GCA 1220/1

Element		Co	Cr	Cu	Fe-Sol	Hg	K	Mg	Mn
Method		/MS	/OE	/OE	/OE	/MS	/OE	/OE	/OE
Detection		0.1	0.01	0.01	0.01	0.1	0.1	0.01	0.01
Units		ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	mg/l
Sample Name									
Control Blank		0.1	0	0	0	0	0	0	0
GCA10651/53-0a HNO3		10.8	0	0.01	0.24	0	7.6	8.6	2.8
GCA10651/53-0b HNO3		0.7	0	0	0	0	1.4	0.6	0.2
GCA10663/64-0a HNO3		138.6	0.01	0.05	0.58	0	35.6	16.2	14.9
GCA10663/64-0b HNO3		91.4	0	0.02	0.37	0	29.1	10.6	9.9
GCA10663/64-0c HNO3		27.6	0	0	0.13	0	15	3.4	3.0
GCA10668/69-0a HNO3		23.9	0	0.04	0.21	0	29.4	6.4	1.7
GCA10668/69-0b HNO3		36.2	0	0	0.08	0	26.4	8.6	2.6
GCA10668/69-0c HNO3		13.9	0	0.01	0.04	0	13.5	3.4	1.1
GCA10674/75-0a HNO3		325.1	0.04	0.03	0.25	0	57.8	115.0	73.4
GCA10674/75-0b HNO3		49.6	0.01	0	0.09	0	24.7	17.2	10.3
GCA10674/75-0c HNO3		9.9	0	0	0.04	0	10.3	3.6	2.1
GCA10678/79-0a HNO3		1920.4	0.32	0.1	0.29	0	78.8	311.8	478.2
GCA10678/79-0b HNO3		600.9	0.09	0.03	0.07	0	36.4	97.1	146.1
GCA10678/79-0c HNO3		287	0.05	0.02	0.04	0	22.5	45.9	68.4
GCA10678/79-0d HNO3		404.7	0.06	0.03	0.03	0	28	63.4	94.7
GCA10678/79-0e HNO3		395.6	0.07	0.02	0.03	0	25.6	61.2	90.7
GCA10682/83-0a HNO3		49.9	0	0	0	0	28.3	53.1	10.8
GCA10682/83-0b HNO3		5.9	0	0	0	0	10.2	6.7	1.6
GCA10687/91-0a HNO3		4.8	0	0.01	0.02	0	34.8	89.8	0.7
GCA10687/91-0b HNO3		0.7	0	0	0	0	15.8	11.1	0.1
GCA10687/91-0b HNO3	check	0.7	0	0	0	0	16	11.2	0.1
GCA10687/91-0c HNO3		0.5	0	0	0	0	13.3	7.4	0.1
DW-0a HNO3		0	0	0	0	0	0	0	0
DW-0b HNO3		0	0	0	0	0	0	0	0
DW-0c HNO3		0	0	0	0	0	0	0	0
Blank-0a HNO3		0	0	0	0	0	0	0	0
Blank-0b HNO3		0	0	0	0	0	0	0	0
Blank-0c HNO3		0.1	0	0	0	0	0	0	0
Alcoa12-OES			0.51	0.51	2.02		4	50.66	0.51
Alcoa18-MS		525.1				4.9			
AlcoaHi4-OES								201.85	19.99

GLS Job Code 143.0/1306572

Client ON GCA 1220/1

Element		Mo	Na	Ni	P	Pb	S	SO4	Sb
Method		/MS	/OE	/OE	/OE	/MS	/OE	/CALC	/MS
Detection		0.05	0.1	0.01	0.1	0.5	0.1	1	0.01
Units		ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	ug/l
Sample Name									
Control Blank		0	0	0	0	0.6	0.3	1	0
GCA10651/53-0a HNO3		0.11	170.9	0	0	3	117.3	351	0.3
GCA10651/53-0b HNO3		0	30.5	0	0	0	23	69	0.3
GCA10663/64-0a HNO3		0.09	45.5	0.24	0	1.2	112.7	338	0.19
GCA10663/64-0b HNO3		0.06	15.7	0.16	0	0.9	73.9	222	0.08
GCA10663/64-0c HNO3		0	3	0.06	0	0	22.5	68	0.06
GCA10668/69-0a HNO3		0	9.1	0.04	0	1.2	27.8	83	0.02
GCA10668/69-0b HNO3		0	6.7	0.04	0	1.4	31.8	95	0.07
GCA10668/69-0c HNO3		0	2.4	0.02	0	1	13.9	42	0.02
GCA10674/75-0a HNO3		0.07	26.5	0.26	0	13.3	278.5	834	0.07
GCA10674/75-0b HNO3		0	8	0.06	0	1.4	51.4	154	0.16
GCA10674/75-0c HNO3		0	2.3	0.02	0	3.8	13	39	0.03
GCA10678/79-0a HNO3		0.15	28.4	1.96	0	6	928.4	2781	0.65
GCA10678/79-0b HNO3		0	7.5	0.71	0	2.3	286.5	858	0.18
GCA10678/79-0c HNO3		0	3.3	0.37	0	1.5	141.9	425	0.08
GCA10678/79-0d HNO3		0.1	4.2	0.5	0	0.8	195.2	585	0.28
GCA10678/79-0e HNO3		0	3.7	0.49	0	0.7	190.4	570	0.13
GCA10682/83-0a HNO3		0	24.4	0.06	0	0	154.6	463	0.07
GCA10682/83-0b HNO3		0	5.4	0	0	0	19.3	58	0.05
GCA10687/91-0a HNO3		41.04	126	0.02	0	0.7	208.5	625	3.04
GCA10687/91-0b HNO3		31.21	47.3	0	0	0	19.5	58	2.01
GCA10687/91-0b HNO3	check	29.97	47.7	0.01	0	0	19.5	59	2.01
GCA10687/91-0c HNO3		12.71	32.5	0	0	0	9.4	28	1.74
DW-0a HNO3		0	0	0	0	0	0.1	0	0
DW-0b HNO3		0	0	0	0	0	0	0	0
DW-0c HNO3		0	0	0	0	0	0	0	0
Blank-0a HNO3		0	0	0	0	0	0	0	0
Blank-0b HNO3		0.06	0	0	0	0	0	0	0.02
Blank-0c HNO3		0	0	0	0	0	0.1	0	0
Alcoa12-OES			248.5	0.51	1		20.2	61	
Alcoa18-MS		5.79				5.4			5.68
AlcoaHi4-OES							255.6	766	

GLS Job Code 143.0/1306572

Client ON GCA 1220/1

Element		Se	Si	Sn	Sr	Th	Tl	U	V	Zn
Method		/MS	/OE	/MS	/MS	/MS	/MS	/MS	/OE	/OE
Detection		0.5	0.05	0.1	0.02	0.005	0.01	0.005	0.01	0.01
Units		ug/l	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l	mg/l	mg/l
Sample Name										
Control Blank		0	0	0	0	0	0	0	0	0
GCA10651/53-0a HNO3		0	10.28	0	122.9	0.054	0.68	0.405	0	0.84
GCA10651/53-0b HNO3		0	9.9	0.1	23.26	0	0.1	0.016	0	0.04
GCA10663/64-0a HNO3		0	5.22	0	186.89	0	41.76	10.596	0	1.19
GCA10663/64-0b HNO3		0	13.74	0	145.62	0	32.77	3.452	0	0.75
GCA10663/64-0c HNO3		0	12.4	0.1	44.4	0	15.92	0.707	0	0.23
GCA10668/69-0a HNO3		0	4.01	0	42.79	0	5.77	0.565	0	0.37
GCA10668/69-0b HNO3		0.6	9.71	0	50.94	0	6.5	0.601	0	0.47
GCA10668/69-0c HNO3		0	6.79	0.1	19.14	0.006	3.55	0.211	0	0.21
GCA10674/75-0a HNO3		0	23.92	0	657.16	0.063	5.73	7.636	0	2.37
GCA10674/75-0b HNO3		0	21.46	0	100.62	0	2.67	0.677	0	0.36
GCA10674/75-0c HNO3		0	9.79	0	19.83	0	1.11	0.149	0	0.07
GCA10678/79-0a HNO3		0	9.8	0.3	1109.61	0.715	22.12	24.792	0	16.3
GCA10678/79-0b HNO3		0	10.12	0	334.14	0.055	11.1	4.444	0	5.03
GCA10678/79-0c HNO3		0	6.37	0	168.04	0.027	6.76	1.777	0	2.41
GCA10678/79-0d HNO3		0	9.93	0	235.96	0.025	8.61	2.634	0	3.3
GCA10678/79-0e HNO3		0	10.78	0	235.55	0.018	7.77	2.484	0	3.19
GCA10682/83-0a HNO3		0.9	6.51	0	735.32	0.005	0.51	1.137	0	0.13
GCA10682/83-0b HNO3		0	3.34	0	89.53	0	0.21	0.351	0	0.03
GCA10687/91-0a HNO3		1.3	4.03	0.1	1313.57	0.041	0.44	94.808	0	0
GCA10687/91-0b HNO3		0	4.5	0	164.44	0	0.21	84.548	0	0.01
GCA10687/91-0b HNO3	check	0	4.56	0	158.92	0	0.22	87.118	0	0
GCA10687/91-0c HNO3		0	4.34	0	107.78	0	0.18	35.409	0	0
DW-0a HNO3		0	0	0	0.03	0	0	0.018	0	0
DW-0b HNO3		0	0	0	0.03	0	0	0.007	0	0
DW-0c HNO3		0	0	0	0	0	0	0.005	0	0
Blank-0a HNO3		0	0	0	0.07	0	0	0	0	0
Blank-0b HNO3		0	0	0	0.2	0	0	0.01	0	0
Blank-0c HNO3		0	0	0	0.3	0	0	0.016	0	0
Alcoa12-OES			19.33						0.51	0.47
Alcoa18-MS		26.5		5.3	521.78	5.023	4.96	5.319		
AlcoaHi4-OES										

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 28/05/2013

GLS Job Code 143.0/1307270

Client ON GCA 1220/1



GENALYSIS
LABORATORY SERVICES



Accredited for compliance with ISO/IEC 17025

Dr G Campbell
CAMPBELL, GRAEME and ASSOCIATES PTY LTD
PO Box 247
BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1307270
No. of SAMPLES	16
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates
DATE RECEIVED	23/05/2013
DATE COMPLETED	10/06/2013

LEGEND

X = Less than Detection Limit
NR = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

A range of solutions were received to be analysed. F, Cl, EC and pH were measured on the raw samples Genalysis method codes: ENV_W011 (F), ENV_W013 (Cl), ENV_W002 (EC) and ENV_W001 (pH). Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS: Genalysis method codes; (ICP_W004, ICPOES, ICP_W003, ICPMS)

The charge balance was calculated as requested and was found to be +/- 5%. In some samples the concentrations of metal ions Fe and Mn are sufficiently high to affect the balance and are included

Results of analysis on:

Element		Acidy	Cl	EC	F	HCO ₃	pH
Method		/VOL	/COL	/MTR	/SIE	/VOL	/MTR
Detection		1	2	10	0.1	1	0.1
Units		mgH ₂ SO ₄ /l	mg/l	uS/cm	mg/l	mgHCO ₃ /l	NONE
Sample Name							
Control Blank			X		X		
GCA10651/53-2 RAW			2	118	0.2	4.7	6.4
GCA10651/53-2 RAW	check		3	118	0.2	4.5	6.4
GCA10663/64-2 RAW			X	108	X	6.1	6.5
GCA10668/69-2 RAW			X	110	X	2.4	5.3
GCA10674/75-2 RAW			X	151	X	2.8	5.5
GCA10678/79-2 RAW		20	3	570	X		4.9
GCA10682/83-2 RAW			6	300	0.9	9.4	6.5
GCA10687/91-2 RAW			X	224	2.2	83	7.6
N191			100				

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BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1307270

Client ON GCA 1220/1

Element	Ag	Al	As	B	Ba	Bi	Ca	Cd
Method	/MS	/OE	/MS	/OE	/MS	/MS	/OE	/MS
Detection	0.01	0.01	0.1	0.01	0.05	0.005	0.01	0.02
Units	ug/l	mg/l	ug/l	mg/l	ug/l	ug/l	mg/l	ug/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10651/53-2 HNO3	0.01	X	1.2	0.03	1.18	X	1.4	X
GCA10663/64-2 HNO3	X	0.03	0.6	0.03	11.62	X	7.1	0.44
GCA10668/69-2 HNO3	0.01	0.03	0.7	0.03	15.87	X	2.37	1.02
GCA10674/75-2 HNO3	X	0.04	0.6	0.02	11.02	X	3.5	0.1
GCA10678/79-2 HNO3	X	0.17	0.7	0.05	13.44	0.017	35.5	5.18
GCA10682/83-2 HNO3	X	0.02	0.3	0.02	4.61	X	20.44	0.06
GCA10687/91-2 HNO3	X	0.06	6	0.03	54.74	X	9.16	X
DW-2 HNO3	X	X	X	X	0.1	X	X	X
Blank-2 HNO3	X	X	X	X	X	X	X	X
Alcoa12-OES		1.96		0.99			48.93	
Alcoa18-MS	5.09		28.8		5.63	4.893		5.15

Element	Co	Cr	Cu	Fe-Sol	Hg	K	Mg	Mn
Method	/MS	/OE	/OE	/OE	/MS	/OE	/OE	/OE
Detection	0.1	0.01	0.01	0.01	0.1	0.1	0.01	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	mg/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10651/53-2 HNO3	1	X	X	0.02	X	1.1	0.25	0.05
GCA10663/64-2 HNO3	12.6	X	X	X	X	8	1.71	1.35
GCA10668/69-2 HNO3	14.7	X	0.02	0.02	X	12.6	2.53	0.74
GCA10674/75-2 HNO3	14.4	X	X	0.01	X	12.1	4.85	2.82
GCA10678/79-2 HNO3	159.1	0.02	0.02	X	X	20.5	23.85	33.09
GCA10682/83-2 HNO3	7.1	X	0.01	X	X	11	10.48	2.79
GCA10687/91-2 HNO3	0.9	X	0.01	X	X	9.4	5.67	0.07
DW-2 HNO3	X	X	X	X	X	X	X	X
Blank-2 HNO3	X	X	X	X	X	X	X	X
Alcoa12-OES		0.51	0.52	2.03		4.1	49.69	0.5
Alcoa18-MS	523.5				4.3			

Element	Mo	Na	Ni	P	Pb	S	SO4	Sb
Method	/MS	/OE	/OE	/OE	/MS	/OE	/CALC	/MS
Detection	0.05	0.1	0.01	0.1	0.5	0.1	1	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	ug/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10651/53-2 HNO3	0.05	19	X	X	2.1	11.9	36	0.36
GCA10663/64-2 HNO3	X	1.3	X	X	X	11	33	0.07
GCA10668/69-2 HNO3	0.13	3.1	X	X	0.7	11.6	35	0.06
GCA10674/75-2 HNO3	X	2.8	X	X	0.7	16.6	50	0.04
GCA10678/79-2 HNO3	0.09	2.6	0.18	X	0.7	87.9	263	0.17
GCA10682/83-2 HNO3	0.06	5.5	X	X	0.7	41.9	126	0.07
GCA10687/91-2 HNO3	13.41	20.3	X	X	X	9.9	30	1.38
DW-2 HNO3	X	X	X	X	2.2	X	X	X
Blank-2 HNO3	X	X	X	X	X	0.1	0	X
Alcoa12-OES		238.8	0.49	1.1		19.8	59	
Alcoa18-MS	6.25				5.3			5.88

GLS Job Code 143.0/1307270

Client ON GCA 1220/1

Element	Se	Si	Sn	Sr	Th	Tl	U	V	Zn
Method	/MS	/OE	/MS	/MS	/MS	/MS	/MS	/OE	/OE
Detection	0.5	0.05	0.1	0.02	0.005	0.01	0.005	0.01	0.01
Units	ug/l	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l	mg/l	mg/l
Sample Name									
Control Blank	X	X	X	X	0.01	X	X	X	X
GCA10651/53-2 HNO3	X	12.57	X	5.5	0.02	0.06	0.017	X	0.02
GCA10663/64-2 HNO3	X	7.91	X	24.5	0.015	8.04	0.1	X	0.08
GCA10668/69-2 HNO3	X	6.12	X	16.3	0.014	3.34	0.1	X	0.14
GCA10674/75-2 HNO3	X	11.61	X	28.2	0.025	1.3	0.2	X	0.11
GCA10678/79-2 HNO3	X	9.54	X	109.9	0.017	6.18	0.6	X	1.2
GCA10682/83-2 HNO3	X	2.02	0.2	152.1	0.036	0.28	0.1	X	0.05
GCA10687/91-2 HNO3	X	2.95	0.2	86.8	0.034	0.16	19.5	X	0.01
DW-2 HNO3	X	0.07	X	0.1	X	X	X	X	X
Blank-2 HNO3	X	X	X	X	X	X	X	X	X
Alcoa12-OES		18.8						0.5	0.49
Alcoa18-MS	28.5		5.6	542.8	5.306	4.73	5.2		

NATA ENDORSED DOCUMENT

Company Accreditation Number 3244

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 10/06/2013

GLS Job Code 143.0/1308065

Client ON GCA 1220/1


GENALYSIS
LABORATORY SERVICES


Accredited for compliance with ISO/IEC 17025

Dr G Campbell

CAMPBELL, GRAEME and ASSOCIATES PTY LTD

PO Box 247

BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1308065
No. of SAMPLES	16
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates set A
DATE RECEIVED	05/06/2013
DATE COMPLETED	24/06/2013

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

A range of solutions were received to be analysed. F, Cl, EC and pH were measured on the raw samples
Genalysis method codes: ENV_W011 (F), ENV_W013 (Cl), ENV_W002 (EC) and ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than or equal to 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS:
Genalysis method codes; (ICP_W004, ICPOES, ICP_W003, ICPMS)

The charge balance was calculated as requested and was found to be +/- 5%. When the concentrations of metal ions Fe and Mn are sufficiently high to affect the balance these ions are included

Results of analysis on:

Element		Acidity	Cl	EC	F	HCO ₃	pH
Method		/VOL	/COL	/MTR	/SIE	/VOL	/MTR
Detection		1	2	10	0.1	1	0.1
Units		mgH ₂ SO ₄ /L	mg/l	uS/cm	mg/l	mgHCO ₃ /L	NONE
Sample Name							
Control Blank			X		X		
GCA10651/53-4 RAW			X	65	0.3	5	6.5
GCA10651/53-4 RAW	check		X	64	0.3	5	6.4
GCA10663/64-4 RAW			X	95	X	4	6.2
GCA10668/69-4 RAW			X	96	X	2	5.3
GCA10674/75-4 RAW			X	93	X	3	6.7
GCA10678/79-4 RAW		11	X	395	X		5.0
GCA10682/83-4 RAW			7	226	1.2	12	6.8
GCA10687/91-4 RAW			X	185	1.5	82	7.9
N191			95				

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Page 1 of 3

GLS Job Code 143.0/1308065

Client ON GCA 1220/1

Element	Ag	Al	As	B	Ba	Bi	Ca	Cd
Method	/MS	/OE	/MS	/OE	/MS	/MS	/OE	/MS
Detection	0.01	0.01	0.1	0.01	0.05	0.005	0.01	0.02
Units	ug/l	mg/l	ug/l	mg/l	ug/l	ug/l	mg/l	ug/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10651/53-4 HNO3	X	0.01	1.5	X	0.77	X	0.93	X
GCA10663/64-4 HNO3	X	0.03	0.9	X	11.57	X	5.23	0.59
GCA10668/69-4 HNO3	0.01	0.04	1	X	18.16	X	2.04	1.02
GCA10674/75-4 HNO3	X	X	0.9	X	6.95	X	2	0.07
GCA10678/79-4 HNO3	0.01	0.13	1	X	9.13	X	23.18	3.27
GCA10682/83-4 HNO3	0.01	0.01	0.3	X	3.59	X	15.95	0.03
GCA10687/91-4 HNO3	X	0.09	5.7	X	70.35	X	8.59	X
DW-4 HNO3	X	0.01	X	X	0.11	X	0.01	X
Blank-4 HNO3	X	X	1.2	X	0.12	X	0.04	X
Alcoa12-OES		2.02		0.97			50.3	
Alcoa18-MS	5.27		29.9		5.32	5.011		5.22

Element	Co	Cr	Cu	Fe-Sol	Hg	K	Mg	Mn
Method	/MS	/OE	/OE	/OE	/MS	/OE	/OE	/OE
Detection	0.1	0.01	0.01	0.01	0.1	0.1	0.01	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	mg/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10651/53-4 HNO3	0.2	X	X	0.02	X	0.6	0.16	0.03
GCA10663/64-4 HNO3	13.4	X	X	0.03	X	8.7	1.79	1.47
GCA10668/69-4 HNO3	9.4	X	X	0.02	X	12.6	2.32	0.69
GCA10674/75-4 HNO3	8.1	X	X	0.03	X	9.3	2.81	1.61
GCA10678/79-4 HNO3	98.7	0.03	0.02	X	X	17.3	15.28	20.8
GCA10682/83-4 HNO3	4.3	X	X	X	X	11.1	8.15	2.19
GCA10687/91-4 HNO3	0.5	X	X	X	X	9.5	5.38	0.07
DW-4 HNO3	X	X	X	X	X	X	X	X
Blank-4 HNO3	0.2	X	X	X	X	0.2	X	X
Alcoa12-OES		0.5	0.53	2.03		4.2	50.22	0.51
Alcoa18-MS	535.3				4.7			

Element	Mo	Na	Ni	P	Pb	S	SO4	Sb
Method	/MS	/OE	/OE	/OE	/MS	/OE	/CALC	/MS
Detection	0.05	0.1	0.01	0.1	0.5	0.1	1	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	ug/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10651/53-4 HNO3	0.17	10.6	X	X	X	6.5	19	0.33
GCA10663/64-4 HNO3	0.07	1	0.03	X	0.6	10.4	31	0.07
GCA10668/69-4 HNO3	X	1.5	X	X	3	10.4	31	0.04
GCA10674/75-4 HNO3	X	1.9	0.02	X	1	10.6	32	0.06
GCA10678/79-4 HNO3	X	1.5	0.13	X	2.4	57.7	173	0.12
GCA10682/83-4 HNO3	0.08	5	X	X	0.5	30.9	93	0.07
GCA10687/91-4 HNO3	7.8	16.2	X	X	0.6	6.9	21	1.26
DW-4 HNO3	X	X	X	X	X	X	X	0.01
Blank-4 HNO3	X	0.1	X	X	1.2	X	X	0.02
Alcoa12-OES		249.9	0.51	1		20.8	62	
Alcoa18-MS	6.19				5.5			5.82

BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1308065

Client ON GCA 1220/1

Element	Se	Si	Sn	Sr	Th	Tl	U	V	Zn
Method	/MS	/OE	/MS	/MS	/MS	/MS	/MS	/OE	/OE
Detection	0.5	0.05	0.1	0.02	0.005	0.01	0.005	0.01	0.01
Units	ug/l	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l	mg/l	mg/l
Sample Name									
Control Blank	X	X	X	0.03	X	X	X	X	X
GCA10651/53-4 HNO3	X	10.87	X	3.77	0.011	0.03	0.026	X	X
GCA10663/64-4 HNO3	X	9.54	X	21.17	X	7.69	0.138	X	0.11
GCA10668/69-4 HNO3	X	6.16	X	13.99	X	3.25	0.128	X	0.12
GCA10674/75-4 HNO3	X	9.36	X	16.1	X	0.98	0.082	X	0.06
GCA10678/79-4 HNO3	X	9.32	0.2	68.78	0.005	4.73	0.31	X	0.78
GCA10682/83-4 HNO3	X	2.05	X	113.11	X	0.23	0.104	X	0.02
GCA10687/91-4 HNO3	X	2.79	0.1	82.84	0.005	0.14	23.827	X	X
DW-4 HNO3	X	0.06	0.1	0.1	X	0.01	0.007	X	X
Blank-4 HNO3	X	X	X	0.56	X	X	0.006	X	X
Alcoa12-OES		19.6						0.5	0.47
Alcoa18-MS	28.5		5.8	552.92	5.437	4.89	5.461		

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 24/06//2013

GLS Job Code 143.0/1309654

Client ON GCA 1220/1



GENALYSIS
LABORATORY SERVICES



Accredited for compliance with ISO/IEC 17025

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JOB INFORMATION

JOB CODE	143/1309654
No. of SAMPLES	16
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates set A
DATE RECEIVED	03/07/2013
DATE COMPLETED	17/07/2013

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

A range of solutions were received to be analysed. F, Cl, EC and pH were measured on the raw samples
Genalysis method codes: ENV_W011 (F), ENV_W013 (Cl), ENV_W002 (EC) and ENV_W001 (pH).
Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than or equal to 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS:
Genalysis method codes; (ICP_W004, ICPOES, ICP_W003, ICPMS)

The charge balance was calculated as requested and was found to be +/- 5%. When the concentrations of metal ions Fe and Mn are sufficiently high to affect the balance these ions are included

Results of analysis on:

Element		Cl	EC	F	HCO ₃	pH
Method		/COL	/MTR	/SIE	/VOL	/MTR
Detection		2	10	0.1	1	0.1
Units		mg/l	uS/cm	mg/l	mgHCO ₃ /L	NONE
Sample Name						
Control Blank		X		X		
GCA10651/53-6 RAW		X	52	0.3	5	6.3
GCA10651/53-6 RAW	check	X	54	0.3	4	6.3
GCA10663/64-6 RAW		X	82	X	3	5.7
GCA10668/69-6 RAW		X	71	X	2	5.2
GCA10674/75-6 RAW		X	112	0.1	2	5.4
GCA10678/79-6 RAW		X	197	X	2	5.1
GCA10682/83-6 RAW		X	153	1.3	12	6.9
GCA10687/91-6 RAW		X	151	0.7	70	7.6
N191		100				
SOLN-001				1		
GWS					120	

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BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1309654

Client ON GCA 1220/1

Element	Ag	Al	As	B	Ba	Bi	Ca	Cd
Method	/MS	/OE	/MS	/OE	/MS	/MS	/OE	/MS
Detection	0.01	0.01	0.1	0.01	0.05	0.005	0.01	0.02
Units	ug/l	mg/l	ug/l	mg/l	ug/l	ug/l	mg/l	ug/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10651/53-6 HNO3	0.04	X	0.8	X	0.9	X	1.26	X
GCA10663/64-6 HNO3	X	X	1.1	X	14.92	X	4.3	0.57
GCA10668/69-6 HNO3	X	X	0.6	X	20	X	1.45	0.69
GCA10674/75-6 HNO3	0.09	X	0.7	X	9.83	X	2.81	0.07
GCA10678/79-6 HNO3	0.01	0.02	0.9	X	8.44	X	10.15	1.35
GCA10682/83-6 HNO3	X	X	0.2	X	2.78	X	10.24	0.02
GCA10687/91-6 HNO3	X	0.02	5.5	X	62.25	X	7.45	X
DW-6 HNO3	X	X	X	X	0.12	X	X	X
Blank-6 HNO3	X	X	0.2	X	0.19	X	X	0.51
Alcoa12-OES		1.96		1			49.69	
Alcoa18-MS	5.07		28.8		5.48	4.774		5.37

Element	Co	Cr	Cu	Fe-Sol	Hg	K	Mg	Mn
Method	/MS	/OE	/OE	/OE	/MS	/OE	/OE	/OE
Detection	0.1	0.01	0.01	0.01	0.1	0.1	0.01	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	mg/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10651/53-6 HNO3	0.2	X	X	X	X	0.4	0.15	0.04
GCA10663/64-6 HNO3	12.5	X	X	0.07	X	8.2	1.6	1.35
GCA10668/69-6 HNO3	6.9	X	X	X	X	10	1.68	0.51
GCA10674/75-6 HNO3	10.8	X	X	X	X	10.8	3.74	2.19
GCA10678/79-6 HNO3	41.5	X	X	X	X	11.2	6.55	8.86
GCA10682/83-6 HNO3	2.5	X	X	X	X	8.7	5.34	1.47
GCA10687/91-6 HNO3	0.2	X	X	X	X	8.5	4.68	0.04
DW-6 HNO3	X	X	X	X	X	X	X	X
Blank-6 HNO3	X	X	X	X	X	X	X	X
Alcoa12-OES		0.48	0.51	1.97		3.9	48.85	0.5
Alcoa18-MS	518.6				5.2			

Element	Mo	Na	Ni	P	Pb	S	SO4	Sb
Method	/MS	/OE	/OE	/OE	/MS	/OE	/CALC	/MS
Detection	0.05	0.1	0.01	0.1	0.5	0.1	1	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	ug/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10651/53-6 HNO3	0.32	8.3	X	X	X	5.1	15	0.35
GCA10663/64-6 HNO3	X	0.7	0.02	X	X	8.8	26	0.05
GCA10668/69-6 HNO3	X	1	0.01	X	0.7	7.5	23	0.04
GCA10674/75-6 HNO3	X	2.1	0.01	X	2.5	12.7	38	0.02
GCA10678/79-6 HNO3	X	1	0.06	X	3.7	24.2	72	0.07
GCA10682/83-6 HNO3	X	3.5	X	X	X	16.5	50	0.07
GCA10687/91-6 HNO3	5.44	12.3	X	X	X	4.7	14	1.03
DW-6 HNO3	X	X	X	X	X	X	X	0.01
Blank-6 HNO3	X	X	X	X	X	X	X	0.02
Alcoa12-OES		246.6	0.48	1		18.9	57	
Alcoa18-MS	5.79				5.7			5.68

GLS Job Code 143.0/1309654

Client ON GCA 1220/1

Element	Se	Si	Sn	Sr	Th	Tl	U	V	Zn
Method	/MS	/OE	/MS	/MS	/MS	/MS	/MS	/OE	/OE
Detection	0.5	0.05	0.1	0.02	0.005	0.01	0.005	0.01	0.01
Units	ug/l	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l	mg/l	mg/l
Sample Name									
Control Blank	X	X	0.1	X	X	X	X	X	X
GCA10651/53-6 HNO3	X	10.67	0.1	5.86	X	0.03	0.011	X	X
GCA10663/64-6 HNO3	X	10.86	X	18.63	X	7.4	0.244	X	0.09
GCA10668/69-6 HNO3	X	6.31	X	10.41	X	2.58	0.095	X	0.08
GCA10674/75-6 HNO3	X	11.77	X	23.3	X	1.06	0.113	X	0.08
GCA10678/79-6 HNO3	X	7.77	X	31.51	X	2.97	0.143	X	0.33
GCA10682/83-6 HNO3	X	1.64	X	75.97	X	0.16	0.085	X	X
GCA10687/91-6 HNO3	X	2.54	X	73.32	X	0.12	18.913	X	X
DW-6 HNO3	X	0.07	X	0.05	X	0.01	0.005	X	X
Blank-6 HNO3	X	X	X	0.11	X	X	0.045	X	X
Alcoa12-OES		19.14						0.5	0.49
Alcoa18-MS	28.1		5.5	544.68	5.297	4.81	5.271		

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Company Accreditation Number 3244

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 17/07/2013

GLS Job Code 143.0/1309906

Client ON GCA 1220/1


GENALYSIS
LABORATORY SERVICES


Accredited for compliance with ISO/IEC 17025

Dr G Campbell

CAMPBELL, GRAEME and ASSOCIATES PTY LTD

PO Box 247

BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1309906
No. of SAMPLES	16
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates set A
DATE RECEIVED	09/07/2013
DATE COMPLETED	26/07/2013

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

A range of solutions were received to be analysed. F, Cl, EC and pH were measured on the raw samples

Genalysis method codes: ENV_W011 (F), ENV_W013 (Cl), ENV_W002 (EC) and ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than or equal to 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS:

Genalysis method codes; (ICP_W004, ICPOES, ICP_W003, ICPMS)

Results of analysis on:

Element		Cl	EC	F	HCO ₃	pH
Method		/COL	/MTR	/SIE	/VOL	/MTR
Detection		2	10	0.1	0.2	0.1
Units		mg/l	uS/cm	mg/l	mgHCO ₃ /L	NONE
Sample Name						
Control Blank		X		X		
GCA10651/53-8 RAW			37		4.8	6.1
GCA10651/53-8 RAW	check		35		4.0	6.1
GCA10663/64-8 RAW			63		2.8	5.7
GCA10668/69-8 RAW			66		2.1	5.2
GCA10674/75-8 RAW			98		2.4	5.4
GCA10678/79-8 RAW			159		2.0	5.1
GCA10682/83-8 RAW		X	118	1.6	14	6.9
GCA10687/91-8 RAW			137	0.8	69	7.6
SOLN-001				1		
GLS					97	

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GLS Job Code 143.0/1309906

Client ON GCA 1220/1

Element	As	Cd	Mn	Pb	S	SO4
Method	/MS	/MS	/OE	/MS	/OE	/CAL
Detection	0.1	0.02	0.01	0.5	0.1	1
Units	ug/l	ug/l	mg/l	ug/l	mg/l	mg/l
Sample Name						
Control Blank	X	X	X	X	X	X
GCA10651/53-8 HNO3	41.5	0.04	0.02	X	3.3	10
GCA10663/64-8 HNO3	2.6	0.44	0.99	X	7.1	21
GCA10668/69-8 HNO3	2	0.61	0.43	1.2	7.2	22
GCA10674/75-8 HNO3	1.5	0.04	1.38	1	9.3	28
GCA10678/79-8 HNO3	1.4	1.01	6.5	2.4	19.6	59
GCA10682/83-8 HNO3	1.1	0.02	1.1	X	11.9	36
GCA10687/91-8 HNO3	8.9	X	0.05	1.3	4	12
DW-8 HNO3	X	X	X	X	X	X
Blank-8 HNO3	X	X	X	X	X	X
Alcoa12-OES			0.5		20.6	
Alcoa18-MS	27.7	5.25		5.6		

Element	Sb	Si	Tl	Zn
Method	/MS	/OE	/MS	/OE
Detection	0.01	0.05	0.01	0.01
Units	ug/l	mg/l	ug/l	mg/l
Sample Name				
Control Blank	X	X	X	X
GCA10651/53-8 HNO3	0.48	10.61	0.02	0.02
GCA10663/64-8 HNO3	0.04	9.03	6.49	0.09
GCA10668/69-8 HNO3	0.01	6.36	2.64	0.08
GCA10674/75-8 HNO3	0.02	9.48	0.86	0.06
GCA10678/79-8 HNO3	0.07	8.01	3.05	0.25
GCA10682/83-8 HNO3	0.06	1.6	0.15	0.01
GCA10687/91-8 HNO3	1.07	2.77	0.13	0.02
DW-8 HNO3	X	0.08	X	0.02
Blank-8 HNO3	X	0.07	X	0.02
Alcoa12-OES		19.25		0.51
Alcoa18-MS	5.62		5.19	

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 26/07/2013

GLS Job Code 143.0/1310478

Client ON GCA1220/1


GENALYSIS
LABORATORY SERVICES


Accredited for compliance with ISO/IEC 17025

Dr G Campbell

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PO Box 247

BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1310478
No. of SAMPLES	10
CLIENT O/N	GCA1220/1
PROJECT	Bowdens
STATE	Column leachates set A
DATE RECEIVED	23/07/2013
DATE COMPLETED	05/08/2013

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

A range of solutions were received to be analysed. EC and pH were measured on the raw samples.

Genalysis method codes: ENV_W002 (EC) and ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than or equal to 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS:

Genalysis method codes; (ICP_W004, ICPOES, ICP_W003, ICPMS)

Results of analysis on:

Element		EC	HCO ₃	pH
Method		/MTR	/VOL	/MTR
Detection		10	1	0.1
Units		uS/cm	mgHCO ₃ /L	NONE
Sample Name				
Control Blank		X	X	X
GCA10663/64-10 RAW		49	3	5.9
GCA10663/64-10 RAW	Check	49	3	5.8
GCA10668/69-10 RAW		56	2	5.3
GCA10674/75-10 RAW		79	2	5.4
GCA10678/79-10 RAW		130	2	5.2
GCA10682/83-10 RAW		104	17	7.1
GWS			118	

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GLS Job Code 143.0/1310478

Client ON GCA1220/1

Element	As	Cd	Mn	Pb
Method	/MS	/MS	/OE	/MS
Detection	0.1	0.02	0.01	0.5
Units	ug/l	ug/l	mg/l	ug/l
Sample Name				
Control Blank				
GCA10663/64-10 HNO3	0.7	0.3	0.76	X
GCA10668/69-10 HNO3	0.6	0.5	0.38	X
GCA10674/75-10 HNO3	0.5	0.04	1.38	0.6
GCA10678/79-10 HNO3	0.5	0.71	5.12	1.1
GCA10682/83-10 HNO3	0.3	0.03	1	X
Alcoa12-OES			0.5	
Alcoa18-MS	29.4	5.2		5.7

Element	S	SO4	Sb	Si	Tl	Zn
Method	/OE	/CALC	/MS	/OE	/MS	/OE
Detection	0.1	1	0.01	0.05	0.01	0.01
Units	mg/l	mg/l	ug/l	mg/l	ug/l	mg/l
Sample Name						
Control Blank						
GCA10663/64-10 HNO3	5.2	16	0.09	7.64	4.68	0.05
GCA10668/69-10 HNO3	5.8	17	0.06	5.88	2.13	0.07
GCA10674/75-10 HNO3	8.5	26	0.03	10.39	0.87	0.04
GCA10678/79-10 HNO3	15	45	0.09	9.6	2.55	0.19
GCA10682/83-10 HNO3	8.7	26	0.09	1.36	0.16	0.01
Alcoa12-OES	20.5	62		19.37		0.46
Alcoa18-MS			5.83		4.84	

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 05/08/2013

GLS Job Code 143.0/1306603

Client ON GCA 1220/1

**GENALYSIS**
LABORATORY SERVICES

Accredited for compliance with ISO/IEC 17025

Dr G Campbell

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PO Box 247

BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1306603
No. of SAMPLES	28
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates
DATE RECEIVED	9/05/2013
DATE COMPLETED	28/05/2013

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

A range of solutions were received to be analysed. F, Cl, EC and pH were measured on the raw samples Genalysis method codes: ENV_W011 (F), ENV_W013 (Cl), ENV_W002 (EC) and ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS: Genalysis method codes: (ICP_W004, ICPOES, ICP_W003, ICPMS)

The charge balance was calculated as requested and was found to be +/- 5%. The concentrations of metal ions Fe and Mn are sufficiently high to affect the balance and are included

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Page 1 of 4

GLS Job Code 143.0/1306603

Client ON GCA 1220/1

Results of analysis on:

Element		Acidly	Cl	EC	F	HCO ₃	pH
Method		/VOL	/COL	/MTR	/SIE	/VOL	/MTR
Detection		1	2	10	0.1	1	0.1
Units		mgH ₂ SO ₄ /L	mg/l	uS/cm	mg/l	mgHCO ₃ /L	NONE
Sample Name							
Control Blank			X		X		
GCA10706/07-0a RAW			104	3388	0.3	63	7.1
GCA10706/07-0a RAW	check		103	3316	0.3	63	7.2
GCA10706/07-0b RAW			4	1421	0.5	133	7.5
GCA10706/07-0c RAW			X	387	0.8	139	8.1
GCA10730/31-0a RAW		418	249	3878	1.4		4
GCA10730/31-0b RAW		13	12	554	0.2		4.9
GCA10740/41-0a RAW			57	1741	0.3	28	7.1
GCA10740/41-0b RAW			2	289	0.6	30	7.1
GCA10747/48/49-0a RAW			17	1103	1.3	37	7.3
GCA10747/48/49-0b RAW			X	374	1.8	81	7.7
GCA10754/55-0a RAW			12	1661	0.5	73	7.3
GCA10754/55-0b RAW			X	489	0.7	107	7.9
pH5-feed		79					

Element		Ag	Al	As	B	Ba	Bi	Ca	Cd
Method		/MS	/OE	/MS	/OE	/MS	/MS	/OE	/MS
Detection		0.01	0.01	0.1	0.01	0.05	0.005	0.01	0.02
Units		ug/l	mg/l	ug/l	mg/l	ug/l	ug/l	mg/l	ug/l
Sample Name									
Control Blank		X	X	X	X	X	X	X	X
GCA10706/07-0a HNO ₃		0.09	0.01	3.7	X	19.7	X	557.4	1.87
GCA10706/07-0b HNO ₃		0.02	X	6.5	X	22.0	X	188.0	0.38
GCA10706/07-0c HNO ₃		X	X	3.7	0.02	36.6	X	30.2	0.04
GCA10730/31-0a HNO ₃		X	53.63	127	0.01	18.7	0.01	66.4	245.2
GCA10730/31-0b HNO ₃		X	0.36	66.7	X	7.3	X	2.8	5.83
GCA10740/41-0a HNO ₃		0.05	0.08	20.8	0.03	16.2	X	124.2	1.92
GCA10740/41-0b HNO ₃		X	0.4	29.2	0.04	3.1	X	8.0	0.13
GCA10747/48/49-0a HNO ₃		X	0.02	38.8	0.01	24.6	X	110.5	0.06
GCA10747/48/49-0b HNO ₃		X	0.01	259.3	0.02	6.3	X	23.4	X
GCA10754/55-0a HNO ₃		X	0.03	0.5	X	31.3	X	240.2	0.11
GCA10754/55-0a HNO ₃	check	X	X	0.4	X	31.4	X	235.6	0.11
GCA10754/55-0b HNO ₃		X	0.04	0.7	X	7.2	X	46.3	X
DW-0a HNO ₃		X	0.01	X	X	0.07	X	X	0.02
DW-0b HNO ₃		X	X	X	X	0.45	X	X	0.05
DW-0c HNO ₃		X	X	X	X	0.24	X	X	X
Blank-0a HNO ₃		X	X	0.2	X	0.15	X	X	X
Blank-0b HNO ₃		X	X	0.2	X	0.14	X	0.01	X
Blank-0c HNO ₃		X	0.02	X	X	0.08	X	X	X
Alcoa12-OES			2.01		1.02			51.34	
Alcoa18-MS		4.95		27		5.6	4.851		5.21
AlcoaHi4-OES								978.5	

BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1306603

Client ON GCA 1220/1

Element		Co	Cr	Cu	Fe-Sol	Hg	K	Mg	Mn
Method		/MS	/OE	/OE	/OE	/MS	/OE	/OE	/OE
Detection		0.1	0.01	0.01	0.01	0.1	0.1	0.01	0.01
Units		ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	mg/l
Sample Name									
Control Blank		X	X	X	X	X	X	X	X
GCA10706/07-0a HNO3		25.5	X	0.03	X	X	80.3	270.26	17.94
GCA10706/07-0b HNO3		6.5	X	0.01	X	X	39.7	84.06	5.64
GCA10706/07-0c HNO3		0.9	X	X	X	X	18.9	13.6	0.89
GCA10730/31-0a HNO3		287.8	0.25	0.03	7.16	X	118.2	219.29	253.96
GCA10730/31-0b HNO3		9.8	0.01	X	0.39	X	31	7.95	8.4
GCA10740/41-0a HNO3		22.4	X	X	X	X	40.5	88.5	6.28
GCA10740/41-0b HNO3		1.1	X	X	0.03	X	11.4	5.69	0.71
GCA10747/48/49-0a HNO3		1.9	X	X	X	X	60	54.15	3.42
GCA10747/48/49-0b HNO3		0.6	X	X	X	X	31.8	12.12	0.99
GCA10754/55-0a HNO3		26.3	X	X	X	X	48.1	101.65	2.52
GCA10754/55-0a HNO3	check	26.1	X	0.01	X	X	48.2	102.96	2.55
GCA10754/55-0b HNO3		4	X	X	X	X	21.4	20.87	0.5
DW-0a HNO3		X	X	X	X	X	X	X	X
DW-0b HNO3		X	X	X	X	X	X	X	X
DW-0c HNO3		X	X	X	X	X	X	X	X
Blank-0a HNO3		X	0.01	X	X	X	X	X	X
Blank-0b HNO3		X	X	X	X	X	X	X	X
Blank-0c HNO3		X	X	X	X	X	X	X	X
Alcoa12-OES			0.53	0.52	2.07		3.9	51.28	0.52
Alcoa18-MS		496.3				5.1			
AlcoaHi4-OES									

Element		Mo	Na	Ni	P	Pb	S	SO4	Sb
Method		/MS	/OE	/OE	/OE	/MS	/OE	/CALC	/MS
Detection		0.05	0.1	0.01	0.1	0.5	0.1	0.3	0.01
Units		ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	ug/l
Sample Name									
Control Blank		X	X	X	X	X	0.3	1	X
GCA10706/07-0a HNO3		9.34	122.5	0.05	X	X	939.5	2815	3.31
GCA10706/07-0b HNO3		31.06	32.8	0.01	X	X	256.2	768	4.09
GCA10706/07-0c HNO3		54.07	11.7	X	X	X	22.2	67	5.23
GCA10730/31-0a HNO3		0.23	499.6	0.29	X	8.9	827.8	2480	3.68
GCA10730/31-0b HNO3		0.09	63.1	0.01	X	0.8	69.3	208	2.67
GCA10740/41-0a HNO3		4.78	157.3	0.02	X	17.4	305.6	916	9.68
GCA10740/41-0b HNO3		4.99	25.6	X	X	7.2	26.6	80	11.42
GCA10747/48/49-0a HNO3		39.72	23.9	X	X	X	178.1	534	13.56
GCA10747/48/49-0b HNO3		23.99	8	X	X	1	30.4	91	26.52
GCA10754/55-0a HNO3		0.88	23.9	0.02	X	1.4	316.1	947	0.28
GCA10754/55-0a HNO3	check	0.84	24.2	0.02	X	1.4	329.6	988	0.31
GCA10754/55-0b HNO3		3.53	6.1	X	X	X	49.1	147	0.4
DW-0a HNO3		X	X	X	X	X	X	X	X
DW-0b HNO3		X	X	X	X	X	0.2	1	X
DW-0c HNO3		X	X	X	X	X	X	X	X
Blank-0a HNO3		X	X	X	X	3.1	0.2	1	0.17
Blank-0b HNO3		X	X	X	X	X	0.2	1	0.01
Blank-0c HNO3		X	X	X	X	X	0.1	0	X
Alcoa12-OES			255.8	0.53	1		20.9	63	
Alcoa18-MS		5.35				5.6			5.45
AlcoaHi4-OES							257.2	771	

GLS Job Code 143.0/1306603

Client ON GCA 1220/1

Element		Se	Si	Sn	Sr	Th	Tl	U	V	Zn
Method		/MS	/OE	/MS	/MS	/MS	/MS	/MS	/OE	/OE
Detection		0.5	0.05	0.1	0.02	0.005	0.01	0.005	0.01	0.01
Units		ug/l	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l	mg/l	mg/l
Sample Name										
Control Blank		X	X	X	X	X	X	X	X	X
GCA10706/07-0a HNO3		0.7	4.85	X	5542	0.013	1.29	2.391	X	0.09
GCA10706/07-0b HNO3		X	3.75	X	1780	X	0.54	7.919	X	0.02
GCA10706/07-0c HNO3		X	3.07	0.1	282	X	0.25	3.826	X	X
GCA10730/31-0a HNO3		1	20.02	0.1	829	1.124	8.51	95	X	11.2
GCA10730/31-0b HNO3		X	16.11	X	35	0.014	1.89	1.527	X	0.4
GCA10740/41-0a HNO3		1.6	6.96	X	1115	0.014	1.71	0.344	X	1.68
GCA10740/41-0b HNO3		X	6.06	0.2	72	0.188	0.43	0.082	X	0.08
GCA10747/48/49-0a HNO3		X	2.93	0.1	561	0.006	0.89	1.089	X	0.03
GCA10747/48/49-0b HNO3		X	4.89	X	118	0.007	0.45	4.098	X	0.01
GCA10754/55-0a HNO3		8.4	1.84	X	1577	X	1.03	0.856	X	X
GCA10754/55-0a HNO3	check	7.6	1.86	0.1	1566	X	1.01	0.839	X	X
GCA10754/55-0b HNO3		1.2	1.69	X	303	X	0.41	1.319	X	X
DW-0a HNO3		X	X	X	0.3	X	X	X	X	X
DW-0b HNO3		X	X	X	0.3	X	X	X	X	X
DW-0c HNO3		X	X	X	0.26	X	X	X	X	X
Blank-0a HNO3		X	X	X	0.25	X	X	X	X	X
Blank-0b HNO3		X	X	X	0.29	X	X	X	X	X
Blank-0c HNO3		X	X	X	0.14	X	X	X	X	X
Alcoa12-OES			19.69						0.51	0.49
Alcoa18-MS		27.8		5.6	513.96	5.298	4.72	5.374		
AlcoaHi4-OES										

NATA ENDORSED DOCUMENT

Company Accreditation Number 3244

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 28/05/2013

GLS Job Code 143.0/1307272

Client ON GCA 1220/1


GENALYSIS
LABORATORY SERVICES


Accredited for compliance with ISO/IEC 17025

Dr G Campbell

CAMPBELL, GRAEME and ASSOCIATES PTY LTD

PO Box 247

BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1307272
No. of SAMPLES	12
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates
DATE RECEIVED	23/05/2013
DATE COMPLETED	10/06/2013

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

A range of solutions were received to be analysed. F, Cl, EC and pH were measured on the raw samples

Genalysis method codes: ENV_W011 (F), ENV_W013 (Cl), ENV_W002 (EC) and ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS:

Genalysis method codes; (ICP_W004, ICPOES, ICP_W003, ICPMS)

The charge balance was calculated as requested and was found to be +/- 5%. In some samples the concentrations of metal ions Fe and Mn are sufficiently high to affect the balance and are included

Results of analysis on:

Element		Acid	Cl	EC	F	HCO ₃	pH
Method		/VOL	/COL	/MTR	/SIE	/VOL	/MTR
Detection		1	2	10	0.1	1	0.1
Units		mgH ₂ SO ₄ /L	mg/l	uS/cm	mg/l	mgHCO ₃ /L	NONE
Sample Name							
Control Blank			X		X		
GCA10706/07-2 RAW			3	269	0.8	19	7.2
GCA10706/07-2 RAW	check		4	269	0.9	18	7
GCA10730/31-2 RAW		11	6	348	0.1		4.8
GCA10740/41-2 RAW			2	352	0.6	4.4	6.3
GCA10747/48/49-2 RAW			2	218	2.4	2.6	5.1
GCA10754/55-2 RAW			X	416	1.3	35	7.4
N191			100				

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Page 1 of 3

GLS Job Code 143.0/1307272

Client ON GCA 1220/1

Element	Ag	Al	As	B	Ba	Bi	Ca	Cd
Method	/MS	/OE	/MS	/OE	/MS	/MS	/OE	/MS
Detection	0.01	0.01	0.1	0.01	0.05	0.005	0.01	0.02
Units	ug/l	mg/l	ug/l	mg/l	ug/l	ug/l	mg/l	ug/l
Sample Name								
Control Blank	X	0.01	X	X	X	X	X	X
GCA10706/07-2 HNO3	X	0.32	2	X	26.95	X	9.26	0.05
GCA10730/31-2 HNO3	0.02	0.52	35.1	0.04	13.05	X	3.2	7.41
GCA10740/41-2 HNO3	0.02	0.06	7.8	0.02	7.46	X	16.93	0.69
GCA10747/48/49-2 HNO3	0.02	0.06	128.8	0.05	3.67	0.006	11.94	0.17
GCA10754/55-2 HNO3	X	0.04	0.9	0.04	7.46	X	38.19	0.07
DW-2 HNO3	X	0.01	X	X	0.06	X	0.04	X
Blank-2 HNO3	X	0.01	X	X	X	X	X	X
Alcoa12-OES		2.06		0.99			50.37	
Alcoa18-MS	5.07		29.7		5.56	4.973		5.08

Element	Co	Cr	Cu	Fe-Sol	Hg	K	Mg	Mn
Method	/MS	/OE	/OE	/OE	/MS	/OE	/OE	/OE
Detection	0.1	0.01	0.01	0.01	0.1	0.1	0.01	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	mg/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10706/07-2 HNO3	1.5	X	X	0.17	X	17.9	8.52	6.01
GCA10730/31-2 HNO3	11.4	X	0.01	0.27	X	21.7	8.3	9.13
GCA10740/41-2 HNO3	5.9	X	0.01	X	X	13.8	11.96	2.42
GCA10747/48/49-2 HNO3	3.7	X	0.02	0.01	X	16.3	6.05	0.79
GCA10754/55-2 HNO3	3.7	X	0.01	X	X	15.5	16.29	0.27
DW-2 HNO3	X	X	X	X	X	X	X	X
Blank-2 HNO3	X	X	X	X	X	X	X	X
Alcoa12-OES		0.52	0.52	2		4	50.41	0.5
Alcoa18-MS	527.9				4.5			

Element	Mo	Na	Ni	P	Pb	S	SO4	Sb
Method	/MS	/OE	/OE	/OE	/MS	/OE	/CALC	/MS
Detection	0.05	0.1	0.01	0.1	0.5	0.1	1	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	ug/l
Sample Name								
Control Blank	X	X	X	X	X	0.2	1	X
GCA10706/07-2 HNO3	28.89	16.5	X	X	X	39.8	119	2.21
GCA10730/31-2 HNO3	0.09	22.9	X	X	1.1	46.6	140	1.13
GCA10740/41-2 HNO3	1.9	19.9	X	X	13.5	46.2	138	10
GCA10747/48/49-2 HNO3	31.8	4	X	X	1.3	23.1	69	28.45
GCA10754/55-2 HNO3	4.92	4.4	X	X	X	48.5	145	0.59
DW-2 HNO3	X	X	X	X	X	0.3	1	0.01
Blank-2 HNO3	X	X	X	X	X	X	X	X
Alcoa12-OES		245.6	0.49	1		20.6	62	
Alcoa18-MS	5.89				5.4			5.85

BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1307272

Client ON GCA 1220/1

Element	Se	Si	Sn	Sr	Th	Tl	U	V	Zn
Method	/MS	/OE	/MS	/MS	/MS	/MS	/MS	/OE	/OE
Detection	0.5	0.05	0.1	0.02	0.005	0.01	0.005	0.01	0.01
Units	ug/l	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l	mg/l	mg/l
Sample Name									
Control Blank	X	X	X	X	X	X	X	X	X
GCA10706/07-2 HNO3	X	4.32	X	182.1	0.013	0.15	0.117	X	0.27
GCA10730/31-2 HNO3	X	6.11	X	37.6	0.012	1.2	1.194	X	0.42
GCA10740/41-2 HNO3	X	3.98	X	150.9	0.012	0.57	0.025	X	0.26
GCA10747/48/49-2 HNO3	X	3.37	0.1	59.9	0.047	0.27	0.109	X	0.03
GCA10754/55-2 HNO3	0.8	1.07	X	259.3	0.012	0.27	0.2	X	0.02
DW-2 HNO3	X	X	X	0.1	X	X	X	X	X
Blank-2 HNO3	X	X	X	X	X	X	X	X	X
Alcoa12-OES		19.14						0.51	0.51
Alcoa18-MS	29.4		5.6	539.5	5.249	4.73	5.239		

NATA ENDORSED DOCUMENT**Company Accreditation Number 3244**

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 10/06/2013

GLS Job Code 143.0/1308066

Client ON GCA 1220/1



GENALYSIS
LABORATORY SERVICES



Accredited for compliance with ISO/IEC 17025

Dr G Campbell
CAMPBELL, GRAEME and ASSOCIATES PTY LTD
PO Box 247
BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1308066
No. of SAMPLES	12
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates set B
DATE RECEIVED	05/06/2013
DATE COMPLETED	24/06/2013

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

A range of solutions were received to be analysed. F, Cl, EC and pH were measured on the raw samples
Genalysis method codes: ENV_W011 (F), ENV_W013 (Cl), ENV_W002 (EC) and ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than or equal to 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS:
Genalysis method codes; (ICP_W004, ICPOES, ICP_W003, ICPMS)

The charge balance was calculated as requested and was found to be +/- 5%. When the concentrations of metal ions Fe and Mn are sufficiently high to affect the balance these ions are included

Results of analysis on:

Element		Acidy	Cl	F	HCO ₃	pH	EC
Method		/VOL	/COL	/SIE	/VOL	/MTR	/MTR
Detection		1	2	0.1	1	0.1	10
Units		mgH ₂ SO ₄ /L	mg/l	mg/l	mgHCO ₃ /L	NONE	uS/cm
Sample Name							
Control Blank			X	X	X		
GCA10706/07-4 RAW			5	0.9	34	7.5	554
GCA10706/07-4 RAW	check		4	1	34	7.4	553
GCA10730/31-4 RAW		11	8	0.1		4.8	268
GCA10740/41-4 RAW			2	0.3	6	6.5	451
GCA10747/48/49-4 RAW			X	1.9	14	6.9	159
GCA10754/55-4 RAW			4	1.4	69	7.8	390
N191			103				
GWS					120		
SOLN-001				1.2			

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BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1308066

Client ON GCA 1220/1

Element	Ag	Al	As	B	Ba	Bi	Ca	Cd
Method	/MS	/OE	/MS	/OE	/MS	/MS	/OE	/MS
Detection	0.01	0.01	0.1	0.01	0.05	0.005	0.01	0.02
Units	ug/l	mg/l	ug/l	mg/l	ug/l	ug/l	mg/l	ug/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10706/07-4 HNO3	X	0.05	2.4	X	25.54	X	52.86	0.04
GCA10730/31-4 HNO3	X	0.3	10.3	0.06	9.43	X	2.83	6.26
GCA10740/41-4 HNO3	X	0.03	2.6	0.03	11.7	X	25.31	1.68
GCA10747/48/49-4 HNO3	0.01	0.06	71.3	0.04	2.96	X	8.53	0.15
GCA10754/55-4 HNO3	X	0.02	1.2	0.02	6.8	X	35.74	X
DW-4 HNO3	X	0.03	X	0.06	0.12	X	0.03	X
Blank-4 HNO3	X	X	1.2	0.06	0.11	X	0.05	X
Alcoa12-OES		2.06		1.05			50.41	
Alcoa18-MS	5.35		31.2		5.68	5.019		5.46

Element	Co	Cr	Cu	Fe-Sol	Hg	K	Mg	Mn
Method	/MS	/OE	/OE	/OE	/MS	/OE	/OE	/OE
Detection	0.1	0.01	0.01	0.01	0.1	0.1	0.01	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	mg/l
Sample Name								
Control Blank	X	X	X	X	X	X	0.01	X
GCA10706/07-4 HNO3	1.4	X	0.01	X	X	19	23.45	1.51
GCA10730/31-4 HNO3	8.6	0.01	X	0.35	X	18.5	7.25	7.81
GCA10740/41-4 HNO3	5.7	X	X	X	X	17.4	18.18	4.69
GCA10747/48/49-4 HNO3	0.8	X	0.01	0.01	X	13.3	4.43	0.87
GCA10754/55-4 HNO3	1.4	X	X	X	X	15.3	15.45	0.26
DW-4 HNO3	X	X	X	X	X	0.2	X	X
Blank-4 HNO3	0.2	X	X	X	X	X	X	X
Alcoa12-OES		0.5	0.54	2.03		4.1	50.39	0.51
Alcoa18-MS	545				4.6			

Element	Mo	Na	Ni	P	Pb	S	SO4	Sb
Method	/MS	/OE	/OE	/OE	/MS	/OE	/CALC	/MS
Detection	0.05	0.1	0.01	0.1	0.5	0.1	1	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	ug/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10706/07-4 HNO3	61	8.6	X	X	X	74.2	222	2.94
GCA10730/31-4 HNO3	0.22	13	0.01	X	1.9	34.1	102	0.76
GCA10740/41-4 HNO3	0.88	18	X	X	64.3	62.1	186	7.37
GCA10747/48/49-4 HNO3	19.4	3.3	X	X	3.6	14.8	45	19.16
GCA10754/55-4 HNO3	6.47	4.8	X	X	0.9	37.7	113	0.75
DW-4 HNO3	X	X	X	X	0.6	X	X	0.01
Blank-4 HNO3	X	0.1	X	X	X	X	X	0.01
Alcoa12-OES		250.9	0.51	1		20.8	62	
Alcoa18-MS	6.34				5.6			5.92

GLS Job Code 143.0/1308066

Client ON GCA 1220/1

Element	Se	Si	Sn	Sr	Th	Tl	U	V	Zn
Method	/MS	/OE	/MS	/MS	/MS	/MS	/MS	/OE	/OE
Detection	0.5	0.05	0.1	0.02	0.005	0.01	0.005	0.01	0.01
Units	ug/l	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l	mg/l	mg/l
Sample Name									
Control Blank	X	X	X	0.03	X	X	X	X	X
GCA10706/07-4 HNO3	X	1.43	0.9	468	0.006	0.22	1.018	X	X
GCA10730/31-4 HNO3	X	4.35	X	32	X	0.94	0.788	X	0.36
GCA10740/41-4 HNO3	X	5.25	X	237	X	0.72	0.015	X	0.56
GCA10747/48/49-4 HNO3	X	2.9	0.2	45	0.012	0.2	0.079	X	0.05
GCA10754/55-4 HNO3	1.2	1.13	0.2	235	X	0.25	0.504	X	0.02
DW-4 HNO3	X	0.06	0.2	0.16	X	X	X	X	X
Blank-4 HNO3	X	X	X	0.57	X	X	X	X	X
Alcoa12-OES		19.63						0.51	0.47
Alcoa18-MS	30		5.8	551.07	5.435	4.95	5.393		

NATA ENDORSED DOCUMENT

Company Accreditation Number 3244

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 24/06//2013

GLS Job Code 143.0/1309655

Client ON GCA 1220/1


GENALYSIS
LABORATORY SERVICES


Accredited for compliance with ISO/IEC 17025

Dr G Campbell

CAMPBELL, GRAEME and ASSOCIATES PTY LTD

PO Box 247

BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1309655
No. of SAMPLES	12
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates set B
DATE RECEIVED	03/07/2013
DATE COMPLETED	17/07/2013

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

A range of solutions were received to be analysed. F, Cl, EC and pH were measured on the raw samples Genalysis method codes: ENV_W011 (F), ENV_W013 (Cl), ENV_W002 (EC) and ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than or equal to 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS:

Genalysis method codes; (ICP_W004, ICPOES, ICP_W003, ICPMS)

The charge balance was calculated as requested and was found to be +/- 5%. When the concentrations of metal ions Fe and Mn are sufficiently high to affect the balance these ions are included

Results of analysis on:

Element		F	pH	Acidy	HCO ₃	Cl	EC
Method		/SIE	/MTR	/VOL	/VOL	/COL	/MTR
Detection		0.1	0.1	1	1	2	10
Units		mg/l	NONE	mgH ₂ SO ₄ /L	mgHCO ₃ /L	mg/l	uS/cm
Sample Name							
Control Blank		X				X	
GCA10706/07-6 RAW		0.8	7.4		33	5	471
GCA10706/07-6 RAW	check	0.9	7.4		32	5	472
GCA10730/31-6 RAW		0.3	4	40	X	5	778
GCA10740/41-6 RAW		0.3	6.5		7	5	527
GCA10747/48/49-6 RAW		1.6	7.1		18	X	157
GCA10754/55-6 RAW		1.2	7.8		69	X	241
N191						100	
SOLN-001		1					

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GLS Job Code 143.0/1309655

Client ON GCA 1220/1

Element	Ag	Al	As	B	Ba	Bi	Ca	Cd
Method	/MS	/OE	/MS	/OE	/MS	/MS	/OE	/MS
Detection	0.01	0.01	0.1	0.01	0.05	0.005	0.01	0.02
Units	ug/l	mg/l	ug/l	mg/l	ug/l	ug/l	mg/l	ug/l
Sample Name								
Control Blank	X	X	X	X	0.06	X	X	X
GCA10706/07-6 HNO3	0.02	0.03	1.7	X	27.86	X	40.32	0.06
GCA10730/31-6 HNO3	0.01	1.96	14.5	0.01	30.63	0.008	11.89	32.08
GCA10740/41-6 HNO3	X	X	2.6	0.03	16.91	X	32.89	3.19
GCA10747/48/49-6 HNO3	0.02	0.48	54.6	0.01	3.28	X	8.92	0.09
GCA10754/55-6 HNO3	X	X	0.5	X	5.15	0.007	21.8	X
DW-6 HNO3	0.01	X	X	X	0.08	X	0.02	X
Blank-6 HNO3	X	X	0.2	X	0.15	X	0.02	0.5
Alcoa12-OES		1.96		0.99			49.86	
Alcoa18-MS		5.15	29.8	5.4	4.956	5.36	546.1	5.1

Element	Co	Cr	Cu	Fe-Sol	Hg	K	Mg	Mn
Method	/MS	/OE	/OE	/OE	/MS	/OE	/OE	/OE
Detection	0.1	0.01	0.01	0.01	0.1	0.1	0.01	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	mg/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10706/07-6 HNO3	0.6	X	X	X	X	14.8	16.88	1.07
GCA10730/31-6 HNO3	44.5	0.03	X	1.8	X	42.2	32.53	36.88
GCA10740/41-6 HNO3	7.8	X	X	X	X	20.3	22.77	7.18
GCA10747/48/49-6 HNO3	0.4	X	X	X	X	13.7	4.6	0.79
GCA10754/55-6 HNO3	0.7	X	X	X	X	11.4	9.2	0.16
DW-6 HNO3	X	X	X	X	X	X	X	X
Blank-6 HNO3	X	X	X	X	X	X	X	X
Alcoa12-OES		0.48	0.51	1.97		4	48.43	0.5
Alcoa18-MS	6.15	5.4	5.83	5.7	539.84	5.258	4.71	5.253

GLS Job Code 143.0/1309655

Client ON GCA 1220/1

Element	Mo	Na	Ni	P	Pb	S	SO4	Sb
Method	/MS	/OE	/OE	/OE	/MS	/OE	/CALC	/MS
Detection	0.05	0.1	0.01	0.1	0.5	0.1	1	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	ug/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10706/07-6 HNO3	54.64	6.4	X	X	X	50.3	151	2.67
GCA10730/31-6 HNO3	0.07	29.3	0.05	X	3.6	107.5	322	1.04
GCA10740/41-6 HNO3	0.59	16.2	X	X	123.4	68.8	206	7.02
GCA10747/48/49-6 HNO3	22.11	2	X	X	1.9	13	39	22.66
GCA10754/55-6 HNO3	3.96	2.9	X	X	X	15.6	47	0.76
DW-6 HNO3	X	X	X	X	X	X	X	0.02
Blank-6 HNO3	X	X	X	X	X	X	X	0.01
Alcoa12-OES		246.9	0.5	1		18.8	56	
Alcoa18-MS	6.15				5.4			5.83

Element	Se	Si	Sn	Sr	Th	Tl	U	V	Zn
Method	/MS	/OE	/MS	/MS	/MS	/MS	/MS	/OE	/OE
Detection	0.5	0.05	0.1	0.02	0.005	0.01	0.005	0.01	0.01
Units	ug/l	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l	mg/l	mg/l
Sample Name									
Control Blank	X	X	X	0.03	X	X	X	X	X
GCA10706/07-6 HNO3	X	1.3	0.2	346.39	0.02	0.17	0.783	X	X
GCA10730/31-6 HNO3	X	18.82	X	147.31	0.014	2.26	5.735	X	1.7
GCA10740/41-6 HNO3	X	6.51	X	301.52	0.006	0.99	0.016	X	0.9
GCA10747/48/49-6 HNO3	X	3.84	0.2	44.72	0.054	0.24	0.189	X	0.02
GCA10754/55-6 HNO3	X	1.02	X	139.06	X	0.18	0.323	X	X
DW-6 HNO3	X	0.08	0.1	0.2	X	X	X	X	X
Blank-6 HNO3	X	0.06	X	0.06	X	X	0.052	X	X
Alcoa12-OES		19.13						0.49	0.49
Alcoa18-MS	28		5.7	539.84	5.258	4.71	5.253		

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 17/07//2013

GLS Job Code 143.0/1309907

Client ON GCA 1220/1



GENALYSIS
LABORATORY SERVICES



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Dr G Campbell
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PO Box 247
BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1309907
No. of SAMPLES	6
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates set B
DATE RECEIVED	09/07/2013
DATE COMPLETED	26/07/2013

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

A range of solutions were received to be analysed. EC and pH were measured on the raw samples Genalysis method codes: ENV_W002 (EC) and ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than or equal to 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS:
Genalysis method codes; (ICP_W004, ICPOES, ICP_W003, ICPMS)

The charge balance was calculated as requested and was found to be +/- 5%. When the concentrations of metal ions Fe and Mn are sufficiently high to affect the balance these ions are included

Results of analysis on:

Element		EC	pH	HCO ₃
Method		/MTR	/MTR	/VOL
Detection		10	0.1	1
Units		uS/cm	NONE	mgHCO ₃ /L
Sample Name				
Control Blank				
GCA10706/07-8 RAW		392	7.5	48
GCA10706/07-8 RAW	check	398	7.5	48
GCA10754/55-8 RAW		220	7.7	64

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BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1309907

Client ON GCA 1220/1

Element	Ag	Al	As	B	Ba	Bi	Ca
Method	/MS	/OE	/MS	/OE	/MS	/MS	/OE
Detection	0.01	0.01	0.1	0.01	0.05	0.005	0.01
Units	ug/l	mg/l	ug/l	mg/l	ug/l	ug/l	mg/l
Sample Name							
Control Blank	X	X	X	X	X	X	X
GCA10754/55-8 RAW							
GCA10706/07-8 HNO3	0.02	X	3.2	X	43.47	X	35.99
GCA10754/55-8 HNO3	0.04	X	3.8	X	5.51	X	21.18
DW-8 HNO3	X	0.01	X	X	0.15	X	0.05
Blank-8 HNO3	X	0.02	X	X	0.18	X	0.08
Alcoa12-OES		2.03		0.99			52.64
Alcoa-High5-MS	19.69		105.9		23.05	19.203	

Element	Cd	Co	Cr	Cu	Fe-Sol	Hg	K
Method	/MS	/MS	/OE	/OE	/OE	/MS	/OE
Detection	0.02	0.1	0.01	0.01	0.01	0.1	0.1
Units	ug/l	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l
Sample Name							
Control Blank	X	X	X	X	X	X	X
GCA10754/55-8 RAW							
GCA10706/07-8 HNO3	0.12	0.7	X	X	0.02	X	15.6
GCA10754/55-8 HNO3	X	0.8	X	X	X	X	11.1
DW-8 HNO3	X	X	X	X	X	X	0.2
Blank-8 HNO3	X	X	X	X	X	X	0.2
Alcoa12-OES			0.48	0.53	2.04		4.3
Alcoa-High5-MS	19.81	536.6				18.3	

Element	Mg	Mn	Mo	Na	Ni	P	Pb
Method	/OE	/OE	/MS	/OE	/OE	/OE	/MS
Detection	0.01	0.01	0.05	0.1	0.01	0.1	0.5
Units	mg/l	mg/l	ug/l	mg/l	mg/l	mg/l	ug/l
Sample Name							
Control Blank	X	X	X	X	X	X	X
GCA10754/55-8 RAW							
GCA10706/07-8 HNO3	15.87	0.98	67.71	6.8	X	X	X
GCA10754/55-8 HNO3	8.72	0.12	2.48	2.2	X	X	0.7
DW-8 HNO3	X	X	X	X	X	X	0.5
Blank-8 HNO3	X	X	X	X	X	X	0.8
Alcoa12-OES	50.7	0.5		260.1	0.49	1	
Alcoa-High5-MS			22.76				19.4

Element	S	SO4	Sb	Se	Si	Sn	Sr
Method	/OE	/CALC	/MS	/MS	/OE	/MS	/MS
Detection	0.1	1	0.01	0.5	0.05	0.1	0.02
Units	mg/l	mg/l	ug/l	ug/l	mg/l	ug/l	ug/l
Sample Name							
Control Blank	X	X	X	X	X	X	X
GCA10754/55-8 RAW							
GCA10706/07-8 HNO3	45.4	136	3.55	X	1.57	X	330.55
GCA10754/55-8 HNO3	16.4	49	0.8	X	1.06	X	137.11
DW-8 HNO3	X	X	X	X	0.08	X	0.21
Blank-8 HNO3	X	X	X	X	0.08	X	0.39
Alcoa12-OES	21.2	64			19.79		
Alcoa-High5-MS			20.8	102.1		20.5	546.55

GLS Job Code 143.0/1309907

Client ON GCA 1220/1

Element	Th	Tl	U	V	Zn
Method	/MS	/MS	/MS	/OE	/OE
Detection	0.005	0.01	0.005	0.01	0.01
Units	ug/l	ug/l	ug/l	mg/l	mg/l
Sample Name					
Control Blank	X	X	X	X	X
GCA10754/55-8 RAW					
GCA10706/07-8 HNO3	X	0.19	1.725	X	0.02
GCA10754/55-8 HNO3	0.006	0.17	0.466	X	0.01
DW-8 HNO3	X	X	X	X	X
Blank-8 HNO3	X	X	X	X	0.01
Alcoa12-OES				0.51	0.47
Alcoa-High5-MS	20.839	19.9	20.52		

NATA ENDORSED DOCUMENT

Company Accreditation Number 3244

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 26/07/2013

GLS Job Code 143.0/1310479

Client ON GCA1220/1


GENALYSIS
LABORATORY SERVICES


Accredited for compliance with ISO/IEC 17025

Dr G Campbell

CAMPBELL, GRAEME and ASSOCIATES PTY LTD

PO Box 247

BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1310479
No. of SAMPLES	8
CLIENT O/N	GCA1220/1
PROJECT	Bowdens
STATE	Column leachates set B
DATE RECEIVED	23/07/2013
DATE COMPLETED	05/08/2013

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

A range of solutions were received to be analysed. F, EC and pH were measured on the raw samples

Genalysis method codes: ENV_W011 (F), ENV_W002 (EC) and ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than or equal to 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS:

Genalysis method codes; (ICP_W004, ICPOES, ICP_W003, ICPMS)

The charge balance was calculated as requested and was found to be +/- 5%.

Results of analysis on:

Element		Acidity	EC	HCO ₃	pH	F
Method		/VOL	/MTR	/VOL	/MTR	/SIE
Detection		1	10	1	0.1	0.1
Units		mgH ₂ SO ₄ /L	uS/cm	mgHCO ₃ /L	NONE	mg/l
Sample Name						
Control Blank			X	X	X	X
GCA10706/07-10 RAW			285	47	7.7	0.9
GCA10706/07-10 RAW	Check		286	47	7.7	0.9
GCA10754/55-10 RAW			216	67	7.9	1.1
GCA10730/31-8 RAW		31	578	X	4.1	
GCA10747/48/49-8 RAW			171	27	7.4	1.8
SOLN-001						1
GWS				118		

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GLS Job Code 143.0/1310479

Client ON GCA1220/1

Element	Ag	Al	As	B	Ba	Bi	Ca
Method	/MS	/OE	/MS	/OE	/MS	/MS	/OE
Detection	0.01	0.01	0.1	0.01	0.05	0.005	0.01
Units	ug/l	mg/l	ug/l	mg/l	ug/l	ug/l	mg/l
Sample Name							
Control Blank	X	X	X	X	X	X	X
GCA10706/07-10 HNO3	X	0.2	6.3	X	48.02	X	25.06
GCA10754/55-10 HNO3	X	0.05	12	X	4.97	X	20.22
GCA10730/31-8 HNO3	X	1.39	15.2	0.01	24.34	0.006	8.95
GCA10747/48/49-8 HNO3	0.01	0.09	80.2	0.01	3.87	0.005	10.9
Alcoa12-OES		2.01		1.03			50.96
Alcoa18-MS	5.12		29.3		5.12	4.993	

Element	Cd	Co	Cr	Cu	Fe-Sol	Hg	K
Method	/MS	/MS	/OE	/OE	/OE	/MS	/OE
Detection	0.02	0.1	0.01	0.01	0.01	0.1	0.1
Units	ug/l	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l
Sample Name							
Control Blank	X	X	X	X	X	X	0.1
GCA10706/07-10 HNO3	0.02	0.9	X	X	X	X	13.9
GCA10754/55-10 HNO3	X	0.4	X	X	X	X	11.1
GCA10730/31-8 HNO3	23.39	31.9	0.03	0.01	1.71	X	34.6
GCA10747/48/49-8 HNO3	0.11	0.5	X	X	X	X	14.6
Alcoa12-OES			0.5	0.54	2.03		3.9
Alcoa18-MS	5.13	497.3				5.3	

Element	Mg	Mn	Mo	Na	Ni	P	Pb
Method	/OE	/OE	/MS	/OE	/OE	/OE	/MS
Detection	0.01	0.01	0.05	0.1	0.01	0.1	0.5
Units	mg/l	mg/l	ug/l	mg/l	mg/l	mg/l	ug/l
Sample Name							
Control Blank	X	X	X	X	X	X	X
GCA10706/07-10 HNO3	11.36	0.71	54.26	5.3	X	X	X
GCA10754/55-10 HNO3	8.48	0.12	2.26	1.9	X	X	X
GCA10730/31-8 HNO3	24.63	28.17	X	17	0.04	X	2.6
GCA10747/48/49-8 HNO3	5.71	0.93	30.46	2.2	X	X	1.8
Alcoa12-OES	50.72	0.51		253.7	0.51	1.1	
Alcoa18-MS			5.86				5.5

BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1310479

Client ON GCA1220/1

Element	S	SO4	Sb	Se	Si	Sn	Sr
Method	/OE	/CALC	/MS	/MS	/OE	/MS	/MS
Detection	0.1	1	0.01	0.5	0.05	0.1	0.02
Units	mg/l	mg/l	ug/l	ug/l	mg/l	ug/l	ug/l
Sample Name							
Control Blank	X	X	X	X	X	X	0.03
GCA10706/07-10 HNO3	28.8	86	3.67	X	1.94	X	241.58
GCA10754/55-10 HNO3	14.4	43	1.05	X	1.02	X	132.97
GCA10730/31-8 HNO3	76.1	228	0.91	X	18.34	X	115.94
GCA10747/48/49-8 HNO3	14.8	44	31.47	X	3.64	X	59.62
Alcoa12-OES	20.6	62			19.49		
Alcoa18-MS			5.76	27.6		5.8	537.12

Element	Th	Tl	U	V	Zn
Method	/MS	/MS	/MS	/OE	/OE
Detection	0.005	0.01	0.005	0.01	0.01
Units	ug/l	ug/l	ug/l	mg/l	mg/l
Sample Name					
Control Blank	X	X	X	X	X
GCA10706/07-10 HNO3	0.03	0.21	1.457	X	0.02
GCA10754/55-10 HNO3	0.006	0.18	0.314	X	0.02
GCA10730/31-8 HNO3	0.012	1.86	4.711	X	1.35
GCA10747/48/49-8 HNO3	0.008	0.23	0.406	X	0.02
Alcoa12-OES				0.5	0.48
Alcoa18-MS	5.28	4.84	5.293		

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 05/08/2013

GLS Job Code 143.0/1307979

Client ON GCA 1220/1



GENALYSIS
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Dr G Campbell
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PO Box 247
BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1307979
No. of SAMPLES	6
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates
DATE RECEIVED	30/05/2013
DATE COMPLETED	24/06/2013

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

A range of solutions were received to be analysed. F, Cl, EC and pH were measured on the raw samples
Genalysis method codes: ENV_W011 (F), ENV_W013 (Cl), ENV_W002 (EC) and ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS:
Genalysis method codes; (ICP_W004, ICPOES, ICP_W003, ICPMS)

The charge balance was calculated as requested and was found to be +/- 5%. The concentrations of metal ions Fe and Mn are sufficiently high to affect the balance and are included

Results of analysis on:

Element		Acid	Cl	EC	F	HCO ₃	pH
Method		/VOL	/COL	/MTR	/SIE	/VOL	/MTR
Detection		1	2	0.01	0.1	0.2	0.1
Units		mgH ₂ SO ₄ /L	mg/l	mS/cm	mg/l	mgHCO ₃ /L	NONE
Sample Name							
Control Blank		X	X	X	X		
GCA10729/52-0a RAW		241	20	2.55	0.5		4.6
GCA10729/52-0a RAW	check	241	20	2.59	0.5		4.6
GCA10729/52-0b RAW		78	6	0.99	0.5		5.0
GCA10729/52-0c RAW			X	0.22	0.2	2.4	5.3
N191			100				
SOLN-001					1.2		

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GLS Job Code 143.0/1307979

Client ON GCA 1220/1

Element	Ag	Al	As	B	Ba	Bi	Ca	Cd
Method	/MS	/OE	/MS	/OE	/MS	/MS	/OE	/MS
Detection	0.1	0.01	0.001	0.01	0.5	0.05	0.01	0.2
Units	ug/l	mg/l	mg/l	mg/l	ug/l	ug/l	mg/l	ug/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10729/52-0a HNO3	X	8.08	30.95	0.05	29	X	217.47	194.8
GCA10729/52-0c1 HNO3	X	1.18	40.852	0.04	29.4	X	58.63	50
GCA10729/52-0c2 HNO3	X	0.05	23.786	0.03	31.2	X	5.99	5
Alcoa12-OES		2.09		1.11			53.43	
Alcoa18-MS	5.1		0.03		5.4	5.03		5.1

Element	Co	Cr	Cu	Fe-Sol	Hg	K	Mg	Mn
Method	/MS	/OE	/OE	/OE	/MS	/OE	/OE	/OE
Detection	0.001	0.01	0.01	0.01	1	0.1	0.01	0.01
Units	mg/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	mg/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10729/52-0a HNO3	0.28	0.13	0.05	11.66	X	341.9	112.69	95.79
GCA10729/52-0c1 HNO3	0.065	0.04	X	7.28	X	122	25.75	26.75
GCA10729/52-0c2 HNO3	0.006	0.01	X	1.19	X	37.2	2.68	3.16
Alcoa12-OES		0.53	0.57	2.15		4.4	53.45	0.52
Alcoa18-MS	0.525				5			

Element	Mo	Na	Ni	P	Pb	S	SO4	Sb
Method	/MS	/OE	/OE	/OE	/MS	/OE	/CALC	/MS
Detection	0.5	0.1	0.01	0.1	0.005	0.1	1	0.1
Units	ug/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ug/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10729/52-0a HNO3	0.8	41.6	0.58	X	1.468	593.1	1777	5.5
GCA10729/52-0c1 HNO3	1.2	10.1	0.13	X	0.425	175.6	526	7.1
GCA10729/52-0c2 HNO3	3.1	1.8	0.01	X	0.026	31.1	93	9.4
Alcoa12-OES		264.4	0.53	1.1		21.4	64	
Alcoa18-MS	6.1				0.006			5.8

Element	Se	Si	Sn	Sr	Th	Tl	U	V	Zn
Method	/MS	/OE	/MS	/MS	/MS	/MS	/MS	/OE	/OE
Detection	0.005	0.05	1	0.2	0.05	0.1	0.05	0.01	0.01
Units	mg/l	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l	mg/l	mg/l
Sample Name									
Control Blank	X	X	X	X	X	X	X	X	X
GCA10729/52-0a HNO3	X	8.42	X	1229.8	X	12.1	1.56	X	94.1
GCA10729/52-0c1 HNO3	X	14.1	X	426.2	X	4.8	0.16	X	20.91
GCA10729/52-0c2 HNO3	X	9.42	X	51.9	X	1.5	X	X	2.12
Alcoa12-OES		20.27						0.53	0.5
Alcoa18-MS	0.029		6	546.7	5.4	5.2	5.37		

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

GLS Job Code 143.0/1307979

Client ON GCA 1220/1

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Company Accreditation Number 3244

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 24/06//2013

GLS Job Code 143.0/1309657

Client ON GCA 1220/1


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Dr G Campbell

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PO Box 247

BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1309657
No. of SAMPLES	4
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Column leachates set D
DATE RECEIVED	03/07/2013
DATE COMPLETED	17/07/2013

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

A range of solutions were received to be analysed. F, Cl, EC and pH were measured on the raw samples

Genalysis method codes: ENV_W011 (F), ENV_W013 (Cl), ENV_W002 (EC) and ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than or equal to 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS:

Genalysis method codes; (ICP_W004, ICPOES, ICP_W003, ICPMS)

Results of analysis on:

Element		Acid	F	Cl	EC	pH
Method		/VOL	/SIE	/COL	/MTR	/MTR
Detection		1	0.1	2	10	0.1
Units		mgH ₂ SO ₄ /L	mg/l	mg/l	uS/cm	NONE
Sample Name						
Control Blank			X	X		
GCA10729/52-2 RAW		84	0.4	10	626	3.7
GCA10729/52-2 RAW	check	80	0.4	10	632	3.7
GCA10729/52-4 RAW		88	0.5	10	599	4.3
N191				100		
SOLN-001			1			

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GLS Job Code 143.0/1309657

Client ON GCA 1220/1

Element	Ag	Al	As	B	Ba	Bi	Ca	Cd
Method	/MS	/OE	/MS	/OE	/MS	/MS	/OE	/MS
Detection	0.01	0.01	0.1	0.01	0.05	0.005	0.01	0.02
Units	ug/l	mg/l	ug/l	mg/l	ug/l	ug/l	mg/l	ug/l
Sample Name								
Control Blank	X	X	0.3	X	X	X	X	X
GCA10729/52-2 HNO3	0.04	1.03	80736	X	24.22	0.019	27.06	37.32
GCA10729/52-4 HNO3	0.12	1.31	109815	X	20.96	0.013	27.46	50.42
Alcoa12-OES		1.95		1			50.03	
Alcoa18-MS	5.09		252		5.35	4.872		5.42

Element	Co	Cr	Cu	Fe-Sol	Hg	K	Mg	Mn
Method	/MS	/OE	/OE	/OE	/MS	/OE	/OE	/OE
Detection	0.1	0.01	0.01	0.01	0.1	0.1	0.01	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	mg/l
Sample Name								
Control Blank	X	X	X	X	X	0.1	X	X
GCA10729/52-2 HNO3	40.6	0.02	X	9.38	X	42.7	11.89	18.26
GCA10729/52-4 HNO3	46.1	0.02	X	14.13	X	43.8	12.7	20.38
Alcoa12-OES		0.48	0.51	1.98		4	48.87	0.5
Alcoa18-MS	536.5				5			

Element	Mo	Na	Ni	P	Pb	S	SO4	Sb
Method	/MS	/OE	/OE	/OE	/MS	/OE	/CALC	/MS
Detection	0.05	0.1	0.01	0.1	0.5	0.1	1	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	ug/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10729/52-2 HNO3	0.15	2.1	0.07	X	57.9	169.2	507	3.53
GCA10729/52-4 HNO3	0.5	2.1	0.08	X	124.5	167.9	503	5.71
Alcoa12-OES		247	0.47	1		20	60	
Alcoa18-MS	6.19				5.9			5.8

Element	Se	Si	Sn	Sr	Th	Tl	U	V	Zn
Method	/MS	/OE	/MS	/MS	/MS	/MS	/MS	/OE	/OE
Detection	0.5	0.05	0.1	0.02	0.005	0.01	0.005	0.01	0.01
Units	ug/l	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l	mg/l	mg/l
Sample Name									
Control Blank	X	X	X	0.02	X	X	X	X	X
GCA10729/52-2 HNO3	1.3	6.61	X	215.06	0.011	1.92	0.069	X	12.32
GCA10729/52-4 HNO3	1.2	9.83	X	225.06	0.012	1.97	0.623	X	15.23
Alcoa12-OES		19.22						0.49	0.49
Alcoa18-MS	28		5.5	542.4	5.383	4.86	5.247		

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 17/07/2013

GLS Job Code 143.0/1310837

Client ON GCA1220/1


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Dr G Campbell

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PO Box 247

BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1310837
No. of SAMPLES	4
CLIENT O/N	GCA1220/1
PROJECT	Bowdens
STATE	Column leachates set D
DATE RECEIVED	30/07/2013
DATE COMPLETED	08/08/2013

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

A range of solutions were received to be analysed. EC and pH were measured on the raw samples Genalysis method codes: ENV_W002 (EC) and ENV_W001 (pH).

Any sample with a pH of 5.0 or greater was analysed for alkalinity and any sample with a pH less than or equal to 5.0 was analysed for acidity (pH 8.3). The alkalinity and acidity (pH 8.3) were measured using APHA method codes: 2320B (alkalinity) 2310B (acidity).

APHA code refers to "Standard methods for the examination of water and wastewater", 22ndnd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS: Genalysis method codes; (ICP_W004, ICPOES, ICP_W003, ICPMS)

Results of analysis on:

Element		Cl	F	Acidity	pH	EC
Method		/COL	/SIE	/VOL	/MTR	/MTR
Detection		2	0.1	1	0.1	10
Units		mg/l	mg/l	mgH ₂ SO ₄ /L	NONE	uS/cm
Sample Name						
Control Blank		X	X			
GCA10729/52-6 RAW		11	0.4	61	4.5	390
GCA10729/52-6 RAW	check	11	0.4	59	4.6	390
GCA10729/52-8 RAW		7	0.3	33	4.7	241
SOLN-001			1			
Acidity std				57		

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Page 1 of 2

GLS Job Code 143.0/1310837

Client ON GCA1220/1

Element	Ag	Al	As	B	Ba	Bi	Ca	Cd
Method	/MS	/OE	/MS	/OE	/MS	/MS	/OE	/MS
Detection	0.01	0.01	0.01	0.01	0.05	0.005	0.01	0.02
Units	ug/l	mg/l	mg/l	mg/l	ug/l	ug/l	mg/l	ug/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10729/52-6 HNO3	0.1	0.66	68.19	X	17.16	X	13.95	27.02
GCA10729/52-8 HNO3	0.07	0.32	55.87	X	19.17	0.015	7.07	17.65
Alcoa18-MS	4.83		0.05		5.24	5.345		4.44
Alcoa12-OES		2.07		1.07			51.42	

Element	Co	Cr	Cu	Fe-Sol	Hg	K	Mg	Mn
Method	/MS	/OE	/OE	/OE	/MS	/OE	/OE	/OE
Detection	0.1	0.01	0.01	0.01	0.1	0.1	0.01	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	mg/l
Sample Name								
Control Blank	X	X	X	X	X	0.3	X	X
GCA10729/52-6 HNO3	23.5	X	X	7.51	X	28.9	6.5	10.85
GCA10729/52-8 HNO3	12.9	X	X	3.77	X	20.4	3.37	5.91
Alcoa18-MS	531.7				1.4			
Alcoa12-OES		0.51	0.54	2.05		4.3	50.66	0.51

Element	Mo	Na	Ni	P	Pb	S	SO4	Sb
Method	/MS	/OE	/OE	/OE	/MS	/OE	/CALC	/MS
Detection	0.05	0.1	0.01	0.1	0.5	0.1	0.3	0.01
Units	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	ug/l
Sample Name								
Control Blank	X	X	X	X	X	X	X	X
GCA10729/52-6 HNO3	0.88	1.2	0.03	0.1	51.8	79	236.7	6.33
GCA10729/52-8 HNO3	1.18	0.7	0.02	X	32.2	42.9	128.5	9.92
Alcoa18-MS	6.01				5.5			5.14
Alcoa12-OES		255.6	0.52	0.9		21.3	63.8	

Element	Se	Si	Sn	Sr	Th	Tl	U	V	Zn
Method	/MS	/OE	/MS	/MS	/MS	/MS	/MS	/OE	/OE
Detection	0.5	0.05	0.1	0.02	0.005	0.01	0.005	0.01	0.01
Units	ug/l	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l	mg/l	mg/l
Sample Name									
Control Blank	X	X	X	X	X	X	X	X	X
GCA10729/52-6 HNO3	0.8	7.51	X	117	0.01	1.23	0.09	X	9.33
GCA10729/52-8 HNO3	0.6	8.53	X	65.61	X	1.01	0.022	X	4.69
Alcoa18-MS	24.5		5.3	540.5	5.559	4.47	5.465		
Alcoa12-OES		19.81						0.51	0.49

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 08/08/2013

GLS Job Code 143.0/1700501

Client ON GCA 1632

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Dr G Campbell

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BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1700501
No. of SAMPLES	170
CLIENT O/N	GCA 1632
PROJECT	Bowdens
STATE	HC leachates
DATE RECEIVED	10/01/2017
DATE COMPLETED	22/02/2017

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

A range of solutions were received to be analysed. The pH, EC, F, Cl, Si and Acidity of requested raw-solutions were measured. (Acidity: APHA method code 2310B, Si: APHA method code 4500-SiO₂ D)

Genalysis method codes: ENV_W001, (pH) ENV_W002, (EC), ENV_W011, (Cl), and ENV_W013 (F)

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS

Genalysis method codes; ICP_W004 (ICPOES) and ICP_W003 (ICPMS)

Results of analysis on:

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GLS Job Code 143.0/1700501

Client ON GCA 1632

Element		Acidy	Cl	EC	F	HCO3	pH	Si
Method		/VOL	/COL	/MTR	/SIE	/VOL	/MTR	/COL
Detection		0.2	0.2	10	0.1	2	0.1	0.5
Units		mgCaCO3/L	mg/l	uS/cm	mg/l	mgCaCO3/L	NONE	mg/l
Sample Name								
Control Blank		1.2	X	X	X	3	5.5	
10664-95 RAW		5.4	X	35	X	2	5	3.7
10663/64-106 RAW		5.2	X	34	X	4	5	3.3
10674/75-106 RAW		6.6	X	80	X	X	4.6	4.8
10678/79-106 RAW		1.5	X	61	X	3	5.1	4.6
HPDW RAW		1.4	0.3	X	X	3	5.6	X
10664-FEED RAW		11.3		54			4.9	
10664-RC10 RAW		12		68			4.8	
10663/64-FEED RAW		9.8		43			5.1	
10663/64-FEED RAW		9.3		44			5.1	
10663/64-RC10 RAW		9.8		46			4.9	
10674/75-FEED RAW		5.4		81			5.5	
10674/75-RC10 RAW		8.1		107			5	
10678/79-FEED RAW		5.9		61			5.8	
10678/79-RC10 RAW		5.4		84			5.2	
10738-59 RAW		6.8	0.3	115	X	2	4.7	8.9
10739-59 RAW		5.9	X	104	X	2	4.7	8.3

Set 1

Elements	Al	Ca	Fe-Sol	K	Mg	Mn	Na	S	Si
Method	/OE	/OE	/OE	/OE	/OE	/OE	/OE	/OE	/OE
Detection	0.01	0.01	0.01	0.1	0.01	0.01	0.1	0.1	0.05
units	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Sample Name									
10664-FEED HNO3	0.02	0.61	0.02	6.7	0.9	0.94	0.5	5.3	6.61
10664-RC10 HNO3	0.05	1.1	X	6.3	1.74	1.8	0.4	7.1	8.5
10663/64-FEED HNO3	0.02	0.61	0.01	5.4	0.57	0.5	0.5	3.8	5.98
10663/64-RC10 HNO3	0.04	0.7	X	4.8	0.88	0.8	0.5	4.3	5.34
10674/75-FEED HNO3	0.02	1.2	X	11.4	1.77	1.02	0.8	8.2	9.16
10674/75-RC10 HNO3	0.03	2.09	X	12.3	3.12	1.77	0.7	11.4	8.72
10678/79-FEED HNO3	X	1.64	X	8.2	1.07	1.36	0.5	6.5	8.21
10678/79-RC10 HNO3	0.01	2.68	X	8.1	1.82	2.42	0.3	8.7	7.16

Set 2

GLS Job Code 143.0/1700501

Client ON GCA 1632

Element		Ag	Al	As	B	Ba	Bi	Ca
Method		/MS	/OE	/MS	/OE	/MS	/MS	/OE
Detection		0.01	0.01	0.1	0.01	0.05	0.005	0.01
Units		ug/l	mg/l	ug/l	mg/l	ug/l	ug/l	mg/l
Sample Name								
Control Blank			X		X			0.01
10664-95 HNO3		0.55	0.02	0.4	0.06	60.86	X	0.52
10663/64-106 HNO3		0.01	0.02	1.1	0.08	96.36	X	0.52
10674/75-106 HNO3		X	0.05	0.5	0.07	15.28	X	1.31
10674/75-106 HNO3	check	X		0.5		15.52	X	
10678/79-106 HNO3		X	X	0.4	0.09	54.69	X	1.67
10738-59 HNO3		X	0.04	0.7	0.06	36.17	X	2
10739-59 HNO3		X	0.05	0.8	0.07	42.92	X	2.54
HPDW HNO3		X	0.01	X	0.05	0.28	X	0.06
TMDW		1.94		80.6		50.18	9.707	

Element		Cd	Co	Cr	Cu	Fe-Sol	Hg	K
Method		/MS	/MS	/OE	/OE	/OE	/MS	/OE
Detection		0.5	0.1	0.01	0.01	0.01	0.1	0.1
Units		ug/l	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l
Sample Name								
Control Blank				X	X	X		X
10664-95 HNO3		X	6.9	X	X	X	X	3.3
10663/64-106 HNO3		X	6	X	X	X	X	3.2
10674/75-106 HNO3		X	5.6	X	X	0.89	X	8.6
10674/75-106 HNO3	check	X	5.6				X	
10678/79-106 HNO3		X	7.3	X	X	X	X	6.4
10738-59 HNO3		X	5.5	X	X	X	X	18.9
10739-59 HNO3		X	5.4	X	X	X	X	14.8
HPDW HNO3		X	X	X	X	X	X	X
TMDW		10.1	24.4				X	

Element		Mg	Mn	Mo	Na	Ni	P	Pb
Method		/OE	/OE	/MS	/OE	/OE	/OE	/MS
Detection		0.01	0.01	0.05	0.1	0.01	0.1	2
Units		mg/l	mg/l	ug/l	mg/l	mg/l	mg/l	ug/l
Sample Name								
Control Blank		X	X		X	X	X	
10664-95 HNO3		0.76	0.78	X	0.1	0.01	X	X
10663/64-106 HNO3		0.65	0.6	X	0.1	0.01	X	X
10674/75-106 HNO3		1.85	1.03	X	0.3	0.01	X	X
10674/75-106 HNO3	check			X				X
10678/79-106 HNO3		1.14	1.49	X	0.2	0.01	X	X
10738-59 HNO3		1.7	1.86	X	0.4	0.01	X	X
10739-59 HNO3		1.98	3.2	X	0.3	0.01	X	X
HPDW HNO3		X	X	X	X	X	X	X
TMDW				103.36				39

GLS Job Code 143.0/1700501

Client ON GCA 1632

Element		S	Sb	Se	Si	Sn	Sr	Th
Method		/OE	/MS	/MS	/OE	/MS	/MS	/MS
Detection		0.1	0.01	0.5	0.05	0.1	0.02	0.005
Units		mg/l	ug/l	ug/l	mg/l	ug/l	ug/l	ug/l
Sample Name								
Control Blank		X			X			
10664-95 HNO3		3.6	0.04	X	3.72	X	5.69	X
10663/64-106 HNO3		3.3	0.01	X	3.31	X	6.18	X
10674/75-106 HNO3		8.3	X	X	4.78	X	10.88	X
10674/75-106 HNO3	check		X	X		X	11.2	X
10678/79-106 HNO3		6.3	0.03	X	4.57	X	5.69	X
10738-59 HNO3		12.2	0.03	X	8.84	X	8.96	X
10739-59 HNO3		12.2	0.08	X	8.17	X	3.9	X
HPDW HNO3		X	X	X	X	X	0.34	X
TMDW			10.29	9.9		X	249.3	X

Element		Tl	U	V	Zn
Method		/MS	/MS	/OE	/OE
Detection		0.01	0.005	0.01	0.01
Units		ug/l	ug/l	mg/l	mg/l
Sample Name					
Control Blank				X	X
10664-95 HNO3		2.84	0.14	X	0.07
10663/64-106 HNO3		2.94	0.126	X	0.05
10674/75-106 HNO3		0.27	0.167	X	0.05
10674/75-106 HNO3	check	0.28	0.164		
10678/79-106 HNO3		0.88	0.034	X	0.08
10738-59 HNO3		0.42	0.122	X	0.07
10739-59 HNO3		0.21	0.078	X	0.09
HPDW HNO3		X	0.01	X	0.01
TMDW		9.91	9.838		

GLS Job Code 143.0/1700501

Client ON GCA 1632

SET 3

Element		Al	Mn	S	Si
Method		/OE	/OE	/OE	/OE
Detection		0.01	0.01	0.1	0.05
Units		mg/l	mg/l	mg/l	mg/l
Sample Name					
10664-1C HNO3		0.14	1.96	9.4	4.71
10664-1D HNO3		0.04	1.38	6.9	3.8
10664-2 HNO3		0.06	2.04	9.2	7
10664-3 HNO3		0.06	1.75	7.7	7.02
10664-3 HNO3	check	0.05	1.75	7.8	6.98
10664-4 HNO3		0.04	1.53	7.5	8.23
10664-5 HNO3		0.03	1.26	5.7	6.14
10664-6 HNO3		0.03	1.46	6.7	8.27
10664-7 HNO3		0.03	1.31	5.9	7.25
10664-8 HNO3		0.03	1.19	5.7	7.44
10664-9 HNO3		0.03	1.11	5.3	7.21
10664-10 HNO3		0.02	1.07	4.8	6.77
10664-14 HNO3		0.03	1	5.4	6.87
10664-15 HNO3		0.02	0.99	5.1	7.65
10664-19 HNO3		0.02	0.92	5.3	6.68
10664-23 HNO3		0.03	1.16	6.4	7.31
10664-34 HNO3		0.03	1.21	6.3	7.1
10664-36 HNO3		0.03	1.21	6.3	8.99
10664-36R HNO3		0.04	0.97	4.6	4.65
10664-38 HNO3		0.02	0.86	3.8	4.4
10664-40 HNO3		0.02	0.84	4.1	5.52
10664-42 HNO3		0.02	0.77	3.6	4.07
10664-47 HNO3		0.02	1.02	4.5	5.01
10664-49 HNO3		0.02	0.82	4	4.82
10664-53 HNO3		0.01	0.84	3.8	4.36
10664-57 HNO3		0.02	0.83	3.7	4.14
10664-63 HNO3		0.02	0.73	3.2	3.27
10664-69 HNO3		0.02	0.78	3.3	3.27
10664-75 HNO3		0.02	0.81	3.4	3.51
10664-85 HNO3		0.02	0.94	3.8	3.89
10663/64-11 HNO3		0.02	0.76	5.3	6.85
10663/64-12 HNO3		0.03	0.67	4.8	7.1
10663/64-13 HNO3		0.02	0.61	4.3	6.29
10663/64-14 HNO3		0.01	0.51	3.7	5.05
10663/64-15 HNO3		0.03	0.51	3.8	6.07
10663/64-16 HNO3		0.02	0.47	3.2	4.51
10663/64-17 HNO3		0.02	0.48	3.6	5.72
10663/64-17 HNO3	check	0.02	0.5	3.5	5.71
10663/64-18 HNO3		0.04	0.49	3.1	4.65
10663/64-19 HNO3		0.02	0.49	3.2	4.93
10663/64-20 HNO3		0.01	0.53	3	4.31

GLS Job Code 143.0/1700501

Client ON GCA 1632

Element		Al	Mn	S	Si
Method		/OE	/OE	/OE	/OE
Detection		0.01	0.01	0.1	0.05
Units		mg/l	mg/l	mg/l	mg/l
Sample Name					
10663/64-21 HNO3		0.01	0.45	3	4.39
10663/64-25 HNO3		0.01	0.42	3.3	5.49
10663/64-29 HNO3		0.02	0.47	3.2	5.35
10663/64-33 HNO3		0.01	0.5	3.9	6.17
10663/64-37 HNO3		0.03	0.61	4.6	6.85
10663/64-45 HNO3		0.03	0.59	4.5	6.81
10663/64-47 HNO3		0.03	0.65	4.9	8.23
10663/64-47R HNO3		0.01	0.46	3	3.45
10663/64-49 HNO3		0.02	0.55	3.3	3.75
10663/64-51 HNO3		0.02	0.42	2.9	3.93
10663/64-53 HNO3		0.01	0.39	2.4	2.85
10663/64-58 HNO3		0.02	0.58	3.3	3.7
10663/64-60 HNO3		0.01	0.45	3	3.68
10663/64-64 HNO3		0.02	0.54	3.2	3.6
10663/64-68 HNO3		0.03	0.56	3.1	3.52
10663/64-74 HNO3		0.02	0.55	2.9	3
10663/64-80 HNO3		0.02	0.54	2.9	2.84
10663/64-86 HNO3		0.02	0.56	3	2.87
10663/64-96 HNO3		0.02	0.61	3.1	3.02
10674/75-11 HNO3		0.08	1.45	10.4	9.78
10674/75-12 HNO3		0.03	1.19	9.5	9.4
10674/75-13 HNO3		0.1	1.05	8.1	8.87
10674/75-14 HNO3		0.03	1.07	8	8.84
10674/75-15 HNO3		0.02	0.85	7	8.3
10674/75-16 HNO3		0.03	1.04	7.8	7.97
10674/75-17 HNO3		0.03	0.91	7.4	8.57
10674/75-18 HNO3		0.02	0.97	7.5	8.01
10674/75-19 HNO3		0.03	0.91	7.1	7.96
10674/75-20 HNO3		0.02	0.94	7.2	8.01
10674/75-21 HNO3		0.03	0.89	7.3	8.24
10674/75-25 HNO3		0.03	0.76	6.8	8.2
10674/75-29 HNO3		0.03	1.03	8.2	9.62
10674/75-33 HNO3		0.02	0.89	7.9	8.79
10674/75-37 HNO3		0.02	1.12	9.3	9.47
10674/75-45 HNO3		0.05	0.79	7.2	7.28
10674/75-47 HNO3		0.04	1.41	11.4	12.72
10674/75-47R HNO3		0.02	1.15	8.8	5.42
10674/75-49 HNO3		0.03	1.14	8.5	5.82
10674/75-51 HNO3		0.03	1.14	8.7	7.07
10674/75-53 HNO3		0.02	1.01	7.7	5.67
10674/75-53 HNO3	check	0.03	1	7.8	5.67
10674/75-58 HNO3		0.03	1.24	8.8	6.04
10674/75-60 HNO3		0.03	1.22	9.1	6.47

BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1700501

Client ON GCA 1632

Element		Al	Mn	S	Si
Method		/OE	/OE	/OE	/OE
Detection		0.01	0.01	0.1	0.05
Units		mg/l	mg/l	mg/l	mg/l
Sample Name					
10674/75-64 HNO3		0.03	0.92	7	5.11
10674/75-68 HNO3		0.02	1.17	8.3	5.56
10674/75-74 HNO3		0.03	1.24	8.5	5.48
10674/75-80 HNO3		0.02	1.27	8.6	5.07
10674/75-86 HNO3		0.02	1.14	8.2	4.85
10674/75-96 HNO3		0.02	1.19	8.3	5.13
10678/79-11 HNO3		X	1.11	5.3	5.7
10678/79-12 HNO3		0.01	1.33	6	6.33
10678/79-13 HNO3		X	1.31	5.9	6.12
10678/79-14 HNO3		0.02	1.4	6.2	6.26
10678/79-15 HNO3		0.02	1.31	5.9	6.54
10678/79-16 HNO3		X	1.29	5.5	5.58
10678/79-17 HNO3		0.02	1.22	5.6	6.38
10678/79-18 HNO3		0.01	1.38	6	6.15
10678/79-19 HNO3		0.01	1.33	5.8	5.88
10678/79-20 HNO3		X	1.31	5.8	6.02
10678/79-21 HNO3		0.02	1.09	5.1	5.69
10678/79-25 HNO3		0.01	1.19	5.8	6.31
10678/79-29 HNO3		0.01	1.43	6.5	7.97
10678/79-33 HNO3		0.02	1.3	6.3	6.86
10678/79-37 HNO3		0.02	1.71	8	8.02
10678/79-45 HNO3		0.03	1.5	7	6.99
10678/79-47 HNO3		0.02	1.67	8	10.69
10678/79-47R HNO3		X	1.44	6.6	4.88
10678/79-49 HNO3		0.02	1.24	5.5	5.3
10678/79-51 HNO3		X	1.29	6	6.28
10678/79-53 HNO3		X	1.12	5	4.72
10678/79-53 HNO3	check	X	1.09	5.1	4.73
10678/79-58 HNO3		X	1.53	6.5	5.26
10678/79-60 HNO3		X	1.24	5.8	5.17
10678/79-64 HNO3		0.01	1.34	5.8	5.01
10678/79-68 HNO3		0.01	1.27	5.8	4.84
10678/79-74 HNO3		0.01	1.4	6	4.34
10678/79-80 HNO3		X	1.46	6.1	4.4
10678/79-86 HNO3		X	1.4	6.1	4.4
10678/79-96 HNO3		X	1.45	6.2	4.45
10738-1 HNO3		0.05	2.22	19.6	4.32
10738-2 HNO3		0.05	1.97	16.6	6.65
10738-4 HNO3		0.07	1.97	17.4	8.23
10738-6 HNO3		0.05	1.82	15.4	7.59
10738-11 HNO3		0.06	2.08	16.1	7.8
10738-13 HNO3		0.05	1.99	16.3	8.56
10738-17 HNO3		0.04	1.78	14	7.85

GLS Job Code 143.0/1700501

Client ON GCA 1632

Element		Al	Mn	S	Si
Method		/OE	/OE	/OE	/OE
Detection		0.01	0.01	0.1	0.05
Units		mg/l	mg/l	mg/l	mg/l
Sample Name					
10738-21 HNO3		0.05	1.94	14.2	8.78
10738-27 HNO3		0.05	1.91	13.4	8.11
10738-33 HNO3		0.04	2.09	13.8	7.68
10738-39 HNO3		0.04	1.9	13.1	7.95
10738-49 HNO3		0.05	2.01	13	7.79
10739-1 HNO3		0.08	6.02	23.3	4.74
10739-2 HNO3		0.06	4.62	17.4	6.42
10739-4 HNO3		0.08	4.57	18.1	7.79
10739-6 HNO3		0.06	4.48	16.6	7.03
10739-11 HNO3		0.07	4.41	16.6	7.32
10739-13 HNO3		0.06	4.24	16.3	8.6
10739-17 HNO3		0.05	3.51	14.5	7.61
10739-21 HNO3		0.05	3.48	13.8	7.12
10739-27 HNO3		0.05	3.47	13.5	6.88
10739-33 HNO3		0.04	3.52	13	6.8
10739-39 HNO3		0.04	3.21	11.9	6.89
10739-49 HNO3		0.04	3.08	11.8	7.13
10738-59 HNO3		0.04	1.86	12.2	8.84
10739-59 HNO3		0.05	3.2	12.2	8.17

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 22/02/2017

GLS Job Code 143.0/1702916

Client ON GCA 1632

**GENALYSIS**
LABORATORY SERVICES

Accredited for compliance with ISO/IEC 17025

Dr G Campbell

CAMPBELL, GRAEME and ASSOCIATES PTY LTD

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JOB INFORMATION

JOB CODE	143/1702916
No. of SAMPLES	
CLIENT O/N	GCA 1632
PROJECT	Bowdens
STATE	HC leachates
DATE RECEIVED	10/01/2017
DATE COMPLETED	02/03/2017

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

A set of solutions were received to be analysed. The samples are set 3 of samples reported in job number 1700501

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES
Genalysis method codes; ICP_W004 (ICPOES)

Results of analysis on:**SET 3**

Element		Fe-Sol
Method		/OE
Detection		0.01
Units		mg/l
Sample Name		
10664-1C HNO ₃		0.1
10664-1D HNO ₃		X
10664-2 HNO ₃		X
10664-3 HNO ₃		0.02
10664-3 HNO ₃	check	0.02
10664-4 HNO ₃		X
10664-5 HNO ₃		X
10664-6 HNO ₃		0.02
10664-7 HNO ₃		0.02
10664-8 HNO ₃		X
10664-9 HNO ₃		X
10664-10 HNO ₃		X

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GLS Job Code 143.0/1702916

Client ON GCA 1632

Element		Fe-Sol
Method		/OE
Detection		0.01
Units		mg/l
Sample Name		
10664-14 HNO3		0.04
10664-15 HNO3		0.02
10664-19 HNO3		0.02
10664-23 HNO3		0.01
10664-34 HNO3		0.03
10664-36 HNO3		0.03
10664-36R HNO3		0.02
10664-38 HNO3		X
10664-40 HNO3		X
10664-42 HNO3		X
10664-47 HNO3		X
10664-49 HNO3		X
10664-53 HNO3		X
10664-57 HNO3		X
10664-63 HNO3		X
10664-69 HNO3		X
10664-75 HNO3		X
10664-85 HNO3		X
10663/64-11 HNO3		0.05
10663/64-12 HNO3		0.02
10663/64-13 HNO3		0.03
10663/64-14 HNO3		0.06
10663/64-15 HNO3		0.06
10663/64-16 HNO3		0.02
10663/64-17 HNO3		0.03
10663/64-17 HNO3	check	0.02
10663/64-18 HNO3		0.03
10663/64-19 HNO3		0.02
10663/64-20 HNO3		X
10663/64-21 HNO3		X
10663/64-25 HNO3		0.01
10663/64-29 HNO3		X
10663/64-33 HNO3		0.01
10663/64-37 HNO3		X
10663/64-45 HNO3		0.01
10663/64-47 HNO3		X
10663/64-47R HNO3		X
10663/64-49 HNO3		X
10663/64-51 HNO3		X
10663/64-53 HNO3		X
10663/64-58 HNO3		X
10663/64-60 HNO3		X
10663/64-64 HNO3		0.02

BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1702916

Client ON GCA 1632

Element		Fe-Sol
Method		/OE
Detection		0.01
Units		mg/l
Sample Name		
10663/64-68 HNO3		X
10663/64-74 HNO3		X
10663/64-80 HNO3		X
10663/64-86 HNO3		X
10663/64-96 HNO3		0.02
10674/75-11 HNO3		0.07
10674/75-12 HNO3		0.02
10674/75-13 HNO3		0.09
10674/75-14 HNO3		0.02
10674/75-15 HNO3		X
10674/75-16 HNO3		X
10674/75-17 HNO3		X
10674/75-18 HNO3		X
10674/75-19 HNO3		X
10674/75-20 HNO3		X
10674/75-21 HNO3		0.01
10674/75-25 HNO3		X
10674/75-29 HNO3		X
10674/75-33 HNO3		X
10674/75-37 HNO3		X
10674/75-45 HNO3		X
10674/75-47 HNO3		X
10674/75-47R HNO3		X
10674/75-49 HNO3		X
10674/75-51 HNO3		X
10674/75-53 HNO3		X
10674/75-53 HNO3	check	X
10674/75-58 HNO3		X
10674/75-60 HNO3		X
10674/75-64 HNO3		X
10674/75-68 HNO3		X
10674/75-74 HNO3		X
10674/75-80 HNO3		X
10674/75-86 HNO3		X
10674/75-96 HNO3		X
10678/79-11 HNO3		X
10678/79-12 HNO3		X
10678/79-13 HNO3		X
10678/79-14 HNO3		X
10678/79-15 HNO3		X
10678/79-16 HNO3		X
10678/79-17 HNO3		X
10678/79-18 HNO3		X

SPECIALIST CONSULTANT STUDIES*Part 3: Materials Characterisation***BOWDENS SILVER PTY LIMITED***Bowdens Silver Project**Report No. 429/25*

GLS Job Code 143.0/1702916

Client ON GCA 1632

Element		Fe-Sol
Method		/OE
Detection		0.01
Units		mg/l
Sample Name		
10678/79-19 HNO3		X
10678/79-20 HNO3		X
10678/79-21 HNO3		X
10678/79-25 HNO3		X
10678/79-29 HNO3		X
10678/79-33 HNO3		X
10678/79-37 HNO3		X
10678/79-45 HNO3		X
10678/79-47 HNO3		X
10678/79-47R HNO3		X
10678/79-49 HNO3		0.01
10678/79-51 HNO3		X
10678/79-53 HNO3		X
10678/79-53 HNO3	check	X
10678/79-58 HNO3		X
10678/79-60 HNO3		X
10678/79-64 HNO3		X
10678/79-68 HNO3		X
10678/79-74 HNO3		X
10678/79-80 HNO3		X
10678/79-86 HNO3		X
10678/79-96 HNO3		X
10738-1 HNO3		0.1
10738-2 HNO3		0.07
10738-4 HNO3		0.07
10738-6 HNO3		0.07
10738-11 HNO3		0.06
10738-13 HNO3		0.06
10738-17 HNO3		0.02
10738-21 HNO3		X
10738-27 HNO3		X
10738-33 HNO3		X
10738-39 HNO3		X
10738-49 HNO3		X
10739-1 HNO3		0.1
10739-2 HNO3		0.08
10739-4 HNO3		0.04
10739-6 HNO3		0.01
10739-11 HNO3		0.02
10739-13 HNO3		0.02
10739-17 HNO3		0.01
10739-21 HNO3		X
10739-27 HNO3		0.01

BOWDENS SILVER PTY LIMITED*Bowdens Silver Project**Report No. 429/25***SPECIALIST CONSULTANT STUDIES***Part 3: Materials Characterisation*

GLS Job Code 143.0/1702916

Client ON GCA 1632

Element		Fe-Sol
Method		/OE
Detection		0.01
Units		mg/l
Sample Name		
10739-33 HNO3		0.01
10739-39 HNO3		X
10739-49 HNO3		X
Control Blank		X
Control Blank		X
Control Blank		X
Control Blank		X
HPDW HNO3		X
TMDW		0.1
TMDW		0.1
TMDW		0.1
TMDW		0.1
TMDW		0.09

NATA ENDORSED DOCUMENT**Company Accreditation Number 3244**

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 02/03/2017

GLS Job Code 143.0/1702054

Client ON GCA 1615



Accredited for compliance with ISO/IEC 17025

Dr G Campbell
CAMPBELL, GRAEME and ASSOCIATES PTY LTD
PO Box 247
BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1703439
No. of SAMPLES	10
CLIENT O/N	GCA 1615
PROJECT	Bowdens
STATE	HC leachates
DATE RECEIVED	10/03/2017
DATE COMPLETED	10/04/2017

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

A range of solutions were received to be analysed. The pH and Acidity of requested raw-solutions were measured. (Acidity pH 8.3: APHA method code 2310B, Acidity* with addition of H₂O₂)

Genalysis method codes: ENV_W001, (pH)

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS
Genalysis method codes; ICP_W004 (ICPOES) and ICP_W003 (ICPMS)

Results of analysis on:

Element		Acidy	Acidy*	EC	pH
Method		/VOL	/VOL	/MTR	/MTR
Detection		1	1	10	0.1
Units		mgCaCO ₃ /L	mgCaCO ₃ /L	us/cm	NONE
Sample Name					
Control Blank		1	1		5.7
10664-191* RAW		3	4		5.1
10663/64-112* RAW		3	4		5.2
10674/75-112* RAW		4	7		5.5
10674/75-112* RAW	check	3	6		5.6
10678/79-112* RAW		3	4		6
10738-65* RAW		5	5		4.8
10739-65* RAW		5	6		4.8
HPDW RAW		1	2		6
Solution A		2	3	28	5.8
Solution A	check	1	3	28	6.2
Solution B		1	3	7	6
Solution B	check	2	3	7	5.8
Bowdens Comp		4	6		5

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ABN 32 008 787 237
www.intertek.com www.genalysis.com.au

BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1702054

Client ON GCA 1615

Element		Al	Ca	Fe-Sol	K	Mg	Mn	Na	Si
Method		/OE	/OE	/OE	/OE	/OE	/OE	/OE	/OE
Detection		0.01	0.01	0.01	0.1	0.01	0.01	0.1	0.05
Units		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Sample Name									
Control Blank		X	X	X	X	X	X	X	X
10664-191* RAW		X	0.42	X	3.1	0.69	0.74	X	3.36
10663/64-112* RAW		X	0.49	X	3.3	0.63	0.61	X	3.23
10674/75-112* RAW		X	1.17	X	8.1	1.8	1.07	0.2	4.97
10674/75-112* RAW	check	X	1.14	X	7.9	1.75	1.03	0.1	4.83
10678/79-112* RAW		X	1.43	X	5.9	1.02	1.35	X	4.55
10738-65* RAW		0.02	1.96	X	16.3	1.71	1.94	0.2	7.18
10739-65* RAW		X	2.22	X	12.8	1.79	3.03	X	7.59
HPDW RAW		X	X	X	X	X	X	X	X
Solution A							5.27		
Solution A	check								
Solution B							1.06		
Solution B	check								
Bowdens Comp		0.01	1.43	X	7.8	1.38	1.59	0.1	5.39
BVEG		49.8	197.15	50.35	100.2	195.48	0.02	505.9	96.55
UNI 1		24.87	25.08	244.32	24.6	24.59	9.88	24.7	50.42

NATA ENDORSED DOCUMENT**Company Accreditation Number 3244**

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 10/04/2017

GLS Job Code 143.0/1704735

Client ON GCA 1632



GENALYSIS
LABORATORY SERVICES



Accredited for compliance with ISO/IEC 17025

Dr G Campbell
CAMPBELL, GRAEME and ASSOCIATES PTY LTD
PO Box 247
BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1704735
No. of SAMPLES	14
CLIENT O/N	GCA 1632
PROJECT	Bowdens
STATE	HC leachates
DATE RECEIVED	30/03/2017
DATE COMPLETED	26/04/2017

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method

A range of solutions were received to be analysed. The pH and Acidity of requested raw-solutions were measured. (Acidity pH 8.3: APHA method code 2310B, Acidity* with addition of H₂O₂)

Genalysis method codes: ENV_W001, (pH)

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS
Genalysis method codes; ICP_W004 (ICPOES) and ICP_W003 (ICPMS)

Results of analysis on:

Element		Acidy	Acidy*	pH
Method		/VOL	/VOL	/MTR
Detection		1	1	0.1
Units		mgCaCO ₃ /L	mgCaCO ₃ /L	NONE
Sample Name				
Control Blank		X	1	
10664-99 RAW		2	4	5.1
10663/64-120 RAW		3	4	5
10674/75-120 RAW		3	4	5.3
10678/79-120 RAW		3	5	5.4
10678/79-120 RAW	check	3	5	5.4
10738-73 RAW		5	6	4.7
10739-73 RAW		4	5	4.7
HPDW RAW		2	2	5.6
GWS-1		54		

15 Davison Street, Maddington WA 6109
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BOWDENS SILVER PTY LIMITED*Bowdens Silver Project**Report No. 429/25***SPECIALIST CONSULTANT STUDIES***Part 3: Materials Characterisation*

GLS Job Code 143.0/1704735

Client ON GCA 1632

Element		Al	Ca	Fe-Sol	K	Mg	Mn	Na	S	Si
Method		/OE	/OE	/OE	/OE	/OE	/OE	/OE	/OE	/OE
Detection		0.01	0.01	0.01	0.1	0.01	0.01	0.1	0.1	0.05
Units		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Sample Name										
Control Blank		X	X	X	X	X	X	X	X	X
10664-99 HNO3		0.03	0.43	0.01	2.6	0.57	0.61	0.1	2.7	2.38
10663/64-120 HNO3		0.09	0.76	0.01	3.2	0.65	0.61	0.2	3.3	3.05
10674/75-120 HNO3		0.06	1.72	0.02	8.7	2.24	1.32	0.4	9	4.97
10678/79-120 HNO3		0.01	1.69	0.03	6.2	1.13	1.52	0.2	6.1	4.38
10678/79-120 HNO3	check	X	1.67	X	6	1.12	1.5	0.2	6.1	4.3
10738-73 HNO3		0.08	2.27	0.04	15.9	1.89	2.13	0.7	12.6	8.7
10739-73 HNO3		0.05	2.37	0.01	12.1	1.84	3.14	0.2	11.6	8.11
HPDW HNO3		X	0.02	X	X	X	X	X	0.1	X
TMDW		0.11	35.57	0.1	2.6	9.28	0.04	6	X	X
UNI 1		24.77	24.9	248.08	25	24.83	9.97	24.8	24.9	49.04

NATA ENDORSED DOCUMENT**Company Accreditation Number 3244**

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 26/04/2017



MINERALS TEST REPORT

CLIENT

CAMPBELL, GRAEME and ASSOCIATES
PO Box 247
BRIDGETOWN, W.A. 6255
AUSTRALIA

JOB INFORMATION

JOB CODE : 143.0/1713267
NO. SAMPLES : 24
NO. ELEMENTS : 8
CLIENT ORDER NO. : GCA1632 (Job 1 of 1)
SAMPLE SUBMISSION NO. :
PROJECT : BOWDENS
DATE RECEIVED : 12/09/2017
DATE REPORTED : 29/09/2017
DATE PRINTED : 29/09/2017

REPORT NOTES

TESTED BY

Intertek
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PO Box 144, Gosnells 6990, Western Australia
Tel: +61 8 9251 8100
Email: min.aus.per@intertek.com
Accredited for compliance with ISO/IEC 17025.
Company Accreditation Number 3244



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JOB NO : 143.0/1713267
CLIENT REF : GCA1632

NOTES

NATA ENDORSED DOCUMENT

Company Accreditation Number 3244

Analysing Laboratory: Intertek Genalysis Perth

The contents of this report have been prepared in accordance with the terms of NATA accreditation and as such should only be reproduced in full.

The analysis results reported herein have been obtained using the following methods and conditions:

Project Bowdens

A range of solutions were received to be analysed. The pH, EC, and acidity of requested raw-solutions were measured.
Genalysis method codes: ENV_W001, (pH) ENV_W002, (EC) APHA code: 2310B(Acidity)
APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES
Genalysis method codes; ICP_W004 (ICPOES)

Intertek Genalysis signatory

Ann Patricia EVERS

Chief Chemist



Date: 28-Sep-2017

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JOB NO : 143.0/1713267

CLIENT REF : GCA1632

Page 2 of 6



SIGNIFICANT FIGURES

It is common practice to report data derived from analytical instrumentation to a maximum of two or three significant figures. Some data reported herein may show more figures than this. The reporting of more than two or three figures in no way implies that figures beyond the least significant digit have significance.

For more information on the uncertainty on individual reported values, please contact the laboratory.

SAMPLE STORAGE

All solid samples (assay pulps, bulk pulps and residues) will be stored for 60 days without charge. Following this samples will be stored at a daily rate until clients written advice regarding return, collection or disposal is received. If storage information is not supplied on the submission, or arranged with the laboratory in writing the default will be to store the samples with the applicable charges. Storage is charged at \$4.00 per m3 per day, expenses related to the return or disposal of samples will be charged at cost. Current disposal cost is charged at \$150.00 per m3.

Samples received as liquids, waters or solutions will be held for 60 days free of charge then disposed of, unless written advice for return or collection is received.

LEGEND	X	= Less than Detection Limit	NA	= Not Analysed
	SNR	= Sample Not Received	UA	= Unable to Assay
	*	= Result Checked	>	= Value beyond Limit of Method
	DTF	= Result still to come	+	= Extra Sample Received Not Listed
	IS	= Insufficient Sample for Analysis		

BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation



ELEMENTS	Acidity	Al	EC	Fe-Sol	Mn	pH
UNITS	mgCaCO ₃ /L	mg/l	uS/cm	mg/l	mg/l	NONE
DETECTION LIMIT	0.2	0.01	10	0.01	0.01	0.1
DIGEST						
ANALYTICAL FINISH	/VOL	/OE	/MTR	/OE	/OE	/MTR
SAMPLE NUMBERS						
0001 10664-111 RAW	3.8		34			5.5
0002 10664-123 RAW	3.8		41			5.0
0003 10663/64-132 RAW	2.8		32			5.8
0004 10663/64-144 RAW	4.0		35			5.2
0005 10674/75-132 RAW	3.0		71			6.0
0006 10674/75-144 RAW	4.0		71			5.4
0007 10678/79-132 RAW	2.3		54			6.1
0008 10678/79-144 RAW	6.3		53			5.5
0009 10738-85 RAW	10.1		103			5.1
0010 10738-97 RAW	5.8		99			4.8
0011 10739-85 RAW	11.6		95			5.2
0012 10739-97 RAW	13.7		100			5.0
0013 10664-111 HNO ₃		0.01		X	1.00	
0014 10664-123 HNO ₃		0.05		X	1.13	
0015 10663/64-132 HNO ₃		0.02		X	0.74	
0016 10663/64-144 HNO ₃		0.02		X	0.75	
0017 10674/75-132 HNO ₃		X		X	1.41	
0018 10674/75-144 HNO ₃		0.06		X	1.30	
0019 10678/79-132 HNO ₃		X		X	1.67	
0020 10678/79-144 HNO ₃		0.05		X	1.56	
0021 10738-85 HNO ₃		0.04		X	2.32	
0022 10738-97 HNO ₃		0.04		X	2.10	
0023 10739-85 HNO ₃		0.02		X	3.41	
0024 10739-97 HNO ₃		X		X	2.99	
CHECKS						
0001 10664-111 RAW	3.5		34			5.6
0002 10738-85 HNO ₃		0.03		X	2.31	
STANDARDS						
0001 Acidity Std 2	53.6					
0002 TMDW		0.12		0.10	0.04	
BLANKS						
0001 Control Blank	4.5	X		X	X	

The results provided are not intended for
commercial settlement purposes

JOB NO : 143.0/1713267
CLIENT REF : GCA1632

Page 4 of 6
Part 1/2



ELEMENTS	S	Si
UNITS	mg/l	mg/l
DETECTION LIMIT	0.1	0.05
DIGEST		
ANALYTICAL FINISH	/OE	/OE
SAMPLE NUMBERS		
0001 10664-111 RAW		
0002 10664-123 RAW		
0003 10663/64-132 RAW		
0004 10663/64-144 RAW		
0005 10674/75-132 RAW		
0006 10674/75-144 RAW		
0007 10678/79-132 RAW		
0008 10678/79-144 RAW		
0009 10738-85 RAW		
0010 10738-97 RAW		
0011 10739-85 RAW		
0012 10739-97 RAW		
0013 10664-111 HNO3	3.9	3.62
0014 10664-123 HNO3	4.7	4.73
0015 10663/64-132 HNO3	3.5	3.18
0016 10663/64-144 HNO3	3.7	3.69
0017 10674/75-132 HNO3	8.9	4.84
0018 10674/75-144 HNO3	8.4	4.80
0019 10678/79-132 HNO3	6.6	4.16
0020 10678/79-144 HNO3	6.3	4.27
0021 10738-85 HNO3	12.9	8.77
0022 10738-97 HNO3	11.6	8.47
0023 10739-85 HNO3	11.5	8.96
0024 10739-97 HNO3	11.0	8.44
CHECKS		
0001 10664-111 RAW		
0002 10738-85 HNO3	12.7	8.71
STANDARDS		
0001 Acidity Std 2		
0002 TMDW	X	X
BLANKS		
0001 Control Blank	X	X

**METHOD CODE DESCRIPTION**

Method Code	Analysing Laboratory
-------------	----------------------

/MTR	Intertek Genalysis Perth
------	--------------------------

No digestion or other pre-treatment undertaken. Analysed with Electronic Meter Measurement
--

/OE	Intertek Genalysis Perth
-----	--------------------------

Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.
--

/VOL	Intertek Genalysis Perth
------	--------------------------

No digestion or other pre-treatment undertaken. Analysed by Volumetric Technique.

MINERALS TEST REPORT

CLIENT

GRAEME CAMPBELL
CAMPBELL, GRAEME and ASSOCIATES
PO Box 247
BRIDGETOWN, W.A. 6255
AUSTRALIA

JOB INFORMATION

JOB CODE : 143.0/1811716
NO. SAMPLES : 12
NO. ELEMENTS : 41
CLIENT ORDER NO. : GCA1632 (Job 1 of 1)
SAMPLE SUBMISSION NO. :
PROJECT : BOWDENS
SAMPLE TYPE : Solutions
DATE RECEIVED : 08/08/2018
DATE REPORTED : 20/08/2018
DATE PRINTED : 20/08/2018

REPORT NOTES

TESTED BY

Intertek
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PO Box 144, Gosnells 6990, Western Australia
Tel: +61 8 9251 8100
Email: min.aus.per@intertek.com
Accredited for compliance with ISO/IEC 17025.
Company Accreditation Number 3244

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JOB NO : 143.0/1811716
CLIENT REF : GCA1632

Page 1 of 11

NOTES

NATA ENDORSED DOCUMENT

Company Accreditation Number 3244

Analysing Laboratory: Intertek Genalysis Perth

The contents of this report have been prepared in accordance with the terms of NATA accreditation and as such should only be reproduced in full.

The analysis results reported herein have been obtained using the following methods and conditions:

Project Bowdens column leachates

The samples were analysed as received.

pH, EC, alkalinity where pH = 5.0, acidity where pH < 5.

Cl and F of requested raw filtered solutions were measured

APHA method codes: (Alkalinity: 2320B) (Acidity ;2310B)

Genalysis method codes: ENV_W001, (pH) ENV_W002, (EC), ENV_W011, (F), and ENV_W013 (Cl)

APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS

Genalysis method codes; ICP_W004 (ICPOES) and ICP_W003 (ICPMS)

Intertek Genalysis signatory

Ann Patricia EVERS

Chief Chemist



Date: 20-Aug-2018

This report relates specifically to the sample(s) tested that were drawn and/or provided by the client or their nominated third party to Intertek. The reported result(s) provide no warranty or verification on the sample(s) representing any specific goods and/or shipment. This report was prepared solely for the use of the client named in this report. Intertek accepts no responsibility for any loss, damage or liability suffered by a third party as a result of any reliance upon or use of this report. The results provided are not intended for commercial settlement purposes.

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JOB NO : 143.0/1811716

CLIENT REF : GCA1632

Page 2 of 11

SIGNIFICANT FIGURES

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For more information on the uncertainty on individual reported values, please contact the laboratory.

SAMPLE STORAGE

All solid samples (assay pulps, bulk pulps and residues) will be stored for 60 days without charge. Following this samples will be stored at a daily rate until clients written advice regarding return, collection or disposal is received. If storage information is not supplied on the submission, or arranged with the laboratory in writing the default will be to store the samples with the applicable charges. Storage is charged at \$4.00 per m³ per day, expenses related to the return or disposal of samples will be charged at cost. Current disposal cost is charged at \$150.00 per m³.

Samples received as liquids, waters or solutions will be held for 60 days free of charge then disposed of, unless written advice for return or collection is received.

LEGEND	X	= Less than Detection Limit	NA	= Not Analysed
	SNR	= Sample Not Received	UA	= Unable to Assay
	*	= Result Checked	>	= Value beyond Limit of Method
	DTF	= Result still to come	+	= Extra Sample Received Not Listed
	IS	= Insufficient Sample for Analysis		

BOWDENS SILVER PTY LIMITED*Bowdens Silver Project**Report No. 429/25***SPECIALIST CONSULTANT STUDIES***Part 3: Materials Characterisation*

ELEMENTS	Acidly	Ag	Al	As	B	Ba
UNITS	mgCaCO ₃ /L	ug/l	mg/l	ug/l	mg/l	ug/l
DETECTION LIMIT	0.2	0.01	0.01	0.1	0.01	0.05
DIGEST						
ANALYTICAL FINISH	/VOL	/MS	/OE	/MS	/OE	/MS
SAMPLE NUMBERS						
0001 GCA10664-135 RAW						
0002 GCA10663/64-156 RAW						
0003 GCA10674/75-156 RAW						
0004 GCA10678/79-156 RAW						
0005 GCA10638-109 RAW	6.6					
0006 GCA10639-109 RAW						
0007 GCA10664-135 HNO ₃		X	0.02	5.6	0.08	60.84
0008 GCA10663/64-156 HNO ₃		0.01	X	4.9	0.13	117.01
0009 GCA10674/75-156 HNO ₃		0.15	0.01	6.2	0.11	17.54
0010 GCA10678/79-156 HNO ₃		X	X	6.9	0.13	57.61
0011 GCA10638-109 HNO ₃		X	0.05	5.3	0.09	34.91
0012 GCA10639-109 HNO ₃		X	0.02	2.4	0.12	45.32
CHECKS						
0001 GCA10639-109 RAW						
0002 GCA10638-109 HNO ₃		X	0.05	5.5	0.10	34.57
STANDARDS						
0001 GWS-2						
0002 GWS-2						
0003 TMDW		2.00		79.0		47.16
0004 TMDW			0.12		X	
BLANKS						
0001 Control Blank	1.5					
0002 Control Blank		X	X	X	X	X

The results provided are not intended for
commercial settlement purposes

JOB NO : 143.0/1811716
CLIENT REF : GCA1632

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Part 1/7

SPECIALIST CONSULTANT STUDIES
Part 3: Materials Characterisation
BOWDENS SILVER PTY LIMITED
Bowdens Silver Project
Report No. 429/25

ELEMENTS	Bi	CO3	Ca	Cd	Cl	Co
UNITS	ug/l	mgCaCO3/L	mg/l	ug/l	mg/l	ug/l
DETECTION LIMIT	0.005	1	0.01	0.5	2	0.1
DIGEST						
ANALYTICAL FINISH	/MS	/VOL	/OE	/MS	/COL	/MS
SAMPLE NUMBERS						
0001 GCA10664-135 RAW		X			X	
0002 GCA10663/64-156 RAW		X			X	
0003 GCA10674/75-156 RAW		X			X	
0004 GCA10678/79-156 RAW		X			X	
0005 GCA10638-109 RAW					X	
0006 GCA10639-109 RAW		X			X	
0007 GCA10664-135 HNO3	0.017		0.63	X		7.4
0008 GCA10663/64-156 HNO3	0.006		0.69	X		7.4
0009 GCA10674/75-156 HNO3	0.005		1.39	X		5.6
0010 GCA10678/79-156 HNO3	X		1.77	X		7.8
0011 GCA10638-109 HNO3	X		2.39	0.6		6.9
0012 GCA10639-109 HNO3	X		2.13	X		4.9
CHECKS						
0001 GCA10639-109 RAW		X			X	
0002 GCA10638-109 HNO3	X		2.41	0.6		6.9
STANDARDS						
0001 GWS-2		X				
0002 GWS-2						
0003 TMDW	8.907			9.5		25.3
0004 TMDW			35.99			
BLANKS						
0001 Control Blank		X			X	
0002 Control Blank	X		X	X		X

The results provided are not intended for commercial settlement purposes

JOB NO : 143.0/1811716
CLIENT REF : GCA1632

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Part 2/7

BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

ELEMENTS	Cr	Cu	EC	F	Fe-Sol	HCO ₃
UNITS	mg/l	mg/l	uS/cm	mg/l	mg/l	mgCaCO ₃ /L
DETECTION LIMIT	0.01	0.01	10	0.1	0.01	2
DIGEST						
ANALYTICAL FINISH	/OE	/OE	/MTR	/SIE	/OE	/VOL
SAMPLE NUMBERS						
0001 GCA10664-135 RAW			43	X		3
0002 GCA10663/64-156 RAW			40	X		3
0003 GCA10674/75-156 RAW			70	X		3
0004 GCA10678/79-156 RAW			62	X		3
0005 GCA10638-109 RAW			115	X		
0006 GCA10639-109 RAW			96	X		3
0007 GCA10664-135 HNO ₃	X	X			X	
0008 GCA10663/64-156 HNO ₃	X	X			0.01	
0009 GCA10674/75-156 HNO ₃	X	X			0.01	
0010 GCA10678/79-156 HNO ₃	X	X			X	
0011 GCA10638-109 HNO ₃	X	X			0.02	
0012 GCA10639-109 HNO ₃	X	X			X	
CHECKS						
0001 GCA10639-109 RAW			96	X		3
0002 GCA10638-109 HNO ₃	X	X			X	
STANDARDS						
0001 GWS-2						99
0002 GWS-2				0.6		
0003 TMDW						
0004 TMDW	0.01	0.02			0.10	
BLANKS						
0001 Control Blank			X	X		3
0002 Control Blank	X	X			X	

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commercial settlement purposes

JOB NO : 143.0/1811716
CLIENT REF : GCA1632

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Part 3/7

SPECIALIST CONSULTANT STUDIES
Part 3: Materials Characterisation
BOWDENS SILVER PTY LIMITED
Bowdens Silver Project
Report No. 429/25

ELEMENTS	Hg	K	Mg	Mn	Mo	Na
UNITS	ug/l	mg/l	mg/l	mg/l	ug/l	mg/l
DETECTION LIMIT	0.1	0.1	0.01	0.001	0.05	0.1
DIGEST						
ANALYTICAL FINISH	/MS	/OE	/OE	/OE	/MS	/OE
SAMPLE NUMBERS						
0001 GCA10664-135 RAW						
0002 GCA10663/64-156 RAW						
0003 GCA10674/75-156 RAW						
0004 GCA10678/79-156 RAW						
0005 GCA10638-109 RAW						
0006 GCA10639-109 RAW						
0007 GCA10664-135 HNO3	X	4.7	0.85	0.867	X	0.3
0008 GCA10663/64-156 HNO3	X	3.6	0.83	0.790	X	0.2
0009 GCA10674/75-156 HNO3	X	8.5	1.96	1.144	0.06	0.4
0010 GCA10678/79-156 HNO3	X	6.7	1.18	1.563	X	0.2
0011 GCA10638-109 HNO3	X	15.8	1.98	2.231	X	0.3
0012 GCA10639-109 HNO3	X	11.3	1.64	2.722	X	0.3
CHECKS						
0001 GCA10639-109 RAW						
0002 GCA10638-109 HNO3	X	15.6	1.99	2.226	X	0.3
STANDARDS						
0001 GWS-2						
0002 GWS-2						
0003 TMDW	X				99.70	
0004 TMDW		2.5	9.02	0.041		6.2
BLANKS						
0001 Control Blank						
0002 Control Blank	X	X	X	X	X	X

The results provided are not intended for
commercial settlement purposes

JOB NO : 143.0/1811716
CLIENT REF : GCA1632

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Part 4/7

BOWDENS SILVER PTY LIMITED*Bowdens Silver Project**Report No. 429/25***SPECIALIST CONSULTANT STUDIES***Part 3: Materials Characterisation*

ELEMENTS	Ni	OH	P	Pb	pH	S
UNITS	mg/l	mgCaCO ₃ /L	mg/l	ug/l	NONE	mg/l
DETECTION LIMIT	0.01	1	0.05	2	0.1	0.1
DIGEST						
ANALYTICAL FINISH	/OE	/VOL	/OE	/MS	/MTR	/OE
SAMPLE NUMBERS						
0001 GCA10664-135 RAW		X			6.0	
0002 GCA10663/64-156 RAW		X			5.7	
0003 GCA10674/75-156 RAW		X			5.8	
0004 GCA10678/79-156 RAW		X			5.8	
0005 GCA10638-109 RAW					4.9	
0006 GCA10639-109 RAW		X			5.1	
0007 GCA10664-135 HNO ₃	0.01		X	X		4.3
0008 GCA10663/64-156 HNO ₃	0.01		X	X		4.0
0009 GCA10674/75-156 HNO ₃	X		X	3		7.3
0010 GCA10678/79-156 HNO ₃	0.01		X	X		6.5
0011 GCA10638-109 HNO ₃	0.01		X	X		12.6
0012 GCA10639-109 HNO ₃	X		X	X		10.4
CHECKS						
0001 GCA10639-109 RAW		X			5.1	
0002 GCA10638-109 HNO ₃	0.01		X	X		12.6
STANDARDS						
0001 GWS-2		X				
0002 GWS-2						
0003 TMDW				37		
0004 TMDW	0.06		X			X
BLANKS						
0001 Control Blank		X			5.5	
0002 Control Blank	X		X	X		X

The results provided are not intended for
commercial settlement purposes

JOB NO : 143.0/1811716
CLIENT REF : GCA1632

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Part 5/7

SPECIALIST CONSULTANT STUDIES*Part 3: Materials Characterisation***BOWDENS SILVER PTY LIMITED***Bowdens Silver Project**Report No. 429/25*

ELEMENTS	Sb	Se	Si	Sn	Sr	Th
UNITS	ug/l	ug/l	mg/l	ug/l	ug/l	ug/l
DETECTION LIMIT	0.01	0.5	0.05	0.1	0.02	0.005
DIGEST						
ANALYTICAL FINISH	/MS	/MS	/OE	/MS	/MS	/MS
SAMPLE NUMBERS						
0001 GCA10664-135 RAW						
0002 GCA10663/64-156 RAW						
0003 GCA10674/75-156 RAW						
0004 GCA10678/79-156 RAW						
0005 GCA10638-109 RAW						
0006 GCA10639-109 RAW						
0007 GCA10664-135 HNO3	0.07	X	4.53	X	6.24	X
0008 GCA10663/64-156 HNO3	0.03	X	3.77	X	7.91	X
0009 GCA10674/75-156 HNO3	0.06	X	5.00	X	10.38	X
0010 GCA10678/79-156 HNO3	0.05	X	4.54	X	5.68	X
0011 GCA10638-109 HNO3	0.06	X	9.50	X	10.33	X
0012 GCA10639-109 HNO3	0.09	X	8.57	X	3.85	X
CHECKS						
0001 GCA10639-109 RAW						
0002 GCA10638-109 HNO3	0.05	X	9.46	X	10.49	X
STANDARDS						
0001 GWS-2						
0002 GWS-2						
0003 TMDW	10.29	9.7		X	241.20	X
0004 TMDW			X			
BLANKS						
0001 Control Blank						
0002 Control Blank	X	X	X	X	X	X

The results provided are not intended for
commercial settlement purposes

JOB NO : 143.0/1811716
CLIENT REF : GCA1632

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Part 6/7

BOWDENS SILVER PTY LIMITED*Bowdens Silver Project**Report No. 429/25***SPECIALIST CONSULTANT STUDIES***Part 3: Materials Characterisation*

ELEMENTS	TI	TotAlk	U	V	Zn
UNITS	ug/l	mgCaCO ₃ /L	ug/l	mg/l	mg/l
DETECTION LIMIT	0.01	5	0.005	0.01	0.01
DIGEST					
ANALYTICAL FINISH	/MS	/CALC	/MS	/OE	/OE
SAMPLE NUMBERS					
0001 GCA10664-135 RAW		X			
0002 GCA10663/64-156 RAW		X			
0003 GCA10674/75-156 RAW		X			
0004 GCA10678/79-156 RAW		X			
0005 GCA10638-109 RAW					
0006 GCA10639-109 RAW		X			
0007 GCA10664-135 HNO ₃	3.66		0.161	X	0.08
0008 GCA10663/64-156 HNO ₃	3.11		0.172	X	0.07
0009 GCA10674/75-156 HNO ₃	0.36		0.093	X	0.06
0010 GCA10678/79-156 HNO ₃	0.79		0.030	X	0.07
0011 GCA10638-109 HNO ₃	0.41		0.165	X	0.09
0012 GCA10639-109 HNO ₃	0.19		0.082	X	0.08
CHECKS					
0001 GCA10639-109 RAW					
0002 GCA10638-109 HNO ₃	0.40		0.153	X	0.09
STANDARDS					
0001 GWS-2					
0002 GWS-2					
0003 TMDW	9.48		9.473		
0004 TMDW				0.03	0.07
BLANKS					
0001 Control Blank					
0002 Control Blank	0.01		X	X	X

The results provided are not intended for
commercial settlement purposes

JOB NO : 143.0/1811716
CLIENT REF : GCA1632

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Part 7/7

METHOD CODE DESCRIPTION

Method Code

Analysing Laboratory

/CALC

Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Results Determined by calculation from other reported data.

/COL

Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed by UV-Visible Spectrometry.

/MS

Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed by Inductively Coupled Plasma Mass Spectrometry.

/MTR

Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed with Electronic Meter Measurement

/OE

Intertek Genalysis Perth

Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

/SIE

Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed by Specific Ion Electrode.

/VOL

Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed by Volumetric Technique.



MINERALS TEST REPORT

CLIENT

GRAEME CAMPBELL
CAMPBELL, GRAEME and ASSOCIATES
PO Box 247
BRIDGETOWN, W.A. 6255
AUSTRALIA

JOB INFORMATION

JOB CODE : 143.0/1816268
NO. SAMPLES : 8
NO. ELEMENTS : 9
CLIENT ORDER NO. : GCA1632 (Job 1 of 1)
SAMPLE SUBMISSION NO. :
PROJECT : BOWDENS
SAMPLE TYPE : Solutions
DATE RECEIVED : 24/10/2018
DATE REPORTED : 06/11/2018
DATE PRINTED : 06/11/2018

REPORT NOTES**TESTED BY**

Intertek

15 Davison Street, Maddington 6109, Western Australia

PO Box 144, Gosnells 6990, Western Australia

Tel: +61 8 9251 8100

Email: min.aus.per@intertek.com

Accredited for compliance with ISO/IEC 17025.

Company Accreditation Number 3244



This report relates specifically to the sample(s) tested that were drawn and/or provided by the client or their nominated third party to Intertek. The reported result(s) provide no warranty or verification on the sample(s) representing any specific goods and/or shipment. This report was prepared solely for the use of the client named in this report. Intertek accepts no responsibility for any loss, damage or liability suffered by a third party as a result of any reliance upon or use of this report. The results provided are not intended for commercial settlement purposes.

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JOB NO : 143.0/1816268
CLIENT REF : GCA1632

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NOTES
NATA ENDORSED DOCUMENT
Company Accreditation Number 3244
Analysing Laboratory: Intertek Genalysis Perth

The contents of this report have been prepared in accordance with the terms of NATA accreditation and as such should only be reproduced in full.

The analysis results reported herein have been obtained using the following methods and conditions:

PROJECT: BOWDENS

The water samples, as listed in the report, were received to be analysed.

The pH, EC and alkalinity of requested raw-solution were measured.

Genalysis method codes: ENV_W001 (pH), ENV_W002 (EC).

APHA method codes: 2320B (Alkalinity).

From the clear, settled solution the results for Al, Fe-Sol, Mn, S and Si determined by ICP-OES (ICP_W004).

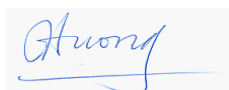
Tl was determined by ICP-MS (ICP_W003).

The assays included the determination of blanks and in-house reference standards. The results are expressed as in milligrams or micrograms per litre in the sample as received.

Intertek Genalysis signatory

Huong ICP PHAM

ICP Chemist



Date: 05-Nov-2018

This report relates specifically to the sample(s) tested that were drawn and/or provided by the client or their nominated third party to Intertek. The reported result(s) provide no warranty or verification on the sample(s) representing any specific goods and/or shipment. This report was prepared solely for the use of the client named in this report. Intertek accepts no responsibility for any loss, damage or liability suffered by a third party as a result of any reliance upon or use of this report. The results provided are not intended for commercial settlement purposes.

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JOB NO : 143.0/1816268

CLIENT REF : GCA1632

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**SIGNIFICANT FIGURES**

It is common practice to report data derived from analytical instrumentation to a maximum of two or three significant figures. Some data reported herein may show more figures than this. The reporting of more than two or three figures in no way implies that figures beyond the least significant digit have significance.

For more information on the uncertainty on individual reported values, please contact the laboratory.

SAMPLE STORAGE

All solid samples (assay pulps, bulk pulps and residues) will be stored for 60 days without charge. Following this samples will be stored at a daily rate until clients written advice regarding return, collection or disposal is received. If storage information is not supplied on the submission, or arranged with the laboratory in writing the default will be to store the samples with the applicable charges. Storage is charged at \$4.00 per m3 per day, expenses related to the return or disposal of samples will be charged at cost. Current disposal cost is charged at \$150.00 per m3.

Samples received as liquids, waters or solutions will be held for 60 days free of charge then disposed of, unless written advice for return or collection is received.

LEGEND	X	= Less than Detection Limit	NA	= Not Analysed
	SNR	= Sample Not Received	UA	= Unable to Assay
	*	= Result Checked	>	= Value beyond Limit of Method
	DTF	= Result still to come	+	= Extra Sample Received Not Listed
	IS	= Insufficient Sample for Analysis		



ELEMENTS	Al	EC	Fe-Sol	HCO ₃	Mn	pH
UNITS	mg/l	uS/cm	mg/l	mgCaCO ₃ /L	mg/l	NONE
DETECTION LIMIT	0.01	10	0.01	2	0.01	0.1
DIGEST						
ANALYTICAL FINISH	/OE	/MTR	/OE	/VOL	/OE	/MTR
SAMPLE NUMBERS						
0001 GCA10664-HC-141 RAW		49		4		6.2
0002 GCA10663/64-HC-162 RAW		43		4		6.1
0003 GCA10674/75-HC-162 RAW		101		5		6.4
0004 GCA10678/79-HC-162 RAW		75		5		6.4
0005 GCA10664-HC-141 HNO ₃	0.03		X		0.96	
0006 GCA10663/64-HC-162 HNO ₃	0.01		0.02		0.68	
0007 GCA10674/75-HC-162 HNO ₃	0.03		0.01		1.59	
0008 GCA10678/79-HC-162 HNO ₃	X		X		1.80	
CHECKS						
0001 GCA10678/79-HC-162 RAW		75		5		6.4
0002 GCA10674/75-HC-162 HNO ₃	0.03		X		1.59	
STANDARDS						
0001 GWS-2				98		
0002 TMDW						
0003 UNI 1	25.46		252.34		10.33	
BLANKS						
0001 Control Blank		X		3		5.5
0002 Control Blank	X		X		X	



ELEMENTS	S	Si	Tl
UNITS	mg/l	mg/l	ug/l
DETECTION LIMIT	0.1	0.05	0.01
DIGEST			
ANALYTICAL FINISH	/OE	/OE	/MS
SAMPLE NUMBERS			
0001 GCA10664-HC-141 RAW			
0002 GCA10663/64-HC-162 RAW			
0003 GCA10674/75-HC-162 RAW			
0004 GCA10678/79-HC-162 RAW			
0005 GCA10664-HC-141 HNO3	4.5	5.09	3.06
0006 GCA10663/64-HC-162 HNO3	3.9	4.59	3.90
0007 GCA10674/75-HC-162 HNO3	10.1	6.41	0.42
0008 GCA10678/79-HC-162 HNO3	7.3	5.91	0.69
CHECKS			
0001 GCA10678/79-HC-162 RAW			
0002 GCA10674/75-HC-162 HNO3	10.1	6.42	0.41
STANDARDS			
0001 GWS-2			
0002 TMDW			10.19
0003 UNI 1	25.2	51.46	
BLANKS			
0001 Control Blank			
0002 Control Blank	X	X	X



METHOD CODE DESCRIPTION

Method Code	Analysing Laboratory
/MS	Intertek Genalysis Perth No digestion or other pre-treatment undertaken. Analysed by Inductively Coupled Plasma Mass Spectrometry.
/MTR	Intertek Genalysis Perth No digestion or other pre-treatment undertaken. Analysed with Electronic Meter Measurement
/OE	Intertek Genalysis Perth Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.
/VOL	Intertek Genalysis Perth No digestion or other pre-treatment undertaken. Analysed by Volumetric Technique.

BOWDENS SILVER PTY LIMITED

Bowdens Silver Project

Report No. 429/25

SPECIALIST CONSULTANT STUDIES

Part 3: Materials Characterisation

GLS Job Code 143.0/1402862

Client ON GCA 1220/1

**GENALYSIS**
LABORATORY SERVICES

Accredited for compliance with ISO/IEC 17025

Dr G Campbell

CAMPBELL, GRAEME and ASSOCIATES PTY LTD

PO Box 247

BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143/1402862
No. of SAMPLES	3
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Soil-clay
DATE RECEIVED	25/03/2014
DATE COMPLETED	9/04/2014

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

The samples were received as dry soil clay. The samples were crushed to a nominal 2mm a split was then taken and fine pulverised to a nominal -75um

Results of analysis on:

Element		S	S-SO4	C
Method		/CSA	S72/GR	/CSA
Detection		0.01	0.01	0.01
Units		%	%	%
Sample Name				
Control Blank		0.01	0.01	X
GCA11380		0.02	X	0.4
GCA11380	check	0.02	X	0.4
GCA11381		0.02	X	0.51
GCA11382		0.01	X	0.24
OREAS 45e		0.05		0.56
PD-1			4.27	
S_SO4_A-2			0.54	
S_SO4_B-2			1.11	

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ABN 32 008 787 237
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GLS Job Code 143.0/1402862

Client ON GCA 1220/1

Notes

1. Total-S and Total-C were determined on the pulps
2. Total-C and Total-S was determined using an induction furnace according to Genalysis method number MPL_W043. The samples are ignited in oxygen ~1700C and the CO₂ and SO₂ measured by infrared detectors
3. S-SO₄ was determined on the pulps by precipitation of BaSO₄ according to Genalysis method number ENV_W039, after digestion with Na₂CO₃ (S72/GR)

Results of analysis on:

sample		Fizz	volume	HCl	NaOH	Colour	pH	ANC	ANC
name		Rate	ml	M	M	Change	Drop	soln pH	(kgH ₂ SO ₄ /t)
GCA11380		0	8	0.474	0.218	N		1.4	4
GCA11380	check	0	8	0.474	0.218	N		1.4	4
GCA11381		0	8	0.474	0.218	N		1.4	3
GCA11382		0	8	0.474	0.218	N		1.5	4

Notes:

1. ANC was determined on 2g -. Acid concentrations are as stated.
2. Colour change: Y indicates the appearance of a green colouration as the pH=7 endpoint was approached. N indicates no colour change. Two drops of 30 % hydrogen peroxide are added to each sample as the endpoint is approached to oxidise any ferrous iron.
3. pH drop : Result reported when the pH drops to a value below 4 on addition of peroxide
4. This "Bulk-ANC" static-testing procedure is based on AMIRA (2002), according to Genalysis method number ENV_W035

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Company Accreditation Number 3244

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Intertek Genalysis Signatory: Ann Evers

Ann Evers

Date: 9/04/2014



ANALYTICAL REPORT

Dr G. CAMPBELL
CAMPBELL, GRAEME and ASSOCIATES
PO Box 247
BRIDGETOWN, W.A. 6255
AUSTRALIA

JOB INFORMATION

JOB CODE : 143.0/1402863
No. of SAMPLES : 3
No. of ELEMENTS : 33
CLIENT O/N : GCA1220/1 (Job 2 of 4)
SAMPLE SUBMISSION No. :
PROJECT : BOWDENS
STATE : Ex-Pulp
DATE RECEIVED : 25/03/2014
DATE COMPLETED : 11/04/2014
DATE PRINTED : 11/04/2014
ANALYSING LABORATORY: Intertek Genalysis Perth

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method
OV = Value over-range for Package

Accredited for compliance with ISO/IEC 17025
Company Accreditation Number 3244

SAMPLE DETAILS

DISCLAIMER

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All work is performed in accordance with the Intertek Minerals Standard Terms and Conditions of work <http://www.intertek.com/terms/>

This report relates specifically to the sample(s) that were drawn and/or provided by the client or their nominated third party. The reported result(s) provide no warranty or verification on the sample(s) representing any specific goods and/or shipment and only relate to the sample(s) as received and tested.

This report was prepared solely for the use of the client named in this report. Intertek accepts no responsibility for any loss, damage or liability suffered by a third party as a result of any reliance upon or use of this report.

The results provided are not intended for commercial settlement purposes.

SIGNIFICANT FIGURES

It is common practice to report data derived from analytical instrumentation to a maximum of two or three significant figures. Some data reported herein may show more figures than this. The reporting of more than two or three figures in no way implies that the third, fourth and subsequent figures may be real or significant.

Intertek Genalysis accepts no responsibility whatsoever for any interpretation by any party of any data where more than two or three significant figures have been reported.

SAMPLE STORAGE DETAILS

GENERAL CONDITIONS

SAMPLE STORAGE OF SOLIDS

Bulk Residues and Pulps will be stored for 60 DAYS without charge. After this time all Bulk Residues and Pulps will be stored at a rate of \$3.30 per cubic metre per day until your written advice regarding collection or disposal is received. Expenses related to the return or disposal of samples will be charged to you at cost. Current disposal cost is charged at \$100.00 per cubic metre.

SAMPLE STORAGE OF SOLUTIONS

Samples received as liquids, waters or solutions will be held for 60 DAYS free of charge then disposed of, unless written advice for return or collection is received.

NOTES

NATA ENDORSED DOCUMENT

Company Accreditation Number 3244

Analysing Laboratory: Intertek Genalysis Perth

The contents of this report have been prepared in accordance with the terms of NATA accreditation and as such should only be reproduced in full.

The analysis results reported herein have been obtained using the following methods and conditions:

The samples as listed were received as being pulps ex job 1402862 which had been pulverised in a zirconia bowl.

The results have been determined according to Genalysis methods codes :

Digestions : MPL_W002 (4A/), MPL_W005 (SE1/), ENV_W012 (FC7/SIE), MPL_W011 (FP1/) and MPL_W008 (HG1/)

Analytical Finishes: ICP_W004 (/OE), ICP_W003 (/MS) and AAS_W004 (/CV).

The results included the assay of blanks and international reference standards: □
OREAS 182, OREAS 45d and STSD-1 □

□
and Genalysis in-house standards:
OREAS 97.01 and HgSTD-6□□

The results are expressed as parts per million or percent by mass in the dried and prepared material.

□

Intertek Genalysis signatory

Ann Patricia EVERS

Chief Chemist



Date: 10-Apr-2014

143.0/1402863 (11/04/2014) CLIENT O/N: GCA1220/1

Page 4 of 8
Part 1/4

ANALYSIS

ELEMENTS	Ag	Al	As	B	Ba	Bi	Ca	Cd	Co	Cr
UNITS	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.01	0.5	50	0.1	0.01	0.1	0.02	0.1	50
DIGEST	4A/	FP1/	4A/	FP1/	4A/	4A/	FP1/	4A/	4A/	FP1/
ANALYTICAL FINISH	MS	OE	MS	OE	MS	MS	OE	MS	MS	OE
SAMPLE NUMBERS										
0001 GCA11380	0.07	5.09	4.6	X	317.9	0.23	X	X	9.1	70
0002 GCA11381	0.07	5.19	7.5	X	257.8	0.28	0.1	0.05	9.2	80
0003 GCA11382	1.02	5.96	15.8	X	421.3	0.20	0.1	0.13	12.2	79

CHECKS

0001 GCA11380	0.08	5.05	4.8	X	318.3	0.23	0.1	0.04	9.3	141
---------------	------	------	-----	---	-------	------	-----	------	-----	-----

STANDARDS

0001 HgSTD-6										
0002 OREAS 182		2.09		X			0.2			8778
0003 OREAS 45d	0.17		13.4		184.9	0.33		0.03	31.2	
0004 OREAS 97.01										
0005 STSD-1										

BLANKS

0001 Control Blank	X	X	X	X	X	X	X	X	X	X
0002 Control Blank	X		X		X	X		X	X	
0003 Control Blank		X		X			X			X
0004 Control Blank										
0005 Control Blank										
0006 Acid Blank	X		X		X	X		X	X	
0007 Acid Blank		X		X			X			X
0008 Acid Blank										
0009 Control Blank										

Results are not intended for commercial settlement purposes

ANALYSIS

ELEMENTS	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni
UNITS	ppm	ppm	%	ppm	%	%	ppm	ppm	ppm	ppm
DETECTION LIMIT	1	50	0.01	0.01	0.05	0.01	1	0.1	20	1
DIGEST	4A/	FC7/	FP1/	HG1/	FP1/	FP1/	4A/	4A/	4A/	4A/
ANALYTICAL FINISH	OE	SIE	OE	CV	OE	OE	OE	MS	OE	OE

SAMPLE NUMBERS										
0001 GCA11380	10	399	1.96	0.03	1.02	0.23	364	1.0	783	22
0002 GCA11381	14	260	2.45	0.02	0.74	0.19	283	1.1	530	25
0003 GCA11382	34	300	2.78	0.02	1.17	0.24	803	1.2	2795	22

CHECKS

0001 GCA11380	10	425	1.94	0.02	0.99	0.23	359	0.9	799	21
---------------	----	-----	------	------	------	------	-----	-----	-----	----

STANDARDS

0001 HgSTD-6				1.75						
0002 OREAS 182			20.14		0.07	5.49				
0003 OREAS 45d	370						491	2.7	1010	231
0004 OREAS 97.01										
0005 STSD-1		1108								

BLANKS

0001 Control Blank	X	X	X	X	X	X	X	X	X	X
0002 Control Blank	X						X	X	X	X
0003 Control Blank			X		X	X				
0004 Control Blank				X						
0005 Control Blank										
0006 Acid Blank	X						X	X	X	X
0007 Acid Blank			X		X	X				
0008 Acid Blank				X						
0009 Control Blank										

Results are not intended for commercial settlement purposes

143.0/1402863 (11/04/2014) CLIENT O/N: GCA1220/1

Page 6 of 8
Part 3/4

ANALYSIS

ELEMENTS	P	Pb	S	Sb	Se	Si	Sn	Sr	Th	Tl
UNITS	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
DETECTION LIMIT	10	0.5	50	0.05	0.01	0.1	0.1	0.05	0.01	0.02
DIGEST	4A/	4A/	4A/	4A/	SE1/	FP1/	4A/	4A/	4A/	4A/
ANALYTICAL FINISH	OE	MS	OE	MS	MS	OE	MS	MS	MS	MS
SAMPLE NUMBERS										
0001 GCA11380	334	16.5	118	0.43	0.07	37.3	2.1	88.30	9.91	0.34
0002 GCA11381	264	18.5	101	0.67	0.18	36.8	2.4	78.14	9.75	0.38
0003 GCA11382	392	42.9	78	1.17	0.09	35.5	2.2	109.14	9.69	0.83

CHECKS

0001 GCA11380	328	16.4	117	0.48	0.08	37.1	2.2	87.79	9.93	0.37
---------------	-----	------	-----	------	------	------	-----	-------	------	------

STANDARDS

0001 HgSTD-6										
0002 OREAS 182						21.8				
0003 OREAS 45d	422	20.9	457	0.86			2.7	31.61	14.02	0.26
0004 OREAS 97.01					0.65					
0005 STSD-1										

BLANKS

0001 Control Blank	X	X	X	X	X	X	0.1	0.05	X	X
0002 Control Blank	X	X	X	X			0.1	X	X	X
0003 Control Blank						X				
0004 Control Blank										
0005 Control Blank					0.19					
0006 Acid Blank	X	X	X	X			X	X	X	X
0007 Acid Blank						X				
0008 Acid Blank										
0009 Control Blank					1.99					

Results are not intended for commercial settlement purposes

ANALYSIS

ELEMENTS	U	V	Zn
UNITS	ppm	ppm	ppm
DETECTION LIMIT	0.01	1	1
DIGEST	4A/	4A/	4A/
ANALYTICAL FINISH	MS	OE	OE
SAMPLE NUMBERS			
0001 GCA11380	2.10	42	49
0002 GCA11381	2.35	59	44
0003 GCA11382	2.22	79	79
CHECKS			
0001 GCA11380	2.06	42	51
STANDARDS			
0001 HgSTD-6			
0002 OREAS 182			
0003 OREAS 45d	2.61	235	45
0004 OREAS 97.01			
0005 STSD-1			
BLANKS			
0001 Control Blank	X	X	X
0002 Control Blank	X	X	X
0003 Control Blank			
0004 Control Blank			
0005 Control Blank			
0006 Acid Blank	X	X	X
0007 Acid Blank			
0008 Acid Blank			
0009 Control Blank			

Results are not intended for commercial settlement purposes

METHOD CODE DESCRIPTION

<u>Method Code</u>	<u>Analysing Laboratory</u>	<u>NATA document</u>
4A/MS	Intertek Genalysis Perth	4A/ : MPL_W002, MS : ICP_W003
	Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Mass Spectrometry.	
4A/OE	Intertek Genalysis Perth	4A/ : MPL_W002, OE : ICP_W004
	Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.	
FC7/SIE	Intertek Genalysis Perth	ENV_W012, SIE : ENV_W012
	Alkaline fusion (Nickel crucible) specific for Fluorine. Analysed by Specific Ion Electrode.	
FP1/OE	Intertek Genalysis Perth	FP1/ : MPL_W011, OE : ICP_W004
	Sodium peroxide fusion (Zirconia crucibles) and Hydrochloric acid to dissolve the melt. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.	
HG1/CV	Intertek Genalysis Perth	
	Low temperature Perchloric acid digest specific for Mercury. Analysed by Cold Vapour Generation Atomic Absorption Spectrometry.	
SE1/MS	Intertek Genalysis Perth	
	Aqua-Regia digest followed by Precipitation and Concentration. Specific for Selenium. Analysed by Inductively Coupled Plasma Mass Spectrometry.	



ANALYTICAL REPORT

Dr G. CAMPBELL
CAMPBELL, GRAEME and ASSOCIATES
PO Box 247
BRIDGETOWN, W.A. 6255
AUSTRALIA

JOB INFORMATION

JOB CODE : 143.0/1402864
No. of SAMPLES : 3
No. of ELEMENTS : 26
CLIENT O/N : GCA1220/1 (Job 3 of 4)
SAMPLE SUBMISSION No. :
PROJECT : BOWDENS
STATE : Ex-Pulp
DATE RECEIVED : 25/03/2014
DATE COMPLETED : 15/04/2014
DATE PRINTED : 15/04/2014
ANALYSING LABORATORY: Intertek Genalysis Perth

LEGEND

X = Less than Detection Limit
N/R = Sample Not Received
* = Result Checked
() = Result still to come
I/S = Insufficient Sample for Analysis
E6 = Result X 1,000,000
UA = Unable to Assay
> = Value beyond Limit of Method
OV = Value over-range for Package

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Results are not intended for commercial settlement purposes

SAMPLE DETAILS

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SAMPLE STORAGE DETAILS

GENERAL CONDITIONS

SAMPLE STORAGE OF SOLIDS

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SAMPLE STORAGE OF SOLUTIONS

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ANALYSIS

ELEMENTS	Al ₂ O ₃	As	BaO	CaO	Cl	Co	Cr ₂ O ₃	Cu	Fe	K ₂ O
UNITS	%	%	%	%	%	%	%	%	%	%
DETECTION LIMIT	0.01	0.001	0.005	0.01	0.002	0.001	0.005	0.001	0.01	0.01
DIGEST	FB1/	FB1/	FB1/	FB1/	FB1/	FB1/	FB1/	FB1/	FB1/	FB1/
ANALYTICAL FINISH	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF
SAMPLE NUMBERS										
0001 GCA11380	9.76	0.002	0.036	0.15	0.003	0.001	0.005	0.001	1.94	1.29
0002 GCA11381	9.89	0.002	0.027	0.13	X	0.001	0.011	0.001	2.43	0.90
0003 GCA11382	11.30	0.003	0.046	0.18	X	0.001	0.010	0.003	2.75	1.48
CHECKS										
0001 GCA11380	9.74	0.002	0.038	0.15	X	0.001	0.009	0.001	1.94	1.29
STANDARDS										
0001 SARM1	12.16	0.003	0.013	0.78	0.022	0.001	0.005	X	1.37	5.01

Results are not intended for commercial settlement purposes

143.0/1402864 (15/04/2014) CLIENT O/N: GCA1220/1

Page 4 of 6
 Part 2/3

ANALYSIS

ELEMENTS	LOI	MgO	MnO	Na2O	Ni	P	Pb	S	SiO2	Sn
UNITS	%	%	%	%	%	%	%	%	%	%
DETECTION LIMIT	0.01	0.01	0.01	0.01	0.001	0.001	0.001	0.001	0.01	0.001
DIGEST		FB1/	FB1/	FB1/	FB1/	FB1/	FB1/	FB1/	FB1/	FB1/
ANALYTICAL FINISH	/TGA	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF
SAMPLE NUMBERS										
0001 GCA11380	3.82	0.39	0.05	0.11	0.002	0.032	X	0.013	81.00	0.002
0002 GCA11381	4.31	0.30	0.04	0.07	0.001	0.027	0.001	0.011	80.10	0.002
0003 GCA11382	4.09	0.40	0.11	0.37	0.001	0.038	0.002	0.006	77.09	0.002
CHECKS										
0001 GCA11380	3.81	0.39	0.05	0.10	0.003	0.031	X	0.012	81.11	0.004
STANDARDS										
0001 SARM1		0.04	0.02	3.29	0.002	0.002	0.002	0.010	75.58	X

Results are not intended for commercial settlement purposes

ANALYSIS

ELEMENTS	Sr	TiO2	Total	V2O5	Zn	Zr
UNITS	%	%	%	%	%	%
DETECTION LIMIT	0.001	0.01	0.01	0.005	0.001	0.001
DIGEST	FB1/	FB1/	FB1/	FB1/	FB1/	FB1/
ANALYTICAL FINISH	XRF	XRF	XRF	XRF	XRF	XRF
SAMPLE NUMBERS						
0001 GCA11380	0.006	0.50	100.04	0.009	0.004	0.031
0002 GCA11381	0.008	0.48	99.87	0.009	0.004	0.031
0003 GCA11382	0.009	0.65	99.84	0.015	0.007	0.028
CHECKS						
0001 GCA11380	0.007	0.49	100.11	0.010	0.004	0.030
STANDARDS						
0001 SARM1	X	0.09		X	0.005	0.024

Results are not intended for commercial settlement purposes

METHOD CODE DESCRIPTION

/TGA

Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed by Thermal Gravimetric Analyser

FB1/XRF

Intertek Genalysis Perth

Fused Disk preparation for XRF analysis Analysed by XRF Spectrometry.

Results are not intended for commercial settlement purposes

GLS Job Code 143.0/1402865

Client ON GCA 1220/1


GENALYSIS
LABORATORY SERVICES


Accredited for compliance with ISO/IEC 17025

Dr G Campbell

CAMPBELL, GRAEME and ASSOCIATES PTY LTD

PO Box 247

BRIDGETOWN WA 6255

JOB INFORMATION

JOB CODE	143.0/1402865
No. of SAMPLES	3
CLIENT O/N	GCA 1220/1
PROJECT	Bowdens
STATE	Soil-clay
DATE RECEIVED	25/03/2014
DATE COMPLETED	17/04/2014

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
()	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method

The samples were received as ex pulp 1402862

The digest AmCl7 was used as follows for the samples which with fizz rate =0 were treated as non calcareous samples:

2g of each of the samples were weighed into a centrifuge tube and pre- washed with 2x 25ml 10 % (v/v) deionised ethylene glycol in 90 % (v/v) ethanol which has been previously deionised by passing through Amberlite resin

After the centrifuge stage there may be finely dispersed material in suspension. If this is the case a few drops of PVA may be necessary. The PVA aqueous solution is 0.05 % (w/v) polyvinyl alcohol. No additions.

This solution was volumed to 50ml and read for Cl and the requested suite of elements by ICPOES (samples suffix rinse.)

Extraction step for Exchangeable cations

After decanting following completion of the 2nd pre-wash, the residue in centrifuge tube is subjected to 2 x 30-minute extractions via end-over-end tumbling at approx. 10 rpm. Each extraction uses 20 ml of 1 M-NH₄Cl buffered at pH 7.0 using ammonia solution 28 % (w/w). At the completion of each extraction, the suspensions are centrifuged and the supernatants decanted and collected into a communal extract. The final communal extract is brought to 50 ml with 4 M-HCl.

Sample analysed for Ca, Mg, K, Mn and Na by ICPOES.

Organic carbon (ORG-C) was measured on the samples using the Walkley- Black method (WB/COL)

References:

eCEC based on procedure 15B2

WB/COL – based on procedure 6A1

Soil Chemical Methods – Australasia; George E. Rayment & David J. Lyons CSIRO Publishing 2011.

Genalysis codes: ICPOES (ICP_W004), Cl/COL(ENV_W013), eCEC (ENV_W049)

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Page 1 of 2

GLS Job Code 143.0/1402865

Client ON GCA 1220/1

Results of analysis on:

Element		Ca	K	Mg	Na	eCEC	Ca	K	Mg	Na
Method		AmCl7/OE	AmCl7/OE	AmCl7/OE	AmCl7/OE		exch	exch	exch	exch
										ESP
Units		cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	%	%	%	%
GCA11380		3.3	0.5	5.2	0.5	9.4	35.1	4.8	55.2	4.9
GCA11380	check	3.5	0.5	5.5	0.5	9.9	35.2	4.8	55.2	4.8
GCA11381		2.4	0.3	3.7	0.6	7.0	34.1	4.2	53.2	8.5
GCA11382		4.2	0.4	4.7	0.7	9.9	42.3	3.7	47.1	6.9
ASPAC-33		40.2	1.6	32.8	2.3	77.0	52.3	2.1	42.7	3.0

Element		ORG-C
Method		WB/COL
Detection		0.1
Units		%
Sample Name		
Control Blank		X
GCA11380		0.4
GCA11380	check	0.4
GCA11381		0.6
GCA11382		0.3
ASPAC-33		
ASPAC-33		1.5

Element		Al	Ca	Cl	Fe-Sol	K	Mg	Mn	Na	S
Method		/OE	/OE	/COL	/OE	/OE	/OE	/OE	/OE	/OE
Detection		1	1	10	1	10	1	1	10	10
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Sample Name										
GCA11380-rinse		3	90	625	<1	<10	<1	<1	100	<10
GCA11380-rinse	check	<1	63	500	<1	<10	<1	<1	100	<10
GCA11381-rinse		<1	65	750	<1	<10	2.5	<1	125	<10
GCA11382-rinse		<1	63	500	<1	<10	<1	<1	100	<10

NATA ENDORSED DOCUMENT

Company Accreditation Number 3244

The contents of this report have been prepared in accordance with the terms of NATA accreditation and as such should only be reproduced in full.

Intertek Genalysis Signatory: Ann Evers

Ann Evers

17/04/2014



GRAEME CAMPBELL AND ASSOC.

13-05-2013

PO BOX 247,

BRIDGETOWN

WA

OUR REFERENCE: 23648

YOUR REFERENCE: 1220/1

CLAY-MINERALOGICAL ASSESSMENT OF THREE PULPS/CRUSHINGS DERIVED FROM CLAYEY,
VALLEY-FLOOR DEPOSITS.

D TOWNEND

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GRAEME CAMPBELL

Ref No: 23648

XRD PROCEDURES

XRD	PANALYTICAL XPERT PRO
DETECTOR	PIXCEL 1D
ANGULAR RANGE	5° TO 110°
DIVERGENCE SLIT	1/2°
ANTI SCATTER SLIT	1°
RADIATION	Co Kα 1.788965
SLIT TYPE	FIXED
GENERATOR	40Kv 40 Ma

XRD/PLM RESULTS

	GCA11380	GCA11381	GCA11382
MINERAL ABUNDANCES ON "WHOLE POWDER" BASIS			
QUARTZ	DOMINANT	DOMINANT	DOMINANT
KAOLINITE	MINOR	MAJOR	MINOR
RANDOMLY INTERSTRATIFIED SMECTITE/ILLITE	ACCESSORY	TRACE	TRACE
MUSCOVITE/ILLITE	ACCESSORY	ACCESSORY	ACCESSORY
SMECTITE		TRACE	TRACE
GOETHITE	ACCESSORY	ACCESSORY	ACCESSORY
TITANIUM OXIDES	TRACE	TRACE	TRACE
K-FELDSPAR	ACCESSORY	ACCESSORY	ACCESSORY
CARBONACEOUS MATERIAL	TRACE	TRACE	TRACE
PLAGIOCLASE			ACCESSORY
ISOLATED GRAIN(S) IDENTIFIED BY OPTICAL AND SEM/EDS ANALYSIS			
HEMATITE	X	X	X
ZIRCON	X	X	X

GRAEME CAMPBELL**Ref No: 23648**

CLAY TREATMENTS

Ten grams of each sample were weighed into a 50 mL centrifuge tube with 20 mL of DI water. The clay fraction ($\sim 2 \mu\text{m}$) was separated using ultrasonic treatment and centrifugation. The sample was then saturated/treated using the following 4 treatments, then examined by XRD analysis:

1. MgCl_2 saturated
2. MgCl_2 saturated and Glycerol
3. KCl saturated
4. KCl saturated and heated at 550°C for 2 hours.

Only samples were chosen for clay treatments for which smectite presence was indicated in the “whole sample” assessment, and/or where identifying smectite on the “whole sample” was difficult through possibly smectite peaks being obscured by peaks from clays with some overlapping d-spacings (e.g. vermiculite/chlorite).

Note. These results reflect the fraction of the mineral in the clay fraction ($<2 \mu\text{m}$).

Note. Dominant ($\geq 50\%$), Major ($\geq 20\%$), Minor ($\geq 10\%$), Accessory ($\geq 1\%$), Trace ($<1\%$), ND (not detected).

	RANDOMLY INTERSTRATIFIED SMECTITE/ILLITE	ILLITE/MICA	KAOLINITE	SMECTITE
GCA11380	MAJOR	ACCESSORY	DOMINANT	
GCA11381	ACCESSORY	ACCESSORY	DOMINANT	TRACE
GCA11382	ACCESSORY	ACCESSORY	DOMINANT	ACCESSORY

NOTE:

The laboratory reports presented in the following pages correspond to the programme of testing carried out on Low-S samples of waste rock from the Fresh-Zone conducted during 2017-2018.

Graeme Campbell & Associates Pty Ltd



Graeme Campbell and Assoc,

8-10-2018

PO Box 247,

Bridgetown

WA 6255

Our reference 24315

Mineralogy (PLM/XRD/ SEM of three rock chip samples.

Roger Townend

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MINERALS TEST REPORT

CLIENT

GRAEME CAMPBELL
CAMPBELL, GRAEME and ASSOCIATES
PO Box 247
BRIDGETOWN, W.A. 6255
AUSTRALIA

JOB INFORMATION

JOB CODE : 143.0/1811752
NO. SAMPLES : 16
NO. ELEMENTS : 4
CLIENT ORDER NO. : GCA1822 (Job 1 of 1)
SAMPLE SUBMISSION NO. :
PROJECT : BOWDENS
SAMPLE TYPE : Drill core
DATE RECEIVED : 08/08/2018
DATE REPORTED : 27/08/2018
DATE PRINTED : 27/08/2018

REPORT NOTES

TESTED BY

Intertek
15 Davison Street, Maddington 6109, Western Australia
PO Box 144, Gosnells 6990, Western Australia
Tel: +61 8 9251 8100
Email: min.aus.per@intertek.com
Accredited for compliance with ISO/IEC 17025.
Company Accreditation Number 3244

This report relates specifically to the sample(s) tested that were drawn and/or provided by the client or their nominated third party to Intertek. The reported result(s) provide no warranty or verification on the sample(s) representing any specific goods and/or shipment. This report was prepared solely for the use of the client named in this report. Intertek accepts no responsibility for any loss, damage or liability suffered by a third party as a result of any reliance upon or use of this report. The results provided are not intended for commercial settlement purposes.

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JOB NO : 143.0/1811752
CLIENT REF : GCA1822

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NOTES

NATA ENDORSED DOCUMENT

Company Accreditation Number 3244

Analysing Laboratory: Intertek Genalysis Perth

The contents of this report have been prepared in accordance with the terms of NATA accreditation and as such should only be reproduced in full.

The analysis results reported herein have been obtained using the following methods and conditions:

Project: Bowdens

The samples were received as mine waste

The samples were crushed to a nominal passing 5mm

200g of crushed samples were fine pulverised in a zirconia bowl.

The results have been determined according to Genalysis methods codes :

1.Total-C and Total-S were determined using an induction furnace

The samples are ignited in oxygen ~1700C and the CO₂ and SO₂ measured by infrared detectors

Genalysis method number MPL_W043.

2.C-Acinsol (acid insoluble carbon) by a C&S analyser after removal of carbonates

and soluble organic carbon using hot hydrochloric acid

Genalysis method number MPL_W046

The results included the assay of blanks and international reference standards:

OREAS 45e

Genalysis in house standards:

TOC-1a,

The results are expressed as parts per million or percent by mass in the dried and prepared material.

Intertek Genalysis signatory

Ann Patricia EVERS

Chief Chemist



Date: 24-Aug-2018

This report relates specifically to the sample(s) tested that were drawn and/or provided by the client or their nominated third party to Intertek. The reported result(s) provide no warranty or verification on the sample(s) representing any specific goods and/or shipment. This report was prepared solely for the use of the client named in this report. Intertek accepts no responsibility for any loss, damage or liability suffered by a third party as a result of any reliance upon or use of this report. The results provided are not intended for commercial settlement purposes.

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JOB NO : 143.0/1811752

CLIENT REF : GCA1822

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SIGNIFICANT FIGURES

It is common practice to report data derived from analytical instrumentation to a maximum of two or three significant figures. Some data reported herein may show more figures than this. The reporting of more than two or three figures in no way implies that figures beyond the least significant digit have significance.

For more information on the uncertainty on individual reported values, please contact the laboratory.

SAMPLE STORAGE

All solid samples (assay pulps, bulk pulps and residues) will be stored for 60 days without charge. Following this samples will be stored at a daily rate until clients written advice regarding return, collection or disposal is received. If storage information is not supplied on the submission, or arranged with the laboratory in writing the default will be to store the samples with the applicable charges. Storage is charged at \$4.00 per m3 per day, expenses related to the return or disposal of samples will be charged at cost. Current disposal cost is charged at \$150.00 per m3.

Samples received as liquids, waters or solutions will be held for 60 days free of charge then disposed of, unless written advice for return or collection is received.

LEGEND	X	= Less than Detection Limit	NA	= Not Analysed
	SNR	= Sample Not Received	UA	= Unable to Assay
	*	= Result Checked	>	= Value beyond Limit of Method
	DTF	= Result still to come	+	= Extra Sample Received Not Listed
	IS	= Insufficient Sample for Analysis		

BOWDENS SILVER PTY LIMITED*Bowdens Silver Project**Report No. 429/25***SPECIALIST CONSULTANT STUDIES***Part 3: Materials Characterisation*

ELEMENTS	C	C-Acinsol	C-CO3	S
UNITS	%	%	%	%
DETECTION LIMIT	0.01	0.01	0.01	0.01
DIGEST		C71/		
ANALYTICAL FINISH	/CSA	CSA	/CALC	/CSA
SAMPLE NUMBERS				
0001 BD17016_35	0.59	0.03	0.56	0.02
0002 BD16003_57	0.02	0.02	X	0.02
0003 BD16016_67	0.73	0.03	0.70	0.38
0004 BD16016_69	0.76	0.03	0.73	0.05
0005 BD16016_105	0.15	0.03	0.12	0.08
0006 BD17007_53	0.58	0.03	0.55	0.32
0007 BD17007_55	0.14	0.04	0.10	0.41
0008 BD17007_65	0.41	0.03	0.38	0.32
0009 BD17014_48	0.24	0.20	0.04	0.25
0010 BD17010_60	0.44	0.04	0.40	0.57
0011 BD13128_73	0.26	0.04	0.22	0.05
0012 BD13128_111	0.05	0.03	0.02	0.08
0013 BD16005_114	0.28	X	0.28	0.11
0014 BD17001_74	1.08	0.03	1.05	0.27
0015 BD17001_76	1.02	0.03	0.99	0.12
0016 BD17001_96	0.24	0.03	0.21	0.23
CHECKS				
0001 BD17001_74	1.10	0.03		0.27
STANDARDS				
0001 OREAS 45e	0.55			0.04
0002 TOC-1a		1.18		
BLANKS				
0001 Control Blank	X	X		X

The results provided are not intended for
commercial settlement purposes

JOB NO : 143.0/1811752
CLIENT REF : GCA1822

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Part 1/1

METHOD CODE DESCRIPTION

Method Code	Analysing Laboratory NATA Laboratory Accreditation	NATA Scope of Accreditation
/CALC	Intertek Genalysis Perth 3244 3237 No digestion or other pre-treatment undertaken. Results Determined by calculation from other reported data.	
/CSA	Intertek Genalysis Perth 3244 3237 Induction Furnace Analysed by Infrared Spectrometry	MPL_W043, CSA : MPL_W043
C71/CSA	Intertek Genalysis Perth 3244 3237 Digestion by hot acid(s) and Induction Furnace Analysed by Infrared Spectrometry	



ANALYTICAL REPORT



Accreditation No. 2562

CLIENT DETAILS

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 Client Graeme Campbell & Associates Pty Ltd
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 WA 6255

Telephone 0897 612 829
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 Email gca@wn.com.au

Project **GCA Job No. 1822 Mine-Waste Samples**
 Order Number **GCA Job No. 1822**
 Samples 10

LABORATORY DETAILS

Manager Ros Ma
 Laboratory SGS Perth Environmental
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SGS Reference **PE128673 R0**
 Date Received 07 Sep 2018
 Date Reported 19 Sep 2018

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(898/20210).

SIGNATORIES

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 ABN 44 000 964 278

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ANALYTICAL REPORT

PE128673 R0

		Sample Number	PE128673.001	PE128673.002
		Sample Matrix	Soil	Soil
		Sample Name	BD16005-114	BD16016-67
Parameter	Units	LOR		

Chromium Reducible Sulphur (CRS) Method: AN217 Tested: 17/9/2018

Chromium Reducible Sulphur (Scr)	%	0.005	0.068	0.22
Chromium Reducible Sulphur (Scr)	moles H ⁺ /T	5	42	140
Chromium Reducible Sulphur (Scr)	kg H ₂ SO ₄ /T	0.25	2.1	6.7



ANALYTICAL REPORT

PE128673 R0

	Sample Number	PE128673.003	PE128673.004
	Sample Matrix	Soil	Soil
	Sample Name	BD17001-74	BD17001-76
Parameter	Units	LOR	

Chromium Reducible Sulphur (CRS) Method: AN217 Tested: 17/9/2018

Chromium Reducible Sulphur (Scr)	%	0.005	0.18	0.096
Chromium Reducible Sulphur (Scr)	moles H+/T	5	99	54
Chromium Reducible Sulphur (Scr)	kg H2SO4/T	0.25	4.9	2.6



ANALYTICAL REPORT

PE128673 R0

		Sample Number	PE128673.005	PE128673.006
		Sample Matrix	Soil	Soil
		Sample Name	BD17001-96	BD17007-53
Parameter	Units	LOR		

Chromium Reducible Sulphur (CRS) Method: AN217 Tested: 17/9/2018

Chromium Reducible Sulphur (Scr)	%	0.005	0.20	0.14
Chromium Reducible Sulphur (Scr)	moles H ⁺ /T	5	120	84
Chromium Reducible Sulphur (Scr)	kg H ₂ SO ₄ /T	0.25	6.0	4.1



ANALYTICAL REPORT

PE128673 R0

	Sample Number	PE128673.007	PE128673.008
	Sample Matrix	Soil	Soil
	Sample Name	BD17007-55	BD17007-65
Parameter	Units	LOR	

Chromium Reducible Sulphur (CRS) Method: AN217 Tested: 17/9/2018

Chromium Reducible Sulphur (Scr)	%	0.005	0.13	0.14
Chromium Reducible Sulphur (Scr)	moles H+/T	5	81	90
Chromium Reducible Sulphur (Scr)	kg H2SO4/T	0.25	4.0	4.4



ANALYTICAL REPORT

PE128673 R0

		Sample Number	PE128673.009	PE128673.010
		Sample Matrix	Soil	Soil
		Sample Name	BD17010-60	BD17014-48
Parameter	Units	LOR		

Chromium Reducible Sulphur (CRS) Method: AN217 Tested: 17/9/2018

Chromium Reducible Sulphur (Scr)	%	0.005	0.34	0.11
Chromium Reducible Sulphur (Scr)	moles H ⁺ /T	5	210	71
Chromium Reducible Sulphur (Scr)	kg H ₂ SO ₄ /T	0.25	10	3.5



QC SUMMARY

PE128673 R0

MB blank results are compared to the Limit of Reporting.

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared to the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

Chromium Reducible Sulphur (CRS) Method: ME-(AU)-[ENV]AN217

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chromium Reducible Sulphur (Scf)	LB150652	%	0.005	<0.005	6 - 16%	86%
Chromium Reducible Sulphur (Scf)	LB150652	moles H+/T	5	<5		
Chromium Reducible Sulphur (Scf)	LB150652	kg H2SO4/T	0.25	<0.25		



METHOD SUMMARY

PE128673 R0

METHOD

AN217

METHODOLOGY SUMMARY

Dried pulped sample is mixed with acid and chromium metal in a rapid distillation unit to produce hydrogen sulfide (H₂S) which is collected and titrated with iodine (I₂(aq)) to measure SCR.

FOOTNOTES

IS Insufficient sample for analysis.
LNR Sample listed, but not received.
* NATA accreditation does not cover the performance of this service.
** Indicative data, theoretical holding time exceeded.

LOR Limit of Reporting
↑↓ Raised or Lowered Limit of Reporting
QFH QC result is above the upper tolerance
QFL QC result is below the lower tolerance
- The sample was not analysed for this analyte
NVL Not Validated

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the "Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.

Note that in terms of units of radioactivity:
a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: <http://www.sgs.com.au/-/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf>

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Graeme Campbell & Associates Pty Ltd

ACID-NEUTRALISATION-CAPACITY (ANC) TESTWORK:
BASED ON AMIRA (2002) WITH VARIATIONS TO CONSTRAIN DISSOLUTION OF
NON-CARBONATE-MINERALS UNRELATED TO CIRCUM-NEUTRAL BUFFERING
SAVE FOR VANISHINGLY-SMALL RATES OF PYRITE OXIDATION

SAMPLE ID	WT (g)	HCl		milli moles H ⁺ Added	Digest-Slurry-Final-pH	NaOH		milli moles OH ⁻ Added	pH after H ₂ O ₂ Added	Vigour of 'Fizzling' from HCl Addition ('in-the-cold')	BULK-ANC (kg H ₂ SO ₄ /tonne)
		Conc. (M)	Pipette Volume (mL)			Conc. (M)	Titre Volume (mL)				
BD16003_57	15.00	0.10	10	1.00	2.5	0.05	5.00	0.250	3.7		2
BD1328_111	10.03	0.10	10	1.00	2.2	0.05	13.30	0.665	3.2		2
BD17014_48	9.98	0.10	10	1.00	3.1	0.05	7.40	0.370	3.2		3
BD17007_55	5.01	0.10	10	1.00	2.4	0.05	8.10	0.405	3.3		6
BD16016_105	6.00	0.10	15	1.50	2.1	0.05	15.25	0.763	3.0		6
BD16016_105 d	5.99	0.10	15	1.50	2.1	0.05	15.60	0.780	3.0		6
BD17001_96	4.99	0.10	20	2.00	1.8	0.05	19.80	0.990	3.5		10
BD13128_73	6.02	0.10	25	2.50	2.1	0.05	30.70	1.535	3.0		8
BD16005_114	4.70	0.10	25	2.50	1.7	0.05	27.70	1.385	3.5	no apparent reaction	12
BD17007_65	4.31	0.10	30	3.00	1.6	0.05	33.70	1.685	3.2	no apparent reaction	15
BD17010_60	4.09	0.10	30	3.00	1.7	0.05	24.80	1.240	3.3	weak-to-moderate*	21
BD17010_60 d	4.09	0.10	30	3.00	1.8	0.05	25.00	1.250	3.3		21
BD17007_53	5.00	0.50	10	5.00	2.7	0.10	15.70	1.570	2.8	weak-to-moderate*	34
BD17016_35	4.89	0.50	10	5.00	1.8	0.10	16.20	1.620	3.0	weak-to-moderate*	34
BD16016_67	4.04	0.50	10	5.00	1.8	0.10	19.80	1.980	2.9	weak-to-moderate*	37
BD16016_69	3.76	0.50	10	5.00	2.2	0.10	18.80	1.880	2.9	weak-to-moderate*	41
BD17001_76	2.85	0.50	10	5.00	1.1	0.10	29.60	2.960	3.9	weak-to-moderate*	35
BD17001_76 d	2.86	0.50	10	5.00	1.1	0.10	27.40	2.740	3.7		39
BD17001_74	2.60	0.50	10	5.00	1.5	0.10	16.40	1.640	3.5	weak-to-moderate*	63
BD17001_74 d	2.60	0.50	10	5.00	1.4	0.10	19.20	1.920	3.3		58
ANC Std	5.00	0.10	25	2.50	2.2	0.05	7.80	0.390	> 4.0		21
ANC Std d	5.00	0.10	25	2.50	2.2	0.05	7.80	0.390	> 4.0		21
0.1 M-HCl	-	0.10	10	1.00		0.05	20.10	1.01			100.5%
0.1 M-HCl (d)	-	0.10	10	1.00		0.05	19.95	1.00			99.8%

Notes:

- Testing performed on -2 mm fraction obtained via dry-sieving of coarse-crushings (viz. nominal -5 mm). [Where undertaken, 'fizz' testing employing 2-3 M-HCl determined on pulp (-75 µm nominal) sample. Reaction responses with an asterisk indicate that reaction was **delayed** (i.e. not immediate reaction)].
- ca. 20 mL** of high-purity-deionised-water (HPDW) added to all samples (including HCl-solution 'blanks') initially.
- HCl solution added manually via volumetric glass pipette (A Class).
- HCl and NaOH solutions are certified reagents from Merck (viz. Titripur® reagents in hermetically-sealed Titripac® casks).
- Sample weight, and volume and strength of HCl added, based on corresponding CO₃-C value(s).
- During acid-digestion temperature of waterbath is **80 +/- 5 °C**, and digestion performed for **1.0 hr** with beakers swirled by hand 1-2 times during this reaction period. Digestion performed using 250 mL tall-form beakers covered with watchglasses.
- After completion of acid-digestion step, the test-slurry is boiled for **ca. 1 min** to expel any dissolved CO₂(aq).
- Following cooling to room-T, **digest-slurry-final-pH** is measured. HPDW is then added to bring test-slurry volume to **ca. 125 mL** for titration with NaOH solution.
- Titration with NaOH performed manually using 50 mL glass burette with slurry stirred using magnetic stirrer-bar. Fast titration with stopcock fully open until slurry-pH rises to approximate range 4.0-4.5 when titration stops for H₂O₂ addition.
- Three drops of **30 % H₂O₂ (v/v)** [adjusted to pH 4.5] added to slurry to oxidise **soluble-Fe(II)** forms ('latent-acidity') and precipitation of Fe(III)/Al-oxyhydroxides, etc. **Minimum slurry-pH** attained following H₂O₂ addition recorded.
- Following completion of H₂O₂ addition, titration with NaOH continues to a **pH=7** end-point. Titration with NaOH undertaken so that slurry-pH at end-point is within range 6.9-7.1 (i.e. pH 7.0 +/- 0.1) for **ca. 30 seconds**. [Related pH-end-point stability criteria for manual titration (cf. autotitration) option applies in ASTM E1915-13, and AS-4969.12-09].
- ANC Standard is pulped mixture of quartz and AR CaCO₃ (CO₃-C = 0.27 %; ANC = 22 kg H₂SO₄/tonne).

The main variations to the AMIRA (2002) method are the use of -2 mm fraction (cf. pulp, -75 µm nominal), and initial 'applied HCl loading', as governed by CO₃-C value.

Dr GD Campbell**1st September 2018**

Graeme Campbell & Associates Pty Ltd
Laboratory Report

NET-ACID-GENERATION (NAG) TESTWORK (SINGLE-ADDITION)

Sample_ ID	Sample Weight (g)	Comments	pH of Test- Suspension After O'Night Reaction [Before Boiling Steps]	Test-Suspension Values After 2nd-Boiling Step [Cu(II) Added Before Boiling]		Titre (mL) (0.1 M-NaOH)		NAG (kg H ₂ SO ₄ /tonne)		
				NAG- pH	NAG-EC (µS/cm)	To pH 4.5	pH 4.5 to pH 7.0	To pH 4.5	pH 4.5 to pH 7.0	To pH 7.0
BD17007 53	5.01	reaction peaked overnight	8.3	8.5	283	-	-	<0.5	<0.5	<0.5
BD17001 96	5.02	reaction peaked overnight	8.7	7.3	181	-	-	<0.5	<0.5	<0.5
BD17007 55	5.00	reaction peaked overnight	4.9	4.7	455	-	1.10	<0.5	1.1	1.1
BD17014 48	4.98	reaction peaked overnight	4.1	4.0	363	0.40	2.90	<0.5	2.9	2.9
BD16016 67	5.02	reaction peaked overnight	8.5	8.7	192	-	-	<0.5	<0.5	<0.5
BD17010 60	5.00	reaction peaked overnight	8.1	8.0	476	-	-	<0.5	<0.5	<0.5
BD17001 76	5.00	reaction peaked overnight	8.7	9.1	181	-	-	<0.5	<0.5	<0.5
BD17007 65	5.00	reaction peaked overnight	5.0	5.9	433	-	0.60	<0.5	0.6	0.6
BD17001 74	4.98	reaction peaked overnight	8.6	8.9	221	-	-	<0.5	<0.5	<0.5
BD17001 74 d	5.01	reaction peaked overnight	8.8	8.8	194	-	-	<0.5	<0.5	<0.5
Blank			4.8	5.6	49	-	0.50	-	"0.5"	"0.5"

Notes: If needed, the pH of the **15 % (v/v) A.R. H₂O₂** solution is adjusted to **pH 4.5** using dilute NaOH solution prior to commencing the NAG Tests. **250 mL** of peroxide solution is added to sample in 500 mL conical Erlenmeyer beaker that is then covered with a watchglass. Following **reaction overnight**, the occurrence and vigour of reaction is judged according to degree of water condensation on the underside of the watchglass. The suspension-pH is measured, and the test-suspensions then boiled for *ca.* 1 hr. After allowing to cool, *ca.* 1 mL of **0.016 M-CuSO₄** is added, and the 2nd-boiling step carried out for *ca.* 1 hr. The added Cu(II) catalyses the decomposition of any residual, unreacted H₂O₂ (AS 4969.12-2009).

Following determination of supernatant-EC and suspension-pH, the test-suspensions are titrated manually with standardised NaOH solution to respective **pH4.5** and **pH7.0** end-points. After allowing for acidity due to addition of CuSO₄, the NaOH titre recorded for the Blank corresponds to a "NAG-[pH7]" value less than 0.5 kg H₂SO₄/tonne for a sample weight of 5.00 gm. All testing performed on **pulps** (nominal -75 µm).

Dr GD Campbell 3rd September 2018

*Graeme Campbell & Associates Pty Ltd**Laboratory Report***pH-(1:2) & EC-(1:2) TESTWORK**

SAMPLE_ ID	SAMPLE WEIGHT (g)	pH-(1:2)	EC-(1:2) (μS/cm)
BD16016_105	30.1	6.5	307
BD17007_53	29.9	6.6	1,610
BD17007_55	30.0	5.1	2,470
BD13128_111	30.1	5.8	542
BD17007_65	29.9	6.2	2,220
BD17001_74	30.0	7.2	940
BD17001_96	30.0	7.3	549
BD17014_48	30.1	5.1	1,650
BD17001_76	29.9	7.2	534
BD13128_73	30.0	7.1	325
BD1328_73 d	29.9	6.9	346
BD17010_60	30.0	7.1	933
BD16016_67	30.1	7.4	852
BD16016_69	30.0	7.6	383
BD16003_57	30.0	6.6	188
BD17016_35	30.0	7.3	268
BD16005_114	29.9	7.4	497
BD16005_114 d	30.0	7.3	480

Notes: EC = Electrical-Conductivity

Testwork performed on coarse-crushings (nominal -5mm).

pH-(1:2) and EC=(1:2) values correspond to pH and EC values for suspensions prepared with deionised-water and a solid:solution ratio of *ca.* 1:2 (w/w) [i.e. approx. 30 g solids + 60 mL DW).

Test-suspensions allowed to 'age' / equilibrate for *ca.* 1-2 days before pH and EC determinations.

Testwork performed in a CT-room (viz. 20 +/- 2 oC).

Dr GD Campbell

2nd September 2018

Graeme Campbell & Associates Pty Ltd

Laboratory Report

pH-BUFFERING TESTWORK (BD13128_075079)

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H₂SO₄/tonne)	pH
0.00	0.0	7.6
0.40	0.4	6.3
0.80	0.8	5.6
1.20	1.2	5.2
1.60	1.6	5.0
2.00	2.0	4.8
2.40	2.4	4.6
2.80	2.7	4.4
3.20	3.1	4.3
3.60	3.5	4.2
4.00	3.9	4.0
4.40	4.3	4.0
4.80	4.7	3.9
5.20	5.1	3.8
5.60	5.5	3.7
6.00	5.9	3.6
6.40	6.3	3.6
6.80	6.7	3.5
7.20	7.1	3.5
7.60	7.4	3.4
8.00	7.8	3.4
8.40	8.2	3.3
8.80	8.6	3.3
9.20	9.0	3.2
9.60	9.4	3.2
10.00	9.8	3.1
10.40	10.2	3.1
10.80	10.6	3.0

Note: Titration performed using a Metrohm® 736 Titrino auto-titrator, and 0.05 M-H₂SO₄. Equilibration time between titrant additions was 15 minutes. 5.00 g of pulped sample initially dispersed in 150 mL of deionised-water. Test mixture in contact with air, at ambient temperature, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = 0 mV (pH=7.00); slope-point = 172 mV (pH=4.00); 96.8 % of Nernstian response for 25 °C.

Dr GD Campbell
29th December 2017

*Graeme Campbell & Associates Pty Ltd**Laboratory Report***pH-BUFFERING TESTWORK (BD16016_067071)**

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH	Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH
0.00	0.0	8.7	17.60	17.2	5.2
0.40	0.4	8.2	18.00	17.6	5.2
0.80	0.8	7.5	18.40	18.0	5.1
1.20	1.2	7.2	18.80	18.4	5.0
1.60	1.6	7.0	19.20	18.8	5.0
2.00	2.0	7.0	19.60	19.2	5.0
2.40	2.4	6.9	20.00	19.6	5.0
2.80	2.7	6.8	20.40	20.0	4.9
3.20	3.1	6.8	20.80	20.4	4.9
3.60	3.5	6.8	21.20	20.8	4.8
4.00	3.9	6.6	21.60	21.2	4.8
4.40	4.3	6.6	22.00	21.6	4.7
4.80	4.7	6.6	22.40	22.0	4.7
5.20	5.1	6.5	22.80	22.3	4.6
5.60	5.5	6.5	23.20	22.7	4.6
6.00	5.9	6.4	23.60	23.1	3.8
6.40	6.3	6.4	24.00	23.5	3.8
6.80	6.7	6.4	24.40	23.9	3.8
7.20	7.1	6.3	24.80	24.3	3.8
7.60	7.4	6.3	25.20	24.7	3.8
8.00	7.8	6.2	25.60	25.1	3.7
8.40	8.2	6.2	26.00	25.5	3.7
8.80	8.6	6.2	26.40	25.9	3.7
9.20	9.0	6.2	26.80	26.3	3.6
9.60	9.4	6.1	27.20	26.7	3.6
10.00	9.8	6.1	27.60	27.0	3.5
10.40	10.2	6.1	28.00	27.4	3.5
10.80	10.6	6.0	28.40	27.8	3.5
11.20	11.0	6.0	28.80	28.2	3.4
11.60	11.4	6.0	29.20	28.6	3.4
12.00	11.8	6.0	29.60	29.0	3.4
12.40	12.2	5.9	30.00	29.4	3.3
12.80	12.5	5.9	30.40	29.8	3.3
13.20	12.9	5.8	30.80	30.2	3.3
13.60	13.3	5.8	31.20	30.6	3.3
14.00	13.7	5.7	31.60	31.0	3.2
14.40	14.1	5.7	32.00	31.4	3.2
14.80	14.5	5.6	32.40	31.8	3.1
15.20	14.9	5.6	32.80	32.1	3.1
15.60	15.3	5.5	33.20	32.5	3.0
16.00	15.7	5.4			
16.40	16.1	5.4			
16.80	16.5	5.4			
17.20	16.9	5.3			

Note: Titration performed using a Metrohm® 736 Titrino auto-titrator, and 0.05 M-H₂SO₄. Equilibration time between titrant additions was 15 minutes. 5.00 g of pulped sample initially dispersed in 150 mL of deionised-water. Test mixture in contact with air, at ambient temperature, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = 0 mV (pH=7.00); slope-point = 171 mV (pH=4.00); 96.6 % of Nernstian response for 25 °C.

Dr GD Campbell 29th December 2017

Graeme Campbell & Associates Pty Ltd

Laboratory Report

pH-BUFFERING TESTWORK (BD16016_087091)

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H₂SO₄/tonne)	pH
0.00	0.0	7.5
0.40	0.4	6.3
0.80	0.8	5.7
1.20	1.2	5.4
1.60	1.6	5.1
2.00	2.0	4.9
2.40	2.4	4.7
2.80	2.7	4.6
3.20	3.1	4.4
3.60	3.5	4.2
4.00	3.9	4.1
4.40	4.3	3.9
4.80	4.7	3.9
5.20	5.1	3.8
5.60	5.5	3.6
6.00	5.9	3.5
6.40	6.3	3.5
6.80	6.7	3.3
7.20	7.1	3.2
7.60	7.4	3.1
8.00	7.8	3.1
8.40	8.2	3.0

Note: Titration performed using a Metrohm® 736 Titrino auto-titrator, and 0.05 M-H₂SO₄. Equilibration time between titrant additions was 15 minutes. 5.00 g of pulped sample initially dispersed in 150 mL of deionised-water. Test mixture in contact with air, at ambient temperature, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = -1 mV (pH=7.00); slope-point = 170 mV (pH=4.00); 96.1 % of Nernstian response for 25 °C.

Dr GD Campbell
28th December 2017

*Graeme Campbell & Associates Pty Ltd**Laboratory Report***pH-BUFFERING TESTWORK (BD17001_082086)**

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H₂SO₄/tonne)	pH
0.00	0.0	8.3
0.40	0.4	7.1
0.80	0.8	6.7
1.20	1.2	6.4
1.60	1.6	6.2
2.00	2.0	6.0
2.40	2.4	5.8
2.80	2.7	5.6
3.20	3.1	5.5
3.60	3.5	5.4
4.00	3.9	5.2
4.40	4.3	5.1
4.80	4.7	5.0
5.20	5.1	5.0
5.60	5.5	4.5
6.00	5.9	4.3
6.40	6.3	4.2
6.80	6.7	4.0
7.20	7.1	3.9
7.60	7.4	3.8
8.00	7.8	3.7
8.40	8.2	3.6
8.80	8.6	3.6
9.20	9.0	3.5
9.60	9.4	3.4
10.00	9.8	3.4
10.40	10.2	3.3
10.80	10.6	3.3
11.20	11.0	3.2
11.60	11.4	3.2
12.00	11.8	3.1
12.40	12.2	3.1
12.80	12.5	3.0

Note: Titration performed using a Metrohm® 736 Titrino auto-titrator, and 0.05 M-H₂SO₄. Equilibration time between titrant additions was 15 minutes. 5.00 g of pulped sample initially dispersed in 150 mL of deionised-water. Test mixture in contact with air, at ambient temperature, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = 0 mV (pH=7.00); slope-point = 172 mV (pH=4.00); 96.8 % of Nernstian response for 25 °C.

Dr GD Campbell
4th January 2018

Graeme Campbell & Associates Pty Ltd

Laboratory Report

pH-BUFFERING TESTWORK (BD17007 049053)

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH	Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH
0.00	0.0	8.2	17.60	17.2	4.0
0.40	0.4	7.4	18.00	17.6	3.9
0.80	0.8	7.0	18.40	18.0	3.9
1.20	1.2	6.9	18.80	18.4	3.9
1.60	1.6	6.8	19.20	18.8	3.8
2.00	2.0	6.7	19.60	19.2	3.8
2.40	2.4	6.6	20.00	19.6	3.8
2.80	2.7	6.5	20.40	20.0	3.7
3.20	3.1	6.5	20.80	20.4	3.7
3.60	3.5	6.4	21.20	20.8	3.7
4.00	3.9	5.9	21.60	21.2	3.6
4.40	4.3	5.8	22.00	21.6	3.6
4.80	4.7	5.6	22.40	22.0	3.6
5.20	5.1	5.5	22.80	22.3	3.6
5.60	5.5	5.5	23.20	22.7	3.6
6.00	5.9	5.4	23.60	23.1	3.5
6.40	6.3	5.3	24.00	23.5	3.5
6.80	6.7	5.2	24.40	23.9	3.5
7.20	7.1	5.2	24.80	24.3	3.5
7.60	7.4	5.1	25.20	24.7	3.4
8.00	7.8	5.1	25.60	25.1	3.4
8.40	8.2	5.0	26.00	25.5	3.4
8.80	8.6	5.0	26.40	25.9	3.4
9.20	9.0	4.9	26.80	26.3	3.3
9.60	9.4	4.9	27.20	26.7	3.3
10.00	9.8	4.8	27.60	27.0	3.3
10.40	10.2	4.8	28.00	27.4	3.3
10.80	10.6	4.7	28.40	27.8	3.2
11.20	11.0	4.7	28.80	28.2	3.2
11.60	11.4	4.6	29.20	28.6	3.2
12.00	11.8	4.6	29.60	29.0	3.1
12.40	12.2	4.5	30.00	29.4	3.1
12.80	12.5	4.5	30.40	29.8	3.1
13.20	12.9	4.5	30.80	30.2	3.0
13.60	13.3	4.5			
14.00	13.7	4.4			
14.40	14.1	4.3			
14.80	14.5	4.3			
15.20	14.9	4.2			
15.60	15.3	4.2			
16.00	15.7	4.1			
16.40	16.1	4.1			
16.80	16.5	4.0			
17.20	16.9	4.0			

Note: Titration performed using a Metrohm® 736 Titrimo auto-titrator, and 0.05 M-H₂SO₄. Equilibration time between titrant additions was 15 minutes. 5.00 g of pulped sample initially dispersed in 150 mL of deionised-water. Test mixture in contact with air, at ambient temperature, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = 0 mV (pH=7.00); slope-point = 171 mV (pH=4.00); 96.4 % of Nernstian response for 25 °C.

Dr GD Campbell
27th December 2017

*Graeme Campbell & Associates Pty Ltd**Laboratory Report***pH-BUFFERING TESTWORK (B7010 058062)**

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH	Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH
0.00	0.0	9.1	17.60	17.2	5.4
0.40	0.4	8.7	18.00	17.6	5.3
0.80	0.8	7.8	18.40	18.0	5.3
1.20	1.2	7.5	18.80	18.4	5.3
1.60	1.6	7.2	19.20	18.8	5.2
2.00	2.0	7.1	19.60	19.2	5.2
2.40	2.4	7.0	20.00	19.6	5.1
2.80	2.7	6.9	20.40	20.0	5.1
3.20	3.1	6.9	20.80	20.4	5.0
3.60	3.5	6.8	21.20	20.8	5.0
4.00	3.9	6.8	21.60	21.2	4.9
4.40	4.3	6.7	22.00	21.6	4.9
4.80	4.7	6.7	22.40	22.0	4.8
5.20	5.1	6.6	22.80	22.3	4.8
5.60	5.5	6.6	23.20	22.7	4.7
6.00	5.9	6.5	23.60	23.1	4.7
6.40	6.3	6.5	24.00	23.5	4.7
6.80	6.7	6.4	24.40	23.9	4.6
7.20	7.1	6.4	24.80	24.3	4.6
7.60	7.4	6.4	25.20	24.7	4.5
8.00	7.8	6.3	25.60	25.1	4.5
8.40	8.2	6.3	26.00	25.5	4.4
8.80	8.6	6.2	26.40	25.9	4.4
9.20	9.0	6.2	26.80	26.3	4.4
9.60	9.4	6.1	27.20	26.7	4.3
10.00	9.8	6.1	27.60	27.0	4.3
10.40	10.2	6.1	28.00	27.4	4.3
10.80	10.6	6.1	28.40	27.8	3.6
11.20	11.0	6.0	28.80	28.2	3.6
11.60	11.4	6.0	29.20	28.6	3.6
12.00	11.8	6.0	29.60	29.0	3.6
12.40	12.2	5.9	30.00	29.4	3.6
12.80	12.5	5.9	30.40	29.8	3.6
13.20	12.9	5.9	30.80	30.2	3.6
13.60	13.3	5.8	31.20	30.6	3.5
14.00	13.7	5.8	31.60	31.0	3.5
14.40	14.1	5.7	32.00	31.4	3.5
14.80	14.5	5.7	32.40	31.8	3.5
15.20	14.9	5.7	32.80	32.1	3.4
15.60	15.3	5.6	33.20	32.5	3.4
16.00	15.7	5.6	33.60	32.9	3.4
16.40	16.1	5.5	34.00	33.3	3.3
16.80	16.5	5.5	34.40	33.7	3.3
17.20	16.9	5.5	34.80	34.1	3.2

Note: Titration performed using a Metrohm® 736 Titrino auto-titrator, and 0.05 M-H₂SO₄. Equilibration time between titrant additions was 15 minutes. 5.00 g of pulped sample initially dispersed in 150 mL of deionised-water. Test mixture in contact with air, at ambient temperature, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = 0 mV (pH=7.00); slope-point = 172 mV (pH=4.00); 96.8 % of Nernstian response for 25 °C.

Dr GD Campbell
30th December 2017

Graeme Campbell & Associates Pty Ltd

Laboratory Report

pH-BUFFERING TESTWORK (BD17016_031035)

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H2SO4/tonne)	pH	Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H2SO4/tonne)	pH
0.00	0.0	9.1	20.00	19.6	5.9
0.40	0.4	8.2	20.40	20.0	5.9
0.80	0.8	7.7	20.80	20.4	5.9
1.20	1.2	7.4	21.20	20.8	5.9
1.60	1.6	7.2	21.60	21.2	5.8
2.00	2.0	7.1	22.00	21.6	5.8
2.40	2.4	7.0	22.40	22.0	5.8
2.80	2.7	7.0	22.80	22.3	5.8
3.20	3.1	6.9	23.20	22.7	5.8
3.60	3.5	6.9	23.60	23.1	5.7
4.00	3.9	6.8	24.00	23.5	5.7
4.40	4.3	6.8	24.40	23.9	5.7
4.80	4.7	6.8	24.80	24.3	5.7
5.20	5.1	6.7	25.20	24.7	5.6
5.60	5.5	6.7	25.60	25.1	5.6
6.00	5.9	6.7	26.00	25.5	5.6
6.40	6.3	6.6	26.40	25.9	5.6
6.80	6.7	6.6	26.80	26.3	5.6
7.20	7.1	6.6	27.20	26.7	5.6
7.60	7.4	6.5	27.60	27.0	5.5
8.00	7.8	6.5	28.00	27.4	5.5
8.40	8.2	6.5	28.40	27.8	5.5
8.80	8.6	6.5	28.80	28.2	5.5
9.20	9.0	6.4	29.20	28.6	5.5
9.60	9.4	6.4	29.60	29.0	5.4
10.00	9.8	6.4	30.00	29.4	5.4
10.40	10.2	6.4	30.40	29.8	5.4
10.80	10.6	6.3	30.80	30.2	5.4
11.20	11.0	6.3	31.20	30.6	5.3
11.60	11.4	6.3	31.60	31.0	5.3
12.00	11.8	6.3	32.00	31.4	5.3
12.40	12.2	6.3	32.40	31.8	5.3
12.80	12.5	6.2	32.80	32.1	5.3
13.20	12.9	6.2	33.20	32.5	5.2
13.60	13.3	6.2	33.60	32.9	5.2
14.00	13.7	6.2	34.00	33.3	5.2
14.40	14.1	6.2	34.40	33.7	5.2
14.80	14.5	6.1	34.80	34.1	5.1
15.20	14.9	6.1	35.20	34.5	3.7
15.60	15.3	6.1	35.60	34.9	3.8
16.00	15.7	6.1	36.00	35.3	4.0
16.40	16.1	6.1	36.40	35.7	4.2
16.80	16.5	6.1	36.80	36.1	4.5
17.20	16.9	6.0	37.20	36.5	4.5
17.60	17.2	6.0	37.60	36.8	4.4
18.00	17.6	6.0	38.00	37.2	4.4
18.40	18.0	6.0	38.40	37.6	4.4
18.80	18.4	6.0	38.80	38.0	4.4
19.20	18.8	6.0	39.20	38.4	4.4
19.60	19.2	5.9	39.60	38.8	4.3

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH	Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH
40.00	39.2	4.3	47.60	46.6	3.8
40.40	39.6	4.3	48.00	47.0	3.8
40.80	40.0	4.3	48.40	47.4	3.8
41.20	40.4	4.2	48.80	47.8	3.7
41.60	40.8	4.2	49.20	48.2	3.7
42.00	41.2	4.2	49.60	48.6	3.6
42.40	41.6	4.2	50.00	49.0	3.6
42.80	41.9	4.1	50.40	49.4	3.6
43.20	42.3	4.1	50.80	49.8	3.6
43.60	42.7	4.1	51.20	50.2	3.5
44.00	43.1	4.1	51.60	50.6	3.5
44.40	43.5	4.0	52.00	51.0	3.5
44.80	43.9	4.0	52.40	51.4	3.5
45.20	44.3	4.0	52.80	51.7	3.4
45.60	44.7	4.0	53.20	52.1	3.4
46.00	45.1	3.9	53.60	52.5	3.3
46.40	45.5	3.9	54.00	52.9	3.2
46.80	45.9	3.9	54.40	53.3	3.2
47.20	46.3	3.8	54.80	53.7	3.2

Note: Titration performed using a Metrohm® 736 Titrino auto-titrator, and 0.05 M-H₂SO₄. Equilibration time between titrant additions was 15 minutes. 5.00 g of pulped sample initially dispersed in 150 mL of deionised-water. Test mixture in contact with air, at ambient temperature, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = 0 mV (pH=7.00); slope-point = 172 mV (pH=4.00); 96.8 % of Nernstian response for 25 °C.

Dr GD Campbell
3rd January 2018

Graeme Campbell & Associates Pty Ltd

Laboratory Report

pH-BUFFERING TESTWORK (BRC17001_041045)

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH	Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H ₂ SO ₄ /tonne)	pH
0.00	0.0	7.8	11.20	11.0	3.6
0.40	0.4	7.2	11.60	11.4	3.6
0.80	0.8	6.8	12.00	11.8	3.5
1.20	1.2	6.4	12.40	12.2	3.5
1.60	1.6	6.0	12.80	12.5	3.5
2.00	2.0	5.7	13.20	12.9	3.4
2.40	2.4	5.5	13.60	13.3	3.4
2.80	2.7	5.3	14.00	13.7	3.4
3.20	3.1	5.1	14.40	14.1	3.3
3.60	3.5	4.9	14.80	14.5	3.3
4.00	3.9	4.7	15.20	14.9	3.3
4.40	4.3	4.6	15.60	15.3	3.2
4.80	4.7	4.5	16.00	15.7	3.2
5.20	5.1	4.4	16.40	16.1	3.2
5.60	5.5	4.3	16.80	16.5	3.2
6.00	5.9	4.3	17.20	16.9	3.1
6.40	6.3	4.2	17.60	17.2	3.1
6.80	6.7	4.2	18.00	17.6	3.1
7.20	7.1	4.1	18.40	18.0	3.1
7.60	7.4	4.1	18.80	18.4	3.1
8.00	7.8	4.0	19.20	18.8	3.0
8.40	8.2	4.0			
8.80	8.6	3.9			
9.20	9.0	3.9			
9.60	9.4	3.8			
10.00	9.8	3.8			
10.40	10.2	3.7			
10.80	10.6	3.7			

Note: Titration performed using a Metrohm® 736 Titrino auto-titrator, and 0.05 M-H₂SO₄. Equilibration time between titrant additions was 15 minutes. 5.00 g of pulped sample initially dispersed in 150 mL of deionised-water. Test mixture in contact with air, at ambient temperature, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = -3 mV (pH=7.00); slope-point = 169 mV (pH=4.00); 96.8 % of Nernstian response for 25 °C.

Dr GD Campbell
14th January 2018



MINERALS TEST REPORT

CLIENT

GRAEME CAMPBELL
CAMPBELL, GRAEME and ASSOCIATES
PO Box 247
BRIDGETOWN, W.A. 6255
AUSTRALIA

JOB INFORMATION

JOB CODE : 143.0/1815068
NO. SAMPLES : 4
NO. ELEMENTS : 34
CLIENT ORDER NO. : GCA1822 (Job 1 of 1)
SAMPLE SUBMISSION NO. :
PROJECT : BOWDENS
SAMPLE TYPE : Pulp
DATE RECEIVED : 02/10/2018
DATE REPORTED : 12/10/2018
DATE PRINTED : 12/10/2018

REPORT NOTES

TESTED BY

Intertek

15 Davison Street, Maddington 6109, Western Australia

PO Box 144, Gosnells 6990, Western Australia

Tel: +61 8 9251 8100

Email: min.aus.per@intertek.com

Accredited for compliance with ISO/IEC 17025.

Company Accreditation Number 3244



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JOB NO : 143.0/1815068

CLIENT REF : GCA1822

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NOTES
NATA ENDORSED DOCUMENT
Company Accreditation Number 3244
Analysing Laboratory: Intertek Genalysis Perth

The contents of this report have been prepared in accordance with the terms of NATA accreditation and as such should only be reproduced in full.

The analysis results reported herein have been obtained using the following methods and conditions:

Project: Bowdens

The sample as listed were received as ex pulp 1811752

The results have been determined according to Genalysis methods codes :

Digestions : MPL_W002 (4A/), MPL_W005 (SE1/), ENV_W012 (FC7/SIE), MPL_W011 (FP1/) and MPL_W008 (HG1/)

Analytical Finishes: ICP_W004 (/OE), ICP_W003 (/MS) and AAS_W004 (/CV)

The results included the assay of blanks and international reference standards:

AMIS0343, AMIS0406 and OREAS 503

Genalysis in house standards:

OREAS 97.01 and HgSTD-8

The results are expressed as parts per million or percent by mass in the dried and prepared material.

Intertek Genalysis signatory

Ann Patricia EVERS

Chief Chemist



Date: 12-Oct-2018

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JOB NO : 143.0/1815068

CLIENT REF : GCA1822

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**SIGNIFICANT FIGURES**

It is common practice to report data derived from analytical instrumentation to a maximum of two or three significant figures. Some data reported herein may show more figures than this. The reporting of more than two or three figures in no way implies that figures beyond the least significant digit have significance.

For more information on the uncertainty on individual reported values, please contact the laboratory.

SAMPLE STORAGE

All solid samples (assay pulps, bulk pulps and residues) will be stored for 60 days without charge. Following this samples will be stored at a daily rate until clients written advice regarding return, collection or disposal is received. If storage information is not supplied on the submission, or arranged with the laboratory in writing the default will be to store the samples with the applicable charges. Storage is charged at \$4.00 per m³ per day, expenses related to the return or disposal of samples will be charged at cost. Current disposal cost is charged at \$150.00 per m³.

Samples received as liquids, waters or solutions will be held for 60 days free of charge then disposed of, unless written advice for return or collection is received.

LEGEND	X	= Less than Detection Limit	NA	= Not Analysed
	SNR	= Sample Not Received	UA	= Unable to Assay
	*	= Result Checked	>	= Value beyond Limit of Method
	DTF	= Result still to come	+	= Extra Sample Received Not Listed
	IS	= Insufficient Sample for Analysis		



ELEMENTS	Ag	Al	As	B	Ba	Bi	Ca	Cd	Co	Cr
UNITS	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.01	0.5	50	0.1	0.01	0.1	0.02	0.1	50
DIGEST	4A/	FP1/	4A/	FP1/	4A/	4A/	FP1/	4A/	4A/	FP1/
ANALYTICAL FINISH	MS	OE	MS	OE	MS	MS	OE	MS	MS	OE
SAMPLE NUMBERS										
0001 BD16016_67	0.18	7.57	15.0	X	427.4	0.36	1.1	1.20	9.8	X
0002 BD17007_53	1.45	7.14	11.5	X	427.8	0.23	1.0	1.26	1.5	X
0003 BD17014_48	0.10	8.00	11.1	X	480.5	0.31	0.3	0.78	0.7	X
0004 BD17001_96	0.45	7.98	15.8	X	508.7	0.17	0.2	0.11	0.7	X
CHECKS										
0001 BD17014_48	0.07	7.88	11.3	X	476.0	0.33	0.3	0.65	0.7	X
STANDARDS										
0001 OREAS 503	1.51		21.4		903.4	2.66		0.15	17.8	
0002 AMIS0406		0.14		538			13.1			404
0003 HgSTD-8										
0004 AMIS0343										
0005 OREAS 97.01										
BLANKS										
0001 Control Blank	X	X	X	X	X	X	X	X	X	X



ELEMENTS	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni
UNITS	ppm	ppm	%	ppm	%	%	ppm	ppm	ppm	ppm
DETECTION LIMIT	1	50	0.01	0.01	0.05	0.01	1	0.1	20	1
DIGEST	4A/	FC7/	FP1/	HG1/	FP1/	FP1/	4A/	4A/	4A/	4A/
ANALYTICAL FINISH	OE	SIE	OE	CV	OE	OE	OE	MS	OE	OE
SAMPLE NUMBERS										
0001 BD16016_67	9	576	1.52	0.02	2.33	0.46	1497	1.1	269	5
0002 BD17007_53	X	506	1.22	0.02	2.60	0.37	1934	1.6	400	X
0003 BD17014_48	X	1029	0.53	0.03	2.91	0.22	517	0.9	497	X
0004 BD17001_96	1	869	0.93	0.01	6.23	0.18	6889	0.6	655	X
CHECKS										
0001 BD17014_48	1	1040	0.52	0.04	2.85	0.22	526	0.9	501	X
STANDARDS										
0001 OREAS 503	5484						561	378.9	2.05%	29
0002 AMISO406			4.67		0.15	2.14				
0003 HgSTD-8				3.17						
0004 AMISO343		2293								
0005 OREAS 97.01										
BLANKS										
0001 Control Blank	X	X	X	X	X	X	2	X	X	X



ELEMENTS	P	Pb	S	Sb	Se	Si	Sn	Sr	Th	Ti
UNITS	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	%
DETECTION LIMIT	10	0.5	50	0.05	0.01	0.1	0.1	0.05	0.01	0.01
DIGEST	4A/	4A/	4A/	4A/	SE1/	FP1/	4A/	4A/	4A/	FP1/
ANALYTICAL FINISH	OE	MS	OE	MS	MS	OE	MS	MS	MS	OE
SAMPLE NUMBERS										
0001 BD16016_67	681	25.3	3871	5.90	0.09	32.0	2.5	817.31	12.53	0.35
0002 BD17007_53	207	269.3	3363	6.33	0.03	32.8	2.4	237.18	14.83	0.21
0003 BD17014_48	87	54.7	2605	5.01	0.04	34.9	2.6	87.22	14.78	0.23
0004 BD17001_96	278	17.8	2435	8.76	0.01	33.6	2.4	227.90	14.44	0.19
CHECKS										
0001 BD17014_48	87	43.7	2588	5.00	0.05	34.6	2.6	87.79	15.04	0.22
STANDARDS										
0001 OREAS 503	1040	26.6	7385	0.74			7.0	377.16	13.59	
0002 AMIS0406						2.2				X
0003 HgSTD-8										
0004 AMIS0343										
0005 OREAS 97.01					0.64					
BLANKS										
0001 Control Blank	X	X	X	X	X	X	X	X	X	X



ELEMENTS	Ti	Tl	U	V	Zn
UNITS	ppm	ppm	ppm	ppm	ppm
DETECTION LIMIT	5	0.02	0.01	1	1
DIGEST	4A/	4A/	4A/	4A/	4A/
ANALYTICAL FINISH	OE	MS	MS	OE	OE
SAMPLE NUMBERS					
0001 BD16016_67	3443	2.79	7.20	64	205
0002 BD17007_53	2048	3.16	4.27	17	269
0003 BD17014_48	2196	3.01	8.03	13	169
0004 BD17001_96	1788	5.28	3.37	12	93
CHECKS					
0001 BD17014_48	2193	3.10	8.01	13	161
STANDARDS					
0001 OREAS 503	4171	0.70	3.74	131	87
0002 AMISO406					
0003 HgSTD-8					
0004 AMISO343					
0005 OREAS 97.01					
BLANKS					
0001 Control Blank	X	X	X	X	X



METHOD CODE DESCRIPTION

Method Code	Analysing Laboratory NATA Laboratory Accreditation	NATA Scope of Accreditation
4A/MS	Intertek Genalysis Perth 3244 3237 Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Mass Spectrometry.	4A/ : MPL_W002, MS : ICP_W003
4A/OE	Intertek Genalysis Perth 3244 3237 Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.	4A/ : MPL_W002, OE : ICP_W004
FC7/SIE	Intertek Genalysis Perth 3244 3237 Alkaline fusion (Nickel crucible) specific for Fluorine. Analysed by Specific Ion Electrode.	ENV_W012, SIE : ENV_W012
FP1/OE	Intertek Genalysis Perth 3244 3237 Sodium peroxide fusion (Zirconia crucibles) and Hydrochloric acid to dissolve the melt. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.	FP1/ : MPL_W011, OE : ICP_W004
HG1/CV	Intertek Genalysis Perth 3244 3237 Low temperature Perchloric acid digest specific for Mercury. Analysed by Cold Vapour Generation Atomic Absorption Spectrometry.	
SE1/MS	Intertek Genalysis Perth 3244 3237 Aqua-Regia digest followed by Precipitation and Concentration. Specific for Selenium. Analysed by Inductively Coupled Plasma Mass Spectrometry.	



MINERALS TEST REPORT

CLIENT

GRAEME CAMPBELL
CAMPBELL, GRAEME and ASSOCIATES
PO Box 247
BRIDGETOWN, W.A. 6255
AUSTRALIA

JOB INFORMATION

JOB CODE : 143.0/1813383
NO. SAMPLES : 18
NO. ELEMENTS : 40
CLIENT ORDER NO. : GCA1822 (Job 1 of 1)
SAMPLE SUBMISSION NO. :
PROJECT : BOWDENS
SAMPLE TYPE : Solutions
DATE RECEIVED : 06/09/2018
DATE REPORTED : 28/09/2018
DATE PRINTED : 28/09/2018

REPORT NOTES**TESTED BY**

Intertek

15 Davison Street, Maddington 6109, Western Australia

PO Box 144, Gosnells 6990, Western Australia

Tel: +61 8 9251 8100

Email: min.aus.per@intertek.com

Accredited for compliance with ISO/IEC 17025.**Company Accreditation Number 3244**

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JOB NO : 143.0/1813383

CLIENT REF : GCA1822

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NOTES
NATA ENDORSED DOCUMENT
Company Accreditation Number 3244
Analysing Laboratory: Intertek Genalysis Perth

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The analysis results reported herein have been obtained using the following methods and conditions:

Project Bowdens water extracts
A range of 500mL-plastic-bottles with slurries was received
and in 125mL bottles, HPDW ... both raw-HPDW and HNO₃-dosed-HPDW.

The test slurries (1:2 solid:water ratio)and the Blank were bottle-rolled overnight,
and left to 'still-stand' for 24 hrs.

The supernatants were then removed for assaying as per below.

pH, EC, alkalinity Cl and F of requested raw filtered solutions were measured
APHA method codes: (Alkalinity: 2320B)
Genalysis method codes: ENV_W001, (pH) ENV_W002, (EC), ENV_W011, (F), and ENV_W013 (Cl)
APHA code refers to "Standard methods for the examination of water and wastewater", 22nd Edition 2012

The HNO₃ dosed filtered solutions were analysed for the requested element suite by ICPOES and ICPMS
Genalysis method codes; ICP_W004 (ICPOES) and ICP_W003 (ICPMS)

Intertek Genalysis signatory
Ann Patricia EVERS
Chief Chemist



Date: 28-Sep-2018

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JOB NO : 143.0/1813383
CLIENT REF : GCA1822

Page 2 of 11

**SIGNIFICANT FIGURES**

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	SNR	= Sample Not Received	UA	= Unable to Assay
	*	= Result Checked	>	= Value beyond Limit of Method
	DTF	= Result still to come	+	= Extra Sample Received Not Listed
	IS	= Insufficient Sample for Analysis		



ELEMENTS	Ag	Al	As	B	Ba	Bi
UNITS	ug/l	mg/l	ug/l	mg/l	ug/l	ug/l
DETECTION LIMIT	0.01	0.01	0.1	0.01	0.05	0.005
DIGEST						
ANALYTICAL FINISH	/MS	/OE	/MS	/OE	/MS	/MS
SAMPLE NUMBERS						
0001 BD16016-67 RAW						
0002 BD17001-74 RAW						
0003 BD17001-96 RAW						
0004 BD17007-53 RAW						
0005 BD17007-55 RAW						
0006 BD17007-65 RAW						
0007 BD17014-48 RAW						
0008 BLANK RAW						
0009 HPDW RAW						
0010 BD16016-67 HNO3	X	0.02	2.0	X	12.98	X
0011 BD17001-74 HNO3	X	0.01	2.0	X	10.88	X
0012 BD17001-96 HNO3	X	0.03	5.1	X	8.26	X
0013 BD17007-53 HNO3	X	0.05	1.7	X	15.24	0.012
0014 BD17007-55 HNO3	0.02	0.23	2.1	X	16.05	0.015
0015 BD17007-65 HNO3	0.10	0.08	1.6	X	21.90	0.011
0016 BD17014-48 HNO3	0.02	0.07	3.4	X	15.08	0.009
0017 BLANK HNO3	X	X	X	X	0.10	X
0018 HPDW HNO3	X	X	X	X	0.12	X
CHECKS						
0001 Ch7: BD17007-55 RAW						
0002 BD16016-67 HNO3	0.03	0.04	2.0	X	13.07	X
STANDARDS						
0001 GWS-2						
0002 GWS-2						
0003 GWS-2						
0004 TMDW	1.92		77.4		46.56	9.270
0005 UNI 1		24.94		5.30		
BLANKS						
0001 Control Blank						
0002 Control Blank	X	X	X	X	X	X



ELEMENTS	CO3	Ca	Cd	Cl	Co	Cr
UNITS	mgCaCO3/L	mg/l	ug/l	mg/l	ug/l	mg/l
DETECTION LIMIT	1	0.01	0.5	0.1	0.1	0.01
DIGEST						
ANALYTICAL FINISH	/VOL	/OE	/MS	/COL	/MS	/OE
SAMPLE NUMBERS						
0001 BD16016-67 RAW	X			4.0		
0002 BD17001-74 RAW	X			4.0		
0003 BD17001-96 RAW	X			3.0		
0004 BD17007-53 RAW	X			3.8		
0005 BD17007-55 RAW	X			7.6		
0006 BD17007-65 RAW	X			8.7		
0007 BD17014-48 RAW	X			4.4		
0008 BLANK RAW	X			X		
0009 HPDW RAW	X			X		
0010 BD16016-67 HNO3		85.47	X		11.3	X
0011 BD17001-74 HNO3		80.18	X		0.6	X
0012 BD17001-96 HNO3		35.71	X		X	X
0013 BD17007-53 HNO3		181.91	2.3		20.4	X
0014 BD17007-55 HNO3		259.83	18.2		73.3	X
0015 BD17007-65 HNO3		302.31	1.9		20.3	X
0016 BD17014-48 HNO3		96.33	3.2		17.4	X
0017 BLANK HNO3		0.02	X		X	X
0018 HPDW HNO3		0.04	X		X	X
CHECKS						
0001 Ch7: BD17007-55 RAW	X			5.5		
0002 BD16016-67 HNO3		84.39	X		11.7	X
STANDARDS						
0001 GWS-2				25.0		
0002 GWS-2	X					
0003 GWS-2						
0004 TMDW			9.0		23.3	
0005 UNI 1		25.23				24.34
BLANKS						
0001 Control Blank	X			X		
0002 Control Blank		X	X		X	X



ELEMENTS	Cu	EC	F	Fe-Sol	HCO ₃	Hg
UNITS	mg/l	uS/cm	mg/l	mg/l	mgCaCO ₃ /L	ug/l
DETECTION LIMIT	0.01	10	0.1	0.01	2	0.1
DIGEST						
ANALYTICAL FINISH	/OE	/MTR	/SIE	/OE	/VOL	/MS
SAMPLE NUMBERS						
0001 BD16016-67 RAW		72	0.5		100	
0002 BD17001-74 RAW		677	1.5		51	
0003 BD17001-96 RAW		397	2.0		70	
0004 BD17007-53 RAW		1216	0.3		98	
0005 BD17007-55 RAW		1716	X		7	
0006 BD17007-65 RAW		1875	X		53	
0007 BD17014-48 RAW		928	X		5	
0008 BLANK RAW		X	X		3	
0009 HPDW RAW		X	X		2	
0010 BD16016-67 HNO ₃	X			X		X
0011 BD17001-74 HNO ₃	X			X		X
0012 BD17001-96 HNO ₃	X			X		X
0013 BD17007-53 HNO ₃	X			X		X
0014 BD17007-55 HNO ₃	X			10.34		X
0015 BD17007-65 HNO ₃	X			0.14		X
0016 BD17014-48 HNO ₃	X			1.11		X
0017 BLANK HNO ₃	X			X		X
0018 HPDW HNO ₃	X			0.02		X
CHECKS						
0001 Ch7: BD17007-55 RAW		1717	X		7	
0002 BD16016-67 HNO ₃	X			X		X
STANDARDS						
0001 GWS-2						
0002 GWS-2					101	
0003 GWS-2			0.4			
0004 TMDW						X
0005 UNI 1	10.17			249.10		
BLANKS						
0001 Control Blank		X	X		2	
0002 Control Blank	X			X		X



ELEMENTS	K	Mg	Mn	Mo	Na	Ni
UNITS	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l
DETECTION LIMIT	0.1	0.01	0.01	0.05	0.1	0.01
DIGEST						
ANALYTICAL FINISH	/OE	/OE	/OE	/MS	/OE	/OE
SAMPLE NUMBERS						
0001 BD16016-67 RAW						
0002 BD17001-74 RAW						
0003 BD17001-96 RAW						
0004 BD17007-53 RAW						
0005 BD17007-55 RAW						
0006 BD17007-65 RAW						
0007 BD17014-48 RAW						
0008 BLANK RAW						
0009 HPDW RAW						
0010 BD16016-67 HNO3	18.3	33.31	0.94	14.95	8.8	X
0011 BD17001-74 HNO3	16.5	28.53	0.49	72.59	8.9	X
0012 BD17001-96 HNO3	22.0	13.24	0.22	9.75	6.8	X
0013 BD17007-53 HNO3	17.0	66.33	8.13	3.03	16.1	X
0014 BD17007-55 HNO3	20.9	101.02	16.90	0.30	22.1	0.02
0015 BD17007-65 HNO3	29.4	112.95	13.33	0.31	25.7	X
0016 BD17014-48 HNO3	22.6	44.57	8.08	0.12	17.4	0.02
0017 BLANK HNO3	X	X	X	X	X	X
0018 HPDW HNO3	X	X	X	X	X	X
CHECKS						
0001 Ch7: BD17007-55 RAW						
0002 BD16016-67 HNO3	17.8	33.19	0.93	15.20	8.8	X
STANDARDS						
0001 GWS-2						
0002 GWS-2						
0003 GWS-2						
0004 TMDW				96.02		
0005 UNI 1	24.7	24.68	10.08		25.9	10.00
BLANKS						
0001 Control Blank						
0002 Control Blank	X	X	X	X	X	X



ELEMENTS	OH	P	Pb	pH	S	Sb
UNITS	mgCaCO ₃ /L	mg/l	ug/l	NONE	mg/l	ug/l
DETECTION LIMIT	1	0.1	2	0.1	0.1	0.01
DIGEST						
ANALYTICAL FINISH	/VOL	/OE	/MS	/MTR	/OE	/MS
SAMPLE NUMBERS						
0001 BD16016-67 RAW	X			7.6		
0002 BD17001-74 RAW	X			7.8		
0003 BD17001-96 RAW	X			7.8		
0004 BD17007-53 RAW	X			6.8		
0005 BD17007-55 RAW	X			4.9		
0006 BD17007-65 RAW	X			5.9		
0007 BD17014-48 RAW	X			5.0		
0008 BLANK RAW	X			5.4		
0009 HPDW RAW	X			5.2		
0010 BD16016-67 HNO ₃		X	X		90.3	2.07
0011 BD17001-74 HNO ₃		X	4		95.9	4.07
0012 BD17001-96 HNO ₃		X	X		34.2	2.97
0013 BD17007-53 HNO ₃		X	56		209.5	2.18
0014 BD17007-55 HNO ₃		X	81		380.8	0.25
0015 BD17007-65 HNO ₃		X	3		418.9	0.83
0016 BD17014-48 HNO ₃		X	15		163.6	0.28
0017 BLANK HNO ₃		X	X		X	X
0018 HPDW HNO ₃		X	X		X	X
CHECKS						
0001 Ch7: BD17007-55 RAW	X			4.9		
0002 BD16016-67 HNO ₃		X	X		92.3	2.13
STANDARDS						
0001 GWS-2						
0002 GWS-2	X					
0003 GWS-2						
0004 TMDW			38			9.73
0005 UNI 1		23.9			24.9	
BLANKS						
0001 Control Blank	X					
0002 Control Blank		X	X		0.1	X



ELEMENTS	Se	Si	Sn	Sr	Th	Tl
UNITS	ug/l	mg/l	ug/l	ug/l	ug/l	ug/l
DETECTION LIMIT	0.5	0.05	0.1	0.02	0.005	0.01
DIGEST						
ANALYTICAL FINISH	/MS	/OE	/MS	/MS	/MS	/MS
SAMPLE NUMBERS						
0001 BD16016-67 RAW						
0002 BD17001-74 RAW						
0003 BD17001-96 RAW						
0004 BD17007-53 RAW						
0005 BD17007-55 RAW						
0006 BD17007-65 RAW						
0007 BD17014-48 RAW						
0008 BLANK RAW						
0009 HPDW RAW						
0010 BD16016-67 HNO3	3.4	2.57	X	716.08	X	0.38
0011 BD17001-74 HNO3	X	2.55	X	595.96	X	0.15
0012 BD17001-96 HNO3	X	7.10	0.2	333.22	X	0.18
0013 BD17007-53 HNO3	X	4.04	X	1575.93	X	1.07
0014 BD17007-55 HNO3	X	6.85	X	2493.82	0.016	4.16
0015 BD17007-65 HNO3	X	4.83	X	3268.51	X	5.61
0016 BD17014-48 HNO3	1.5	9.29	X	1082.75	0.035	1.04
0017 BLANK HNO3	X	X	X	0.08	X	X
0018 HPDW HNO3	X	X	X	0.19	X	X
CHECKS						
0001 Ch7: BD17007-55 RAW						
0002 BD16016-67 HNO3	3.1	2.56	X	733.66	X	0.39
STANDARDS						
0001 GWS-2						
0002 GWS-2						
0003 GWS-2						
0004 TMDW	9.6		X	240.91	X	9.64
0005 UNI 1		50.58				
BLANKS						
0001 Control Blank						
0002 Control Blank	X	X	X	X	X	X



ELEMENTS	TotAlk	U	V	Zn
UNITS	mgCaCO3/L	ug/l	mg/l	mg/l
DETECTION LIMIT	5	0.005	0.01	0.01
DIGEST				
ANALYTICAL FINISH	/CALC	/MS	/OE	/OE
SAMPLE NUMBERS				
0001 BD16016-67 RAW	100			
0002 BD17001-74 RAW	51			
0003 BD17001-96 RAW	70			
0004 BD17007-53 RAW	98			
0005 BD17007-55 RAW	7			
0006 BD17007-65 RAW	53			
0007 BD17014-48 RAW	5			
0008 BLANK RAW	X			
0009 HPDW RAW	X			
0010 BD16016-67 HNO3		18.823	X	X
0011 BD17001-74 HNO3		0.495	X	X
0012 BD17001-96 HNO3		3.406	X	X
0013 BD17007-53 HNO3		1.599	X	0.15
0014 BD17007-55 HNO3		1.938	X	3.82
0015 BD17007-65 HNO3		0.202	X	0.04
0016 BD17014-48 HNO3		3.384	X	0.14
0017 BLANK HNO3		X	X	X
0018 HPDW HNO3		X	X	X
CHECKS				
0001 Ch7: BD17007-55 RAW				
0002 BD16016-67 HNO3		19.011	X	X
STANDARDS				
0001 GWS-2				
0002 GWS-2				
0003 GWS-2				
0004 TMDW		9.467		
0005 UNI 1			10.04	9.70
BLANKS				
0001 Control Blank				
0002 Control Blank		X	X	X

**METHOD CODE DESCRIPTION**

Method Code	Analysing Laboratory
/CALC	Intertek Genalysis Perth No digestion or other pre-treatment undertaken. Results Determined by calculation from other reported data.
/COL	Intertek Genalysis Perth No digestion or other pre-treatment undertaken. Analysed by UV-Visible Spectrometry.
/MS	Intertek Genalysis Perth No digestion or other pre-treatment undertaken. Analysed by Inductively Coupled Plasma Mass Spectrometry.
/MTR	Intertek Genalysis Perth No digestion or other pre-treatment undertaken. Analysed with Electronic Meter Measurement
/OE	Intertek Genalysis Perth Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.
/SIE	Intertek Genalysis Perth No digestion or other pre-treatment undertaken. Analysed by Specific Ion Electrode.
/VOL	Intertek Genalysis Perth No digestion or other pre-treatment undertaken. Analysed by Volumetric Technique.