EARL GREY LITHIUM PROJECT
STATIC WASTE AND LOW GRADE ORE CHARACTERISATION

PREPARED FOR:

COVALENT LITHIUM PTY LTD

OCTOBER 2023

PREPARED BY:

Martinick Bosch Sell Pty Ltd
4 Cook Street
West Perth WA 6005
Ph: (08) 9226 3166
Email: info@mbsenvironmental.com.au
Web: www.mbsenvironmental.com.au

MARTINICK BOSCH SELL PTY LTD
ABN 60 102 614 479
MBS ENVIRONMENTAL
environmental and geoscience consultants

EARL GREY LITHIUM PROJECT
STATIC WASTE ROCK AND LOW GRADE ORE CHARACTERISATION

Distribution List:

Document Version	Company	Contact name	Copies	Date
Original Report	Kidman Resources	Chris Williams, General Manager	1	15 May 2017
Amended Report Phase 1	Covalent Lithium Pty Ltd	David Richards, Acting Manager Environment and Approvals	1	21 November 2019
	Covalent Lithium Pty Ltd	Cliff Bennison, Specialist Environment and Approvals	1	21 November 2019
Phase 2 Report	Covalent Lithium Pty Ltd	Anthea Pate Manger Environment and Approvals	1	13 May 2020
Phase 3 Report	Covalent Lithium Pty Ltd	Anthea Pate Manger Environment and Approval	1	3 October 2023

Document Control for Job Number: CLMHWRC23

Document Status	Prepared By	Authorised By	Date	Comments/Changes
Draft Report	Michael North	David Allen	2 March 2017	For Kidman Resources
Final Report	Michael North	Alan Wright	12 March 2017	
Final Report Amended	Tom Robson	Michael North	21 November 2019	Amendments for Project changes and for edits resulting from peer review.
Draft Report Phase	Greg Lekmine	Michael North	12 May 2020	Phase 2 10 to 15 year pit sampling
Final Report Phase	Greg Lekmine	Michael North	13 May 2020	
Final Report Phase 1 Extended	Michael North	Michael North	18 November 2021	Extended Report additional analysis for 10 yr pit approval
Draft Report Phase 3	Elliott Duncan Louise Crawley	Michael North	6 September 2023	2051 LOM Pit Extension Sampling
Final Report Phase 3	Elliott Duncan Louise Crawley	Michael North	3 October 2023	

Disclaimer, Confidentiality and Copyright Statement
This report is copyright. Ownership of the copyright remains with Martinick Bosch Sell Pty Ltd (MBS Environmental). This report has been prepared for **Covalent Lithium Pty Ltd** on the basis of instructions and information provided by **Covalent Lithium Pty Ltd** and therefore may be subject to qualifications which are not expressed.

No person other than those authorised in the distribution list may use or rely on this report without confirmation in writing from MBS Environmental. MBS Environmental has no liability to any other person who acts or relies upon any information contained in this report without confirmation. This report has been checked and released for transmittal to **Covalent Lithium Pty Ltd**.

EXECUTIVE SUMMARY

Covalent Lithium operates the Earl Grey Lithium Project (the Project), which is located 105 km south southeast of Southern Cross in the Yilgarn Mineral Field of Western Australia. The Project is situated within the previously abandoned Mt Holland gold mine site. Mining of gold mining waste material commenced in April 2021 and pegmatite ore extraction from the mine pit commenced late in January 2023. Concentrator and commissioning infrastructure including a concentrator and tailing storage facility (TSF) is currently being commissioned. Pegmatite ore from the mine pit is processed via the crusher and concentrator by a series of physical methods to produce a spodumene concentrate. Further offsite processing of spodumene concentrate into lithium hydroxide as a final product occurs at the refinery in Kwinana. Waste rock produced from open pit mining will be placed into surface waste rock landforms as well as some progressive backfilling into the mine void as mining progresses from south to north across the deposit. Additional waste rock will be used in rock armouring of the TSF slopes or other onsite construction. The primary objective of the study was to identify any potential environmental risks associated with extracted waste rock and stockpiled ore, and to inform waste landform designs.

Waste rock characterisation from within the Earl Grey mine pit was undertaken for Covalent in three phases by MBS to align with the Project development and approvals submissions for mining. This report has collated results from across testwork conducted. Initial approval of mining was for the first 10 years. Current works intend to extend mine life to 2051 (life of mine, LOM).

Summary of Findings

Fresh and Transitional Waste Rock

- All samples from the approved first 10 years of mining were classified as non-acid forming (NAF). Consistent with examination of sulfur assay data and increases in sulfur content, some mafic samples beyond 10 years of mining were identified as potentially acid forming (PAF) or uncertain. A small proportion of mafic waste rock form the fresh and transitional rock zones with higher total sulfur contents (0.46–3.3%) were classified as PAF or uncertain. All NAF fresh waste rock is considered overall to be geochemically benign. Ultramafic waste assessed was NAF and assay data also indicates lower mean sulfur content in ultramafic rock. Banded iron formation (BIF) and sedimentary waste rock was a minor lithology (<2%) not encountered in the first 10 years of mining.
- A very conservative cutoff for delineation of PAF versus NAF delineation in fresh rock based on all static testing is 0.4% total sulfur. This includes allowance for the four samples of mafics which were classified as uncertain (0.42–1.1 % total sulfur). This is based on fresh mafic waste rock but could be very conservatively applied to all transitional and fresh rock types in the mine block model if desired.
- Water leachates of NAF waste rock (especially fresh rock) were alkaline and with low salinity and indicated very low to less than detectable concentrations of most metals and metalloids, which is consistent with the insoluble nature of the expected mineral forms. Most results were well below ANZECC 2000 livestock drinking and DoH 2014 non-potable groundwater water use guidelines, with the exception of arsenic in some samples and aluminium for which variable results were a result of very fine (colloidal) particulate material.
- The concentrations of arsenic in the water leachates for current phase 3 sampling fresh and transitional samples were considered much lower overall than those from the already approved 10-year pit shell. Only three samples equalled or exceeded the livestock drinking water guideline of 0.5 mg/L compared to eight samples from the 10-year pit shell. As for findings from earlier works, median concentrations of arsenic in the bulk waste, slowed rates of oxidation and sorption to iron oxides/oxy-hydroxides are considered to limit the potential for net arsenic mobility from waste landforms. Seepage or runoff from these materials is predicted to be alkaline, low to brackish salinity with very low concentrations of metals and metalloids and low levels of soluble alkalinity. As such, the risk of seepage or run-off adversely impacting the surrounding environment across the LOM is considered to be very low.
- Under acidic conditions such as oxidation of PAF materials (should this occur), seepage or runoff is likely to contain iron, aluminium, manganese, nickel, cobalt and arsenic (variable). Calcium, magnesium and sulfate will also be released as part of the process although of low environmental concern.

- Fresh waste rock, apart from that identified as PAF material, is considered suitable for general use within the mining area, as rock armouring or as a construction material. Transitional waste rock (below 30–35 m from surface) is considered suitable for use in landform rehabilitation as a subsoil water storage layer underneath topsoil on flat surfaces. Long term placement on exposed slopes would be subject to further assessment as to physical strength and resistance to long term erosion.
- Calculated natural radioactivity levels in waste rock were very low, and all studies across LOM material have indicated that although mafic and ultramafic waste contains actinolite, the mineral is not asbestiform in nature. There are no considered implications for closure design in either of these aspects.
- Comparison of sulfur and arsenic assay data from approved 10-year pit shell versus extension to 2051 (LOM) of pegmatite ore indicates lower concentrations of both elements in future mining and hence further reduced risk from acid formation or arsenic mobilisation in stockpiled ore or tailings from proposed mining. Concentrations and solubility of other elements in ore were consistent with previous findings and a separate tailings characterisation (MBS 2019) has been conducted.

Oxidised/Weathered Mine Wastes

- Clay-rich oxide overburden material (mafic and pegmatite derived) within 30–35 m of surface is likely to be naturally saline and acidic, with significant levels of exchangeable aluminium acidity. It is considered low in most other soluble metals and metalloids. This form of natural exchangeable acidity presents a much lower potential environmental risk compared to acidity generated by oxidation of sulfide minerals (oxide is considered NAF). The levels of exchangeable aluminium (and salinity) however, will make these materials unsuitable for use in rehabilitation as a growth medium.
- Due to the elevated fines content and sodic nature, oxide and some higher clay content transitional mine waste material is either dispersive, or likely to become dispersive, if placed in exposed (surface or near surface) locations as excess salt content, which currently stabilises clay aggregates, gradually leaches and generates dispersive clays.
- Management of oxide mine waste should avoid placing the material on sloped surfaces in order to prevent erosion. Suitable options would include returning oxide mine waste materials into the pit void (ideally covered with transitional waste) and/or encapsulation within competent rock waste in an above ground landform. Rehabilitation outcomes for pit void filling would be improved if the most acidic and saline oxide material is placed in the lower parts of the backfill (not in the upper 2–3 m of the backfill). Transitional zone material should be placed in this upper part of the backfill to facilitate rehabilitation.
- Clay rich oxide material is suitable for use for any required low permeability cover layer for PAF waste rock from the fresh or transitional zones provided it is in turn armoured to prevent erosion and exposure of underlying PAF.

IMPLICATIONS FOR MANAGEMENT

Fresh and Transitional Rock

As a result of this study the following are deemed suitable uses for the fresh rock waste from the 2051 LOM pit shell:

- The fresh rock from later portions of mining after the currently approved 10 year pit shell (2051 LOM pit shell) has slightly different geology to earlier mining (including BIF 1.7% of waste rock) and this and mafic fresh rock in particular contains portions of potentially PAF waste rock which will require management. A sulfur based mine block model to segregate higher sulfur content waste as PAF will need to be implemented based on 0.4% sulfur content for mafic and BIF waste. As for previous works, higher sulfur samples which may be PAF (above 0.4% total sulfur) are indicated to be close to shear zones.
- The ultramafic waste is lower in sulfur (assay data mean 0.15% sulfur) than mafic (mean 0.36%) waste rock and testing indicates significantly higher levels of acid neutralisation capacity (ANC). This lithology could be managed using a higher sulfur cutoff than 0.4% total sulfur in the mine block model if desired subject to

further testing. As an example, a sample of komatiite ultramafic at 0.65% sulfur was still NAF with an alkaline pH after forced oxidation testing.

- PAF waste rock (fresh or transitional) should be buried internally within a waste rock dump or placed as backfill into the pit. Placed as internal waste in an above ground dump, it should ideally be covered with waste oxide (low permeability cover) and subsequently a store and release cover of suitable thickness to minimise net infiltration to the PAF oxide cover layer.
- NAF fresh waste rock is considered otherwise suitable for use in mine use, rock armouring, construction or other purposes as required.
- Transitional waste material below 30–35 m from surface is expected to be circum-neutral in pH and slightly to moderately saline. This material should be suitable as a subsoil water storage layer for rehabilitation underneath topsoil on flat surfaces (store and release layer). Long-term placement on exposed slopes would require further assessment as to physical strength and resistance to long term erosion.

Oxide Waste

Management of oxide waste from the Project should be considered as follows:

- After initial harvesting of topsoils, underlying clay rich oxide overburden regolith material (mafic and pegmatite derived) within 30–35 m of the surface is likely to be naturally saline and acidic with significant levels of exchangeable aluminium acidity. Although low in general soluble toxicants, these properties make the material unsuitable as growth medium. This said, titratable acidity is low, and risk of significant acidic seepage is low as the materials represent naturally highly leached clays with low permeability.
- Due to the elevated fines content and sodic nature of the oxide mine waste materials, all oxide and the more clay rich saprolite transitional waste is either dispersive, or likely to become dispersive, if placed in exposed (surface or near surface) locations where the salt, which currently stabilises clay aggregates, will gradually leach from the material. Oxidic clays derived from weathering of mafics have an elevated fines content and are particularly likely to erode if placed on slopes (erosion being a somewhat different process to dispersion).
- Management of oxide mine waste should avoid placing the material on sloped surfaces in order to prevent erosion. Suitable options would include returning oxide mine waste materials into the pit void (ideally covered with transitional waste) and/or covering with competent mafic rock waste in an above ground landform. Rehabilitation outcomes for pit void filling would be improved if the most acidic and saline oxide material is not placed in the upper 2–3 m of the backfill. Transitional zone material should be used in this upper most part of the backfill.
- Clay rich oxide material is suitable for use for use as a low permeability cover layer over PAF waste rock provided it is in turn armoured to prevent erosion and exposure of underlying PAF.

TABLE OF CONTENTS

TABLES

FIGURES

CHARTS

APPENDICES

1. INTRODUCTION

1.1 PROJECT BACKGROUND

Covalent Lithium operates the Earl Grey Lithium Project (the Project), which is located 105 km south southeast of Southern Cross in the Yilgarn Mineral Field of Western Australia (Figure 1). The Project is situated within the abandoned Mt Holland mine site, which operated between 1988 and 2001. Historically, the Mt Holland gold mine produced in excess of 1.4 M ounces of gold from several open pits (including the Earl Grey pit) and underground operations. Remaining infrastructure at the Project is largely unrehabilitated and currently a liability for the State of Western Australia. A discovery of a large pegmatite (hosting lithium resource as spodumene) hard-rock deposit underlying the gold-bearing mafic and ultramafic lithologies was made in 2016 by Kidman Resources (Kidman), which the current owner Covalent Lithium, has developed into a fully integrated mine and processing operation.

Approval and development of the Earl Grey pit has been given and started for 10 years of mining. Covalent are currently planning a further northwards expansion of the mine pit. As a result of this planned mine pit expansion and to support approvals and planning, additional waste rock to be extracted from the extension area needs to be geochemically assessed to ensure that potentially problematic waste materials are identified and managed, and similarly, to ensure that waste rock materials suitable for waste landform rehabilitation are also identified and managed.

MBS Environmental (MBS) was engaged to undertake the geochemical mine waste characterisation. As the Project was initially commenced by Kidman, this work has been conducted on sampling taken over a number of years and reports for Project changes. The current report has aimed to combine all key results and findings from previous work in discussions. Static waste rock and low grade ore characterisation reports completed are:

- MBS 2017. Initial reporting (Phase 1 samples) for Kidman 10-year mine life prior to changes to pit design and other aspects.
- MBS 2020. Additional sampling (Phase 2 samples) and reporting for extension to 15 years (internal report not submitted as 15-year pit mining proposal did not proceed).
- MBS 2021a. MBS Phase 1 report completed January 2021 after peer review. First 10 years of mine life.
- MBS 2021b. MBS Phase 1 extended sampling completed November 2021. First 10 years of mine life using additional sampling and analysis to address DMIRS requests for information regarding closure planning risks and chromium(VI) generation in rehabilitation materials.
-

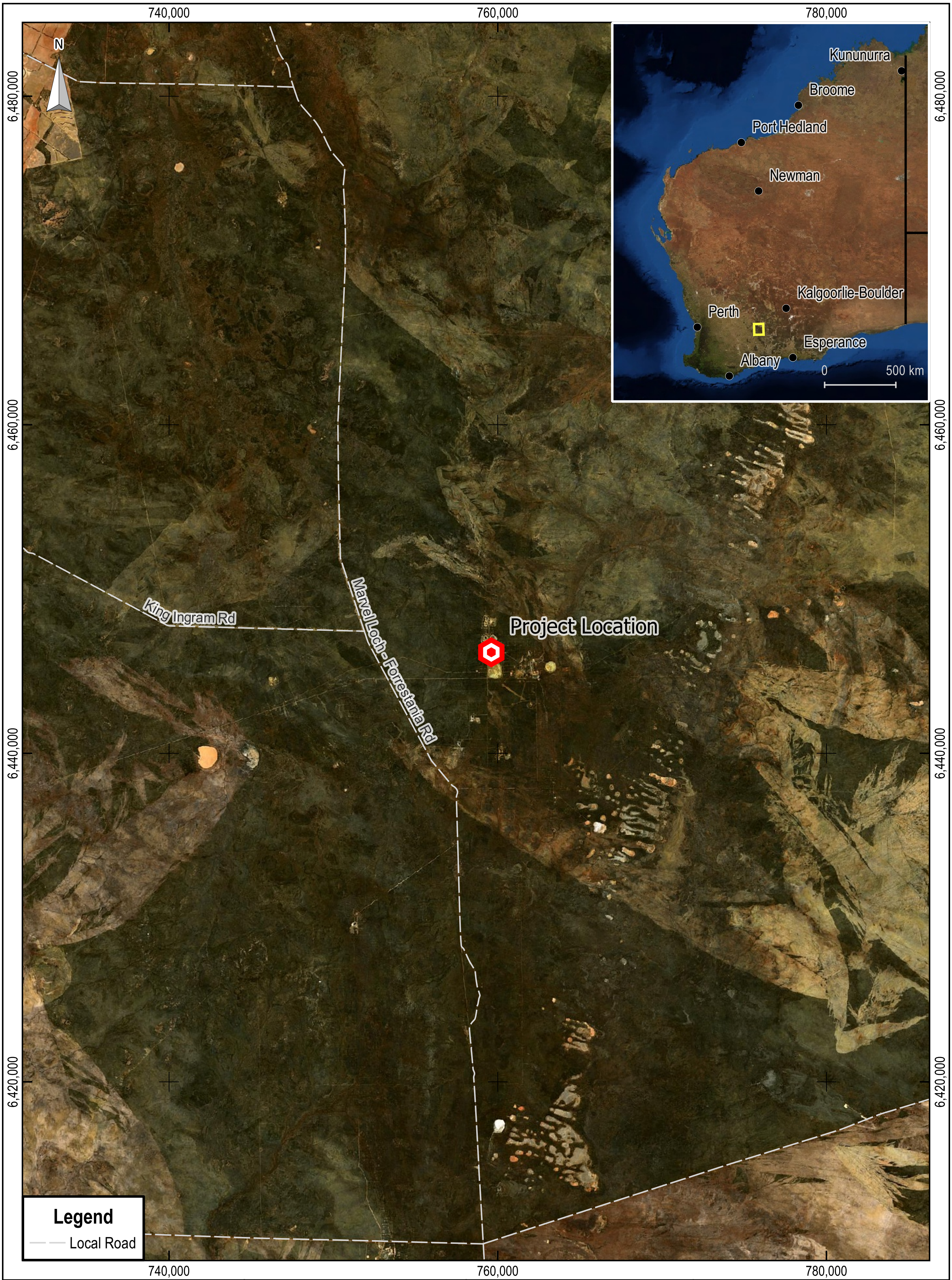
A separate spodumene tailings characterisation assessment has been conducted (MBS 2019) to which the reader should refer regarding tailings geochemical properties.

1.2 SCOPE OF WORK

The scope of work performed by MBS included:

- Liaising with Covalent to select waste rock samples from drill core and or RC samples across the current pit extension area from available drilling material.
- Reviewing and updating sulfur drill log assays for the Mt Holland site in comparison to previous results.
- Liaising with a relevant NATA accredited laboratory for the appropriate geochemical analysis of waste rock samples to ensure potentially problematic materials are characterised and options for re-use of suitable materials are identified.
- Collating and analysing all data produced from the Project thus far (i.e. all 3 phases).
- Preparing a static waste rock characterisation report (this report) which includes:

- Classification of all samples in terms of potential for formation of acid and metalliferous drainage (AMD) based on acid base accounting (ABA) methodology.
- Assessment of geochemical enrichment and the potential of mine wastes to produce saline or neutral mine drainage using static laboratory leach procedures.
- Screening of potential cover materials for potential risks of plant uptake in the root zone of elements of interest - lithium, arsenic etc.
- Screening of the materials for NORM (naturally occurring radioactive materials) based on total composition (U, Th concentration).
- Screening the minerology of waste rock lithologies encountered during the Project. This will include screening for fibrous materials by elutriation and high-resolution TEM/EDS of lithology composites to confirm (as per previous), a lack of asbestiform minerals.
- Assessment of whether waste rock materials are likely to be structurally competent for use in the creation of mine waste landforms (e.g. TSF, WRL).
- An overhead figure showing spatial distribution of sample locations in relation to the proposed pit based on selected droll collar co-ordinates. Covalent to supply long-section views of the pit shell, lithologies, weathering zones intercepted.
- Recommendations and tables for Covalent relating to suggested management of waste rock for closure and suitable/unsuitable use based on outcomes of the above assessment and guidelines for data requirements for Mining Proposals (DMP 2016). These would satisfy the requirements for conceptual landform planning and permitting requirements.



Scale: 1:300000
Original Size: A4
Image: Copernicus Sentinel Data 2020
Grid: GDA94 / MGA zone 50

0 5 10 km

Covalent Lithium
Mt Holland Project

Figure 1

Location Plan

Martinick Bosch Sell Pty Ltd
4 Cook St
West Perth WA 6005
Australia
t: +61 8 9226 3166
info@mbsenvironmental.com.au
www.mbsenvironmental.com.au

W:\Covalent Lithium\Mt Holland Project\GIS Common\Mt Holland_Location Plan.qgz 31/07/2023

2. PROJECT DESCRIPTION

In 2016, a significant new discovery of a large pegmatite (hosting lithium resource as spodumene) hard-rock deposit underlying the gold-bearing mafic and ultramafic lithologies was made by Kidman Resources, which Covalent have since developed into a fully integrated mine and spodumene beneficiation operation.

A spodumene concentrator was constructed at the Mt Holland site, which is used to produce a spodumene concentrate from pegmatite ore via crushing and Dense Media Separation (DMS) using ferrosilicon. This concentrate is then further processed into a lithium hydroxide product at the Kwinana refinery in Western Australia. Other infrastructure for the Project includes a Run-of-Mine (ROM) pad, water supply infrastructure, office and workshop facilities and an accommodation village (to be established at the historic camp site).

Waste rock produced from the open pit operations is to be stored either within a surface waste rock dump (WRD), progressively backfilled into the mine pit as mining progresses from the south to the north of the deposit or in construction. Construction use will include the Tailings Storage Facilities. Waste rock may also be disposed of by in-pit backfilling of other historic mine voids associated with the previously abandoned Mt Holland Gold Mine

The initial LOM (Phase 1 and 2 sampling, 2017 and 2020) was for 10 and 15 years, respectively, of mining. This was estimated to produce a waste volume of approximately 115 million tonnes (Mt) of waste of which 41 to 45% was oxide material, 29 to 31% transitional (lower saprolite and saprock) and 26 to 28% fresh rock predominantly as mafic and ultramafic lithologies. The LOM has now been extended until 2051 and progresses mining deeper into fresh rock as it progresses. It is now expected to produce approximately 527 Mt of mined materials, of which 105 Mt is pegmatite ore/low grade ore and 422 Mt of waste rock material over the whole life of mine as outlined below in Table 1. Approximately 21% of the waste material will be oxide, 21.5% transitional saprock and 58 % in the fresh rock zone.

Table 1: Breakdown of Earl Grey Materials Across LOM

Weathering Zone	Lithology Type	Produced (Mt)	Proportion of Waste (%)
Oxide (Clay / Saprolite)	All Lithologies	85.57	20.3
Transitional Saprock	Mafic[1]	71.20	16.9
	Ultramafic (Komatite)	13.27	3.1
	BIF	0.906	0.21
	Pegmatite (waste pegmatite)	5.48	1.3
Fresh Rock	Mafic[1]	190.8	45.2
	Ultramafic (Komatite)	45.48	10.8
	BIF	5.10	1.2
	Pegmatite (waste pegmatite)	4.59	1.1
Total Mined		**527**	
Total Waste		**422**	**100**

[1] *Mafic lithologies were grouped for simplicity and comprise in turn: komatitic basalt (37% of Mafics), basalt (20%), high magnesium basalt (40%), intrusive waste (1%), and proterozoic Dyke (2.4%).*

The lithologies encountered in current extensional mining are almost entirely as per previous geochemical testworks for 0 to 15 years of mining (MBS 2017 and MBS 2021). The exception is the intersection of banded iron formation (BIF) and sedimentary waste in relatively small amounts (1.7% of total waste) thus samples of this lithology were included in the current assessment. Historic gold mining targeted the contact zone between BIF and mafics/ultramafics.

3. EXISTING ENVIRONMENT

3.1 REGIONAL SETTING

The Project is located within the Yilgarn region, which forms part of the Eastern Wheatbelt of Western Australia. Historically, the wider region encompassing the Project has been subject to a variety of mining and minerals exploration activities and remains subject to numerous Mining Leases and Exploration Licences. As a consequence of previous mining activities for the abandoned Mt Holland Gold Mine, the Project area has extensive areas of existing land disturbance (including mine pits, waste rock landforms, tailings storage facilities, access roads, former pits and underground workings).

The Mt Holland mine site is located in unallocated Crown Land remote from sensitive receptors as although regionally pastoralism and dryland agriculture have been recognised as primary industries, there are no pastoral leases or other significant land uses within the vicinity of the Project.

The Project is located in the Southern Cross subregion of the Coolgardie Interim Biogeographic Regionalisation for Australia (IBRA) Bioregion. This bioregion is characterised by subdued relief, comprising gently undulating uplands dissected by broad valleys with bands of low greenstone hills and numerous saline playa lakes. The vegetation is dominated by *Eucalyptus* woodlands, shrublands of *Allocasuarina* and *Acacia*, and mixed heath of *Melaleuca* and *Acacia*. *Banksia arborea* occurs on deeper sandy phases at the Project.

3.2 CLIMATE

A desktop assessment of available climate data was completed by Groundwater Resource Management (2014). The Project area experiences a semi-arid climate and is subject to extremes where droughts and major floods can occur within a few years of each other.

The Bureau of Meteorology (BoM) Lake Carmody rainfall station (No. 10670) is located approximately 50 km southwest of the Project and provides > 110 complete years of data. Over this period annual rainfall has ranged from 83.7–562.8 mm with a long-term average of 314 mm. On average, there were approximately 66 rain days each year, although the frequency of rainfall has historically varied greatly from 15–130 days per annum (MBS 2017a). The rainfall that occurs during the early winter months (June and July) tends to be more reliable and a greater volume than summer months (December to March) (Chart 1). Occasionally, heavy rainfall in the region can be attributed to remnant tropical cyclones and associated depressions. However, these weather systems are unpredictable and infrequent.

No temperature data is available from the Lake Carmody weather station. The BoM Hyden synoptic station (BoM No. 010568, >400 years of complete data), approximately 90 km west southwest of the Project has recorded:

- Mean daily maximum temperatures ranging from 33.7°C in January to 16.5°C in July (Chart 1).
- Mean daily minimum temperatures ranging from 15.9°C in February to 4.6°C in July (Chart 1).
- Highest and lowest daily temperatures of 48.6°C and -5.6°C in February (2007) and July (1982), respectively.
- Typically there will be in the order of 10 days each year with daily maximum temperatures in excess of 40°C, approximately 8.5 of which will occur in December, January and February.
- On average 31 days each year can be expected when minimum temperatures will be 2°C or less and light ground frosts are possible. Two thirds of such days will occur in June, July and August.

In the absence of a local evaporation record, the average of pan evaporation data for the Merredin and Salmon Gums Research Stations has been applied to the Project. This provides a mean annual pan evaporation of some 1,867 mm.

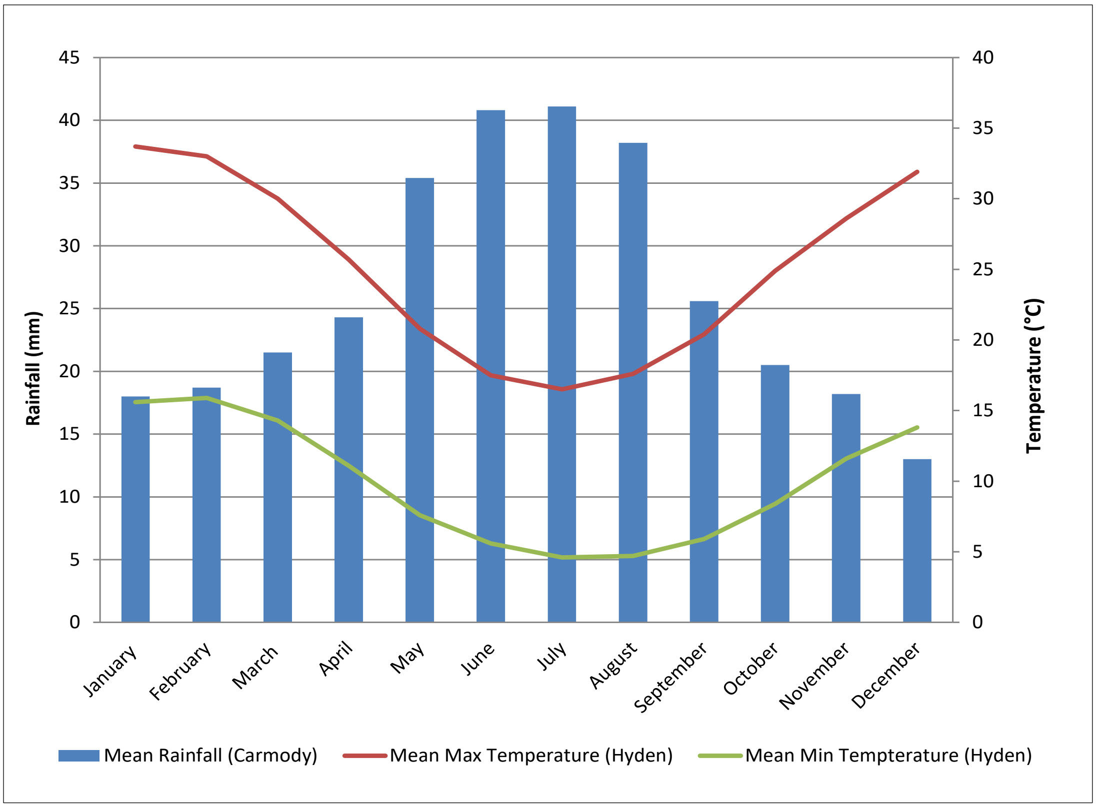


Chart 1: Historical Rainfall (Recorded at Carmody) and Temperature (Recorded at Hyden) Data (BoM 2023)

3.3 GEOLOGY

3.3.1 Regional Geology

The Mt Holland Gold Field covers southern sections of the Archaean Southern Cross–Forrestania Greenstone Belt. The Belt extends over 300 km from Carterton in the north to Hatters Hill in the south and generally strikes north northwest (Kidman 2017, Harvey 2001). Regional mapping identified two distinct lithostratigraphic units within the Belt; a younger mafic-ultramafic metavolcanic suite intercalated with a sequence of overlying immature clastic metasediments (Package 1) and an older mafic-ultramafic suite (Package 2). Both units are regionally folded with a north plunging synform, steep east and shallow west limbs (East and West ultramafic-mafic domains) with a core of Package One ultramafic-mafic-sedimentary rocks). This fold pattern produces three regionally recognisable zones, these being the Eastern, Central and Western domains (Kidman 2017, Harvey 2001).

The greenstones are predominantly mafic and ultramafic flows generally Intercalated with BIF, cherts, and clastic sediments. Regional metamorphism is recorded at amphibolite grade, with local areas of retrograde chlorite metamorphic facies. The Belt is enclosed by syntectonic granitoids.

The Eastern Domain mafic-ultramafic basal rocks comprise a thick sequence of tholeiitic basalts with minor high-magnesium basalts and interflow sediments. The basal rocks overlie a granitoid basement and are overlain by the Bounty sequence. The Bounty sequence is approximately 600 m thick and consists of komatiitic high magnesium peridotite flows (regional nickel host) and low magnesium basalts (dolerite/gabbro) which are intercalated with BIF sequences. This sequence is host to the Bounty Gold mine and the nickel mineralisation within the Forrestania Belt. A dolerite sill overlies the Bounty sequence and is the basal unit of the uppermost ultramafic suite, which also contains tholeiitic basalts and miner exhalative sediment horizons.

The basal rocks of the Western Domain consist of clastic metasediments which lie upon a younger intrusive granitoid (west). Stratigraphically above the basal metasediments are a thick package of (from bottom to top) komatiitic high MgO olivine orthocumulate; then a low MgO pyroxenite with locally developed dolerite-gabbro differentiates and intercalated flow sediments; then finally a unit of high MgO basalts with intercalated flow sediments (Kidman 2017, Harvey 2001).

The Central Domain is a thick (approximately 2000 m) unit consisting mainly of pelitic and psammitic schists (±garnet), thin BIF lenses and minor bands of graphitic schists. The Forrestania Greenstone Belt was metamorphosed to amphibolite grade facies with localised zones of annealed (retrograde) greenschist facies. The belt is bounded by syngenetic ovoid granite-gneiss complexes. Numerous roughly east-west striking Proterozoic dolerite dykes crosscut the north-trending granite-greenstones) (Kidman 2017, Harvey 2001).

Two major shear zones in the Forrestania Belt separate the three domains. The Mt Holland Shear defines the Central and Eastern Domains. Likewise, the Van Uden Shear separates the Central and Western Domains. Additional shear zones are recorded as parallel and crosscutting stratigraphy dominantly orientated north south; and north-northwest to south-southeast (Kidman 2017, Harvey 2001). Additional shear zones are recorded as parallel and cross-cutting stratigraphy dominantly orientated north south; and north-northwest to south-southeast (Harvey 2001).

3.3.2 Project Geology

The "Twinings group" of gold deposits consist of the mined Earl Grey, Darjeeling, and Jasmine deposits with the Irish Breakfast deposit still undeveloped. These deposits straddle the Eastern-Central Domain contact, along the Mount Holland shear, and are hosted entirely within tremolite-chlorite low MgO ultramafics, with small boudins of iron formation also encountered in Earl Grey.

The Earl Grey pegmatite was emplaced into the steeply dipping N-S trending amphibolite facies mafic and ultramafic lithologies of the Mid-Eastern ultramafic belt. The pegmatite itself is a massive albite-spodumene pegmatite of the lithium-caesium-tantalum (LCT) family of pegmatites. It is relatively flat-lying plunging gently to the north and is intersected and offset by regional shears. The main body of pegmatite can be 30–90 m thick, with footwall and hangingwall splays being up to 30 m thick. The lithium is primarily contained within the minerals spodumene ($LiAlSi_2O_6$) and petalite ($LiAlSi_4O_{10}$). Proterozoic dolerites crosscut the pegmatite, and at the southern margin the pegmatite terminates against the Binneringie dyke.

Figure 2 presents an overhead (plan) view of surficial geology of the Project area in relation to the historic Earl Grey gold pit. Figure 3 shows the spatial arrangement of the north-south shear zones and the Earl Grey (EG) Dolerite Dyke intrusion relative to the currently proposed pit shell and the former much smaller Earl Grey gold pit and TSF1 and the eastern waste landform (EWLF).

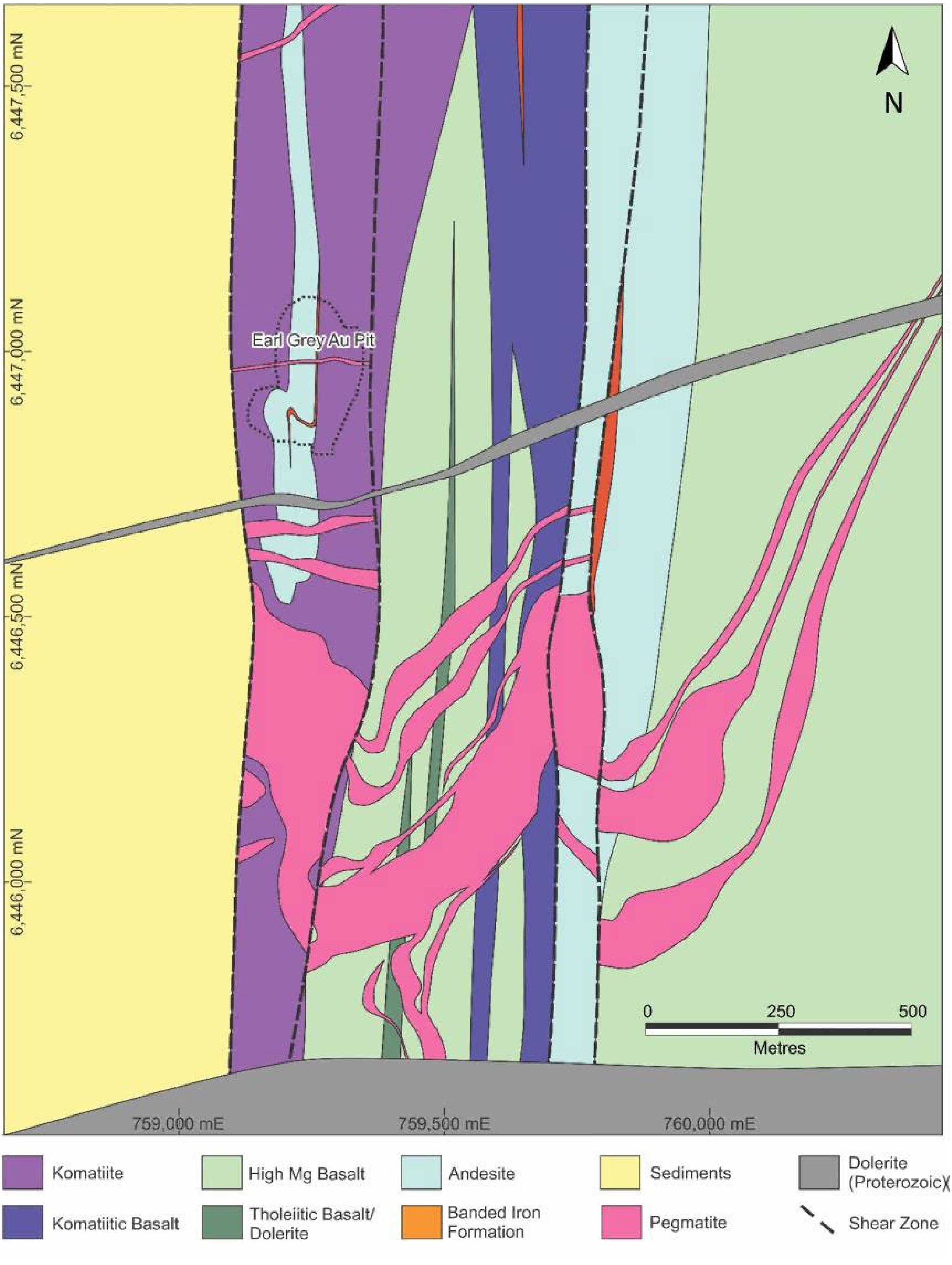


Figure 2: Plan View of Surficial Geology Earl Grey Lithium Deposit

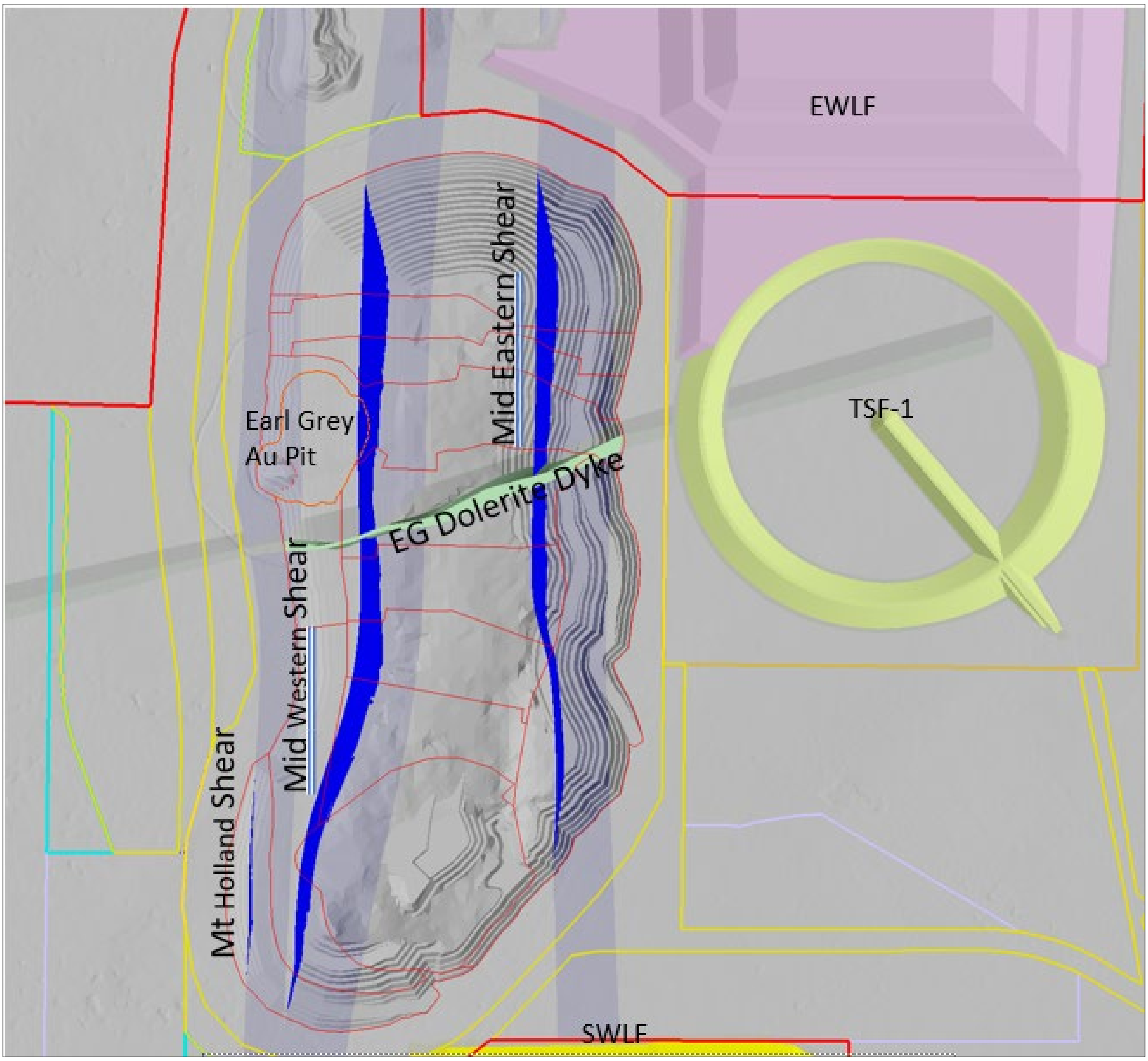


Figure 3: Earl Grey Lithium Deposit Shears and Landforms

3.4 LANDFORM AND SOILS

The Project is located in the Kalgoorlie Province, which has been described at the regional level (Tille 2006) as undulating plains, with some sandplains, hills and salt lakes, on granitic rocks and greenstone of the Yilgarn Craton. The Kalgoorlie Province is located in the southern Goldfields between Paynes Find, Menzies, Southern Cross and Balladonia.

A soil and landform assessment by MBS Environmental (MBS 2017) identified two soil and landform units within the Project area:

- Gently undulating sandplain. The dominant soil type within this unit was described as duplex sandy gravel (DAFWA Soil Group 302).
- Broad valleys and drainage lines. The dominant soil type within this unit was described as yellow/brown loamy duplex (DAFWA Soil Group 508).

Duplex sandy gravel soil profiles consist of a shallow gravelly sand A-horizon over compacted lateritic gravel in sandy clay matrix B-horizon. This soil type is present on topographically elevated areas and usually identified by association with sandplain heath vegetation, with sparse to scattered low eucalypts. Its typical profile is naturally strongly acidic[1] throughout (with lower pH in the B-horizon), non-saline and low sodicity. Deeper sand phases, indicated by the presence of *Banksia* species, may become water repellent when dry.

Yellow/brown loamy duplex soil profiles consist of a shallow sandy loam A-horizon over a compacted sandy clay to clay loam B-horizon. This soil type is present on lower lying landscapes and drainage lines within the Project area and usually identified by association with low eucalypt woodland and *Melaleuca* shrubs. The duplex character of profiles of this soil type is reflected by a circum-neutral, non-saline A-horizon over an alkaline, saline and highly sodic B-horizon.

3.5 SURFACE WATER DRAINAGE

No significant surface water features or watercourses occur within the vicinity of the Project. Minor ephemeral drainage lines are present, but only flow for short periods following intense rainfall events. Runoff from the Project area generally drains offsite as sheet flow and shallow concentrated flow in these minor watercourses, flowing in a northeasterly direction.

3.6 REGIONAL HYDROGEOLOGY AND GROUNDWATER QUALITY

The Project is within the Westonia Groundwater Area of the Southern Cross Province. The main groundwater sources in the Southern Cross Province are derived from:

- Regional catchment-controlled flow systems in fresh and weathered fractured rock.
- Tertiary palaeochannel sands.
- Calcrete units that commonly overlie palaeochannel deposits.
- Shallow alluvium.

Significant aquifer types in the Southern Cross region are derived from palaeochannel, calcrete and shallow alluvial deposits. Groundwater quality varies with salinity generally increasing downstream along the drainage lines. The lowest salinity groundwater typically occurs beneath catchment divides. In the vicinity of Earl Grey, tertiary palaeochannel sediments comprise gypsiferous silt and sands to the east of the Project area (MBS 2017).

The deep weathering profile of the ultramafic and basaltic sequences, characteristic of the Southern Cross region, comprises a thick siliceous caprock. Modest supplies of groundwater can be derived from fractured rock aquifers within this weathered zone. Fractured basement aquifers are characterised by secondary porosity and permeability, resulting in complex fracturing enhanced by chemical dissolution. The storage capacity and hydraulic conductivity of these aquifers is largely related to the degree of fracture intensity. In the vicinity of the Project area fracturing below the caprock is prevalent, with the development of siliceous magnesite veins. The groundwater supplies are typically hypersaline and neutral to slightly alkaline (GRM 2017). The depth to groundwater in the vicinity of Earl Grey pit is deep, being approximately 65 metres below ground level (mBGL) (GRM 2017).

Very small quantities of potable water are known to occur in fractures within granite outcrops. Typically, the limited exposure of granite indicates there is minimal recharge potential and consequently the supply is not considered sustainable as a Project supply. Fresh water for the Project is sourced via a buried HDPE offtake pipeline from the Perth-Kalgoorlie pipeline that forms part of Water Corporations' Integrated Water Supply System (IWSS).

---

[1] Natural strongly acidic soils are widespread throughout the semi-arid areas of southwestern Australia. The natural acidity was caused by extended periods of intense leaching during geological periods associated with formation of lateritic landscapes. In agricultural regions, these soils are referred to as ‘Wodjil’ soils.

Water quality data from the monitoring of seven monitoring bores (MB1 to MB7) is included in Table 2. Water quality data from these and various other production and dewatering bores in the area indicates that natural groundwater quality can be characterised as the following:

- Circum-neutral to slightly alkaline, with pH values indicated to be in the range of 7.2 to 8.2.
- Hypersaline, with total dissolved solids (TDS) concentrations varying between approximately 21,000 and 54,000 mg/L with very high hardness. As such, groundwater is not suitable for livestock drinking or any other beneficial use other than as mine process water (gold extraction only) and has no known surface expressions. The depth to groundwater (approximately 65 mBGL) is also such that seepage to groundwater or potential for groundwater impacts is extremely limited.
- Relatively consistent major ion composition, with sodium and chloride as the dominant ions. Sulfate, bicarbonate, calcium and magnesium are also present in elevated concentrations and the water is therefore classified as very hard (hardness greater than 10,000 mg/L as $CaCO_3$).
- Low but significant average concentrations of lithium (1.1 mg/L), boron (1/8 mg/L), rubidium (0.17 mg/L) and caesium (0.31 mg/L) due to natural LCT pegmatite mineralisation.
- Slightly elevated versus typical concentrations of manganese (1.8 mg/L) and uranium (0.019 mg/L).

Table 2: Site Water Analysis Results 2023 (Bores MB1 to MB4, MB6 and MB7)

Parameter	Mean	Median	Maximum
TDS (mg/L)	29,683	24,300	54,000
Major Ions (mg/L)			
Calcium	582	475	1,200
Magnesium	1,715	1,530	2,780
Sodium	8,988	7,325	16,100
Potassium	207	171	327
Chloride	15,683	12,150	30,800
Sulfate	2,355	2,015	3,540
Bicarbonate	426	411	567
Dissolved Metals and Metalloids (mg/L)			
Aluminium	<0.1	<0.1	<0.1
Antimony	<0.001	<0.001	<0.001
Arsenic	0.011	0.01	0.022
Boron	1.75	1.81	1.91
Beryllium	<0.001	<0.001	<0.001
Cadmium	<0.001	<0.001	<0.001
Caesium	0.306	0.306	0.56
Chromium	<0.01	<0.01	<0.01
Cobalt	0.014	0.005	0.034
Copper	<0.001	<0.001	<0.001
Iron	0.27	0.08	1.24
Lithium	1.13	1.16	1.57
Manganese	1.83	1.97	2.81
Molybdenum	0.004	0.004	0.006
Nickel	0.05	0.02	0.13
Lead	<0.001	<0.001	<0.001
Rubidium	0.17	0.15	0.31
Selenium	<0.01	<0.01	<0.01
Thallium	<0.001	<0.001	<0.001
Thorium	<0.001	<0.001	<0.001
Tin	<0.001	<0.001	<0.001
Uranium	0.019	0.016	0.045
Vanadium	<0.01	<0.01	<0.01
Zinc	0.025	0.025	0.041

4. ABA METHODOLOGY AND SAMPLE SELECTION

4.1 ACID-FORMING WASTE CLASSIFICATION METHODOLOGY

There is no single method to reliably determine whether mine or process wastes containing small quantities of sulfur will produce net acidity upon field exposure to air and water. Sulfide minerals are variable in their behaviour under oxidising conditions and not all forms will produce sulfuric acid (H_2SO_4). The acid neutralising capacity of these materials is also variable, and the relative rates of acid-forming and acid-neutralising reactions is important when considering if the materials have potential to generate acidic and metalliferous drainage. The net balance of these factors is approximated in acid base accounting (ABA) methodology.

A combination of approaches is often applied to more accurately classify mine or process waste. These approaches are listed below in order of increasing data requirements (and therefore increased reliability):

- The method of “Sulfur Analysis”, which only requires data for total sulfur content. Total sulfur content data is generally readily available (and extensive) from mineral exploration drilling programs. Its adoption is based on long term experience of hard rock wastes from Western Australian mine sites under arid and semi-arid climatic conditions. Experience has shown that hard rock waste containing very low sulfur contents (less than 0.2–0.3 %) rarely produces significant amounts of acidic seepage (Price 1997 and MBS experience in WA).
- The concept of “Ratio Analysis”, which compares the relative proportions of acid neutralising minerals, measured by the Acid Neutralising Capacity (ANC), to acid generating minerals, measured by the Maximum Potential Acidity (MPA). Experience has shown that the risk of generating acidic seepage is generally low when this ratio (the Neutralisation Potential Ration – NPR) is above a value of two (Price 2009) and is not possible if the NPR is more than four.
- Acid-Base Accounting (ABA), in which the Net Acid Producing Potential (NAPP) value, which is calculated by subtracting ANC from MPA, is used to classify the acid-generating potential of mine waste. Positive NAPP values indicate that the waste has the potential to generate more acid than it can neutralise.
- Procedures recommended by AMIRA International (2002), which take into consideration measured values provided by the Net Acid Generation (NAG) test and calculated NAPP values.
- Kinetic leaching column test data, which provides information for the relative rates of acid generation under controlled laboratory conditions (typically over a period of between 6, 12 or 24 months depending on reactivity of the material) intended to simulate those within a waste rock stockpile or tailings storage facility. Due to the time required, kinetic testing is generally only undertaken where other testing methods and volumes of waste indicate a significant PAF risk or the results of the testing are 'Uncertain'.

Classification of wastes in this report uses is based on consideration of NAPP and NAG pH results as well as total sulfur analysis and the ratio analysis concepts above where this is appropriate. The following is a definition of terms as used in ABA reporting by MBS:

- Analysis for total sulfur (Tot_S) and sulfate-sulfur (SO_4_S), both reported as sulfur (% w/w).
- Analysis for ANC (reported as kg H_2SO_4/t).
- Calculation of carbonate ANC (CC ANC), reported as kg H_2SO_4/t, from measured concentrations of total carbon (TC) or total inorganic carbon (TIC) (TIC avoids interferences for some samples such as shales from organic carbon).
- Calculation of Maximum Potential Acidity (MPA) = Tot_S * 30.6, reported as kg H_2SO_4/t.
- Calculation of Acid Production Potential (AP) = [(Tot_S – SO_4_S) * 30.6] kg H_2SO_4/t.
- Calculation of NAPP = [AP – ANC] kg H_2SO_4/t. Using AP versus MPA corrects for non-oxidisable sulfur present in the sample (i.e. sulfate).

- Calculation of Effective NAPP = [AP – CC ANC] kg H_2SO_4/t. Effective NAPP values correspond more directly to ANC associated with readily reactive carbonates, compared to NAPP values providing non-neutralising carbonates are not present (refer Appendix 1).
- Analysis for NAG potential (reported as kg H_2SO_4/t) to both pH 4.5 and pH 7.
- Analysis for NAG pH (the pH of the NAG test liquors).
- Calculation of NPR = ANC/AP (reported as kg H_2SO_4/t).

This AMIRA approach is more conservative than either the Analysis Concept or the Ratio Concept alone, although it assumes the absence of insoluble sulfur such as barite (barium sulfate), which is a non-acid-producing mineral that can interfere with the results. The AMIRA approach of using NAG testing is particularly useful for PAF-LC (Potentially Acid Forming – Low Capacity) materials or where there is very low ANC in the host rock. A combined acid generation classification scheme based on NAPP, and NAG determinations is presented in Table 3 (see also Appendix 1). This classification system, based on static ABA procedures and used in conjunction with geological, geochemical and mineralogical analysis can still leave materials classified as 'Uncertain' which may warrant further investigation by, for example, kinetic characterisation.

Table 3: Acid Formation Risk Classification Criteria

Primary Geochemical Waste Type Class	**NAPP Value kg H_2SO_4/t**	**NAG pH**
Potentially Acid Forming (PAF)	≥10	<4.5
Potentially Acid Forming – Low Capacity (PAF-LC)	0–10	<4.5
Uncertain (UC)	Positive	>4.5
Uncertain (UC)	Negative	<4.5
Non-Acid Forming (NAF)	Negative	>4.5 or sulfur <0.2%*
Acid Consuming (AC)	<-100	>4.5
Barren	≤2 and sulfur <0.05%	-

** Application of 0.2 % sulfur cut-off as a screening tool for the need for determination of NAG pH for classification may be applied on a site-specific basis in conjunction with assessment of ANC and NPR. This uses a ratio analysis approach for low-risk samples based on Western Australian conditions where extensive experience has indicated no potential for samples with less than 0.2 % sulfur to generate net acidity in arid conditions for hard rock mining waste rock. A negative NAPP and NPR of more than 4 (DIIS 2016) indicates no considered risk of acid generation in such instances.*

A sound knowledge of geological and geochemical processes must also be employed in the application of the above methods. These approaches and methods are described in greater detail in Appendix 1, which also describes potential biases/contribution from:

- Non-pyrite sulfides (e.g. pyrrhotite and base metal sulfides).
- Existing acidity (e.g. sulfate minerals such as jarosite) or exchangeable acidity.
- Reactive carbonates which do not contribute overall to neutralisation (e.g. siderite).

4.2 SAMPLE SELECTION

Selection of drill core/chip material for geochemical characterisation was chosen on the basis of the following:

- Drill hole material that was available and has been protected from contamination and excessive weathering or oxidation and spread across the proposed pit area (Figure 4). Some drill hole material, while logged and assayed and reviewed in Section 6, was not all available for further waste characterisation testwork and therefore could not be selected.
- A minimum of 10 drill holes across the proposed mining area within each phase of work, providing at least three samples from each significant lithological rock type identified. The lithologies were mafic or ultramafic (these not distinguished in phase 1 drill logging), pegmatite and the immediate contact zone between these lithologies which was subject to metamorphic alteration and hence also assessed as an alteration of the parent rock type. The actual number of samples from each lithological waste rock type was intended to be consistent with its relative contribution to the total waste rock volume and to represent a suitable spread across the sulfur content range based on available assay data presented in Section 6.
- Consideration was also made for suitable sampling of each lithology type identified by the weathering zones (Fresh, Transitional and Oxide) intercepted in proposed mining. Higher sampling numbers were chosen from the fresh and transitional rock waste which (particularly fresh rock), as this has higher potential for presence of oxidisable sulfur forms and acid generation.
- There was some bias, particularly in Phase 2 sampling towards selection of samples with a higher than typical sulfur content in order to determine approximate levels at which oxdisable sulfur presence would results in net acid formation, thus the % of samples in geochemical testwork which are potentially acid forming is not necessarily reflective of the mine waste. This information should be drawn from the mine block model mapping of sulfur contents as discussed later in this report.
- Sampling was to a depth at least 10 m below the proposed maximum depth of mining.

All samples represented at least one linear metre of core with depths as indicated in Table A2-1 of Appendix 2. A summary breakdown of sample numbers selected across lithology and weathering zone is shown in Appendix 2 — note that all fresh rock pegmatite is considered ore material.

A total of 210 samples have been characterised across the three phases of this geochemical assessment with 64 samples assessed in Phase 1, 50 in Phase 2 and 96 in Phase 3. These samples were generated from 41 drill holes across the Project area as outlined in Figure 4. A summary of the samples analysed is provided below in Table 4 with the full list of samples provided in Table A2-1 of Appendix 2. Table 5 provides a breakdown of analysis performed across all works, descriptions of methodology are provided in the following section.

Table 4: Summary of Waste Rock Samples Assessed

Weathering Zone	Lithology Type	Samples Phase 1	Samples Phase 2	Samples Phase 3	Total Analysed
Oxide (Clay)	Mafic	7	3	5	15
Oxide (Clay)	Pegmatite	4	-	-	4
Oxide	Saprolite	-	-	9	9
Transitional	Mafic	5	3	10	18
Transitional	Ultramafic	-	-	3	3
Transitional	Pegmatite	4	-	1	5
Fresh	Mafic	24	25	45	94
Fresh	Ultramafic	-	18	8	26
Fresh	BIF	-	-	5	5
Fresh	Contact Zone/Dyke	5	1	2	8
Ore	Pegmatite	15	-	8	23
Total Number of Samples		**64**	**50**	**96**	**210**

A summary of the laboratory tests implemented for each phase of the Project is provided below in Table 5.

Table 5: Summary of Laboratory Analyses Conducted

Analysis	Samples Phase 1	Samples Phase 2	Samples Phase 3	Comments
Total S + ANC Screen	60	27	-	
Full ABA	4	23	78	
Elemental Composition — 4 Acid	22	24	39	
Elemental Composition — Aqua Regia	-	-	32	
ASLP — DI water Leach	13	28	38	
ASLP — Acetic Acid Leach	13	10	33	
Particle Size Distribution (PSD)	6	4	10*	*Composite samples — transitional/oxide lithologies
Exchangeable Cations	10	4	10*	
Emerson Class (Dispersion)	8	3	10*	
Mehlich-3 Extraction (Plant available elements)	-	-	10*	
Minerology (XRD)	5	5	-	
Asbestiform Minerals**	-	-	6*	*Composite samples — fresh lithologies

*** Additional significant work on potentially asbestiform minerals was performed by others (Glossop Consultancy) in Phase 2, samples in the current are intended to confirm these findings are still consistent with present material.*

Scale: 1: 10,000
Original Size: A4

Grid: GDA94 / MGA zone 50
0 100 200 m

Covalent Lithium
Mt Holland Project
Earl Grey Extension WRC 2023

Figure 4

Waste Rock Sampling Locations (Phases 1-3)

Martinick Bosch Sell Pty Ltd
4 Cook St
West Perth WA 6005
Australia
t: +61 8 9226 3166
info@mbsenvironmental.com.au
www.mbsenvironmental.com.au

\\mbssvr\working\Covalent Lithium\Mt Holland Project\Baseline Studies\Waste Rock Characterisation\Earl Grey Extension WRC 2023\GIS\Mt Holland_ Earl Grey Extension WRC 2023.qgz 06/09/2023 F4 Waste Rock Sampling Locations

5. LABORATORY METHODS

Unless otherwise specified all references to percentage (%), refer to weight/weight basis.

5.1 ACID BASE ACCOUNTING

Sample analysis was performed by a NATA accredited laboratory (Intertek Genalysis). Preliminary analysis included selected acid base accounting (ABA) parameters.

Total sulfur and total carbon were measured by combustion-based elemental analysis using a 'LECO' type instrument.

The ABA scheme relies on measurement of oxidisable sulfur. The value of this fraction of sulfur in mine waste samples is calculated as the difference between total sulfur and sulfate-sulfur, which is present in a fully oxidised form and therefore not capable of generating additional acidity. Sulfate-sulfur content was determined (for samples containing >0.2 % total S) by a heated hydrochloric acid extraction followed by Inductively Coupled Plasma – Optical Emission Spectrometry (ICP-OES) analysis.

Sample ANC was measured by a modified Sobek procedure (AMIRA International 2002), which involves addition of dilute hydrochloric acid to the sample, followed by gentle simmering (two hours) to complete the reaction. The concentration of acid used for this procedure is first determined by testing the vigour of the reaction of the sample with hydrochloric acid, as assessed by the rate evolution of carbon dioxide gas and any colour change (a 'fizz rating'). The ANC was then determined by titrating the excess acid remaining after addition and reaction, using standardised sodium hydroxide solution.

Samples containing >0.2 % total S were subjected to NAG test procedures. The NAG test involves the addition of hydrogen peroxide, a strong oxidising agent, to a sample of mine waste to oxidise reactive sulfides. After cooling the sample pH is measured (NAG pH) and any acidity generated is measured by back titrating with sodium hydroxide solution to a pH of 4.5 (NAG to pH 4.5) and then pH 7 (NAG to pH 7). NAG is expressed in units of kg H_2SO_4/t. A significant NAG result (i.e. final NAG pH less than 4.5) generally indicates that the sample is PAF, and the test provides a direct measure of the NAG potential. A NAG pH of 4.5 or more generally indicates that the sample is NAF but may still be capable of generating metalliferous drainage following oxidation of the sulfide minerals. Results for titrations of aliquots of the NAG solution to endpoint pH values of 4.5 and 7.0 allow estimation by the difference between these results of the relative amounts of non-acid producing base metal (e.g. copper) and iron sulfides in the sample. Further analytical details are provided in Appendix 1.

5.2 ELEMENTAL COMPOSITION

Major and trace metals/metalloids were measured following digestion of a finely ground sample with a four-acid mixture of nitric, hydrochloric, perchloric and hydrofluoric acids, which is a total determination for the elements measured. The method is not suitable for accurate measurement of volatile elements such as mercury and boron.

Digest solutions were analysed using inductively coupled plasma mass spectrometry (ICP-MS) or ICP-OES. Samples were analysed for a suite of metals and metalloids (Table A2-3, Appendix 2).

From this data, the global abundance index (GAI) for each element was calculated by comparison to the average earth crustal abundance (AIMM 2001). The main purpose of the GAI is to provide an indication of any elemental enrichment that could be of environmental significance (INAP 2009). The GAI (based on a log-2 scale) is expressed in integer increments from 0 to 6. A GAI of 0 indicates that the content of the element is less than or up to three times the average crustal abundance; a GAI of 1 corresponds to a three-to-six-fold enrichment; a GAI of 2 corresponds to a 6-to-12-fold enrichment and so forth, up to a GAI of 6, which corresponds to a 96-fold, or greater, enrichment above average crustal abundances. A GAI of 3 or more is generally considered significant and may warrant further investigation.

The elemental composition of waste rock materials was also determined using an aqua regia (Nitric and hydrochloric acid in a 1:3 ratio) digest coupled with ICPAES finish. The results from this analysis represent concentrations of elements that may potentially be released by geochemical processes such as weathering over geological timescales and is used for waste classification purposes against the NEPM environmental investigation levels (EILs) and as required according to Landfill Waste Classification and Waste Definitions 1996 (as amended 2019, DWER 2019).

5.3 WATER LEACHABLE CHARACTERISATION

Pulverised waste rock samples examined during this investigation were subject to a water leach similar to the Australian Standards Leaching Procedure (ASLP) 4439.3 Class 1 specification, except that the dilution used was 1:5 weight/weight, sample to water, instead of a 1:20 weight/weight, sample to water. The use of a tumbled water extract of a finely ground sample allows the laboratory water extraction test to mimic weathering conditions that may be expected in a temperate, semi-arid environment over a period of several years. Extracting samples at a solid to liquid ratio of 1:5 in the present work was a compromise between the higher solid to liquid ratios that may be experienced in saturated waste rock storage conditions and the 1:20 ratio often used to simulate short-term leaching by rainwater and comparison to water quality criteria (ASLP extraction ratios are derived from a United States Environmental Protection Authority (USEPA) default attenuation factor of 20). Hence 1:5 extract ratio results are conservative if comparison to water quality criteria but appropriate for comparison to plant uptake considerations. Analytical finish of the filtered (0.45 µm) extract was via ICP-OES or ICP-MS finish, as necessary, for a range of elements based on the total concentrations determined from four acid digestion. This included sodium, potassium, calcium, magnesium, water soluble sulfur (sulfate) and other environmentally significant metals and metalloids (including mercury).

Water extracts of waste rock samples were simultaneously tested for Electrical Conductivity (EC), pH, alkalinity (bicarbonate, carbonate and hydroxide forms), sulfate, fluoride and chloride.

5.4 DILUTE ACID LEACHABLE CHARACTERISATION

Pulverised waste rock samples examined during this investigation were subject to analysis using dilute acetic acid as the leaching fluid (initial pH 2.9) according to Australian Standards Leaching Procedure (ASLP) 4439.3 specification (1:20 extraction ratio). Analytical finish of the filtered (0.45 µm) extract was via ICP-OES or ICP-MS finish, as necessary, for the same metals and metalloids as performed for the water leachable fraction excluding sulfur) and also included boron, iron and silicon. This test provides indication of metals and metalloids that are likely to be leached should acid condition prevail; either by oxidation of sulfide minerals in the waste rock materials being assessed or by co-storage with other sources of PAF mine waste.

5.5 EXCHANGEABLE CATIONS

Ten selected samples of oxide waste rock and alluvium were analysed by the Chemistry Centre for exchangeable cations (calcium, magnesium, sodium and potassium) following extraction of samples with ammonium chloride solution at pH 7 (CSIRO 1999). Effective Cation Exchange Capacity (ECEC) was calculated by the sum of the concentrations of individual cations expressed with units of centimoles of positive charge per kilogram (cmol(+)/kg). Exchangeable Sodium Percentage (ESP), a measure of waste rock sodicity, was calculated by the percentage of exchangeable sodium of ECEC. Waste rock with moderate to high ESP values (>15%) and containing substantial amounts of clay minerals are prone to water erosion, resulting in waste dump instability by processes including tunnelling, rilling and deep gully formation.

Although rarely encountered as an exchangeable soil cation, lithium was included in the analytical suite. Exchangeable lithium has similar properties to exchangeable sodium in that its presence increases potential for clay dispersion.

5.6 PLANT AVAILABLE MEHLICH 3 EXTRACTABLE ELEMENTS

The Mehlich 3 soil extraction (Mehlich, 1984) is used as an estimate of the plant-available content of a range of nutrients, metals and metalloids. The extractant combines acetic acid (CH_3COOH), ammonium nitrate (NH_4NO_3), ammonium fluoride (NH_4F), nitric acid (HNO_3) and ethylenediaminetetraacetic acid (EDTA) at pH 2.5. This extraction is above to assess mine site soils for potential nutrient deficiencies, toxicity or imbalance that may affect revegetation outcomes.

5.7 MINERALOGICAL ASSESSMENT

Five samples (representing two fresh mafic, one fresh pegmatite ore, one transitional mafic and one transitional pegmatite) were chosen for mineralogical determination. These samples were submitted to Intertek Genalysis Laboratory Services for a quantitative powder X-Ray diffraction analysis (XRD) of the crystalline and amorphous contents. Samples were further ground to a very fine powder in an agate mortar and pestle and subsampled for analysis with and without addition of zinc oxide (solid dilution 10% by weight) to determine amorphous content. XRD patterns were then collected on PANalytical Cubix wavelength dispersive XRD with quantitative analysis performed using an automated Rietveld method of correction. Full experimental details are provided in the mineralogical laboratory report presented in Appendix 3

5.8 FIBROUS MINERALS

Selected samples of fresh waste rock lithologies were combined into six composite samples for asbestos fibre identification using Transmission Electron Microscopy (TEM) and elemental analysis by Energy Dispersive X-ray Spectroscopy (EDXS). These bulk composite samples were elutriated by diluting a weighed sample in distilled water and placing in an ultrasonic bath. A surface aliquot (representing material in the respirable range) was filtered onto a polycarbonate membrane and transferred onto TEM grids.

The grid openings were examined for fibre identification following standard ISO 22262-1 using TEM. A fibre is defined as having parallel or stepped sides with an aspect ratio equal to or greater than 3:1. An elongated mineral particle (EMP) follows the same aspect ratio as a fibre but does not have parallel or stepped sides. A potential fibre will be considered asbestiform if has both the morphology and aspect ratio of a fibre and the chemical composition matches. The morphology and chemical composition is made in comparison to reference asbestiform fibres of that asbestiform fibre type.

6. REVIEW OF TOTAL SULFUR ASSAY DATA

6.1 WASTE ROCK

Sulfur assay data for waste rock from drilling programs for the Earl Grey Project were provided by Project geologists to MBS for review as part of this report. Assays of samples from the area of mining corresponding to the first 15 years of mine life were assessed and presented in the Phase 2 (MBS 2020) report. Assay data corresponding to Phase 3 are presented in this report.

The total sulfur assays comprised 10,391 samples from drill cores which included 744 oxide samples, 902 transitional samples, and 8,745 fresh samples. The fresh samples in turn included 493 BIF, 2,204 mafic, and 6,048 ultramafic samples.

Results presented in Table 6 and Chart 2 indicate that the primary fresh rock waste lithologies of mafic and ultramafic have average sulfur contents of 0.36% and 0.15%, respectively, with maximum sulfur content of 17.5% and 14.6%, respectively, across all samples. Approximately 93% of the ultramafic samples had a sulfur content of less than 0.4% adopted in previous works for sulfur cutoff. In contrast, the majority (75%) of BIF samples exceeded 0.4% total sulfur. This indicates that BIF, although a minor lithology of less than 2% waste by volume (Table 1) typically has higher sulfur content and potentially sulfides. Fresh mafic samples had 357 samples (16%) above 0.4% total sulfur. Data was indicated to be bimodal with this likely being a result of a large number of samples away from the faults being lower in sulfur and higher results likely in association with faulting and hydrothermal alteration.

Table 6: Sulfur (%) Summary for Phase 3 Assay Data

Type	# Samples	Average (mean)	Median	Minimum	Maximum	Samples above 0.4
Oxide	744	0.04	0.03	0.005	0.46	1 (0.13%)
Transitional	902	0.42	0.02	0.005	33.2	65 (7.2%)
Fresh Mafic (Basalts)	2,204	0.36	0.05	0.01	17.5	357 (16.2%)
Fresh Ultramafic (Komatite and High Mg Basalt)	6,048	0.15	0.04	0.005	14.6	437 (7.2%)
Fresh BIF	493	1.93	0.92	0.01	29.2	370 (75%)

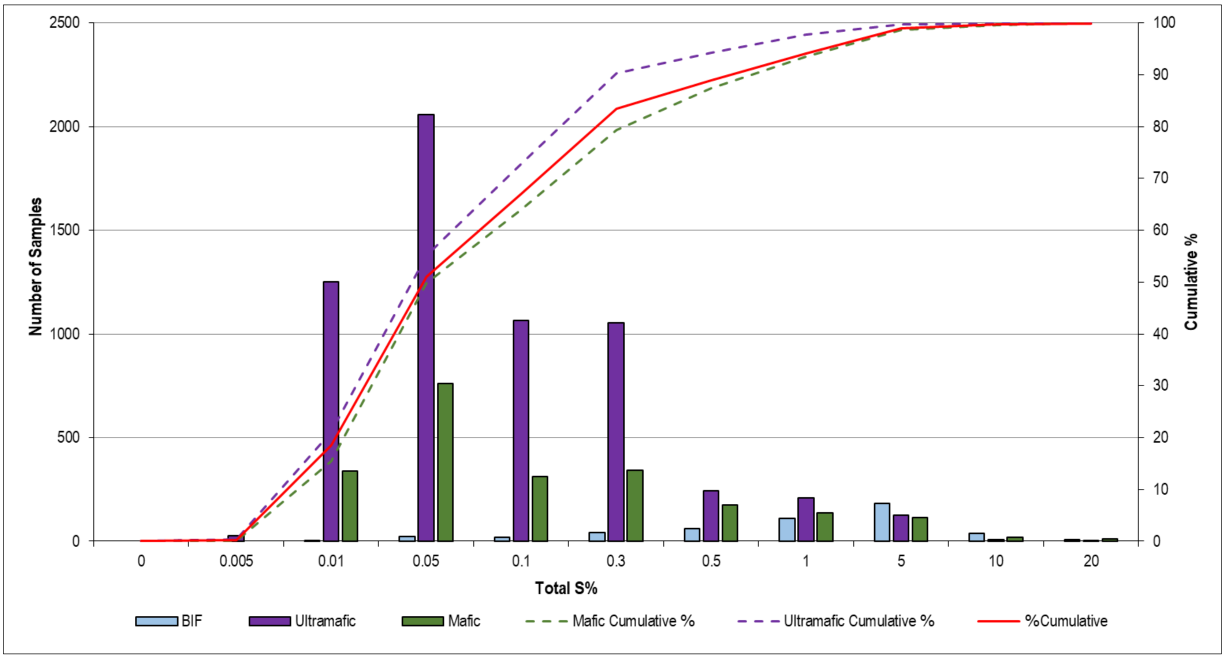


Chart 2: Phase 3 Histogram of Total Sulfur Concentrations from Assay Data

The 95% confidence limit of the mean ranges (lower confidence limit and upper confidence limit, LCL and UCL) were determined for both Phase 2 and Phase 3 log normalised data. This was to compare the data sets for the main lithologies (mafic and ultramafic) which occur in all stages of mining. Table 7 provides the 95% lower and upper confidence limits of the mean for both Phase 2 and Phase 3 total sulfur data. Both sets of data (Phase 2 and Phase 3) were log normalised (log normal distribution of data) to allow a more accurate statistical comparison. The data shows, that current assay data although still have a low mean and median sulfur content is higher for both mafics and ultramafics than previous. It also confirms that the ultramafic waste is statistically significantly lower in distribution of sulfur than fresh mafic waste. The 95th percentile of mafic and ultramafic waste from current assay data was 1.6% and 0.57% sulfur respectively.

Table 7: 95% Confident Limits for Mafic and Ultramafic Lithologies

Lithology	**Fresh Mafic**		**Fresh Ultramafic**	
Mining Phase	**0 to 10 years**	**10 years on**	**0 to 10 years**	**10 years on**
n	1,672	2,204	128	6,048
Mean (% S)	0.0204	0.0733	0.034	0.04973
Median(% S)	0.01	0.0507	0.020	0.040
Std dev.(% S)	0.000304	0.00049	0.000402	0.00037
95% LCL mean (% S)	0.0192	0.0680	0.0257	0.0497
95% UCL mean(% S)	0.0217	0.0792	0.0449	0.0498
Statistically Different?	**Yes: 10 years on is Higher**		**Yes: 10 years on is Higher**	

6.2 PEGMATITE ORE

Sulfur and arsenic assay data for pegmatite ore from drilling programs for the Earl Grey Project were provided by Project geologists to MBS for review as part of this report and provide a comparison of proposed ore to previously approved feed ore for zero to ten years of mine life. A full tailings characterisation for the spodumene beneficiation carried out on site at the Project was previously conducted and should be referred to for information regards the tailings properties (MBS 2019).

Apart from sulfur content, arsenic content was of interest as it is known that portions of the Project geology can be enriched in arsenic. Assay data from the pegmatite ore and indications in significant changes informs the characteristics of any low grade ore which is stockpiled over life of mine. Changes to feed ore composition will proportional influence the tailings to be disposed within the tailings storage facility.

Sulfur and arsenic assay data corresponding to Phase 3 (2051 LOM) is presented in Table 8 and in histograms in Chart 3 and Chart 4. Key points are that sulfur content is low (95% UCL mean of 0.01475% sulfur) which is at a level considered incapable of acid generation and that the arsenic content while higher in some samples (possibly associated with gold mineralisation), the 95% UCL mean of 106.4 mg/kg is still less than NEPM 2013 industrial soil added contaminant limit (ACL) of 160 mg/kg and hence represents a low risk.

Table 8: Sulfur and Arsenic Assay Data (ppm) Summary — Proposed Mining Pegmatite Ore

Type	# Samples	Average (mean)	Median	Minimum	Maximum	95% UCL Mean
Sulfur	5553	143	134	0.25	62,405	147.5
Arsenic	8020	106	100	0.05	3,493	106.4

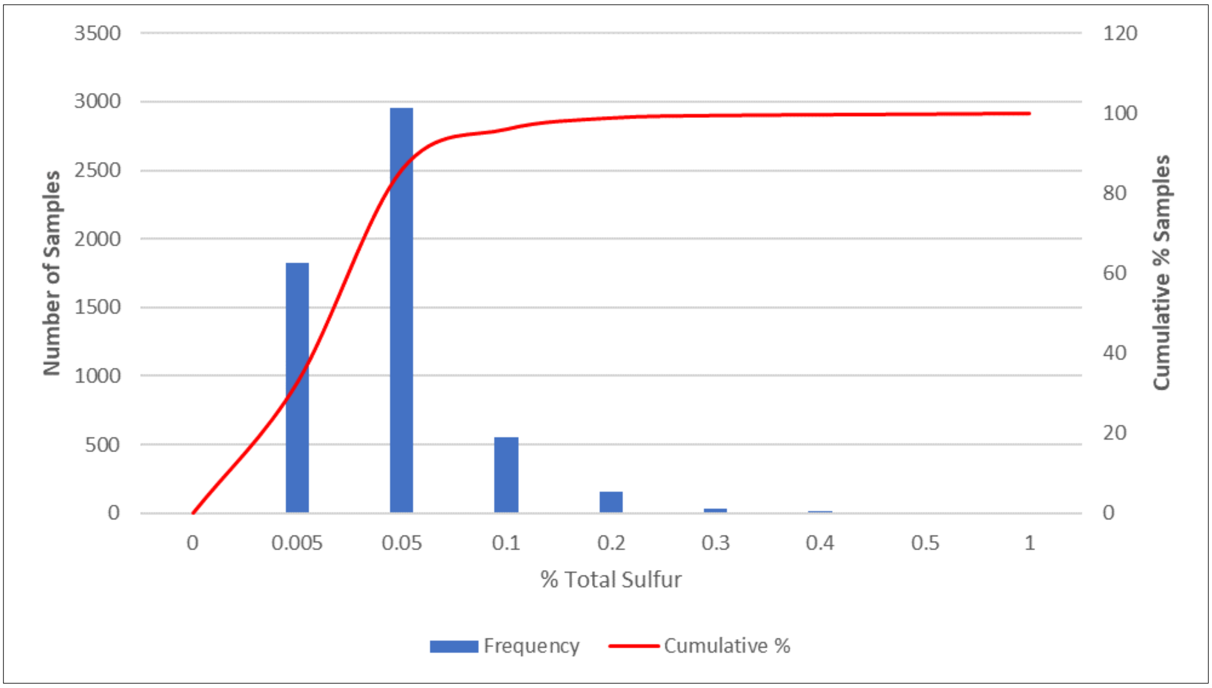


Chart 3: Total Sulfur Concentrations Pegmatite Ore Assay Data 10 years to LOM

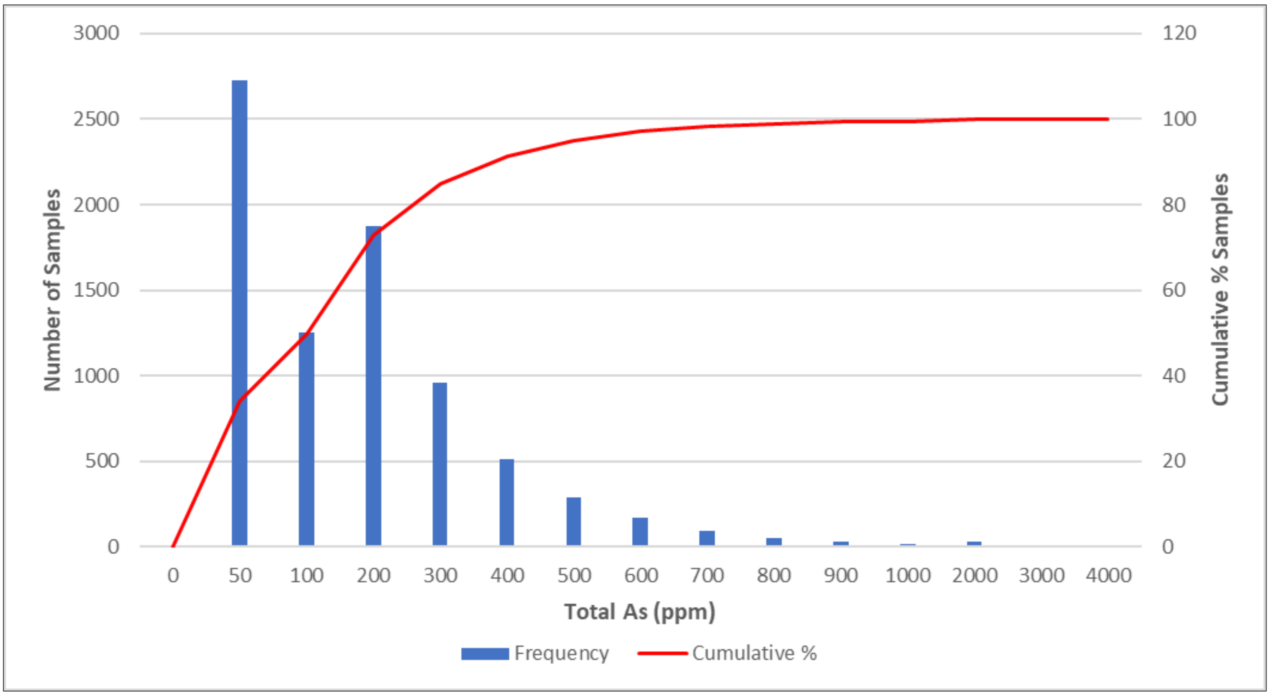


Chart 4: Arsenic Concentrations From Pegmatite Ore Assay Data 10 years to LOM

The assay data was also compared to previous data within the pit shell for currently approved zero to ten years of mining of the Early Grey pit. The 95% confidence limit of the mean ranges (lower confidence limit and upper confidence limit, LCL and UCL) were determined for both this and subsequent (Phase 2 and Phase 3) mining log normalised data (Table 9). Based on this comparison (although noting the 0 to 10 years is a much smaller dataset), both sulfur and arsenic contents in proposed mining envelopes are statistically lower for both elements than the initial mining period, indicating less risk.

Table 9: 95% Confident Limits for Sulfur and Arsenic from Pegmatite Ore (ppm)

Analyte	**Sulfur**		**Arsenic**	
Mining Phase	**0 to 10 years**	**10 years on**	**0 to 10 years**	**10 years on**
n	402	5553	402	8020
Mean	204.8	142.6	145	106.3
Median	200	133.7	100.0	100.1
Std dev.	2.57	3.10	2.277	2.93
95% LCL mean	204.7	137.8	145.0	106.2
95% UCL mean	204.9	147.5	145.1	106.4
Statistically Different?	**Yes: 10 years on is Lower**		**Yes: 10 years on is Lower**	

7. RESULTS AND DISCUSSION

7.1 ACID BASE ACCOUNTING

Laboratory results for total sulfur, sulfate-sulfur, ANC, acid base accounting parameters and NAG tests of waste rock samples are collated in Table A2-2 of Appendix 2.

7.1.1 Sulfur Forms and Distribution

Based on examination of the data in Table A2-2 (Appendix 2) and a summary of total sulfur data provided in Table 10 and Chart 5, the following are noted as key points:

- Across the entire dataset (phases 1–3) total S concentrations of samples tested ranged from <0.01–3.85%.
- 159 samples, representing 83% of the dataset, contained total S concentrations of <0.3% which typically means that materials pose little risk of AMD formation in hard rock mining given even marginal levels of ANC.
- 10 samples conversely contained relatively high total S values >1%, with high S samples typically being fresh mafic or transitional (mafic) lithologies.
- Transitional (0.54%) and fresh mafic (0.36%) lithologies also had the highest mean S concentrations of all tested lithologies.
- It is indicated based on previous works that higher sulfur concentrations are associated with the north-south shear zones as shown in Figure 3.

Table 10: Total Sulfur Content Summary by Lithology Unit (%)

Lithology Unit	No. of Samples	Minimum	Maximum	Mean	Median
Fresh BIF	5	0.18	0.36	0.25	0.22
Fresh Contact Zone	5	0.005	0.25	0.07	0.02
Fresh Dyke	2	0.09	0.11	0.10	-
Fresh Mafic	95	0.005	3.83	0.36	0.08
Fresh Ultramafic	26	0.005	0.65	0.18	0.16
Oxide	26	0.005	0.28	0.04	0.02
Pegmatite Ore	19	0.005	0.2	0.05	0.02
Transitional	14	0.01	3.85	0.54	0.02

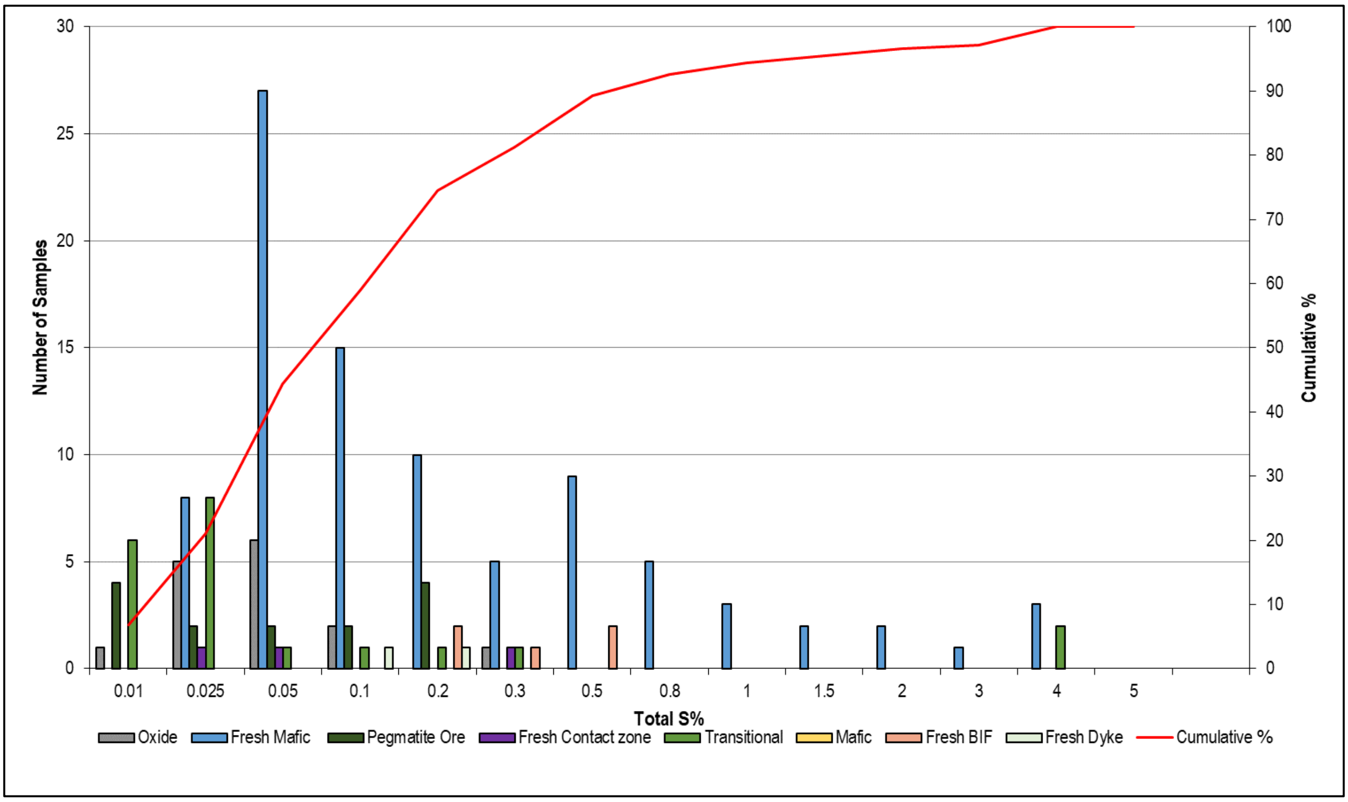


Chart 5: Frequency Plot of Total Sulfur Content for Phase 3 Waste Rock and Ore

7.1.2 Acid Neutralisation Capacity (ANC)

Based on examination of the data in Table A2-2 (Appendix 2) and a summary of ANC data provided in Table 11 and Chart 6. The following are noted as key points:

- ANC values ranged from <1–252 kg H_2SO_4/t across the dataset (phases 1–3).
- Fresh ultramafic and fresh BIF lithologies contained the highest mean ANC values of 83 kg H_2SO_4/t and 127 kg H_2SO_4/t, respectively, although it must be noted that only 5 BIF samples were analysed in this assessment compared with 26 ultramafic samples.
- Oxide materials (8 kg H_2SO_4/t), transitional materials (18 kg H_2SO_4/t) and pegmatite ore (20 kg H_2SO_4/t) typically had the lowest mean ANC values of all tested lithologies, which in the case of oxide and transitional samples is consistent with a higher degree of weathering.
- Carbonate ANC (CC-ANC) values ranged from <0.8–230 kg H_2SO_4/t.
- Fresh BIF samples had a high average CC-ANC value of 98 kg H_2SO_4/t whereas all other lithologies had much lower mean CC-ANC values of <29 kg H_2SO_4/t. This indicates that ANC in BIF is more likely to be present as reactive carbonates such as calcite versus less readily reactive silicates in other lithologies.
- Fresh Dyke, Oxide, Pegmatite Ore and Transitional lithologies all had relatively low mean CC-ANC values of <10 kg H_2SO_4/t.
- ANC and CC-ANC values had a moderate correlation (R^2= 0.66), particularly at higher values whereby CC-ANC values were reflective of ANC values suggesting the bulk of ANC could be attributed to carbonate minerals. At lower ANC values (<100 kg H_2SO_4/t) many samples contained low CC-ANC values, which suggests that silicates rather than carbonates are contributing to the bulk of the ANC in these samples.

Table 11: ANC and Carbonate NP Summary by Lithology Unit (kg H_2SO_4/t)

Lithology Unit	No. of Samples	ANC Min.	ANC Max.	ANC Mean	ANC Median	CC ANC Min.	CC ANC Max.	CC ANC Mean	CC ANC Median
Oxide	26	0.1	36	8	6	1	25	5	3
Transitional	14	2	39	18	16	<0.8	12	2	1
Fresh BIF	5	69	189	127	116	47	153	98	84
Fresh Contact Zone	5	8	68	27	25	2	51	17	10
Fresh Dyke	2	61	68	65	-	2	2	2	-
Fresh Mafic	95	9	252	40	28	<0.8	230	17	6
Fresh Ultramafic	26	46	209	83	69	2	112	29	14
Pegmatite Ore	19	4	105	20	9	2	36	8	6

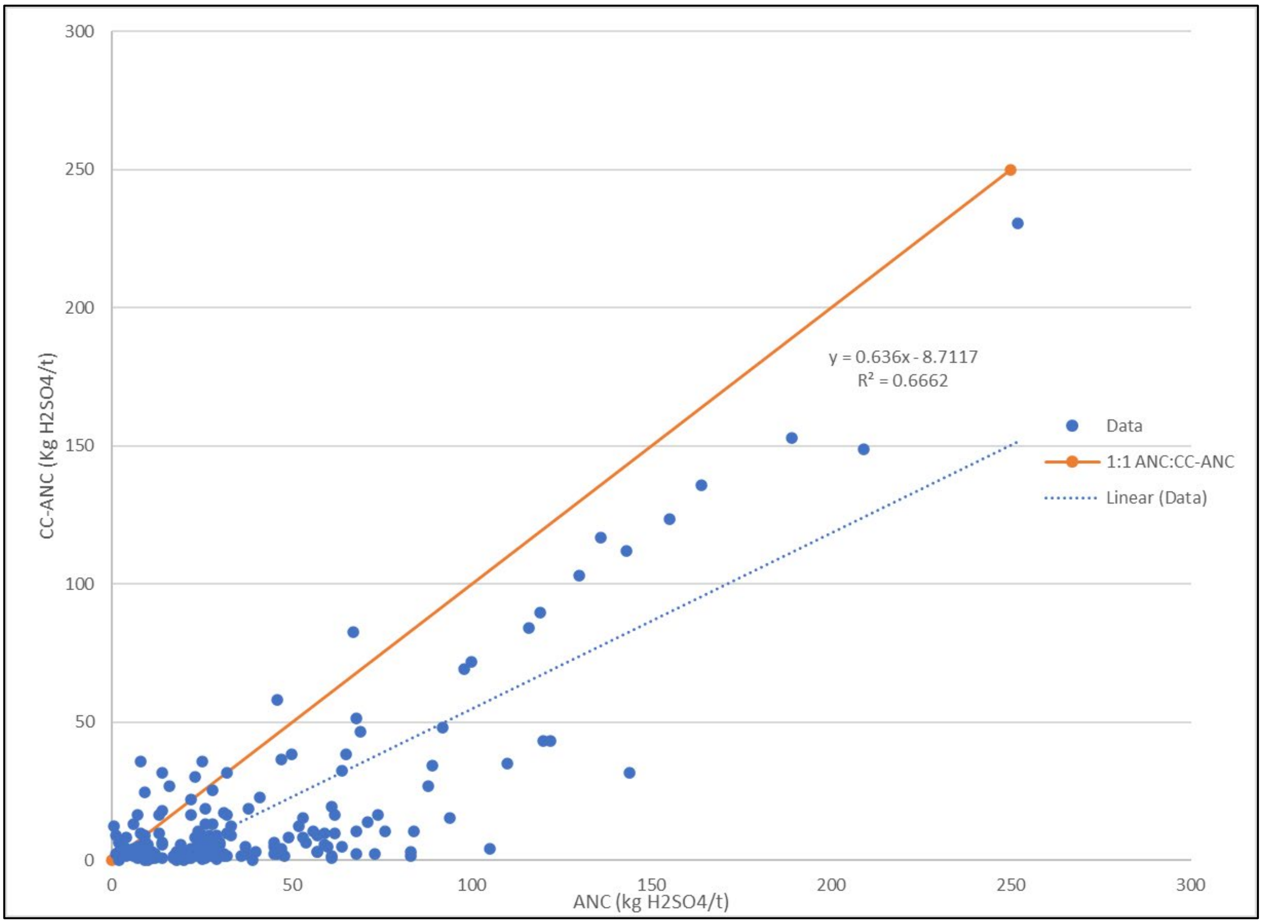


Chart 6: ANC vs CC-ANC Plot

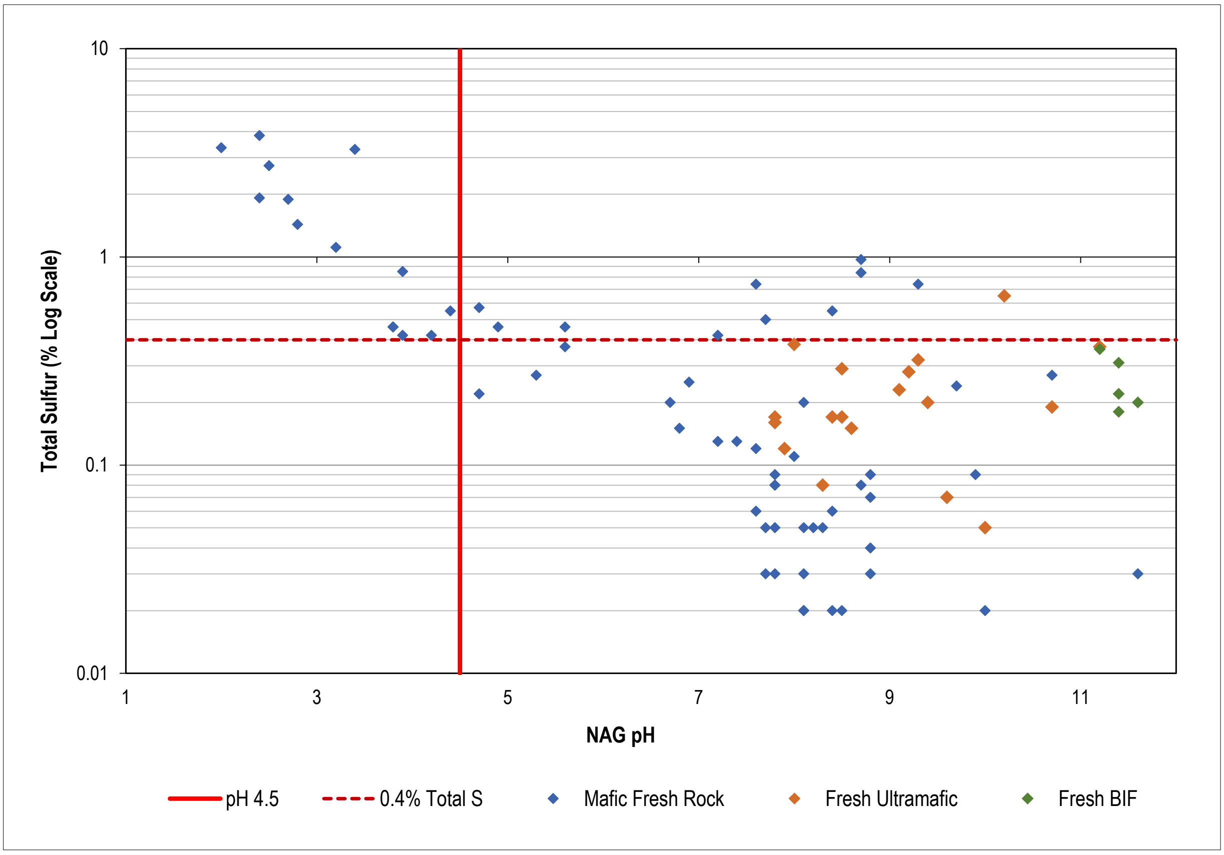
7.1.3 Acid Drainage Classification

Based upon classification methods outlined in Section 4.1 and results of analysis of Earl Grey samples (Appendix 2, Table A2-2), the following key points regarding acid classifications are made as summarised in Table 12.

Table 12: AMD Classification by Lithology Unit

Lithology Unit	No. of Samples	NAF	NAF(AC)	Uncertain	PAF	PAF-LC	Total
Fresh BIF	5	2	3	-	-	-	5
Fresh Contact Zone	5	5	-	-	-	-	5
Fresh Dyke	2	2	-	-	-	-	2
Fresh Mafic	95	79	4	4	7	1	95
Fresh Ultramafic	26	20	6	-	-	-	26
Oxide	26	25	-	-	-	1	26
Pegmatite Ore	19	18	1	-	-	-	19
Transitional	14	10	-	-	2	2	14
Total	**192**	**161**	**14**	**4**	**9**	**4**	**192**

- The vast majority of samples (175) across all three phases of this assessment were NAF or NAF(AC), which accounted for 91% of the samples tested.
- A total of 13 samples were classed as PAF or PAF-LC. These samples were generally fresh mafic or transitional lithologies, which as discussed in section 7.1.1 were the only lithologies to contain elevated total S values of >1% S of those tested. Assay data does indicate samples of BIF which were higher in sulfur and potentially PAF although likely also higher in carbonate content based on findings of samples tested.
- An additional four fresh mafic samples were classified as uncertain, due to a negative NAPP values but a NAG pH of less than 4.5. Based on NAG pH values (<4.5), these are likely to also be PAF-LC samples overall. The laboratory measured ANC is likely to be overestimated in these samples (silicate based ANC in mafic rock).
- Based on the plot of NAG pH vs Total S% (Chart 7), fresh mafic samples with a total S% concentration above 0.4% have the potential to be PAF (based on NAG pH only which is conservative). This material thus should be managed as such. This estimate is likely to be very conservative for ultramafic and BIF lithologies as these have higher levels of ANC and hence a similar sulfur content in these lithologies is unlikely to be PAF as can be seen from Chart 7. Six of the ultramafic samples were acid consuming and BIF has readily reactive carbonates — none of these lithologies tested were PAF. A more refined determination of criteria for PAF versus NAF by total sulfur content and by lithology could be performed using milder oxidation methods/kinetic testing which is more representative of field conditions, however use of a 0.4% criteria is very conservative and suitable in the absence of further work.



-

Chart 7: NAG pH Vs Total S% Plot

7.2 TOTAL ELEMENTAL COMPOSITION

Table A2-3 of Appendix 2 presents heavy metal and metalloid compositions for the 85-waste rock and ore samples selected for elemental analysis. Table A2-4 of Appendix 2 presents the calculated GAIs for these samples, as outlined in Section 5.2.

Mineral deposits by their nature are anticipated to have various elements present in concentrations above the average crustal abundance. The GAI does, however, provide a useful screening tool for identifying elements requiring further assessment by more specific test methods. Examination of the total element concentrations and the corresponding GAI values for Earl Grey waste rock samples are summarised below in Table 13.

Table 13: Summary of Elemental Enrichment Across Waste Lithologies

Element	Concentration Range (mg/kg)	Background Concentration (mg/kg)	Number of Enriched Samples (GAI >3)	% Enriched	Enriched Lithologies
Lithium	7 – 9,391	30	52	60	All except oxide zone
Antimony	0.1 – 7.4	0.2	24	28	Variably in all except dolerite dyke, contact zone and pegmatite ore
Caesium	0.8 – 640	3	24	28	Transitional Fresh Mafic Pegmatite Ore Fresh BIF Fresh Ultramafic
Arsenic	2 – 1,279	25	20	24	Fresh Mafic Fresh Contact Zone Fresh Ultramafic
Tungsten	0.2 – 294	1	17	20	Oxide Transitional Fresh Mafic Fresh Contact Zone Fresh BIF Fresh Ultramafic
Chromium	10 – 3,218	200	15	18	Transitional Fresh Mafic
Beryllium	0.1 –167	3	9	11	Transitional Fresh Mafic Fresh Contact Zone Pegmatite Ore
Rubidium	0.6 – 3,274	120	9	11	Transitional Fresh Mafic Fresh Contact Zone Pegmatite Ore
Tantalum	0.03 – 72	2	8	9	Transitional Fresh Contact Zone Pegmatite Ore
Nickel	20 – 1,122	80	3	4	Fresh Mafic Pegmatite Ore
Tellurium	0.1 – 0.2	0.001	3	4	Fresh Mafic
Tin	0.3 – 46	2.5	2	2	Fresh Mafic Fresh Ultramafic
Cobalt	0.4 – 268	25	1	1	Transitional
Rhenium	<0.002 – 0.01	0.001	1	1	Fresh Ultramafic
Selenium	0.1 – 2.3	0.2	1	1	Transitional

- As expected for a lithium deposit, lithium was enriched in 52 samples (60%) of the samples analysed across the three phases of the Project. Lithium was enriched in all major lithologies except for the oxide zone (weathering and leaching associated). Unsurprisingly, the highest Lithium concentrations were associated with pegmatite ore and contact zone samples which were in the 4,200 – 9,400 mg/kg range. Caesium was also enriched in all fresh rock lithologies and in transitional samples with the highest concentrations (>100 mg/kg) typically found in fresh mafic and ultramafic lithologies.
- Antimony at low levels and caesium were found to be enriched in 24 samples, representing 28% of the samples analysed. Antimony was enriched in most major lithologies, with the exception of fresh contact zone and dyke samples. The highest antimony concentrations were typically present in fresh mafic, oxide and transitional samples (>5 mg/kg) compared to an average crustal abundance of 0.2 mg/kg.
- Arsenic was enriched in 20 samples (24%) and was predominantly enriched in fresh mafic, ultramafic and contact zone samples. The highest concentrations (>500 mg/kg) were predominantly associated with fresh mafic waste rock.
- Tungsten and chromium were enriched in 17 and 15 samples respectively, which accounts for 20% and 18% of the samples analysed. Tungsten was enriched in all lithologies excluding pegmatite ore, whilst chromium was only enriched in fresh mafic and transitional wastes.
- Beryllium (9 samples, 11%), rubidium (9 samples, 11%) and tantalum (8 samples, 9%) were primarily enriched in transitional and fresh rock lithologies, predominantly the pegmatite ore samples.
- Elements including nickel, tellurium, tin, cobalt, rhenium and selenium were enriched in less than 3 samples each across the dataset.
- Elements of potential environmental significance such as aluminium, cadmium, manganese, lead, uranium, vanadium and zinc were not considered to be enriched in any of the samples assessed across the three phases of this Project.

7.3 AQUA REGIA COMPOSITION

Table A2-5 of Appendix 2 presents environmentally significant heavy metal and metalloid compositions for the 46-waste rock and ore samples. Results of aqua regia digests were compared against the NEPC (2013) soil ecological investigation levels (EILs) as a very conservative screening tool given material represents waste rock and not finely divided soils. The NEPC EILs have three classes depending on the land use, which consist of: ecological significance; urban/residential/public open space; and commercial/industrial. Given the likely land uses during operations and post closure digest results were mainly compared to the EILs for public open space and commercial/industrial areas as outlined below in Table 14.

Table 14: Aqua Regia Digest Results Against Relevant NEPC (2013) EILs

Element	Concentration Range		Public Open Space EIL			Commercial/Industrial EIL		
	Minimum (mg/kg)	Maximum (mg/kg)	EIL (mg/kg)	Exceedances	Lithologies	EIL (mg/kg)	Exceedances	Lithologies
Arsenic	1	1,884	100	14	Mafic, BIF, Ultramafic	160	9	Mafic, BIF, Ultramafic
Cobalt*	2	123	50	7	Mafic, BIF, Dyke	N/A	N/A	N/A
Chromium (total)	12	1,586	530	4	Mafic	870	3	Mafic
Manganese*	8	1,678	500	5	Mafic, BIF, Ultramafic, Dyke	N/A	N/A	N/A
Nickel	17	731	200	7	Mafic	340	3	Mafic
Sulfur*	18	35,931	600	14	Mafic, BIF, Ultramafic	N/A	N/A	N/A
Vanadium*	21	695	50	30	All	N/A	N/A	N/A

- ** Generic EIL provided in DEC (2010) guidelines*
- Major results included:
- With respect to commercial/industrial EILs: mafic, ultramafic and BIF lithologies were observed to exceed the EILs for arsenic (14 samples — mostly in mafic basalts although maximum was in a BIF sample), total chromium (3 samples) and nickel (3 samples). There were no exceedances of commercial/industrial EILs for other potential contaminants.
- With respect to the Urban/residential/public open space EILs: exceedances were observed for the following elements: arsenic, cobalt, chromium (total), manganese, nickel, sulfur and vanadium. All lithologies were represented in these exceedances, however, mafic, BIF and ultramafic samples were represented for all elements, whereas for pegmatites exceedances only for vanadium were observed.

7.4 CHROMIUM (VI) STUDIES

As discussed above, various mafic/ultramafic waste including derived laterite and gravel samples and contain elevated chromium concentrations in addition to presence of manganese in the form of manganese oxides (MnO_2, pyrolusite or birnessite). Concerns were raised that such conditions have been noted elsewhere to have the potential to naturally generate hexavalent chromium by oxidation of chromium (III) by the manganese oxide in pore waters. This includes Brazil, Sri Lanka and New Caledonia (high rainfall environments) by Fandeur et al. 2009 and others. Oxidation from chromium(III) to chromium(VI) is favoured in oxic conditions at neutral to alkaline pH. The chromium (VI) may release into groundwaters (especially in iron depleted alkaline soils) or bind with iron oxides including goethite (FeO(OH) (Deng et al. 1996) and amorphous forms. The latter is variably in an ion exchangeable form and released under certain conditions (Raous et al. 2010 and 2013) — notably application of phosphate fertilisers or a rise in pH/alkalinity.

As part of additional works as Phase 1 extended sampling (Figure 4), the presence of soluble or existing bound or mineral chromium (VI) forms in site materials was assessed by determination of both total (USEPA method 3060a), soluble (water leachable) and exchangeable chromium (VI). The purpose was to determine if an existing 'reservoir' of chromium (VI) exists in the possible rehabilitation materials which may potentially be mobilised either by physical movement (erosion) or desorption (e.g. interaction with saline or alkaline water or increased phosphate in pore waters). Results are provided in Table A2-5 of Appendix 2. A summary of findings is as follows:

- Following an 18-hour tumbled reaction at 1:5 ratio, the dissolved chromium concentrations (all forms including Cr(VI)) in natural water leachates were very low (<0.01 mg/L) for all samples. This indicates that the environmental risks related to direct chromium (VI) leaching following rainfall as chromium (VI) are low.
- Exchangeable chromium (VI) concentrations in all samples assessed (by phosphate extraction at room temperature) were less than the limit of reporting (0.1 mg/kg).
- The USEPA method 3060a determined total chromium (VI) concentrations under stronger extraction/digestion conditions to the above were at or below the limit of reporting (1 mg/kg) for all samples except one (Shallow Mafic Laterite 3 (SML3), 2 mg/kg).
- Sample SML3 and the equivalent SML2 (two highest chromium concentration samples, 1,573 mg/kg and 1,305 mg.kg respectively) were mixed 1:1 with MDUS comp and PDUS comp (high manganese samples up to 2,200 mg/kg manganese) to assess short term potential for such mixtures of elevated chromium and manganese lateritic waste from different depths to generate chromium (VI). Results for both mixtures, both tests were less than the limits of reporting.
- The testwork above indicates the risk of formation and release of chromium (VI) from Earl Grey waste materials and impact to surface waters or groundwaters is very low. This is a combination of very low site rainfall (limited timeframes for kinetically slow oxidation of chromium in waste porewaters), lack of an existing reservoir of total or exchangeable chromium (VI) for release and also the nature of the anaerobic groundwaters at site which would destroy chromium (VI) (reaction with ferrous (II) or manganous (II) ions) on contact. Risk can however be further reduced by avoiding placement of the highest chromium and manganese waste concentrations away from the final closure surfaces.

7.5 WATER LEACHATE CHARACTERISATION

7.5.1 pH and Soluble Major Ions

Results for pH, EC and major ions in the 1:5 extracts are given in Table A2-5 of Appendix 2. Samples across the lithology types were found to have:

- Samples followed trends of previous Earl Grey pit samples as shown in the Appendix tables with most samples being either alkaline (fresh rock) or slightly acidic (oxide and transitional zone material). Only a minority of all samples tested were considered circum-neutral (6.5 – 8.5).
- Waste rock leachates were generally of low salinity. A few samples (of varying lithologies) contained TDS values of >1,000 mg/L, possibly a result of contamination with saline groundwater. No samples exceeded the ANZECC (2000) Livestock Drinking Water Guideline Value of 4,000 mg/L. Higher salinities (and lower pH from lateritic weathering) are considered more likely to be associated with subsoil clays.
- Calcium concentrations were highly variable ranging from 0.04 – 633 mg/L across samples, however, there were no exceedances of the ANZECC (2000) Livestock Drinking Water Guideline Value (1,000 mg/L).
- Two samples (both Fresh Mafic) exceeded the ANZECC (2000) Livestock Drinking Water Guideline Value for sulfate (1,000 mg/L). All remaining samples had concentrations of less than 212 mg/L which are well below the relevant trigger value.
- One oxide sample (KEGM054) contained a soluble fluoride concentration — 2.34 mg/L that exceeded the ANZECC 2000 livestock drinking water guideline of 2 mg/L. All remaining samples contained concentrations of <1 mg/L.
- Four samples (3 oxide, 1 fresh mafic) contained chloride concentrations between 313 – 825 mg/L which exceeded the DoH Non-Potable Use Guideline (NPUG) Value of 250 mg/L. In general, however, chloride concentrations in most samples were low.
- Relatively low soluble alkalinity (range <5 – 55 mg/L), present as a mixture of bicarbonate and carbonate alkalinity.

7.5.2 Soluble Metals and Metalloids

Results for water soluble metals and metalloids in the 1:5 extracts are given in Table A2-5 of Appendix 2. ANZECC livestock drinking water guidelines (cattle) and Department of Health non-potable groundwater use guidelines (DoH 2014) are provided for comparison. Instances of values above the higher of these two guidelines is indicated in blue highlights in this table. There are no identified groundwater uses or receptors in the vicinity of the Project other than for use as process water. When comparing results, it needs to be kept in mind that as the analysis was performed on a 1:5 extract (appropriate for soil criteria comparison and seepage estimation in arid environments), versus a commonly used comparison ratio of 1:10 or 1:20 extraction (deionised water ASLP).

Key observations of soluble metals and metalloids data across both phases are:

- In general, concentrations of most metals and metalloids in 1:5 water leachates were negligible (in the low µg/L range) and very low potential for adversely impacting groundwater and surface water quality by a process of leaching or run-off from rainfall. This is given the site conditions of deep, hypersaline groundwater and a lack of any known surface water receptors. Arsenic (discussed below) and particular samples influenced by aluminium colloids or prior field oxidation of higher sulfur PAF samples to produce acidic water leachates upon extraction were the primary notable exceptions.
- Arsenic was the most environmentally significant soluble metal/metalloid species in water extracts with concentrations ranging from 0.1 – 3,395 µg/L and 11 samples exceeding 500 µg/L (ANZECC livestock drinking water guideline) in the 1:5 water extract. The overall median soluble concentration in fresh rock waste extracts however was significantly lower at 25 µg/L and this is a better representation of the bulk waste risk. Elevated arsenic concentrations were associated with mafic and ultramafic waste rock with no arsenic exceedances noted for pegmatite or BIF lithologies. More soluble arsenic was generally associated with higher total arsenic composition, although not all samples with arsenic enrichment produced elevated arsenic leachates. Many of the higher concentrations of soluble arsenic in the ground samples were associated with samples from the approved 15-year pit shell (phase 2 work). It is considered that soluble arsenic in these extracts may be a result of the age of the phase 2 samples being approximately two years old (field exposed) at time of analysis. Drilling was conducted in the latter half of 2017 for phase 2 samples. Arsenopyrite (likely form of arsenic in the fresh rock) is noted as being highly reactive and one of the first sulfide minerals to oxidise. Levels of total and soluble arsenic in current phase 3 post 15-year pit shell were generally lower than those of phases.
- Despite enrichment in antimony and its general association with arsenic, soluble antimony concentrations only exceeded the non-potable groundwater use guideline of 30 µg/L in one sample (35 µg/L, also KEGM058 153-154 as above).
- Aluminium concentrations were very variable with results between <0.01 – 101.4 mg/L in the 1:5 extract of waste samples, with five samples exceeding the livestock drinking water guideline of 5 mg/L. Although aluminium can dissolve under strongly acidic or alkaline conditions and various samples were alkaline in nature, the trend of solubility did not match pH or alkalinity. As these highest concentration samples and levels found did not correlate with acetic acid soluble aluminium (Table A2-6 of Appendix 2), it is considered these aluminium results are largely an artefact very fine colloidal material, followed by acidification for analysis which will dissolve small amounts of particulate aluminium. Two transitional zone samples (KEGM058 30-31 and KEGM59 37-38) were particularly high in what was expected to be colloidal material (aluminium approximately 100 mg/L) despite filtration to 0.45 µm. Re-filtration and analysis of a 0.2-µm-filtered sample returned concentrations of aluminium of less than 0.1 mg/L.
- Samples KEGM45 64-65, KEGR152 78-79 and KEGM45 69-50 are all classified as PAF samples with elevated sulfur of 1.9% or more. These samples, given approximately two years of field exposure of the drill core, produced marginally acidic leachates (pH 4.3 – 5.5) which has influenced the solubility of various metals and metalloids. Iron was elevated in comparison to other samples and the NPUG (0.3 mg/L) and manganese (119 mg/L) and nickel (5.4 mg/L) exceeded the comparison values in Table A2-5 of Appendix 2.
- Lithium solubility was only slightly correlated to measured total lithium concentrations, however the highest concentration in the 1:5 extract was in a pegmatite ore sample (KEGR77 110-115) at 1.62 mg/L. There are no aquatic ecological, livestock or human health drinking water guidelines for lithium although it is known

that toxicity of lithium in aquatic systems decreases in saline or high hardness waters. The ANZECC 2000 irrigation guideline (long term) for lithium is 2.5 mg/L. Groundwater concentrations of lithium in the area are likely to be naturally elevated due to the presence of pegmatite (1.1 mg/L or higher, Section 3.6).

- Despite significant enrichment in total beryllium, tin, tungsten and tantalum associated with pegmatite ore, these elements were present only at trace concentrations in the water extracts reflecting the insoluble nature of the minerals involved. Likewise, chromium and nickel enrichment in mafic or mafic derived rocks did not correspond to soluble chromium or nickel unless, in the case of nickel, oxidation of available sulfides to produce acidic conditions has occurred.

7.6 DILUTE ACETIC ACID LEACHATE

Dilute acetic acid leachate results are presented in Table A2-6 of Appendix 2. As discussed in Section 5.4, analysis of this leachate can provide an indication of heavy metals and metalloids that may be leachable over extended periods of acidic conditions if weakly acidic conditions (approximately pH 3.5) were to prevail. In the case of the Earl Grey resource, this is considered only possible if waste rock comes into contact with sulfidic PAF materials.

Key observations of soluble metals and metalloids data across both phases are:

- Under the acidic conditions of this test, the primary elements released were iron, aluminium, and arsenic, which are all considered a slight dissolution of acid reactive species.
- Aluminium concentrations were overall higher under acid extraction (1:20) compared to water extracts (1:5 ratio) when accounting for the difference in extraction ratio. Eight of the samples reported aluminium concentrations exceeding the livestock drinking water guideline of 5 mg/L. It is also noted that in previous works for Earl Grey pit waste indicated that strongly weathered mafic derived waste tended to be naturally acidic with high levels of exchangeable aluminium (MBS 2021).
- Iron concentrations were generally higher under acid extraction (1:20) compared to water extracts (1:5 ratio) when accounting for the difference in extraction ratio. Fifty-two (52) of the 69 samples reported iron concentrations exceeding the non-potable water guideline value of 0.3 mg/L.
- Arsenic concentrations were generally lower under acetic acid extraction (1:20) conditions compared to water extracts (1:5 ratio) when accounting for the difference in extraction ratio — despite the amphoteric nature of arsenate. This is most likely a result of higher iron concentrations present under acidic conditions which then limit arsenic solubility by formation of insoluble iron arsenate. It is also an indication that release of arsenic from exposure of PAF rock will be more limited to early stages of oxidation only while still circum-neutral (as per particular samples of the water leaches discussed previously). Net impact to groundwater however of early stage oxidation fluids will be extremely minimal due to the same adsorption of the arsenic oxy-anions onto hydrous iron oxide minerals in soils and subsoils.
- Fresh mafic, high magnesium basalt and BIF lithologies released elevated concentrations of calcium under acidic conditions indicating presence of reactive calcite ($CaCO_3$).
- Chromium concentrations in samples filtered to 0.2 µm (initial phase 1 samples were filtered to 0.45 µm and considered slightly affected by colloidal clays) were all very low across all lithologies and waste types indicating tightly bound and not readily bioavailable forms of Cr dominating. This is consistent with various studies, involving higher concentrations of chromium (e.g. 30,000 mg/kg) in lateritic soils which indicate that chromium (as III or VI) is not readily plant available (e.g. Vithanage et al. 2019). Chromium (VI) in the presence of plant root organic acid exudates is extremely reactive and rapidly reacts to form insoluble Chromium (III) (Saputro et al. 2014). This indicates that for Earl Grey, under mildly acidic conditions alone (contact with pH 4 to 5 material, plant root exudates) chromium as measured by aqua regia digestion is not at risk of mobilisation and/or plant uptake.
- All oxide/transitional materials and fresh waste assessed in 0.2 µm filtered samples (those other than initial Phase 1), released low lithium concentrations (0.0016 to 0.76 mg/L), relative to a comparison 2.5 mg/L for irrigation waters. Fresh rock pegmatite subgrade ore of potential application to rehabilitation was the highest

of these results, however this also represents material which is finely crushed for testing versus fresh rock which would apply as rock armouring (hence much lower bioaccessibility).

- Pegmatite ore samples (KEGR96 60-65 and KEGR77 110-115) released a moderate concentration of lithium (5.6 mg/L and 1.4 mg/L in 1:20 extract), but ore samples are considered unlikely to be in prolonged contact with acidic materials.

Concentrations of other environmentally significant metals and metalloids were not found to significantly increase versus a 1:5 water extract and therefore mobilisation of these species is not expected under any of the conditions expected for the Project.

7.7 EXCHANGEABLE CATIONS AND DISPERSION POTENTIAL

A total of 39 samples/composited samples of moderately to highly weathered waste materials have been analysed for parameters to characterise the likely physical/clay characteristics of oxidic waste from Earl Grey.

Results for analysis of particle size distribution, pH, electrical conductivity (EC), Emerson Class and exchangeable cations (as well as derived parameters ECEC and ESP) are provided in Table A2-8 of Appendix 2. As indicated previously in Section 5.5, the ESP (especially above 15 %), is an indication of the sodicity and hence potential dispersivity of clay rich waste. An Emerson Class of one or two indicates by physical testing if the clay fraction of natural aggregates is spontaneously dispersive.

Examination of the results in comparison to typical criteria for soils (MBS 2017) indicated the following properties of Earl Grey oxide waste:

- Ten samples measured for particle size distribution had variable results, with levels of clay fraction content of up to 39%. Sand contents varied in range from 32% to 78% which categorised most samples as sandy clay loams to silty clay loams.
- There was a strong correlation of pH with depth. Excluding the oxide phase 2 sample KEGM058 10-11 which was alkaline (pH of 8), the pH of all samples less than approximately 30 m deep (i.e. the near surface, most highly weathered samples) were found to be naturally strongly to extremely acid, with pH values in the range of 3.9 – 5.4. The acidity is associated with the intensively leached characteristics of Earl Grey mafic derived oxide waste which are results in leaching of basic cations (calcium, magnesium, sodium and potassium) with acidic cations (mainly aluminium with lesser manganese and iron) remaining. This natural exchangeable acidity is not considered risk for acidic seepage or runoff.
- Two weathered pegmatite samples from phase 1 (KEGR32 34-36 and KEGR26 44-45) and the two transitional phase 2 samples (KEGM058 30-31 and KEGM059 37-38) at deeper depths were circum-neutral with pH values between 7.4 and 8.4. These samples also had high ECEC values ranging between 20 and 25.3 cmol(+)/kg. These observations suggest a shift at approximately this depth (30 – 35 m) from highly weathered, naturally acidic kaolinite-based clays to less weathered illite ‘layered’ clays.
- All oxide and transitional samples were sodium and magnesium dominant with high ESPs of between 16 and 80%, indicating all samples of weathered waste are highly sodic and prone to being dispersive.
- Emerson Class testing indicated seven of the twelve clay rich samples tested were Emerson Class one or two and spontaneously dispersive. These dispersive samples all had EC values in the 1:5 extract of less than 1,500 µS/cm. Higher salinity samples, despite high sodicity are not spontaneously dispersive due to the salt content holding the clay material together. Gradual leaching of salt from these samples in the field from rainfall however is expected to result in the samples becoming increasingly dispersive, based on the ESP and clay contents.
- The levels of exchangeable aluminium (e.g. KEGR32 3-7 0.73 cmoles(+)/kg) indicates that exchangeable aluminium is a major source of acidity in weathered oxide wastes of mafic rock. The levels of exchangeable aluminium (as well as the salinity and high silt content) would make the materials hostile for use in rehabilitation as a growth medium. However, leachate from oxide waste contains relatively little titratable

acidity and has limited capacity for mobilising heavy metals (AMD) when compared to acidity generated by oxidation of sulfide minerals in fresh rock lithologies.

Overall results indicated that most of the oxide/laterite, transitional and fresh mineralised waste were sodic (ESP >15%) and/or potentially dispersive where there is sufficient fines (clay) content. This particularly applies to harvested clay rich bulk material B5 which should not be used on slopes (or for regrowth). Oxide and transitional pegmatite waste were found to be low in salinity, circum-neutral to alkaline with low levels of exchangeable aluminium, manganese, and lithium. These materials could be used in rehabilitation as a growth layer on flat or non-erosion prone surfaces of waste landforms.

7.8 PLANT AVAILABLE MEHLICH 3

Ten additional composite samples of transitional and oxide material from phase 3 sampling work were assessed using the Mehlich-3 extraction to determine the availability of certain nutrients, metals and metalloids to plants (Table A2-9 of Appendix 2). Concentrations assigned to low, typical and elevated ranges have been generated from the results of Walton and Allen, 2004 and results of surface samples analysed from DAFWA and DPaW soil surveys and previous mine site surveys conducted by MBS Environmental.

The “Low” rating corresponds approximately to the lowest fifth percentile of unfertilised WA surface soil types and indicates conditions that may result in deficiency to plants not adapted to very low nutrient concentrations in soils. These soil types are often highly weathered siliceous sands in moderate to high rainfall areas in the southwest of WA.

The “Elevated” rating corresponds approximately to the 95th percentile of unfertilised WA surface soil types and may indicate conditions resulting in either nutrient imbalances or toxicities to plant not adapted to high nutrient (especially micronutrients such as boron) concentrations.

Major results included:

- Most metals and metalloids such as calcium, cobalt, copper, potassium, manganese, magnesium, nickel, sulfur, and zinc were considered either deficient or typical of bioavailable concentrations for plant growth in WA soils. On this basis it is unlikely that there will be excessive accumulation of metals such as cobalt and nickel within plant tissues and thus the trophic transfer of metals from plants to grazing animals is also unlikely to be extensive.
- For multiple samples elements such as cobalt, manganese, molybdenum, nickel and phosphorus were present in concentrations that are in the bottom 5% of reference study sites from Walton and Allen, 2004. These elements are therefore the most likely to be considered deficient if plants were to be grown on a matrix based on these waste rock materials post closure.
- Most samples had plant available iron and sodium concentrations that are considered high (>95% of samples from Walton and Allen, 2004). Selected samples contained high plant-available concentrations of boron, copper and potassium, however, given that most samples were in the low-typical range it is unlikely that the high concentrations in some samples are reflective of the oxide material as a whole.
- One sample (Transitional Cal-Alk basalt 2 — Mafic) contained a Mehlich extractable arsenic concentration of 5.4 mg/kg which is considered high although all other samples were significantly lower. Potential for deleterious effects on vegetation and fauna exist at this level if used in growth media but a single result does not indicate the bulk of material will be in this range. No typical guideline value is available for arsenic in WA soils, but bioavailable concentrations for other samples were all classified as not elevated (<5 mg/kg) for all the samples and do not present a risk for significant plant uptake and accumulation which is consistent with the aqua regia concentrations being below the NEPM 2013 soil EIL for public open space.
- Concentrations of all other potential contaminants were low across all oxide samples and are thus of no environmental concern.

7.9 MINEROLOGY

Results for the mineralogical assessment of the crystalline and quantification of amorphous content of five selected samples from phase 1 (fresh and transitional rock zones) and five samples from phase 2 (fresh mafic and ultramafic) are summarised in Table 15. The quantitative X-ray diffraction analysis report is provided in Appendix 3. No additional samples were assessed in phase 3 works as (apart from BIF), the lithologies are a continuation of previous mine waste.

The results for phase 1 samples were consistent with the low sulfur contents of all assessed samples in that phase with non-detectable (i.e. less than approximately 1%), sulfide minerals. Calcite and/or dolomite as readily reactive carbonate minerals for acid neutralisation were also absent in the mafic waste. Significant amounts of reactive silicate ANC were found to be present as chlorite and illite/muscovite, although these minerals react very slowly and are only capable of acid neutralisation to pH 4.5 – 5.0. Mafic samples were dominated by various dark coloured amphiboles collectively classed as hornblende, as well as sodium plagioclase (albite). The weathered pegmatite sample KEGR32 34-36 is notable for being dominated by mixed layer clays such as illite/smectite (along with quartz), which is consistent with the high ECEC values of these samples and tendency towards clay dispersion.

The presence of a lithium aluminium hydroxy sheet silicate — cookeite (9 %) tentatively identified in the transitional pegmatite sample KEGR32 34-36 is consistent with a process of weathering of spodumene in the fresh rock. The lithium bearing minerals petalite (a tectosilicate) or lepidolite (a mica) were not detected in this ore sample, although petalite was indicated originally by Kidman Resources geologists as also being present in pegmatite ore from Earl Grey. Lepidolite is a possible mineral source of the rubidium enrichment by isomorphous substitution of rubidium for lithium. Consistent with variable enrichment in lithium (Section 7.2) in the mafic lithology, the fresh mafic sample KEGR22 90-99 was identified as having lithium amphiboles (3 %) present.

The results for phase 2 samples (higher sulfur content samples being selectively chosen for mineralogy), showed a mixture of pyrite (2 – 3%) and pyrrhotite (2 – 3%) in all four fresh mafic samples. The ultramafic sample (KEGM065 167-168) had no detectable sulfide minerals (also however being lower in sulfur content than the mafics at 0.32%). Carbonate minerals were also detected as calcite (1 – 4%), dolomite (1 – 2%) and magnesite (1% in the ultramafic sample only) available for potential acid neutralisation. Like phase 1, silicates contributing to ANC were present as chlorite in all samples with a particularly high concentration for the fresh ultramafic sample KEGM065 167-168 (26 %). Other silicates participating to silicate ANC like clinopyroxenes, illite/muscovite, pyrophyllite and plagioclases were detected in the fresh mafic samples KEGM054 273-274 and KEGM056 254-255.

Table 15: Mineralogical Summary

Sample	Phase	Weathering Zone	Lithology	Mineral Content (%)
KEGR22 55-60	1	Fresh	Mafic	Hornblende/calcium aluminium amphiboles (69), sodium plagioclase/albite (14), clinopyroxene (5), chlorite (5), quartz (2), amorphous (2), illite/muscovite (1), goethite (1), potassium feldspar (1).
KEGR22 90-99	1	Fresh	Mafic	Hornblende/calcium aluminium amphiboles (52), sodium plagioclase/albite (22), clinopyroxene (1), chlorite (10), quartz (2), amorphous (6), illite/muscovite (4), lithium amphibole (3), potassium feldspar (2).
KEGR27 60-67	1	Transitional	Mafic	Hornblende/calcium aluminium amphiboles (52), calcium plagioclase (18), clinopyroxene (9), chlorite (3), quartz (4), amorphous (5), illite/muscovite (2), tourmaline (2), potassium feldspar (4), clay (2).
KEGR50 64-66	1	Fresh	Pegmatite (Ore)	Sodium plagioclase/albite (27), hornblende/calcium aluminium amphiboles (17), quartz (22), spodumene (10), illite/muscovite (6), potassium feldspar (9), clays (2), chlorite (1), amorphous (2).

Sample	Phase	Weathering Zone	Lithology	Mineral Content (%)
KEGR32 34-36	1	Transitional	Pegmatite	Quartz (37), mixed layer clays (24), sodium plagioclase/albite (6), cookeite (9), hornblende/calcium aluminium amphiboles (1), illite/muscovite (4), potassium feldspar (3), chlorite (5), amorphous (9), kaolinite/other clays (1).
KEGM065 167-168	2	Fresh	Ultramafic	Amphibole (33), amorphous (16), calcite (2), chlorite (26), dolomite (2), clay (3), magnesite (1), rutile (1), serpentine (9), siderite (1), talc (7).
KEGM054 273-274	2	Fresh	Mafic	Amphibole (24), amorphous (33), calcite (1), chlorite (9), clinopyroxene (5), dolomite (1), hematite (1), illite/muscovite (6), periclase (1), potassium feldspar (9), pyrite (3), pyrophyllite (2), pyrrhotite (3), quartz (3).
KEGM056 254-255	2	Fresh	Mafic	Amphibole (32), amorphous (15), calcite (2), chlorite (5), clinopyroxene (37), dolomite (1), illite/muscovite (2), periclase (1), pyrophyllite (2), pyrrhotite (2), quartz (<1).
KEGR152 104-105	2	Fresh	Mafic	Amphibole (37), amorphous (5), calcite (4), chlorite (1), clinopyroxene (19), gypsum (3), pyrite (2), quartz (29).
KEGM045 64-65	2	Fresh	Mafic	Amphibole (2), amorphous (5), pyrite (3), quartz (89), siderite (1).

7.10 NATURALLY OCCURRING RADIONUCLIDES

Naturally occurring radioactive materials (NORM) arises due to the presence of one or more radioactive isotopes naturally present in a material. Key amongst these are thorium (Th-232) and uranium (U-238) which are naturally radioactive gamma (ϒ) emitting elements present in ores and concentrates. Potassium (K-40) is also a low-level gamma emitter. Rubidium and potassium are natural low-level beta (β) radiation emitters with long half-lives (slow decay), due to the Rb-87 and K-40 isotopes respectively, however β emission is a significantly lower risk to health than gamma emission and normally only assessed in regards for internal ingestion in waters, food etc (DMP 2010).

The activities of the Earl Grey waste and ore materials can be calculated based on their elemental concentrations (Table A2-3 of Appendix 2) and specific activities for each of the four naturally occurring radioactive elements (U, Th, K and Rb). The minimum, maximum and average concentrations of waste rock and pegmatite ore, across all phase samples are outlined in Table 16. The specific activities for naturally occurring proportions of the isotopes applied were: U (U-238) 12,445 Bq/g, Th (Th-232) 4,059 Bq/g, K (K-40) 30.9 Bq/g and Rb (Rb-87) 890 Bq/g (IAEA 2006).

A level of 1 Bq/g head of chain activity concentration is considered 'inherently safe' to humans for uranium and thorium series radionuclides (IAEA 2004, IAEA 2006) and this value is set as the 'exclusion limit' as the resulting effective dose to workers is very unlikely to be more than 1 mSv/year. The level of 1 Bq/g for these applies individually to each radionuclide (U/Th), however the sum is often compared to this value as a conservative screening tool (Table 16). Levels of Th/U head of chain activity above 10 Bq/g are considered a dangerous good (ten times the exclusion limit) for transport purposes (ARPANSA 2014).

Rubidium is geochemically enriched (GAI ≥ 3) in all pegmatite samples as well as some of the other samples assessed (Table A2-3, Appendix 2). Uranium and thorium were not geochemically enriched.

For rubidium, the *Radiation Safety Act 1975* (WA) and *Radiation Safety (General Regulations) 1983* (WA) has a defined criterion of 30 Bq/g for a NORM radioactive material or a total activity (accounting for volume and activity) of less than 0.4 M Bq for Rb-87 (Schedule V, General Regulations). A level of 10,000 Bq/g is applicable in relation to placarding and management during transport of Rb-87 based on naturally occurring radioactive material (ARPANSA 2014, Table 2). No exclusion limit specifically for Rb-87 appears to have been set, although IAEA 2004 noted that naturally occurring Rb-87 was assessed and deemed to not require specific risk assessment. Based on ARPANSA 2014 exclusion principles of DG transport criteria being 10 times the NORM exclusion limit, the inferred exclusion limit/inherently safe level for Rb-87 would be 1,000 Bq/g.

Overall, naturally occurring radiation levels in all assessed samples and calculated pegmatite ore were very low, consistent in particular with lack of enrichment in uranium or thorium. They do not classify under any relevant criteria described above (Table 16), being well below the levels of activity (exemption limits) which would trigger possible further assessment. Monitoring under part 16.2 of the *Mines Safety Inspection Regulations 1995* (WA) for radiation risk in relation to handling of this material is not required.

Table 16: Calculated Activity of Waste Rock and Ore

Nuclide		Waste Rock			Pegmatite Ore			Exclusion Limit
		Minimum	Maximum	Average	Minimum	Maximum	Average	
U	mg/kg	0.024	5.48	0.6	2.42	4.05	3.16	N/A
	Bq/g	0.0003	0.0677	0.00755	0.0299	0.05	0.039	1
Th	mg/kg	0.09	16.4	1.06	1.21	2.51	1.78	N/A
	Bq/g	0.0004	0.0665	0.0044	0.0049	0.0102	0.0072	1
U + Th	Bq/g	0.0007	0.102	0.0118	0.035	0.0574	0.0462	1
K	mg/kg	0.002	2.41	0.47	1.52	2.33	1.87	N/A
	Bq/g	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	10
Rb	mg/kg	0.64	2,985	167	1,154	3,274	2,390	N/A
	Bq/g	0.0006	2.65	0.1488	1.03	2.91	2.13	1000

7.11 FIBROUS MINERALS

7.11.1 Background and Previous Work

Current testwork and its results should be considered in the additional context of previous work Covalent Lithium (samples submitted for optical microscopy analysis), Occuhealth (Occuhealth 2021) and Glossop Consultancy (Glossop 2021).

A summary of previous work and findings for the Earl Grey pit lithologies is as follows:

- Initial analysis work on samples selected by Project geologists was by optical microscopy according to AS4964 2004 *Method for the Qualitative Identification of Asbestos in Bulk Samples* on multiple samples of crushed mafic/ultramafic fresh and transitional rock types. This indicated strong presence of actinolite, in particular, which is one of six potentially classified asbestos minerals. Samples from the oxidic zone or pegmatite ore were determined to be absent of asbestos or asbestiform minerals.
- Positive assignment as being asbestiform (versus cleavage fragments) in nature, however, depends on comparison to known morphology examples and the resolution of the instrument which is not generally possible by optical microscopy on ground samples. In particular, non-asbestiform actinolite (which has an acicular habit with 'bladed' type morphology with clusters of parallel crystals), is well known to create cleavage fragments during crushing/grinding which biases high the number of 'countable fibres'. In such instances, high resolution SEM-EDS or TEM analysis of morphology is normally required as further investigation to determine between truly asbestiform material and cleavage fragments. At the time of writing, AS4964 2004 is undergoing revision for inclusion of TEM or scanning electron microscopy (SEM) to reduce the known potential for false positives of asbestos determinations in natural rock samples using optical microscopy.

- In January 2021, Occuhealth (Occuhealth 2021) noted doubts over the assignment of the fibres as asbestiform based on experience and visual assessment of waste at Mt Holland. Occuhealth recommended re-analysis by Glossop Consultancy.
- In April 2021, Laurie Glossop of Glossop Consultancy (Glossop 2021), examined a large number of respirable 'fibres' from selected representative drill cores within the Earl Grey pit. While multiple examples of actinolite and anthopphyllite of appropriate size and aspect ratio were identified and examined in mafic and ultramafic rock, none were determined to truly asbestiform in nature. The overall potential concentration of asbestos in these waste rock types was considered to be <0.001% w/w with correspondingly extremely low risk for use of fresh rock in armouring etc. at final closure or other construction use where a comparable criteria would be 0.02% w/w for bonded asbestos in public open spaces soils (0.05% w/w in industrial).

7.11.2 Current Work

Six bulk composite waste rock samples (Table 17) considered representative of mine waste were screened for the presence of fibrous asbestiform minerals in the current assessment of extensional mining. Pegmatite was not included as there is no considered potential for pegmatite to contain asbestos or asbestiform minerals. Work was conducted in conjunction with Dr Laurie Glossop of Glossop Consultancy. The laboratory report is provided in Appendix 3**.**

A number of elongated mineral particles (EMPs) of actinolite, tremolite and anthophyllite were detected in each sample. These are considered cleavage fragments and not truly asbestiform noting that each of these minerals can exist in asbestiform or non-asbestiform habits. One fibre (cummingtonite/anthophyllite) was reported in composite sample KOMBASALT Comp2, and one non-asbestiform fibre (magnesiohornblende) was reported in composite sample ALKBASALT Comp1.

Table 17: Asbestiform Mineral Assessment

Composite Sample ID	Original Sample IDs
KOMBASALT Comp1	WC006 WC007 WC008
KOMBASALT Comp2	WC014 WC016 WC017
ALKBASALT Comp1	WC029 WC030 WC031
ALKBASALT Comp2	WC069 WC070 WC075
High Mg BASALT Comp	WC044 WC045 WC048
BIF Comp	WC081 WC085

Overall, these results are all consistent with previous works described above and asbestiform content is considered to be <0.001% w/w in all rock types across all weathering zones. Asbestos comparison criteria for solids/bulk materials vary depending on the application and jurisdiction, they include:

- 0.1% for classification of a product as Category 1A carcinogenic substance under the Globally Harmonised System (GHS) for classification and labelling of chemicals (GHS 2009). This is also the maximum allowable site specific clean up criteria for asbestos in soil set by WA Department of Health (DoH) (DoH 2021).
- A criterion of 0.01% w/w adopted by Department of Water and Environmental Regulation (DWER) for approvals of exporting of bulk (100 tonnes or more per day) granular materials through WA ports under Category 58 of the *Environmental Protection Regulations 1987* (DWER 2018). This is in turn intended to control airborne asbestos fibres below public health exposure guideline for limited duration activities of 0.01 fibres/mL (NOHSC definition, enHealth 2005, DoH 2021)
- Department of Health soil asbestos investigation criteria (DoH 2021) for tier 1 risk screening criteria of soils/near surface material which would apply post closure:
  - 0.001% w/w for friable asbestos (FA) and asbestos fines (AF) contamination for all soil types.
  - 0.01% w/w for bonded asbestos containing materials (ACM) in residential soil (open access).
  - 0.02% w/w for bonded asbestos containing materials (ACM) in recreational/public open space areas.
  - 0.05% w/w for bonded asbestos containing materials (ACM) in industrial soils.

Given the rocks can be considered a form of bonded ACM with minimal if any potential to release fibres and evidence is lacking for anything but a negligible concentration of asbestiform fibres, there is no considered need for particular management of any material as containing asbestos. A conservative approach for fine dusts (which include hazardous silica dust) is to implement controls on respirable dust levels (particularly during drilling and blasting) during operations. There are no considered implications for closure design.

8. CONCLUSIONS

8.1 FRESH ROCK WASTE CHARACTERISATION

A total of 133 fresh waste rock samples were selected and assessed across three phases of sampling for the Project. During phases 1 and 2, the selection of samples involved a bias to include higher sulfide samples to inform PAF management. Results indicated that:

- All samples from phase 1 testing (first 10 years of mining) were classified as NAF, with only one sample (of 29) having a total sulfur content greater than 0.3 %. Consistent with examination of sulfur assay data and increases in sulfur content in later stages of mining, some mafic samples beyond 10 years of mining were identified as PAF or uncertain. Two fresh mafic samples with marginal sulfur contents of 0.42 – 0.46% were classified as uncertain but assigned as 'PAF' on the basis of NAG pH less than 4.5. The laboratory ANC value is likely overestimated due to slow acting silicate ANC.
- Of the 60 phase 3 samples (current extension sampling), three samples were reported as PAF or PAF-LC and two were reported as uncertain. The uncertain samples are assumed PAF based on their low NAG pH values (3.2 and 3.9). All five samples were fresh mafic lithologies with sulfur contents of 0.46 – 3.3%. All ultramafic, BIF and pegmatite ore lithologies were classified as NAF or NAF (AC). All ultramafic samples assessed from all current and former works were NAF and were variably acid consuming.
- A conservative cutoff for delineation of PAF versus NAF delineation in fresh rock based on all static testing is 0.4% total sulfur. This includes allowance for the four samples of mafics which were classified as uncertain (0.42 – 1.1 % total sulfur). It is conservative on the basis that:
    - It assumes the absence of calcite which although often found present, was inconsistent. Calcite is more consistently present in BIF waste rock.
    - Static testing (compared to milder oxidation or kinetic testing) tends to overestimate potential for net acid production (finely ground powder, rapid, forced reaction conditions).
    - The ultramafic waste is lower in sulfur (assay data mean 0.15% sulfur) than mafic (mean 0.36%) waste rock and testing indicates significantly higher levels of ANC. This lithology could be managed using a higher sulfur cutoff than 0.4% total sulfur in the mine block model if desired and subject to further testing. As an example, a sample of komatiite ultramafic at 0.65% sulfur was still NAF with a NAG pH of 10.
- All mafic/ultramafic and contact zone waste rocks showed significant enrichment in lithium, chromium and beryllium consistent with the geology of the orebody formation and the mafic/ultramafic rock types. Arsenic (maximum 1,884 mg/kg) and antimony (maximum 7.4 mg/kg) were the other most commonly enriched elements. Although other selected samples (in particular, contact zone samples close to the pegmatite orebody) were also enriched in antimony, rubidium, tin, tantalum, tungsten and cadmium from these lithologies, the levels of enrichment were marginal and average overall concentrations of environmentally significant metals and metalloids were low.
- Water leachates of NAF waste rock were alkaline and with low salinity and indicated very low to less than detectable concentrations of most metals and metalloids, which is consistent with the insoluble nature of the expected mineral forms. Most results were well below ANZECC 2000 livestock drinking and DoH 2014 non-potable groundwater water use guidelines, with the exception of arsenic in some samples and aluminium for which variable results were a result of very fine particulate material. The concentrations of arsenic in the water leachates for current phase 3 fresh samples were much lower than those from previous with only two samples exceeding the livestock drinking water guideline 0.5 mg/L compared to eight samples from phase 1 and 2. Other elements although enriched were not found to be significantly soluble in NAF waste rock. Seepage or runoff from these materials is predicted to be alkaline, low to brackish salinity with very low concentrations of metals and metalloids and low levels of soluble alkalinity.
- Under acidic conditions generated by acetic acid leaches or field oxidisation of higher sulfur PAF materials, the primary metals released will be iron, aluminium, manganese, nickel, arsenic (variable), calcium and magnesium. Variable solubility of arsenic in test results was deemed as initial release by oxidation of arsenopyrite, however the significant presence of iron (either from oxidation of iron sulfides or contact with

iron rich weathered materials) will then form insoluble iron arsenates such as scorodite under more neutral conditions.

- Calculated NORM activity levels of fresh waste rock material were all very low.
- Although actinolite in particular and also anthophyllite are present in the mafic and ultramafic fresh and transitional rock, this is not considered to be present as asbestiform mineral fibres.

8.2 TRANSITIONAL AND OXIDE WASTE CHARACTERISATION

A total of 26 transitional and 28 oxide waste rock samples were selected and assessed across three phases of the Project. Geochemical assessment of transitional and oxide mafic or pegmatite derived samples indicated that:

- Four of the 26 transitional samples were classified as PAF. Three samples were mafic and the fourth sample was quartz/pegmatite. One sample (WC062) contained existing acidity (pH 4.5) and low total sulfur (0.29%). Whereas the remaining samples reported high total sulfur of total sulfur. The remaining two mafic samples report total sulfur of 0.0 and 3.8%. The remaining transitional mine waste rock samples were classified as NAF.
- Oxidic, clay rich samples within 30 metres of surface were found to be naturally strongly to extremely acid, with pH values in the range 3.9 – 6.9. One such sample (KEGR32 from 3 – 7 metres) was classified as PAF (NAG pH less than 4.5, initial pH 3.9). This sample, along with other oxide waste samples, should be considered as naturally acidic subsoil/oxide waste where acidity is associated with residual or exchangeable acidity rather than acid formation potential due to the lack of oxidisable sulfides. This form of natural exchangeable acidity presents a much lower potential environmental risk compared to acidity generated by oxidation of sulfide minerals in fresh rock although the levels of exchangeable aluminium (and salinity) will make these materials hostile for use in rehabilitation as a growth medium.
- Similar to fresh rock samples, transitional mine waste rocks showed significant enrichment in lithium and beryllium, but these were absent in more highly weathered oxide clays. Tungsten and antimony were the only elements geochemically enriched in oxide samples. Transitional samples enrichment was similar to fresh rock and included lithium, beryllium, cobalt, chromium, nickel, antimony, tin and tantalum. Overall, the concentrations of environmentally significant metals and metalloids were lower than for fresh rock material.
- Arsenic was the most soluble environmentally significant metal or metalloid in water leachates with a maximum of 1.0 mg/L soluble in a sample of transitional pegmatite (1:5 extract) which exceeded the ANZECC 2000 livestock drinking water guideline of 0.5 mg/L. As other samples were considerably lower in concentration, there is no considered risk to the surrounding environment — particularly given the hypersaline nature of the groundwater. The concentrations of arsenic in the water leachates for phase 3 transitional samples were very low with no samples exceeding either livestock drinking water guideline or non-potable water guideline of 0.1 mg/L.
- The pH and salinity of transitional and oxide mine waste material was strongly correlated with depth. All samples less than approximately 30 – 35 m deep (i.e. the most weathered of oxide waste) were strongly to extremely acid, with pH values in the range 3.9 – 6.9, and highly to extremely saline (EC >780 µS/cm). Transitional samples at deeper depths were circum-neutral and only slightly saline (approximately 200 – 300 µS/cm in a 1:5 extract). Both observations suggest a shift at approximately this depth (30 m) from highly weathered acidic kaolinite-based clays to less weathered illite 'layer' clays. Transitional samples from phase 3 were non-saline (<90 µS/cm) and the pH was variable as either slightly acidic or alkaline.
- All oxide samples were sodium and magnesium dominant with high ESP values between 16 and 80%, indicating all samples of clay-rich oxide waste from the Project are highly sodic and prone to be dispersive. Emerson Class results indicated 7 of the 12 oxide/transition samples tested were spontaneously dispersive. The remaining samples which were not spontaneously dispersive all had EC values in the 1:5 extract of greater than 1,500 µS/cm. This indicates that gradual leaching of excess salt from these higher salinity samples in the field (if exposed to rainfall), is expected to result in these materials becoming increasingly dispersive, based on the ESP and clay contents.

- Mehlich extractible (plant available) concentrations of most tested nutrients and metal(oids) were within the typical range of unfertilised WA soils. Elements including cobalt, manganese, molybdenum, nickel and phosphorus were amongst those most likely to be limiting if these materials were used as a plant growth medium. Conversely, iron and sodium are likely to be present in excessive concentrations and thus could potentially limit plant growth. A composite sample of transitional mafic (Cal-Alk Basalt) contained an elevated Mehlich extractable arsenic concentration considered to be high (5.4 mg/kg) but was a single sample versus others which were much lower.
- Calculated NORM activity levels of the oxide and transitional waste rock material were very low and as asbestiform minerals were not detected in fresh rock composites, weathered waste is considered even less likely to contain asbestiform minerals.

8.3 ORE CHARACTERISATION

A total of 23 pegmatite ore samples were selected and assessed across the LOM pit shell for the Project. The results indicated that:

- All samples of pegmatite ore contained extremely low levels of total sulfur (average 0.03% and maximum 0.12%) which resulted in all ore samples, being classified as NAF.
- As expected for a pegmatite orebody, all ore samples showed significant geochemical enrichment in lithium, beryllium, rubidium, tantalum and tin. Ore samples were otherwise very low in significant enrichment with only arsenic in one ore sample recording a value considered enriched (GAI 3) versus an average soil abundance of 25 mg/kg.
- Water leachate results for ore samples, were alkaline, non-saline and contained very low to less than detectable concentrations of most metals and metalloids. All results were well below ANZECC 2000 livestock drinking water and DoH 2014 non-potable groundwater water use guidelines, with the exception of aluminium for which overall results were inconsistent and more likely to be a result of very fine particulate material. Arsenic, despite enrichment in one sample, had very low solubility in water extracts (lower than for corresponding concentrations in mafic waste rock).
- Low grade ore samples/mineralised waste pegmatite is likely to contain cookeite and petalite as non-economic lithium minerals.
- Calculated NORM activity levels of the ore (both from all samples tested and also calculated from 5,117 drilling assay sample results) were low and do not require further assessment.
- Comparison of sulfur and arsenic assay data from approved 10-year pit shell versus extension to 2051 (LOM) indicates lower concentrations of both elements in future mining and hence further reduced risk from acid formation or arsenic mobilisation in stockpiled ore or tailings from proposed mining.

9. IMPLICATIONS FOR MANAGEMENT

9.1 FRESH ROCK WASTE

As a result of this study the following are deemed suitable uses for the fresh rock waste from the LOM pit shell:

- The fresh rock from later portions of mining (2051 LOM pit shell) has slightly different geology to earlier mining (including BIF, 1.7% of waste rock) and this and mafic fresh rock in particular is indicated to contain portions of potentially acid forming (PAF) waste rock which will require management. Based on a conservative total sulfur cutoff of 0.4% and information from site geologists, the proportion of PAF fresh rock is estimated at approximately 6 % (Table 18) of total fresh mafic and ultramafic rock waste (life of mine (LOM) pit shell).
- PAF waste rock (fresh or transitional) should be buried internally within a waste rock dump or placed as backfill into the pit. Placed as internal waste in an above ground dump it should ideally be covered with waste oxide (low permeability cover) and subsequently a store and release cover of suitable thickness to minimise net infiltration to the PAF oxide cover layer.
- NAF fresh waste rock is considered suitable for use in mine use, rock armouring, construction or other purposes as required. Any pegmatite fresh rock which is not ore can be considered NAF.

9.2 TRANSITIONAL WASTE

As a result of this study the following are deemed suitable uses for the transitional waste from the Project:

- Most transitional waste rock is considered NAF and overall, geochemically benign with low levels of soluble metals and metalloids with minimal risk of any seepage or run-off impacting the surrounding environment.
- Transitional material below 30 – 35 m (based across all results) is expected to be circum-neutral in pH and slightly to moderately saline. This material should be suitable as a subsoil water storage layer for rehabilitation underneath topsoil on flat surfaces (store and release layer). Long term placement on exposed slopes would be subject to further assessment as to physical strength and resistance to long term erosion.

9.3 OXIDE WASTE

Management of oxide waste from the Project should be considered as follows:

- After initial harvesting of topsoils, underlying clay rich oxide overburden regolith material (mafic and pegmatite derived) within 30 – 35 m of the surface is likely to be highly saline to extremely saline and slightly to highly naturally acidic with significant levels of exchangeable aluminium acidity. Although low in general soluble toxicants, these properties make the material unsuitable as growth medium. This said, titratable acidity is low, and risk of significant acidic seepage is extremely low as the materials represent naturally highly leached clays with low permeability.
- Due to the elevated fines content and sodic nature of the oxide mine waste materials, all oxide and the more clay rich saprolite transitional waste is either spontaneously dispersive or likely to become so if placed in exposed (surface or near surface) locations where the salt, which currently stabilises clay aggregates, will gradually leach from the material. Oxidic clays derived from weathering of mafics have an elevated fines content and are particularly likely to erode if placed on slopes (erosion being a somewhat different process to dispersion).
- Management of oxide mine waste should avoid placing the material on sloped surfaces in order to prevent erosion. Suitable options would include returning oxide mine waste materials into the pit void (ideally covered with transitional waste) and/or covering with competent mafic rock waste in an above ground landform. Rehabilitation outcomes for pit void filling would be improved if the most acidic and saline oxide material is not placed in the upper 2 – 3 m of the backfill. Transitional zone material should be used in this uppermost part of the backfill.

- Clay rich oxide material is suitable for use for use as a low-permeability cover layer over PAF waste rock provided it is in turn armoured to prevent erosion and exposure of underlying PAF.

9.4 SUMMARY OF MANAGEMENT IMPLICATIONS

As a result of waste and low grade ore characterisation and the implications, these suggested outcomes were applied to the mine block model. Table 18 provides the relevant breakdown of PAF material by lithology from the mine block model based on a 0.4% total sulfur cutoff for all lithologies other than weathered oxide material.
The outcomes for management of mine waste material and summarised in Table 19.

Table 18: NAF / PAF Breakdown of Waste Material based on 0.4% Total S Cutoff

Weathering	Lithology	Waste Rock (Mt)			PAF % of Waste
		NAF	PAF	Total	%
Oxide	All lithologies	85.6	0	85.6	0
Transitional and Fresh	Mafic	245.3	16.6	262	3.9
	Ultramafic	55	4.12	59	1.0
	BIF	2	4.14	6	1.0
	Pegmatite Waste	10.1	0	10	0
Total	**All Lithologies**	**397.5**	**24.9**	**422**	**5.9**

Table 19: Summary of Risk Factors and Suggestions for Rehabilitation Materials and Waste Rock

Material Type	Approx. Depth	Elevated Acid Extractable Elements	Salinity	Key Soluble or Plant Available Metals/Metalloids	Dispersion/Erosion Potential	Comments, Suitable Uses/Management
Topsoils	0- 300 mm	Cr, Ni	Low salinity		Likely erosive on slopes	Harvest and replace at closure as final topsoil layer.
Near Surface Gravels	0.3 to 3 m	Cr	Moderate		Not dispersive due to gravel size, likely minor erosion potential on slopes	Potentially suitable cover material mixed with topsoil, may require armouring if placed on slopes. Concrete potentially.
Near Surface Silty Gravel, Silty Sand	0.3– m		Moderate		Not dispersive due to size, likely erosion potential on slopes	Potentially suitable as subsoil store and release layer but would require armouring on slopes.
Oxide Clays, Gravelly Clay	0.3–3 m		High to Extreme	B	Sodic and Dispersive, high erosion potential on slopes	Not suitable for rehabilitation use. Clay rich material may be useful as low permeability layer when compacted (e.g. over historical TSF).
Shallow Pegmatite Laterite (Gravel-Clay)	3–15 m	Cr	Moderate		Sodic but unlikely dispersive, some erosion potential on slopes	Potentially acidic in parts and elevated in Al, Cr. Unless required dispose to waste.
Shallow Mafic Laterite (Gravel-Clay)	3–15 m	Cr	Moderate		Sodic but unlikely dispersive, some erosion potential on slopes	Potentially acidic in parts and elevated in Al, Cr. Unless required dispose to waste.
Mafic Derived Upper Saprolite	15–30 m	Mn, Ni	Moderate to Low	Ni, Co at low levels	Sodic but unlikely dispersive or significantly erosive due to size	Neutral pH lower salinity than laterite. Minor risk Ni, Co uptake. Unless required as subsoil/cover dispose to waste.
Mafic Derived Lower saprolite/saprock	>30 m	Mn, Ni	Moderate to Low	Ni, Co at low levels	Sodic but unlikely dispersive or significantly erosive due to size	Neutral pH lower salinity than overlying material. Higher levels of manganese and nickel but not indicating as high risk. Use if required and NAF or dispose to waste.
Pegmatite derived upper Saprolite	15–30 m	Mn, Ni	Moderate to Low	Ni, Co at low levels Mo, P	Sodic but unlikely dispersive or significantly erosive	Neutral pH lower salinity than laterite. Minor risk Ni, Co uptake by vegetation. Unless required as subsoil/cover dispose to waste.
Pegmatite derived lower saprolite/saprock	>30 m	Mn (slight)	Moderate to Low	Mo, P, Li	Sodic but unlikely dispersive or significantly erosive	Should be suitable for use as cover where required overlain with available topsoil and should not require armouring. Low levels of metals enrichment. Preferred to material 3–30 m depth. Next best material for armouring after fresh rock.

Material Type	Approx. Depth	Elevated Acid Extractable Elements	Salinity	Key Soluble or Plant Available Metals/Metalloids	Dispersion/Erosion Potential	Comments, Suitable Uses/Management
Subgrade Pegmatite/Petalite	Fresh	Li, Rb, Cs	Low	Mo, P, Li	Not erosive	Indicated low potential for leaching, can be used as rock armour as required for rehabilitation.
Fresh Mafic (basalts)	Fresh	Mn, Ni, Cr, As, V, Cu	Low	As, Li, Co at low levels	Not erosive	Indicated low potential for leaching based on previous works, NAF waste can be used as rock armour or construction as required for rehabilitation. PAF waste should be backfilled into pit or buried internally in an above ground facility covered by low permeability oxidic clays.
Fresh Ultramafic (komatiite)	Fresh	Mn, Ni, Cr, As	Low	Li, Co at low levels	Not erosive	Indicated low potential for leaching based on previous works, NAF can be used as rock armour or construction as required for rehabilitation. PAF waste should be backfilled into pit or buried internally in an above ground facility covered by low permeability oxidic clays.
Fresh Sediments/BIF (Minor <2% of waste)	Fresh	Mn, Ni, Cr, As	Low	Li	Not erosive	Indicated low potential for leaching based on previous works, NAF waste can be used as rock armour or construction as required for rehabilitation. PAF waste should be backfilled into pit or buried internally in an above ground facility covered by low permeability oxidic clays.

10. REFERENCES

AIMM 2001. Field Geologists' Manual. Australasian Institute of Mining and Metallurgy Monograph 9. Fourth Edition. Carlton, Victoria.

AMIRA 2002. *ARD Test Handbook: Project 387A Prediction and Kinetic Control of Acid Mine Drainage.* Australian Minerals Industry Research Association, Ian Wark Research Institute and Environmental Geochemistry International Pty Ltd, May 2002.

ANZECC 2000. *National Water Quality Management Strategy, Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.

ARPANSA 2014. *Safe Transport of Radioactive Material Code, Radiation Protection Series C-2.* Australian Radiation Protection and Nuclear Safety Agency, Australian Government December 2014.

Bureau of Meteorology (BoM). 2023. Rainfall Statistics for Lake Carmody (Site Number 10670) and Hyden (Site Number 010568) Lake Carmody Rainfall Data and Hyden Climate Data [Accessed 1 February 2017].

CSIRO 1999. Soil Analysis – an Interpretation Manual. K.I. Peverill et. al. Commonwealth Scientific and Industrial Research Organisation Publishing Collingwood, Victoria.

DoH 2014. Contaminated Sites Ground and Surface Water Chemical Screening Guidelines, Department of Health, Government of Western Australia, December 2014.

DoH 2021. *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia.* Department of Health, Government of Western Australia July 2021.

DWER 2018. *Guideline: Port Authority Bulk Handling Trials.* Department of Water and Environmental Regulation, Government of Western Australia November 2018.

DIIS 2016. Preventing Acid and Metalliferous Drainage (Department of Industry, Innovation and Science) September 2016.

DMP 2010. *Managing Naturally Occurring Radioactive Material (NORM) in Mining and Mineral Processing – Guideline*. NORM-5 Dose Assessment. Prepared by the Department of Mines and Petroleum (WA), Resources Safety

DMP 2016. *Materials Characterisation Baseline Data Requirements for Mining Proposals (Draft Guidance).* Prepared by the Department of Mines and Petroleum (WA), March 2016.

enHealth 2005. Management of Asbestos in the Non-Occupational Environment. Department of Health and Aging (enHealth council), Commonwealth Government of Australia. 2005.

Fandeur et al. 2009. Fandeur, D., Juillot, F., Morin G, olivi, L., Cognigni, A., Webb, S.M., Ambrosi, J.P., Fritsch, E., Guyot, F., Gordon, E, Brown, J.R. XANES Evidence for Oxidation of Cr(III) to Cr(VI) by Mn-Oxides in a Lateritic Regolith developed on Serpentinized Ultramafic Rocks of New Caledonia. *Environ Sci Technol* 43, pp 7384-7390.

Glossop 2021. Qualitative Risk Assessment of Solid Samples from the Earl Grey Deposit (Mt Holland) for Fibrous Minerals. Letter Report produced for Covalent Lithium (Tim Gilbert) by Glossop Consultancy, April 2021.

GHS 2009. Globally Harmonised System of Classification and Labelling Chemicals (GHS), 3rd Edition 2009. United Nations, New York

GRM 2017. Mount Holland Lithium Project Hydrogeological Study. Report prepared for Kidman Resources by Groundwater Resource Management, December 2017, Report J160015R01.

Harvey, G. L. 2001. Combined Mineral Exploration Report on the Mt Hope North Reporting Group, Forrestania District, W. A. for the Period 1 July 2000 to 30 June 2001. Viceroy Australia Limited, Report No. A63424.

IAEA 2004. *Application of the Concepts of Exclusion, Exemption and Clearance* IAEA Safety Standards Series RS-G-1.7, IAEA, Vienna (2004).

IAEA. 2006. Assessing the Need for Radiation Protection Measures in Work Involving Minerals and Raw Materials IAEA Safety Standards Series Number 49, International Atomic Energy Agency, Vienna (2006).

INAP 2009. Global Acid Rock Drainage (GARD) Guide. International Network for Acid Prevention, http://www.gardguide.com (accessed 11 September 2019).

Kidman 2017*. The geological setting, mineralogy and geochemistry of the Earl Grey lithium pegmatite*. Internal Technical Report, Kidman Resources. May 2017.

MBS 2017. Earl Grey Lithium Deposit Soil and Landform Assessment. Report prepared for Kidman Resources by MBS Environmental, March 2017.

MBS 2019. Earl Grey Lithium Project Spodumene Concentrator Process Waste Geochemical Assessment. Report prepared for Covalent Lithium Pty Ltd by MBS Environmental. November 2019.

MBS 2020. Earl Grey Lithium Project Waste Rock and Ore Characterisation - Phase 2. Report prepared for Covalent Lithium Pty Ltd by MBS Environmental. May 2020.

MBS 2021a. Earl Grey Lithium Project Waste Rock and Ore Characterisation - Phase 1. Report prepared for Covalent Lithium Pty Ltd by MBS Environmental. January 2021.

MBS 2021b. Earl Grey Lithium Project Waste Rock and Ore Characterisation - Phase 1 Extended Geochemical Assessment. Report prepared for Covalent Lithium Pty Ltd by MBS Environmental. November 2021.

Mehlich, A. 1984. Mehlich 3 Soil Test Extractant: A Modification of Mehlich 2. *Communications of Soil Science and Plant Analysis* 15: 1409-1416.

NEPC 2013. Guideline on Investigation Levels for Soil and Groundwater. Schedule B1. *National Environment Protection (Assessment of Site Contamination) Measure 1999*. Prepared by the Office of Parliamentary Counsel Canberra.

Occuhealth 2021. Covalent Lithium Gap Analysis Update Report. Report re asbestiform mineral potential produced for Covalent Lithium by Occuhealth Pty Ltd (Adam Hiscox), January 2021.

Price, W. A. 1997. Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia. British Columbia Mine Reclamation Section, Ministry of Employment and Investment, April 1997 http://mend-nedem.org/mend-report/draft-guidelines-and-recommended-methods-for-the-prediction-of-metal-leaching-and-acid-rock-drainage-at-minesites-in-british-columbia/ (accessed 6//9/2023).

Price, W. A. 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. Report prepared for the MEND (Mine Environment Neutral Drainage Program) Report 1.20.1 by CANMET Mining and Mineral Sciences Laboratories. Natural Resources Canada, December 2009. http://mend-nedem.org/mend-report/prediction-manual-for-drainage-chemistry-from-sulphidic-geologic-materials/ (accessed 6 September 2023)

Raous et al. 2010. Raous, S., Becquer, T., Garnier, J., F., Martins, E.S., Echevarria, G. and Sterckeman, K.. Mobility of metals in nickel mine spoil materials. *Applied Geochemistry.* 25 (2010), pp 1746-1755.

Raous et al. 2013. Raous, S., Echevarria, G., Sterckeman, K., Hanna, K., Thomas, F., Martins, E.S., Becquer, T. Potentially toxic metals in ultramafic mining materials: Identification of the main bearing and reactive phases. *Geoderma.* 192, pp 111-119.

Saputro et al. 2014. Saputro, S., Yoshimura, K., Matsuoka, S., Takehara, K., Narsito, Aizawa, J., Tennichi, Y. Speciation of dissolved chromium and the mechanisms controlling its concentration in natural water. *Chem. Geol.*, 364:33-44.

USEPA Method 306A: Alkaline Digestion for Hexavalent Chromium. United States Environmental Protection Agency methods SW 846 December 1996

Vithanage et al. 2019. Vithanagea, M., Kumarathilakab, P., Ozec, C., Karunatilaked, S., Seneviratnee, M., Hseuf, Z-Y., Gunarathnea, V., Dassanayakeg, M., Yong Sik Okh, Rinklebei, J. Occurrence and cycling of trace elements in ultramafic soils and their impacts on human health: A critical review. *Environment International*, 13, 104974.

Walton, K and Allen, D. 2004. *Mehlich No. 3 Soil Test - The Western Australian Experience*. SuperSoil 2004: 3rd Australian New Zealand Soils Conference, 5 – 9 December 2004, University of Sydney, Australia.

11. GLOSSARY OF TECHNICAL TERMS

Term	Explanation
AC	Acid consuming material. Defined as NAF material which has a NAPP value in excess of –100 kg H_2SO_4/t.
ANC	Acid Neutralising Capacity. A process where a sample is reacted with excess 0.5 m HCl at a pH of about 1.5, for 2-3 hours at 80-90ºC followed by back-titration to pH=7 with sodium hydroxide. This determines the acid consumed by soluble materials in the sample.
ankerite	A calcium, iron, magnesium, manganese carbonate mineral of general formula $Ca(Fe,Mg,Mn)(CO_3)_2$. In composition it is closely related to dolomite, but differs from this in having magnesium replaced by varying amounts of iron(II) and manganese. The calcium and magnesium components are acid consuming, but the iron and manganese components are not.
AP	Acid Potential. Similar to MPA, but only is based on the amount of sulfide-sulfur (calculated at the difference between total sulfur and sulfate-sulfur (SO4-S)) rather than total sulfur. AP (kg H_2SO_4/t) = (Total S – SO_4-S) x 30.6.
basalt	A dark coloured fine grained mafic extrusive igneous rock composed chiefly of calcium plagioclase and pyroxene. Extrusive equivalent of gabbro underlies the ocean basins and comprises oceanic crust.
beryl	A group of minerals all of composition $Be_3Al_2(SiO_3)_6$ (hexagonal cyclosilicates) found almost exclusively in granitic pegmatites. Gemstone varieties (differences in colour only) include emerald and aquamarine.
BIF	Banded Iron Formation. Layered rock formed from banded deposits of iron rich sediment laid down at the bottom of primordial oceans.
calcite	Calcium carbonate $CaCO_3$.
CC ANC	Carbonate Neutralisation Potential. The amount of ANC provided by carbonate minerals. CC ANC (kg H_2SO_4/t) = TIC (%) x 81.7.
cassiterite	Tin oxide SnO_2 a highly insoluble tetragonal tin mineral associated with pegmatites and the primary tin ore.
circum-neutral pH	pH value near 7.
Contact zone	Line of contact between rock types, mostly commonly in relation to intrusive magmatics with host rock (primary contact) or secondary contact zones associated with faults and shears (shear zone).
dolerite	A mafic, holocrystalline, subvolcanic rock equivalent to volcanic basalt (but larger grained) or plutonic gabbro.
dolomite	Calcium magnesium carbonate $CaMg(CO_3)_2$.
EC	Electrical conductivity. A measurement of solution salinity. Conversion: 1,000 µS/cm = 1 dS/m = 1 mS/cm.
ECEC	Effective Cation Exchange Capacity, defined as the total amount of exchangeable cations, which are mostly sodium, potassium, calcium and magnesium in non-acidic regolith, and include aluminium in acidic regolith. Units for ECEC and individual exchangeable cations are centimoles of positive charge equivalents per kilogram (cmol(+)/kg).
ESP	Exchangeable sodium percentage – the proportion of exchangeable sodium cations to the total exchangeable cation capacity (sodium, potassium, calcium, magnesium and possibly aluminium).

Term	Explanation
felsic	Silicate minerals, magma, and rocks which are enriched in the lighter elements such as silicon, oxygen, aluminium, sodium, and potassium.
granite	A coarse-grained, intrusive igneous rock composed primarily of light coloured minerals such as quartz, plagioclase, orthoclase and muscovite mica. Granite is one of the main components of continental crust.
lepidolite	A mica mineral with the general formula $K(Li,Al,Rb)_2(Al,Si)_4O_{10}(F,OH)_2$.
mafic	Descriptive of igneous rock containing a high content of ferromagnesian silicate minerals, but less than those present in ultramafic rocks. Common mafic rocks include basalt, dolerite and gabbro.
MPA	Maximum Potential Acidity. A calculation where the total sulfur in the sample is assumed to all be present as pyrite. This value is multiplied by 30.6 to produce a value known as the Maximum Potential Acidity reported in units of kg H_2SO_4/t.
NAG	Net Acid Generation. A process where a sample is reacted with 15 vol% hydrogen peroxide solution at pH = 4.5 to oxidise all sulfides and then time allowed for the solution to react with acid soluble materials. This is a direct measure of the acid generating capacity of the sample but can be affected by the presence of organic materials.
NAG pH	The pH after the NAG test with hydrogen peroxide and heating is completed i.e. oxidation of all sulfides.
NAPP	Net Acid Producing Potential. NAPP (kg H_2SO_4/t) = AP – ANC.
PAF	Potentially Acid Forming.
PAF-LC	Potentially Acid Forming – Low Capacity. Waste rock classification for samples with NAPP values less than or equal to 10 kg H_2SO_4/t.
PAF-HC	Potentially Acid Forming – High Capacity. Waste rock classification for samples with NAPP values greater than 10 kg H_2SO_4/t.
petalite	Lithium aluminium tectosilicate [$LiAlSi_4O_{10}$] a feldspar mineral associated with pegmatites and ore of lithium. It converts to spodumene and quartz upon heating to ca. 500 °C.
pyrite	Iron (II) sulfide, FeS_2. Pyrite is the most common sulfide minerals and the major acid forming mineral oxidising to produce sulfuric acid.
saprock	A rock chemically broken down in its original place by deep weathering of the bedrock surface. It consists of partially weathered and unweathered primary minerals and maintains all of the fabric and structural features of the parent fresh rock.
saprolite	Highly weathered saprock. Minerals such as feldspars and micas have been fully weathered to clay minerals, while only highly resistant minerals such as quartz and zircon remain unaltered. Saprolite retains the fabric and some of the features of the parent fresh rock.
siderite	Iron(II) carbonate $FeCO_3$.
spodumene	Lithium aluminium inosilicate [$LiAl(SiO_3)_2$] the primary source of ‘hard rock’ lithium.
tantalite	Tantalum oxide [$(Fe, Mn)Ta_2O_6$] a highly insoluble mineral associated with pegmatites and the primary source of tantalum.
Transitional waste	Transitional material comprises the sum of the saprock and saprolite zones and occurs above fresh (unweathered) rock and below the fully weathered oxide zone. It is shown in profiles as the zone between bottom of complete oxidation (BOCO) and top of fresh rock (TOFR) lines.
Ultramafic	An igneous rock with very low silica content and rich in minerals such as hypersthene, augite and olivine. These rocks are also known as ultrabasic rocks.

APPENDICES

APPENDIX 1: ACID FORMING WASTE CLASSIFICATION METHODOLOGY

ACID FORMING WASTE CLASSIFICATION METHODOLOGY

1. OXIDATION OF SULFIDES

There is no simple method of defining whether mine waste containing small quantities of sulfur will produce net acid release upon field exposure to air and water. Sulfide minerals containing ferrous iron such as pyrite (FeS_2), marcasite (FeS_2) and pyrrhotite ($Fe_{(1-x)}S$) normally oxidise to produce sulfuric acid and ferric oxy-hydroxide. Whilst sulfur in pyrite will always form sulfuric acid, a portion of the sulfur in marcasite and pyrrhotite forms highly soluble sulfite, thiosulfate, more complex polythionate ions and elemental sulfur, some or all of which may never form acid (discussed in more details in Section 4). Similarly, sulfur in chalcopyrite and arsenopyrite rarely forms sulfuric acid due to simultaneous oxidation of copper and/or arsenic resulting in formation of non-acid forming copper sulfides and soluble sulfates (Section 5). Sulfur in galena (PbS), sphalerite (ZnS), molybdenite (MoS_2), stibnite (Sb_2S_3) and other iron-free sulfides is non-acid producing. Sulfur present as sulfate in minerals such as barite ($BaSO_4$), anhydrite ($CaSO_4$), gypsum ($CaSO_4.2H_2O$), epsomite ($MgSO_4.7H_2O$) and alkali sulfates is also non-acid producing.

There is also a group of iron and aluminium sulfate minerals that fall into a special category as acid releasing sulfates. An example is the mineral jarosite ($KFe_3(OH)_6(SO_4)_2$) or natrojarosite ($NaFe_3(OH)_6(SO_4)_2$), an oxidation product of pyrite formed under certain environmental conditions. Substitution of aluminium for iron results in the common aluminium sulfate mineral, alunite ($KAl_3(OH)_6(SO_4)_2$). Although sulfur in jarosite/natrojarosite (and alunite) is fully oxidised and therefore cannot produce further acidity under oxidising conditions, it can release acidity by hydrolysis as indicated by the chemical Equation 1:

Equation 1

$$KFe_3(OH)_6(SO_4)_2 + 3H_2O \rightarrow 3Fe(OH)_3 + K^+ + 3H^+ + 2SO_4^{2-}$$

This form of acidity is commonly referred to as "stored acidity" or "residual acidity" and does not fit in within traditional acid base accounting (ABA) which are designed to consider acid generation capacity from sulfides. This aspect of acidity in discussed further in Section 6 of this Appendix.

Potential for acid production relies on determination of total sulfur content (Tot_S), and non-sulfide sulfur content (commonly described as sulfate sulfur (SO_4_S)). Where necessary, determination of sulfur in the acid insoluble minerals barite (barium sulfate) and celestite (strontium sulfate), may be undertaken.

2. ACID NEUTRALISATION

Acid Neutralising Capacity (ANC) is a measure of the natural ability of the sample to neutralise acid. It is normally determined in the laboratory by measuring the amount of residual acidity following reaction of a finely ground sample of mine waste with an excess of dilute hydrochloric acid. The concentration of acid used for the ANC method is first determined by testing the vigour of the reaction of the sample with hydrochloric acid, as assessed by the rate evolution of carbon dioxide gas and any colour change (a 'fizz rating'). This method captures all minerals, including carbonates, oxides, hydroxides, phosphates and some silicate minerals that are capable of neutralising hydrochloric acid. Iron carbonates such as siderite ($FeCO_3$) and ferroan ankerite ($CaFe[CO_3]_2$) do not overall contribute to neutralisation of acid due to oxidation of the ferrous iron (Fe^{2+}) to ferric iron (Fe^{3+}) which in turn releases acid due to hydrolysis of the ferric ion. To correct for presence of these iron carbonate minerals, ANC is generally determined by a modified method (Sobek *et al.* 1978). This uses an indicator (phenanthroline) to show presence ferrous ions following reaction with hydrochloric acid (reported as a colour change in laboratory reports), followed by forced oxidation of the ferrous ions (hydrogen peroxide) prior to back titration with sodium hydroxide.

The standard ANC results are based on the assumption that all acid-neutralising materials are rapid-acting – which is generally only true for reactive carbonates such as calcite ($CaCO_3$) and dolomite ($CaMg(CO_3)_2$). In practice, some neutralising capacity is supplied by silicate and alumino-silicate minerals which can have slow to very slow reaction kinetics which is also only capable of buffering to a pH of approximately 3 to 4 which may be insufficient to prevent metalliferous drainage. Measurement of total carbon content (or total inorganic carbon) provides a simple method of estimating the contribution of the former, more reactive, carbonate minerals to the ANC although iron carbonates (if present) will interfere with this calculation (bias high). The reactivity of common silicate and carbonate neutralising minerals (at pH 5) are shown in Table A1-1 (Sverdrup 1990). Minerals in the dissolving, fast and intermediate weathering mineral groups (relative reactivity between 0.4 and 1, Table A1-1) are considered to have practical neutralising capacity in the field (Kwong 1993).

The Acid Buffering Characteristic Curve (ABCC) test can be employed in cases where the proportion of readily available ANC needs to be assessed. The ABCC test involves slow titration of a sample with acid while continuously monitoring the solution pH. While silicate based ANC will continue to react for a long period, the neutralising capacity to pH 4.5 from the ABCC is a useful indicator of the readily available ANC.

Table A1-1: Common Acid Consuming Silicate and Carbonate Minerals

Mineral Group	Typical Minerals	Relative Reactivity at pH 5
Dissolving	calcite, aragonite, dolomite, magnesite, brucite	1.0
Fast weathering	anorthite, nepheline, olivine, garnet, jadeite, leucite, spodumene, diopside, wollastonite, forsterite	0.6
Intermediate weathering	epidote, zoisite, enstatite, hypersthene, augite, hedenbergite, hornblende, glaucophane, serpentine, amphibole, chlorite, biotite	0.4
Slow weathering	albite, oligoclase, labradorite, montmorillonite, vermiculite, gibbsite, kaolinite	0.02
Very slow weathering	K-feldspars, muscovite	0.01
Inert	quartz, rutile, zircon	0.004

3. WASTE CLASSIFICATION

3.1 BACKGROUND

The Department of Mines, Industry Regulation and Safety (DMIRS) has issued draft procedures for geochemical characterisation of mine waste materials *Draft Guidance Materials Characterisation Baseline Data Requirements for Mining Proposals* (DMP 2016). These guidelines have not yet been finalised following feedback from industry (including MBS) and other departments. The 2016 DMIRS recommends that characterisations of subsurface materials and processing waste include the following information:

- A description of the host geology and mineralisation of the project area.
- The indicative volume of ore and waste materials that will be mined.
- The indicative tonnages and proportion of each waste lithology.
- Adequate characterisation of the subsurface materials (including overburden) and processing waste to ensure that the risk(s) posed by adverse components can be determined.
- Diagram(s) and map(s) of the sampling locations sufficient to indicate, the location of key mine activities and the 3D spatial distribution of samples.
- A description of the methodology used to characterise the materials.
- Interpretation of baseline data and broad implications for risk assessment and treatments.

Whilst these guidelines remain as draft, this report has been prepared in accordance with the draft guidelines and equivalent federal guidelines (DIIS 2016) where possible. The main deviation from DMP 2016 guidelines in MBS assessment is that only selected samples below 0.2 % total sulfur are analysed for Net Acid Generation (NAG) testing based on alternative assessment and previous experience in WA (DMP 2016 proposed all samples above 0.05 % sulfur should be tested).

3.2 ACID FORMING CLASSIFICATION

There is no single method to reliably determine whether mine or process wastes containing small quantities of sulfur will produce net acidity upon field exposure to air and water. Sulfide minerals are variable in their behaviour under oxidising conditions and not all forms will produce sulfuric acid (H_2SO_4). The acid neutralising capacity of these materials is also variable, and the relative rates of acid-forming and acid-neutralising reactions is important when considering if the materials have potential to generate acidic and metalliferous drainage.

Instead, a combination of approaches is often applied to more accurately classify mine or process waste. These approaches are listed below in order of increasing data requirements (and therefore increased reliability):

- The method of “Sulfur Analysis”, which only requires data for total sulfur content. Its adoption is based on long term experience of hard rock wastes from Western Australian mine sites under arid and semi-arid climatic conditions. Experience has shown that waste rock containing very low sulfur contents (less than 0.2 to 0.3 %) rarely produces significant amounts of acidic seepage (Price 1997).
- The concept of “Ratio Analysis”, which compares the relative proportions of acid neutralising minerals, measured by the Acid Neutralising Capacity (ANC), to acid generating minerals, measured by the Maximum Potential Acidity (MPA). Experience has shown that the risk of generating acidic seepage is generally low when this ratio (the Neutralisation Potential Ration – NPR) is above a value of two and considered non-existent above a value of four (Price 2009, DIIS 2016).
- Acid-Base Accounting (ABA), in which the Net Acid Producing Potential (NAPP) value, which is calculated by subtracting ANC from MPA, is used to classify the acid generating potential of mine waste. Positive NAPP values indicate that the waste has the potential to generate more acid than it can neutralise.

- Procedures recommended by AMIRA International (AMIRA 2002), which take into consideration measured values provided by the Net Acid Generation (NAG) test and calculated NAPP values.
- Kinetic leaching column test data, which provides information for the relative rates of acid generation under controlled laboratory conditions, intended to simulate those within a waste rock stockpile or tailings storage facility.

The "analysis concept" methodology is suitable to characterise mine waste during the early stages of feasibility drilling to ensure potentially acid forming materials are not missed - total sulfur should always be included as an element within assay data collection for resource drilling and insufficient sulfur assays of waste rock may hinder later approvals (DMP 2016). Ratio concept classification can be incorrect due to SO_4_S and barium sulfate content, particularly in manganese ores and most zinc-copper stratiform sulfide horizons where barite is often a substantial rock forming mineral. The ratio concept often gives incorrect results when used with acid sulfate soils and in conditions of very high salinity. It will also give incorrect results if applied to waste dumps that have not been rehabilitated and where the dominant residual sulfides in the wastes are base metal sulfides. This includes the iron-bearing sulfides chalcopyrite, bornite and arsenopyrite which all have high sulfur content but generate little or no acid.

Classification of wastes in this report uses procedures recommended by AMIRA (2002) based on NAPP and NAG pH results as well as total sulfur analysis/ratio analysis concepts above where this is appropriate. The following is a definition of terms as used in ABA reporting by MBS:

- Analysis for total sulfur (Tot_S) and sulfate-sulfur (SO_4_S), both reported as sulfur. Sulfate sulfur is conventionally determined by a heated 4 molar hydrochloric acid digestion followed by ICP-OES finish. In some circumstances, however, an alkaline extraction method using sodium carbonate may be appropriate to resolve interferences with high barium/strontium sulfate minerals as these are substantially more soluble under alkaline conditions. Chromium Reducible Sulfur (CRS) may also be used in conjunction with total sulfur and sulfate sulfur, which provides a direct analysis for sulfide sulfur. However, it should be noted that CRS was developed for finely divided acid sulfate soils specific to framboidal pyrite and without careful controls by the laboratory may not yield reliable results for waste rock, particularly when crystalline sulfide minerals are not micro-crystalline.
- Analysis for ANC (reported as kg H_2SO_4/t).
- Calculation of carbonate ANC (CC ANC), reported as kg H_2SO_4/t, from measured concentrations of total carbon (TC) or total inorganic carbon (TIC) (TIC avoids interferences for some samples such as shales from organic carbon).
- Calculation of Maximum Potential Acidity (MPA) = Tot_S * 30.6, reported as kg H_2SO_4/t.
- Calculation of Acid Production Potential (AP) = [(Tot_S – SO_4_S) * 30.6] kg H_2SO_4/t.
- Calculation of NAPP = [AP – ANC] kg H_2SO_4/t. Using AP versus MPA corrects for non-oxidisable sulfur present in the sample (i.e. sulfate).
- Calculation of Effective NAPP = [AP – CC ANC] kg H_2SO_4/t. Effective NAPP values correspond more directly to ANC associated with readily reactive carbonates, providing non-neutralising carbonates such as siderite are absent.
- Analysis for NAG potential (reported as kg H_2SO_4/t) to both pH 4.5 and pH 7.
- Analysis for NAG pH (the pH of the NAG test liquors).
- Calculation of NPR = ANC/AP (reported as kg H_2SO_4/t).

This AMIRA approach is more conservative than either the Analysis Concept or the Ratio Concept alone, although it assumes the absence of insoluble sulfur such as barite (barium sulfate), which is a non-acid producing mineral that can interfere with the results. The AMIRA approach of using NAG testing is particularly useful for PAF-LC (Potentially Acid Forming – Low Capacity) materials or where there is very low ANC in the host rock. A combined acid generation classification scheme based on NAPP and NAG determinations which is based on AMIRA 2002 and the 2016 DMIRS *Draft Guidance Materials Characterisation Baseline Data Requirements for Mining Proposals* (DMP 2016) and the equivalent federal; guidelines (DIIS 2016), is presented in Table A1-2.

Table A1-2: Acid Formation Risk Classification Criteria

Primary Geochemical Waste Type Class	NAPP Value kg H2SO4/t	NAG pH
Potentially Acid Forming (PAF)	≥10	< 4.5
Potentially Acid Forming – Low Capacity (PAF-LC)	0 to 10	< 4.5
Uncertain (UC)	Positive	> 4.5
Uncertain (UC)	Negative	< 4.5
Non-Acid Forming (NAF)	Negative	> 4.5 or sulfur < 0.2 %*
Acid Consuming (AC)	< -100	> 4.5
Barren	≤2 and sulfur < 0.05 %	-

** Application of 0.2% sulfur cut-off as a screening tool for the need for determination of NAG pH for classification may be applied on a site specific basis in conjunction with assessment of ANC and NPR). This uses a ratio analysis approach for low risk samples based on WA conditions where extensive experience has indicated no potential for samples with less than 0.2% sulfur to generate net acidity in arid conditions for waste rock from hard rock mines. A negative NAPP and NPR of more than 4 (DIIS 2016) indicates no considered risk of acid generation in such instances.*

This classification system, based on static ABA procedures and used in conjunction with geological, geochemical and mineralogical analysis can still leave materials classified as ‘Uncertain’ which may warrant further investigation by, for example, kinetic characterisation. An optional NAF subclassification of 'Barren' is included to account for materials which have neither acid forming nor acid generating potential. Samples which are ‘Uncertain’ due to conflicting NAPP versus NAG pH values may be tentatively assigned as NAF or PAF based on a NAG pH value above or below pH 4.5 respectively, however further examination/justification may be warranted. A sound knowledge of geological and geochemical processes must also be employed in the application of the above methods.

4. PYRRHOTITE OXIDATION REACTIONS

As indicated in Section 1, the oxidation chemistry of pyrrhotite is more complicated than that of pyrite, which forms the basis of standardised acid base accounting procedures. The nature of the oxidation products of pyrrhotite and the associated amount of acid produced will depend on several factors, the most important being the availability of oxygen (or redox potential), pH and the presence of specialised bacteria (sulfide oxidising and/or sulfate reducing).

There are many possible reaction products that can be formed by the oxidation of pyrrhotite, depending on the oxidation state of both iron and sulfur in the reaction products. In the case of iron, the reaction products contain either ferrous iron (Fe^{2+}) or ferric iron (Fe^{3+}). Ferrous iron is readily oxidised and so it can only be formed as a major reaction product under conditions of very low redox potential (*i.e.*, extremely low available oxygen). Ferric ion is soluble only at low pH values, typically < 1.5. At pH values > 4.5, it is rapidly precipitated as hydroxide/oxide minerals such as ferrihydrite ($Fe(OH)_3$) or goethite (FeOOH). At pH values between 1.5 and 4.5, it can form various sulfate minerals such as jarosite ($KFe_3(SO_4)_2(OH)_6$), copiapite ($(Fe,Mg)Fe_4(SO_4)_6(OH)_2.20H_2O$) or schwertmannite ($Fe_8O_8(OH)_6SO_4$).

The situation with the sulfur reaction products from pyrrhotite is much more complex. Table A1-3 lists some, but not all, of the various sulfur reaction products produced by oxidation of pyrrhotite under varying conditions, the most important of which is the degree of oxygen availability. Other important factors that influence the reactivity of pyrrhotite in tailings are the size and morphology of the pyrrhotite minerals. The crystal structure of pyrrhotite changes with different values of ‘x’ in the chemical formula for pyrrhotite, $Fe_{(1-x)}S$. When the value of ‘x’ is close to zero, the crystal structure is hexagonal. At higher values of ‘x’, pyrrhotite adopts a monoclinic structure.

Table A1-3: Sulfur Species Produced by Reaction of Pyrrhotite with Oxygen and Water

Sulfur Species	Chemical Formula	Oxidation Number of S	Increasing Oxidation Potential
Sulfide	S^{2-}, e.g. FeS	-2	↓
Hydrogen sulfide	H_2S	-2	
Disulfide	S_2^{2-}, e.g. FeS_2	-1	
Elemental sulfur	S, S_8	0	
Thiosulfate	$S_2O_3^{2-}$	+2	
Tetrathionate	$S_4O_6^{2-}$	+2.5	
Trithionate	$S_3O_6^{2-}$	+3.33	
Sulfite	SO_3^{2-}	+4	
Dithionate	$S_2O_6^{2-}$	+5	
Sulfate	SO_4^{2-}	+6	

The dithionate, trithionate and tetrathionate are the first three members of a group of sulfur oxy-anions referred to as ‘polythionates’. In acid mine drainage context, the combination of the polythionate ions with thiosulfate and the sulfite ion is referred to as the ‘sulfite’ group.

The following discussion can be considered as an understanding of the following generalised (unbalanced) reaction equation (Equation 2) for the oxidation of iron sulfides with oxygen and water:

Equation 2

$$Fe_{(1-x)}S + H_2O + O_2 \rightarrow Fe^{2+}/Fe^{3+} + S_aO_b^{c-} + H^+$$

Note: 'x' = 0.5 corresponds to pyrite.

'x' = 0.0 corresponds to 'pyrrhotite' for this discussion.

a = 1, b = 0, c = 0 corresponds to elemental sulfur.

a = 1, b = 4, c = 2 corresponds to sulfate.

From this knowledge, it is possible to determine the theoretical amounts of acid that can be produced by oxidation of the iron sulfides. Table A1-4 lists the maximum amounts of acidity that can be generated by the oxidation of the sulfide in pyrrhotite. The final oxidation state of the sulfur-containing reaction product is determined by the availability of oxygen, as indicated by the O_2:FeS ratio in increasing value listed in Table A1-3. Three scenarios for acid generation for each sulfur species are considered, depending on the oxidation state of the iron-containing reaction product. If only the sulfur in FeS is oxidised, the oxidation state of iron remains at +2 and so the acid generated is only sourced by the oxidation reaction of the sulfide component. If the Fe^{2+} is oxidised and precipitated as $Fe(OH)_3$, then two moles of acid will be produced from every mole of oxidised Fe^{2+}. However, if the ferric hydroxide subsequently reacts with sulfuric acid to form jarosite according to Equation 3, then the net result is that only one mole of free acid is generated for every mole of Fe^{2+} oxidised. Minerals such as jarosite are said to represent 'stored' acidity, *i.e.* their formation consumes some of the acidity generated by the oxidation of the iron sulfides, but addition of alkali is required to increase the pH to neutral or higher.

Equation 3

$$K^+ + 3Fe(OH)_3 + 3H^+ + 2SO_4^{2-} \rightarrow [KFe_3(SO_4)_2(OH)_6] + 3H_2O$$

Although the discussion provided above may prove difficult to understand by people with a limited understanding of chemistry, the information provided below in Table A1-4 is extremely important in the understanding of the implications for acid generation by the oxidation of iron sulfides. Table A1-4 lists the theoretical amounts of acid that can be produced, depending on the end-products of the reactions with both iron and sulfur.

Thus, depending on the reaction conditions, the reaction of pyrrhotite with oxygen and water may be either acid-consuming or acid-generating. The maximum amount of acid consumption occurs under conditions of limited oxygen supply when elemental sulfur (plus pyrite) is formed. Note that the reaction described by Equation 4 usually occurs at very low pH values (pH < 2) which are rarely achieved in the field. Maximum acid generation occurs when sulfate and Fe^{3+} hydrolysis products including ferrihydrite are the reaction products. In these situations, associated with high oxygen availability, up to 2 moles of H^+ (1 mole of sulfuric acid H_2SO_4) can be produced from every mole of pyrrhotite. Overall however, the oxidation of pyrrhotite only becomes net acid producing if the hydrolysis of released Fe^{3+} is a major reaction and this is often in practice prevented by precipitation reactions from fully occurring.

Table A1-4: Amount of Acid Produced by the Oxidation of Pyrrhotite as Determined by the Nature of the Iron and Sulfur Reaction Products

Sulfur oxidation product(s)	**Number of moles of acidity (H^{+}) produced per mole of sulfur**				**Increasing Oxygen Availability**
	O_2:FeS ratio	**Fe^{2+} product**	**Jarosite product**	**Ferric hydroxide product**	↓
H_2S	Nil	2 moles consumed (Equation 4)	1 mole consumed	None	
Pyrite + S	0.25	1 mole consumed (Equation 5)	None	1 mole produced	
Elemental S	0.5	2 moles consumed (Equation 6)	1 mole consumed	None	
Sulfite	1.5	Nil (Equation 7)	1 mole produced	2 moles produced	
Dithionate	1.75	1 mole consumed (Equation 8)	None	1 mole produced	
Sulfate	2.0	None (Equation 9)	1 mole produced	2 moles produced	
		Acidic	pH Stability Range →	Neutral	

Equation 4

$$FeS + 2H^{+} \rightarrow Fe^{2+} + H_2S$$

Equation 5

$$3FeS + 4H^{+} + O_2 \rightarrow FeS_2 + S + 2Fe^{2+} + 2H_2O$$

Equation 6

$$2FeS + 4H^{+} + 3O_2 \rightarrow 2Fe^{2+} + 2S + 2H_2O$$

Equation 7

$$2FeS + 3O_2 \rightarrow 2Fe^{2+} + 2SO_3^{2-}$$

Equation 8

$$4FeS + 7O_2 + 4H^{+} \rightarrow 4Fe^{2+} + 2S_2O_6^{2-} + 2H_2O$$

Equation 9

$$FeS + 2O_2 \rightarrow Fe^{2+} + SO_4^{2-}$$

5. ACID GENERATION FROM OTHER SULFIDE MINERALS

The principle of Acid Base Accounting procedures described above is based on the acid generating properties of the iron sulfide mineral pyrite (FeS_2). Pyrite reacts with oxygen and water to produce acidity (H^+) according to Equation 10:

Equation 10

$$4FeS_2 + 15O_2 + 14H_2O \rightarrow 4Fe(OH)_3 + 16H^+ + 8SO_4^{2-}$$

The stoichiometry of this reaction indicates that oxidation of one mole of pyrite will produce two moles of sulfuric acid or alternatively, 30.6 kg of sulfuric acid will be produced by oxidation of one tonne of mine waste containing 1% by weight of sulfur.

Other iron sulfides, such as pyrrhotite ($Fe_{(1-x)}S$), marcasite (FeS_2) and mackinawite ($Fe_{(1+x)}S$) react by different mechanisms, but all have a maximum potential production capacity of one mole of sulfuric acid per mole of sulfur. This gives a factor of 30.6 kg of sulfuric acidic potentially produced by oxidation of one tonne of mine waste containing 1% by weight of sulfur.

Copper sulfide minerals also react with oxygen, however the amount of acid produced depends on the composition of the mineral, and in particular the iron content. Chemical equations for the oxidation of copper sulfide minerals such as chalcocite (Cu_2S), covellite (CuS), chalcopyrite ($CuFeS_2$) and bornite (Cu_5FeS_4) are presented in Equation 11 to Equation 14 (inclusive):

Equation 11

$$2Cu_2S + 2H_2O + 5O_2 \rightarrow 2Cu(OH)_2 + 2Cu^{2+} + 2SO_4^{2-}$$

Equation 12

$$CuS + 2O_2 \rightarrow Cu^{2+} + SO_4^{2-}$$

Equation 13

$$4CuFeS_2 + 17O_2 + 10H_2O \rightarrow 4Cu^{2+} + 4Fe(OH)_3 + 8SO_4^{2-} + 8H^+$$

Equation 14

$$4Cu_5FeS_4 + 18H_2O + 37O_2 \rightarrow 12Cu^{2+} + 8(Cu(OH)_2 + 4Fe(OH)_3 + 16SO_4^{2-} + 8H^+$$

Other base metal sulfides containing metals including cobalt, nickel, lead and zinc indicate similar behaviour to those of copper sulfides. Chemical equations for the oxidation of common nickel sulfide minerals such as millerite (NiS), pentlandite ($Fe_xNi_{(9-x)}S_8$), and violarite ($FeNi_2S_4$) are presented in Equation 15 to Equation 17 (inclusive):

Equation 15

$$NiS + 2O_2 \rightarrow Ni^{2+} + SO_4^{2-}$$

Equation 16

$$Fe_xNi_{(9-x)}S_8 + {}^{(5x-2)}/_{2}H_2O + {}^{(36-7x)}/_{2}O_2 \rightarrow (9-x)Ni^{2+} + xFe(OH)_3 + 8SO_4^{2-} + (2x-2)H^+$$

Equation 17

$$4FeNi_2S_4 + 14H_2O + 31O_2 \rightarrow 8Ni^{2+} + 4Fe(OH)_3 + 16SO_4^{2-} + 16H^+$$

The predicted maximum amounts of sulfuric acid that can be produced by complete oxidation of various iron, copper and nickel sulfide minerals are listed in Table A1-5. These values indicate that acid generation is only possible if the sulfide mineral contains iron. Chalcopyrite, a common iron-copper sulfide mineral, has potential to generate acidity upon complete oxidation, but the maximum amount of potential acidity per percentage unit of sulfur in the mine waste is only half that of pyrite (or marcasite or pyrrhotite).

Table A1-5: Predicted Sulfur Acid Generation Potential from Oxidation of Iron, Copper and Nickel Sulfide Minerals

Mineral Name	Formula	Acid Generation Potential (kg H_2SO_4/t)	
		Per tonne of Mineral	Per 1% Sulfur
Pyrite	FeS_2	1,633	30.6
Marcasite	FeS_2	1,633	30.6
Pyrrhotite	$Fe_{(1-x)}S$	1,115	30.6
Chalcocite	Cu_2S	Nil	Nil
Covellite	CuS	Nil	Nil
Chalcopyrite	$CuFeS_2$	267	15.3
Bornite	Cu_5FeS_4	49	7.6
Millerite	NiS	Nil	Nil
Pentlandite	$Fe_xNi_{(9-x)}S_8$	Variable, depending on the value of x.	
Violarite	$FeNi_2S_4$	650	15.3

It should also be noted that oxidation of copper and nickel sulfide minerals can form soluble copper (Cu^{2+}) and nickel (Ni^{2+}) ions. Both metals form slightly soluble hydroxides (($Cu(OH)_2$) and $Ni(OH)_2$)), which significantly reduces the concentration of free metal ions in solution if the pH remains above 6.5. However, oxidation of copper and nickel sulfide minerals containing iron (e.g. chalcopyrite and violarite) can result in very low pH values, typically below 4.5 if there are insufficient carbonate minerals present to consume the generated acidity. For this reason, it is recommended that NAG measurements for mine waste containing copper and/or nickel sulfides be conducted to endpoint pH values of 4.5 and 7.0:

- NAG acidity to pH 4.5 includes hydrogen (H^+), ferric (Fe^{3+}), manganese (Mn^{2+}) and aluminium (Al^{3+}) ion acidity, but not copper ions (Cu^{2+}) or nickel (Ni^{2+}) ions.
- NAG acidity to pH 7.0 also includes the amount of alkalinity required to precipitate all of the soluble copper ions as $Cu(OH)_2$ and nickel ions as $Ni(OH)_2$. The difference between NAG acidity to pH 4.5 and NAG acidity to pH 7.0 is a measure of the amount of oxidisable copper and nickel sulfides in the sample.

The potential for mixed element iron sulfides to generate variable amounts of acidity is further complicated by the presence of arsenic. Arsenopyrite (FeAsS) is a common sulfide mineral often associated with gold mineralisation in the Western Australian goldfields.

Oxidation of arsenopyrite may be described by Equation 18 and Equation 19:

Equation 18

$$4FeAsS + 21O_2 + 16H_2O \rightarrow 4Fe(OH)_3 + 4SO_4^{2-} + 4AsO_4^{3-} + 20H^+$$

Equation 19

$$2FeAsS + 7O_2 + 2H_2O \rightarrow 2\text{"}FeAsO_4\text{"} + 2SO_4^{2-} + 4H^+$$

"$FeAsO_4$" may vary from crystalline ferric arsenate minerals such as scorodite ($FeAsO_4.2H_2O$) to arsenate anions adsorbed onto hydrous iron oxide surfaces. Regardless of the actual form of "FeAsO4", oxidation of arsenopyrite results in formation of 30.6 kg of sulfuric acid from one tonne of mine waste containing 1% by weight of sulfur, as for pyrite, marcasite and pyrrhotite (Table A1-5). If, however, the iron end product is $Fe(OH)_3$, then the resulting amount of acid (in the form of both sulfuric acid, H_2SO_4, and arsenic acid, H_3AsO_4) will be 2.5 times higher. Oxidation of arsenopyrite by this reaction results in formation of 76.5 kg of sulfuric acid equivalents from one tonne of mine waste containing 1% by weight of sulfur.

In conclusion, using a factor of 30.6 to calculate the amount of acidity as kg H_2SO_4/t is only valid if all of the sulfur is present as iron sulfide minerals. If mixed copper, nickel and other base metals are present, use of the 30.6 conversion factor will over-estimate the amount of acidity produced. If arsenopyrite is present, use of the 30.6 conversion factor may under-estimate the amount of acidity produced.

6. RESIDUAL ACIDITY

It is important to note that material classified as NAF by acid-base accounting methodology described above may not have circum-neutral or alkaline pH values. For reasons outlined in this section, it is possible for NAF waste to be moderately to highly acidic as a result of existing “residual” or “natural” acidity. Conversely, it is common for PAF waste to be slightly to moderately alkaline. Laterite waste rock is an example of material that usually classifies as NAF by acid-base accounting procedures described above, but often records moderate to highly acidic pH values.

As discussed in Section 1 of this Appendix, most of the “residual” or “natural” acidity of these materials is explained by the presence of iron and aluminium sulfate minerals including jarosite and alunite. Additional acidity may be associated with cation exchange properties of highly weathered clay minerals. The sum of the concentrations of “acidic” cations including H^+, Al^{3+} and Mn^{2+} (present in acidic clays and expressed in units of centimoles of positive charge per kilogram) is referred to as “exchangeable acidity”. The contribution of “exchangeable acidity” in acidic, clay-rich lateritic waste rock may be as high as 5 kg H_2SO_4/t (depending on clay mineralogy).

It is important to note that leachate from materials containing only “exchangeable acidity” usually contain low levels of soluble acidity, which presents a low risk to the receiving environment. However, elevated levels of “exchangeable acidity” are toxic to plants (phytotoxic), meaning that such materials are unsuitable as a growth medium or as a subsoil water storage for plants.

A summary of typical pH conditions associated with different waste types is presented in Table A1-6. It should be noted that standard ABA classification of clay rich laterites and saprock may result in ‘PAF’ classification if the NAG pH is < 4.5, however this ignores the initial 1:5 pH (which may be as low as pH 4 for these materials). Such naturally acidic laterites/subsoils have no further potential for acid generation (no sulfides) and are perhaps better termed ‘Actual Acid Sulfate Soils’ when considering management.

Table A1-6: pH Control of Various Waste Rock Types by Significant Minerals

Typical pH Values	Significant Minerals	Typical Waste Rock Types
Greater than 9.0	Sodium and potassium carbonate, reactive silicates such as forsterite (Mg_2SiO_4), wollastonite ($CaSiO_3$) and cordierite ($(Mg,Fe)_2Al3(Si_5AlO_{18})$).	Mafic and ultramafic volcanics.
8.0 to 9.0	Calcium and magnesium carbonates such as calcite ($CaCO_3$), magnesite ($MgCO_3$), dolomite ($CaMg(CO_3)_2$) and ankerite ($Ca(Fe,Mg,Mn)(CO_3)_2$).	Mafic and ultramafic volcanics, calcareous sedimentary rocks.
5.0 to 9.0	Many common silicate and aluminosilicate minerals such as feldspars, micas and pyroxenes.	Many igneous, non-calcareous sedimentary and metamorphic rock types.
4.0 to 5.0	Highly weathered clay minerals including kaolinite ($Al_2Si_2O_5(OH)_4$), goethite (FeOOH) and gibbsite ($Al(OH)_3$).	Laterite and saprock developed over acidic igneous rock types.
Less than 4.0	Alunite, jarosite and related minerals.	Gossans, acid sulfate soils, oxidised sulfidic wastes.

7. REFERENCES

AMIRA International. 2002. *ARD Test Handbook: Project 387A Prediction and Kinetic Control of Acid Mine Drainage. Prepared for AMIRA International by* Ian Wark Research Institute and Environmental Geochemistry International Pty Ltd. http://www.amira.com.au/documents/downloads/P387AProtocolBooklet.pdf (accessed 18 January 2019).

DMP. 2016. *Draft Guidance Materials Characterisation Baseline Data Requirements for Mining Proposals – March 2016.* Perth WA: Government of Western Australia Department of Mines and Petroleum.

DIIS. 2016. Preventing Acid and Metalliferous Drainage: Leading Practice Sustainable Development Program for the Mining Industry. Department of Industry, Innovation and Science. https://industry.gov.au/resource/Documents/LPSDP/LPSDP-AcidHandbook.pdf (accessed 23 October 2019).

INAP. 2009. Global Acid Rock Drainage (GARD) Guide. International Network for Acid Prevention. http://www.gardguide.com (accessed 18 November 2019).

Kwong, Y. T. J. 1993. Prediction and Prevention of Acid Rock Drainage from a Geological and Mineralogical Perspective. MEND Project 1.32.1. National Hydrology Research Institute. Saskatoon, Canada. October 1993.

Price, W. A. 1997. Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia. British Columbia Mine Reclamation Section, Ministry of Employment and Investment, April 1997 http://mend-nedem.org/mend-report/draft-guidelines-and-recommended-methods-for-the-prediction-of-metal-leaching-and-acid-rock-drainage-at-minesites-in-british-columbia/ (accessed 21/10/2019).

Price, W. A. 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. Report prepared for the MEND (Mine Environment Neutral Drainage Program) Report 1.20.1 by CANMET Mining and Mineral Sciences Laboratories. Natural Resources Canada, December 2009. http://mend-nedem.org/mend-report/prediction-manual-for-drainage-chemistry-from-sulphidic-geologic-materials/ (accessed 11 October 2019)

Sobek, A. A., Schuller, W. A., Freeman, J. R., and Smith, R. M. 1978. *Field and Laboratory Methods Applicable to Overburdens and Minesoils*. National and Technical Information Service Report PB-280, 495. United States Environmental Protection Agency Report EPA-600/2-78-054. Washington, D.C. March 1978.

Sverdrup, H. U. 1990. *The Kinetics of Base Cation Release due to Chemical Weathering*. Lund University Press. Lund, Sweden.

APPENDIX 2: COLLATED GEOCHEMICAL RESULTS

Table A2-1: Sample Descriptions

Sample ID	Phase	Weathering	Lithology	Classification
KEGR22 3-11	1	Clay	Weathered Mafic	Oxide
KEGR22 55-60	1	Fresh	Mafic	Fresh Mafic
KEGR22 85-89	1	Ore	Pegmatite Ore	Pegmatite Ore
KEGR22 90-99	1	Fresh	Mafic	Fresh Mafic
KEGR22 106-107	1	Fresh	Contact zone	Fresh Contact zone
KEGR22 140-145	1	Ore	Pegmatite Ore	Pegmatite Ore
KEGR32 3-7	1	Clay	Weathered Mafic	Oxide
KEGR32 11-15	1	Oxide/transition	Mafic	Transitional
KEGR32 34-36	1	Oxide/transition	Pegmatite	Transitional
KEGR32 86-102	1	Fresh	Mafic	Fresh Mafic
KEGR32 102-112	1	Ore	Pegmatite Ore	Pegmatite Ore
KEGR32 140-147	1	Fresh	Mafic	Fresh Mafic
KEGR25 6-11	1	Clay	Weathered Mafic	Oxide
KEGR25 15-18	1	Clay	Weathered Pegmatite	Oxide
KEGR25 45-50	1	Oxide/transition	Mafic	Transitional
KEGR25 90-95	1	Fresh	Mafic	Fresh Mafic
KEGR25 145-147	1	Fresh	Contact zone	Fresh Contact zone
KEGR25 150-155	1	Ore	Pegmatite Ore	Pegmatite Ore
KEGR25 195-200	1	Fresh	Mafic	Fresh Mafic
KEGR26 44-45	1	Clay	Weathered Pegmatite	Oxide
KEGR26 50-52	1	Fresh	Contact zone	Fresh Contact zone
KEGR26 90-95	1	Fresh	Mafic	Fresh Mafic
KEGR26 110-115	1	Ore	Pegmatite Ore	Pegmatite Ore
KEGR26 152-153	1	Fresh	Contact zone	Fresh Contact zone
KEGR26 160-165	1	Fresh	Mafic	Fresh Mafic
KEGR27 17-25	1	Clay	Weathered Pegmatite	Oxide
KEGR27 37-44	1	Clay	Weathered Mafic	Oxide
KEGR27 60-67	1	Oxide/transition	Mafic	Transitional
KEGR27 81-84	1	Fresh	Mafic	Fresh Mafic
KEGR50 13-19	1	Clay	Weathered Pegmatite	Oxide
KEGR50 19-21	1	Clay	Weathered Mafic	Oxide
KEGR50 21-25	1	Oxide/transition	Mafic	Transitional
KEGR50 35-40	1	Ore	Pegmatite Ore	Pegmatite Ore
KEGR50 64-66	1	Ore	Pegmatite Ore	Pegmatite Ore
KEGR50 69-70	1	Fresh	Contact zone	Fresh Contact zone
KEGR50 70-75	1	Fresh	Mafic	Fresh Mafic
KEGR50 80-85	1	Fresh	Mafic	Fresh Mafic
KEGR58 43-47	1	Oxide/transition	Pegmatite	Transitional
KEGR58 55-60	1	Ore	Pegmatite Ore	Pegmatite Ore
KEGR58 85-90	1	Fresh	Mafic	Fresh Mafic
KEGR60 40-42	1	Oxide/transition	Pegmatite	Transitional
KEGR60 42-45	1	Fresh	Mafic	Mafic
KEGR60 50-53	1	Ore	Pegmatite Ore	Pegmatite Ore
KEGR60 61-63	1	Ore	Pegmatite Ore	Pegmatite Ore
KEGR60 65-70	1	Fresh	Mafic	Fresh Mafic
KEGR90 52-56	1	Fresh	Mafic	Fresh Mafic
KEGR90 70-75	1	Fresh	Mafic	Fresh Mafic
KEGR90 154-156	1	Ore	Pegmatite Ore	Pegmatite Ore
KEGR90 175-180	1	Ore	Pegmatite Ore	Pegmatite Ore
KEGR90 200-205	1	Fresh	Mafic	Fresh Mafic
KEGR96 6-10	1	Clay	Weathered Mafic	Oxide
KEGR96 31-34	1	Oxide/transition	Mafic	Transitional
KEGR96 35-40	1	Fresh	Mafic	Fresh Mafic
KEGR96 44-50	1	Fresh	Mafic	Fresh Mafic
KEGR96 60-65	1	Ore	Pegmatite Ore	Pegmatite Ore
KEGR96 95-100	1	Fresh	Mafic	Fresh Mafic
KEGR77 39-43	1	Oxide/transition	Pegmatite	Transitional
KEGR77 54-59	1	Fresh	Mafic	Fresh Mafic
KEGR77 75-80	1	Fresh	Mafic	Fresh Mafic
KEGR77 110-115	1	Ore	Pegmatite Ore	Pegmatite Ore
KEGR77 145-150	1	Ore	Pegmatite Ore	Pegmatite Ore
KEGR14 15-20	1	Clay	Weathered Mafic	Oxide
KEGR14 52-55	1	Fresh	Mafic	Fresh Mafic
KEGR14 83-88	1	Fresh	Mafic	Fresh Mafic
SLP1	1 extended	Oxide	Pegmatite Laterite Gravel-clay-colluvium	Waste
SLP2	1 extended	Oxide	Pegmatite Laterite Gravel-clay-colluvium	Waste
SLP3	1 extended	Oxide	Pegmatite Laterite Gravel-clay-colluvium	Waste
SLPComp	1 extended	Oxide	Pegmatite Laterite Gravel-clay-colluvium	Waste
SML1	1 extended	Oxide	Mafic Laterite-clay	Waste
SML2	1 extended	Oxide	Mafic Laterite-clay	Waste
SML3	1 extended	Oxide	Mafic Laterite-clay	Waste
SMLComp	1 extended	Oxide	Mafic Laterite-clay	Waste
B1	1 extended	Oxide	Oxide Gravel	Waste
B3	1 extended	Oxide	Oxide Gravelly Clay	Waste
B4	1 extended	Oxide	Oxide Silty Sand	Waste
B2	1 extended	Oxide	Oxide Silty Gravel	Waste

Table A2-1: Sample Descriptions

Sample ID	Phase	Weathering	Lithology	Classification
B5	1 extended	Oxide	Oxide Clays	Waste
TP1	1 extended	Transitional	Transitional Pegmatite	Waste
TP2	1 extended	Transitional	Transitional Pegmatite	Waste
TP3	1 extended	Transitional	Transitional Pegmatite	Waste
TP4	1 extended	Transitional	Transitional Pegmatite	Waste
TPComp	1 extended	Transitional	Transitional Pegmatite	Waste
MDTLSS2	1 extended	Transitional	Transitional Mafic	Waste
MDTLSS3	1 extended	Transitional	Transitional Mafic	Waste
MDTLSS1	1 extended	Transitional	Transitional Mafic	Waste
MDTLSSComp	1 extended	Transitional	Transitional Mafic	Waste
PDUS1	1 extended	Transitional	Transitional Pegmatite-clay/mafic	Waste
PDUS2	1 extended	Transitional	Transitional Pegmatite-clay/mafic	Waste
PDUS3	1 extended	Transitional	Transitional Pegmatite-clay/mafic	Waste
PDUSComp	1 extended	Transitional	Transitional Pegmatite-clay/mafic	Waste
MDUS1	1 extended	Transitional	Transitional Mafic	Waste
MDUS2	1 extended	Transitional	Transitional Mafic	Waste
MDUS3	1 extended	Transitional	Transitional Mafic	Waste
MDUSComp	1 extended	Transitional	Transitional Mafic	Waste
PET1	1 extended	Fresh	Subgrade Pegmatite/Petalite	Waste
PET2	1 extended	Fresh	Subgrade Pegmatite/Petalite	Waste
PET3	1 extended	Fresh	Subgrade Pegmatite/Petalite	Waste
PET4	1 extended	Fresh	Subgrade Pegmatite/Petalite	Waste
PETComp	1 extended	Fresh	Subgrade Pegmatite/Petalite	Min Waste
KEGM036 122-123	1 extended	Fresh	Galaxy subgrade petalite	Min Waste
KEGM036 126-127	2	Fresh	Mafic volcanic	Fresh Mafic
KEGM036 135-136	2	Fresh	Mafic volcanic	Fresh Mafic
KEGM036 167-168	2	Fresh	Fresh Ultramafic	Fresh Ultramafic
KEGM045 59-60	2	Fresh	Mafic volcanic	Fresh Mafic
KEGM045 64-65	2	Fresh	Mafic Schist	Fresh Mafic
KEGM045 69-70	2	Fresh	Fresh Mafic	Fresh Mafic
KEGM045 126-127	2	Fresh	Mafic volcanic	Fresh Mafic
KEGM045 149-150	2	Fresh	Mafic volcanic	Fresh Mafic
KEGM045 170-171	2	Fresh	Mafic volcanic	Fresh Mafic
KEGM049 151-152	2	Fresh	Fresh Ultramafic	Fresh Ultramafic
KEGM049 153-154.34	2	Fresh	Fresh Ultramafic	Fresh Ultramafic
KEGM049 272-273	2	Fresh	Mafic volcanic	Fresh Mafic
KEGM049 276-277	2	Fresh	Mafic volcanic	Fresh Mafic
KEGM052 175-176	2	Fresh	Mafic volcanic	Fresh Mafic
KEGM052 196-197	2	Fresh	Mafic volcanic	Fresh Mafic
KEGM052 219-220	2	Fresh	Dolerite	Fresh Mafic
KEGM052 272-273	2	Fresh	Fresh Ultramafic	Fresh Ultramafic
KEGM052 289-290	2	Fresh	Mafic volcanic	Fresh Mafic
KEGM054 12-13	2	Oxide	Clay	Oxide
KEGM054 065-66	2	Saprolite	Clay	Oxide
KEGM054 270-271	2	Fresh	Mafic	Fresh Mafic
KEGM054 273-274	2	Fresh	Mafic	Fresh Mafic
KEGM054 306-307	2	Fresh	Fresh Ultramafic	Fresh Ultramafic
KEGM056 242-243	2	Fresh	Mafic volcanic	Fresh Mafic
KEGM056 254-255	2	Fresh	Mafic volcanic	Fresh Mafic
KEGM056 317-318	2	Fresh	Mafic Schist	Fresh Mafic
KEGM056 328-329	2	Fresh	Mafic volcanic	Fresh Mafic
KEGM058 10-11	2	Oxide	Clay	Oxide
KEGM058 30-31	2	Saprolite	Mafic Volcanic	Mafic Volcanic
KEGM058 145-146	2	Fresh	Fresh Ultramafic	Fresh Ultramafic
KEGM058 153-154	2	Fresh	Fresh Ultramafic	Fresh Ultramafic
KEGM058 162-163	2	Fresh	Fresh Ultramafic	Fresh Ultramafic
KEGM058 171-172	2	Fresh	Fresh Ultramafic	Fresh Ultramafic
KEGM059 16-17	2	Oxide	Clay	Oxide
KEGM059 37-38	2	Saprolite	Clay	Oxide
KEGM059 95-96	2	Fresh	Fresh Ultramafic	Fresh Ultramafic
KEGM059 104-105	2	Fresh	Fresh Ultramafic	Fresh Ultramafic
KEGM059 127-128	2	Fresh	Fresh Ultramafic	Fresh Ultramafic
KEGM059 133-133.72	2	Fresh	Fresh Ultramafic	Fresh Ultramafic
KEGM065 160-161	2	Fresh	Fresh Ultramafic	Fresh Ultramafic
KEGM065 167-168	2	Fresh	Fresh Ultramafic	Fresh Ultramafic
KEGM065 171-172	2	Fresh	Fresh Ultramafic	Fresh Ultramafic
KEGM065 177-178	2	Fresh	Fresh Ultramafic	Fresh Ultramafic
KEGM152 90-91	2	Fresh	Mafic volcanic	Fresh Mafic
KEGR152 68-69	2	Fresh	Mafic volcanic	Fresh Mafic
KEGR152 78-79	2	Fresh	Fresh Ultramafic	Fresh Ultramafic
KEGR152 90-91	2	Fresh	Mafic volcanic	Fresh Mafic
KEGR152 94-95	2	Fresh	Mafic volcanic	Fresh Mafic

Table A2-1: Sample Descriptions

Sample ID	Phase	Weathering	Lithology	Classification
KEGR152 104-105	2	Fresh	Mafic volcanic	Fresh Mafic
KEGR152 118-119	2	Fresh	Mafic volcanic	Fresh Mafic
WC001	3	Fresh	KOM BASALT	Fresh Mafic
WC002	3	Fresh	KOM BASALT	Fresh Mafic
WC003	3	Fresh	KOM BASALT	Fresh Mafic
WC004	3	Fresh	KOM BASALT	Fresh Mafic
WC005	3	Fresh	KOM BASALT	Fresh Mafic
WC006	3	Fresh	KOM BASALT	Fresh Mafic
WC007	3	Fresh	KOM BASALT	Fresh Mafic
WC008	3	Fresh	KOM BASALT	Fresh Mafic
WC011	3	Fresh	KOM BASALT	Fresh Mafic
WC012	3	Fresh	KOM BASALT	Fresh Mafic
WC013	3	Fresh	KOM BASALT	Fresh Mafic
WC014	3	Fresh	KOM BASALT	Fresh Mafic
WC015	3	Fresh	KOM BASALT	Fresh Mafic
WC016	3	Fresh	KOM BASALT	Fresh Mafic
WC017	3	Fresh	KOM BASALT	Fresh Mafic
WC018	3	Fresh	KOM BASALT	Fresh Mafic
WC022	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC023	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC024	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC025	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC026	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC027	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC028	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC029	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC030	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC031	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC032	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC036	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC037	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC038	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC039	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC063	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC064	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC065	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC066	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC067	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC068	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC069	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC070	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC075	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC076	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC077	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC078	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC079	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC080	3	Fresh	CAL-ALK BASALT	Fresh Mafic
WC043	3	Fresh	HIGH MG BASALT	Fresh Ultramafic
WC044	3	Fresh	HIGH MG BASALT	Fresh Ultramafic
WC045	3	Fresh	HIGH MG BASALT	Fresh Ultramafic
WC046	3	Fresh	HIGH MG BASALT	Fresh Ultramafic
WC047	3	Fresh	HIGH MG BASALT	Fresh Ultramafic
WC048	3	Fresh	HIGH MG BASALT	Fresh Ultramafic
WC049	3	Fresh	HIGH MG BASALT	Fresh Ultramafic
WC050	3	Fresh	HIGH MG BASALT	Fresh Ultramafic
WC051	3	Fresh	MW Petalite Peg	Pegmatite Ore
WC052	3	Fresh	MW Petalite Peg	Pegmatite Ore
WC053	3	Fresh	MW Petalite Peg	Pegmatite Ore
WC054	3	Fresh	MW Petalite Peg	Pegmatite Ore
WC055	3	Fresh	MW Petalite Peg	Pegmatite Ore
WC056	3	Fresh	MW Petalite Peg	Pegmatite Ore
WC057	3	Fresh	MW Petalite Peg	Pegmatite Ore
WC058	3	Fresh	MW Petalite Peg	Pegmatite Ore
WC081	3	Fresh	BIF	Fresh BIF
WC082	3	Fresh	BIF	Fresh BIF
WC083	3	Fresh	BIF	Fresh BIF
WC084	3	Fresh	BIF	Fresh BIF
WC085	3	Fresh	BIF	Fresh BIF
WC086	3	Fresh	DYKE	Fresh Dyke
WC087	3	Fresh	DYKE	Fresh Dyke
WC009	3	Transitional	KOM BASALT	Transitional
WC010	3	Transitional	KOM BASALT	Transitional

Table A2-1: Sample Descriptions

Sample ID	Phase	Weathering	Lithology	Classification
WC019	3	Transitional	QTZ/PEG	Transitional
WC020	3	Transitional	CAL-ALK BASALT	Transitional
WC021	3	Transitional	CAL-ALK BASALT	Transitional
WC034	3	Transitional	CAL-ALK BASALT	Transitional
WC035	3	Transitional	CAL-ALK BASALT	Transitional
WC040	3	Transitional	HIGH MG BASALT	Transitional
WC041	3	Transitional	HIGH MG BASALT	Transitional
WC042	3	Transitional	HIGH MG BASALT	Transitional
WC061	3	Transitional	CAL-ALK BASALT	Transitional
WC062	3	Transitional	CAL-ALK BASALT	Transitional
WC073	3	Transitional	CAL-ALK BASALT	Transitional
WC074	3	Transitional	CAL-ALK BASALT	Transitional
WC033	3	Oxide	CAL-ALK BASALT	Oxide
WC059	3	Oxide	CAL-ALK BASALT	Oxide
WC060	3	Oxide	CAL-ALK BASALT	Oxide
WC071	3	Oxide	CAL-ALK BASALT	Oxide
WC072	3	Oxide	CAL-ALK BASALT	Oxide
WC088	3	Oxide	SAPROLITE	Oxide
WC089	3	Oxide	SAPROLITE	Oxide
WC090	3	Oxide	SAPROLITE	Oxide
WC091	3	Oxide	SAPROLITE	Oxide
WC092	3	Oxide	SAPROLITE	Oxide
WC093	3	Oxide	SAPROLITE	Oxide
WC094	3	Oxide	SAPROLITE	Oxide
WC095	3	Oxide	SAPROLITE	Oxide
WC096	3	Oxide	SAPROLITE	Oxide

Table A2-2: Acid Base Accounting (ABA) Summary

Sample ID	Phase	Weathering	Lithology	pH	EC	TDS	Total S	SO4_S	Total C	Acid Insoluble C	ANC	AP	NAPP	NAG pH	NAG (pH 4.5)	NAG (pH 7)	MPA	CC-ANC	Eff. NAPP (CC-ANC)	NPR	Classification
				pH Units	uS/cm	mg/L	%	%	%	%	kg H_2SO_4/tonne			pH Units	kg H_2SO_4/tonne					Ratio	
KEGR22 3-11	1	Clay	Weathered Mafic	5.5	1130	723	0.04	N.D.	0.04	N.D.	2	1.2	-1	N.D.	N.D.	N.D.	1.2	3	-2	1.6	NAF
KEGR22 55-60	1	Fresh	Mafic	8	290	186	0.04	N.D.	0.04	N.D.	28	1.2	-27	N.D.	N.D.	N.D.	1.2	3	-2	22.9	NAF
KEGR22 85-89	1	Ore	Pegmatite Ore	N.D.	N.D.	N.D.	0.01	N.D.	0.05	N.D.	8	0.3	-8	N.D.	N.D.	N.D.	0.3	4	-4	26.1	NAF
KEGR22 90-99	1	Fresh	Mafic	9.7	110	70	0.03	N.D.	0.06	N.D.	26	0.9	-25	N.D.	N.D.	N.D.	0.9	5	-4	28.3	NAF
KEGR22 106-107	1	Fresh	Contact zone	N.D.	N.D.	N.D.	0.02	N.D.	0.63	N.D.	68	0.6	-67	N.D.	N.D.	N.D.	0.6	51	-51	111.1	NAF
KEGR22 140-145	1	Ore	Pegmatite Ore	N.D.	N.D.	N.D.	0.03	N.D.	0.09	N.D.	9	0.9	-8	N.D.	N.D.	N.D.	0.9	7	-6	9.8	NAF
KEGR32 3-7	1	Clay	Weathered Mafic	N.D.	N.D.	N.D.	0.28	N.D.	0.15	N.D.	0.5	8.6	8	4.2	0	2	8.6	12	-4	0.1	PAF-LC
KEGR32 11-15	1	Oxide/transition	Mafic	N.D.	N.D.	N.D.	0.02	N.D.	0.02	N.D.	6	0.6	-5	N.D.	N.D.	N.D.	0.6	2	-1	9.8	NAF
KEGR32 34-36	1	Oxide/transition	Pegmatite	7.9	250	160	0.02	N.D.	0.04	N.D.	7	0.6	-6	N.D.	N.D.	N.D.	0.6	3	-3	11.4	NAF
KEGR32 86-102	1	Fresh	Mafic	N.D.	N.D.	N.D.	0.07	N.D.	0.16	N.D.	28	2.1	-26	N.D.	N.D.	N.D.	2.1	13	-11	13.1	NAF
KEGR32 102-112	1	Ore	Pegmatite Ore	N.D.	N.D.	N.D.	0.04	N.D.	0.07	N.D.	10	1.2	-9	N.D.	N.D.	N.D.	1.2	6	-4	8.2	NAF
KEGR32 140-147	1	Fresh	Mafic	N.D.	N.D.	N.D.	0.04	N.D.	0.16	N.D.	26	1.2	-25	N.D.	N.D.	N.D.	1.2	13	-12	21.2	NAF
KEGR25 6-11	1	Clay	Weathered Mafic	N.D.	N.D.	N.D.	0.06	N.D.	0.04	N.D.	2	1.8	0	N.D.	N.D.	N.D.	1.8	3	-1	1.1	NAF
KEGR25 15-18	1	Clay	Weathered Pegmatite	6.1	2907	1,860	0.04	N.D.	0.05	N.D.	3	1.2	-2	N.D.	N.D.	N.D.	1.2	4	-3	2.5	NAF
KEGR25 45-50	1	Oxide/transition	Mafic	N.D.	N.D.	N.D.	0.02	N.D.	0.07	N.D.	14	0.6	-13	N.D.	N.D.	N.D.	0.6	6	-5	22.9	NAF
KEGR25 90-95	1	Fresh	Mafic	N.D.	N.D.	N.D.	0.03	N.D.	0.08	N.D.	25	0.9	-24	N.D.	N.D.	N.D.	0.9	7	-6	27.2	NAF
KEGR25 145-147	1	Fresh	Contact zone	N.D.	N.D.	N.D.	0.25	N.D.	0.23	N.D.	26	7.7	-18	6.5	0	0	7.7	19	-11	3.4	NAF
KEGR25 150-155	1	Ore	Pegmatite Ore	N.D.	N.D.	N.D.	0.02	N.D.	0.1	N.D.	4	0.6	-3	N.D.	N.D.	N.D.	0.6	8	-8	6.5	NAF
KEGR25 195-200	1	Fresh	Mafic	8.8	3264	2,089	0.12	N.D.	0.45	N.D.	47	3.7	-43	N.D.	N.D.	N.D.	3.7	37	-33	12.8	NAF
KEGR26 44-45	1	Clay	Weathered Pegmatite	N.D.	N.D.	N.D.	<0.01	N.D.	0.03	N.D.	7	<0.3	-7	N.D.	N.D.	N.D.	<0.3	2	-7	7.0	NAF
KEGR26 50-52	1	Fresh	Contact zone	7.8	540	346	<0.01	N.D.	0.02	N.D.	9	<0.3	-9	N.D.	N.D.	N.D.	<0.3	2	-9	9.0	NAF
KEGR26 90-95	1	Fresh	Mafic	N.D.	N.D.	N.D.	0.04	N.D.	0.07	N.D.	19	1.2	-18	N.D.	N.D.	N.D.	1.2	6	-4	15.5	NAF
KEGR26 110-115	1	Ore	Pegmatite Ore	N.D.	N.D.	N.D.	0.02	N.D.	0.05	N.D.	4	0.6	-3	N.D.	N.D.	N.D.	0.6	4	-3	6.5	NAF
KEGR26 152-153	1	Fresh	Contact zone	N.D.	N.D.	N.D.	0.05	N.D.	0.12	N.D.	8	1.5	-6	N.D.	N.D.	N.D.	1.5	10	-8	5.2	NAF
KEGR26 160-165	1	Fresh	Mafic	N.D.	N.D.	N.D.	0.04	N.D.	0.13	N.D.	24	1.2	-23	N.D.	N.D.	N.D.	1.2	11	-9	19.6	NAF
KEGR27 17-25	1	Clay	Weathered Pegmatite	N.D.	N.D.	N.D.	0.02	N.D.	0.03	N.D.	1	0.6	0	N.D.	N.D.	N.D.	0.6	2	-2	1.6	NAF
KEGR27 37-44	1	Clay	Weathered Mafic	N.D.	N.D.	N.D.	0.01	N.D.	0.02	N.D.	4	0.3	-4	N.D.	N.D.	N.D.	0.3	2	-1	13.1	NAF
KEGR27 60-67	1	Oxide/transition	Mafic	9.3	60	38	0.02	N.D.	0.01	N.D.	26	0.6	-25	N.D.	N.D.	N.D.	0.6	1	0	42.5	NAF
KEGR27 81-84	1	Fresh	Mafic	N.D.	N.D.	N.D.	0.07	N.D.	0.02	N.D.	24	2.1	-22	N.D.	N.D.	N.D.	2.1	2	1	11.2	NAF
KEGR50 13-19	1	Clay	Weathered Pegmatite	N.D.	N.D.	N.D.	0.04	N.D.	0.11	N.D.	1	1.2	0	N.D.	N.D.	N.D.	1.2	9	-8	0.8	NAF
KEGR50 19-21	1	Clay	Weathered Mafic	N.D.	N.D.	N.D.	0.05	N.D.	0.08	N.D.	2	1.5	0	N.D.	N.D.	N.D.	1.5	7	-5	1.3	NAF
KEGR50 21-25	1	Oxide/transition	Mafic	N.D.	N.D.	N.D.	0.01	N.D.	0.16	N.D.	6	0.3	-6	N.D.	N.D.	N.D.	0.3	13	-13	19.6	NAF
KEGR50 35-40	1	Ore	Pegmatite Ore	N.D.	N.D.	N.D.	0.01	N.D.	0.44	N.D.	8	0.3	-8	N.D.	N.D.	N.D.	0.3	36	-36	26.1	NAF
KEGR50 64-66	1	Ore	Pegmatite Ore	9.4	60	38	<0.01	N.D.	0.2	N.D.	13	<0.3	-13	N.D.	N.D.	N.D.	<0.3	16	-13	13.0	NAF
KEGR50 69-70	1	Fresh	Contact zone	N.D.	N.D.	N.D.	<0.01	N.D.	0.04	N.D.	25	<0.3	-25	N.D.	N.D.	N.D.	<0.3	3	-25	25.0	NAF
KEGR50 70-75	1	Fresh	Mafic	9.6	150	96	0.03	N.D.	0.31	N.D.	28	0.9	-27	N.D.	N.D.	N.D.	0.9	25	-24	30.5	NAF
KEGR50 80-85	1	Fresh	Mafic	N.D.	N.D.	N.D.	<0.01	N.D.	0.39	N.D.	32	<0.3	-32	N.D.	N.D.	N.D.	<0.3	32	-32	32.0	NAF
KEGR58 43-47	1	Oxide/transition	Pegmatite	N.D.	N.D.	N.D.	<0.01	N.D.	0.04	N.D.	5	<0.3	-5	N.D.	N.D.	N.D.	<0.3	3	-5	5.0	NAF
KEGR58 55-60	1	Ore	Pegmatite Ore	N.D.	N.D.	N.D.	<0.01	N.D.	0.04	N.D.	6	<0.3	-6	N.D.	N.D.	N.D.	<0.3	3	-6	6.0	NAF
KEGR58 85-90	1	Fresh	Mafic	N.D.	N.D.	N.D.	0.03	N.D.	0.21	N.D.	31	0.9	-30	N.D.	N.D.	N.D.	0.9	17	-16	33.8	NAF
KEGR60 40-42	1	Oxide/transition	Pegmatite	N.D.	N.D.	N.D.	<0.01	N.D.	0.06	N.D.	3	<0.3	-3	N.D.	N.D.	N.D.	<0.3	5	-3	3.0	NAF
KEGR60 42-45	1	Fresh	Mafic	N.D.	N.D.	N.D.	<0.01	N.D.	0.03	N.D.	20	<0.3	-20	N.D.	N.D.	N.D.	<0.3	2	-20	20.0	NAF
KEGR60 50-53	1	Ore	Pegmatite Ore	N.D.	N.D.	N.D.	<0.01	N.D.	0.03	N.D.	6	<0.3	-6	N.D.	N.D.	N.D.	<0.3	2	-6	6.0	NAF
KEGR60 61-63	1	Ore	Pegmatite Ore	N.D.	N.D.	N.D.	<0.01	N.D.	0.02	N.D.	24	<0.3	-24	N.D.	N.D.	N.D.	<0.3	2	-24	24.0	NAF
KEGR60 65-70	1	Fresh	Mafic	N.D.	N.D.	N.D.	0.55	N.D.	0.47	N.D.	65	16.8	-48	8.4	0	0	16.8	38	-22	3.9	NAF
KEGR90 52-56	1	Fresh	Mafic	N.D.	N.D.	N.D.	<0.01	N.D.	0.02	N.D.	9	<0.3	-9	N.D.	N.D.	N.D.	<0.3	2	-9	9.0	NAF
KEGR90 70-75	1	Fresh	Mafic	N.D.	N.D.	N.D.	0.04	N.D.	0.08	N.D.	14	1.2	-13	N.D.	N.D.	N.D.	1.2	7	-5	11.4	NAF
KEGR90 154-156	1	Ore	Pegmatite Ore	N.D.	N.D.	N.D.	0.12	N.D.	0.12	N.D.	13	3.7	-9	N.D.	N.D.	N.D.	3.7	10	-6	3.5	NAF
KEGR90 175-180	1	Ore	Pegmatite Ore	N.D.	N.D.	N.D.	0.07	N.D.	0.07	N.D.	9	2.1	-7	N.D.	N.D.	N.D.	2.1	6	-4	4.2	NAF
KEGR90 200-205	1	Fresh	Mafic	N.D.	N.D.	N.D.	0.2	N.D.	0.13	N.D.	84	6.1	-78	8.1	0	0	6.1	11	-5	13.7	NAF
KEGR96 6-10	1	Clay	Weathered Mafic	N.D.	N.D.	N.D.	0.04	N.D.	0.08	N.D.	2	1.2	-1	N.D.	N.D.	N.D.	1.2	7	-5	1.6	NAF
KEGR96 31-34	1	Oxide/transition	Mafic	N.D.	N.D.	N.D.	0.01	N.D.	0.3	N.D.	9	0.3	-9	N.D.	N.D.	N.D.	0.3	25	-24	29.4	NAF
KEGR96 35-40	1	Fresh	Mafic	N.D.	N.D.	N.D.	<0.01	N.D.	0.22	N.D.	14	<0.3	-14	N.D.	N.D.	N.D.	<0.3	18	-14	14.0	NAF
KEGR96 44-50	1	Fresh	Mafic	9.5	190	122	0.11	N.D.	0.44	N.D.	25	3.4	-22	N.D.	N.D.	N.D.	3.4	36	-33	7.4	NAF
KEGR96 60-65	1	Ore	Pegmatite Ore	9.8	130	83	0.01	N.D.	0.11	N.D.	29	0.3	-29	N.D.	N.D.	N.D.	0.3	9	-9	94.8	NAF
KEGR96 95-100	1	Fresh	Mafic	N.D.	N.D.	N.D.	0.07	N.D.	0.12	N.D.	32	2.1	-30	N.D.	N.D.	N.D.	2.1	10	-8	14.9	NAF
KEGR77 39-43	1	Oxide/transition	Pegmatite	N.D.	N.D.	N.D.	<0.01	N.D.	0.03	N.D.	4	<0.3	-4	N.D.	N.D.	N.D.	<0.3	2	-4	4.0	NAF
KEGR77 54-59	1	Fresh	Mafic	N.D.	N.D.	N.D.	0.04	N.D.	0.04	N.D.	11	1.2	-10	N.D.	N.D.	N.D.	1.2	3	-2	9.0	NAF
KEGR77 75-80	1	Fresh	Mafic	N.D.	N.D.	N.D.	0.04	N.D.	0.04	N.D.	29	1.2	-28	N.D.	N.D.	N.D.	1.2	3	-2	23.7	NAF
KEGR77 110-115	1	Ore	Pegmatite Ore	9.2	210	134	<0.01	N.D.	0.05	N.D.	6	<0.3	-6	N.D.	N.D.	N.D.	<0.3	4	-6	6.0	NAF
KEGR77 145-150	1	Ore	Pegmatite Ore	N.D.	N.D.	N.D.	0.01	N.D.	0.11	N.D.	9	0.3	-9	N.D.	N.D.	N.D.	0.3	9	-9	29.4	NAF
KEGR14 15-20	1	Clay	Weathered Mafic	N.D.	N.D.	N.D.	0.02	N.D.	0.2	N.D.	7	0.6	-6	N.D.	N.D.	N.D.	0.6	16	-16	11.4	NAF

Table A2-2: Acid Base Accounting (ABA) Summary

Sample ID	Phase	Weathering	Lithology	pH	EC	TDS	Total S	SO4_S	Total C	Acid Insoluble C	ANC	AP	NAPP	NAG pH	NAG (pH 4.5)	NAG (pH 7)	MPA	CC-ANC	Eff. NAPP (CC-ANC)	NPR	Classification
				pH Units	uS/cm	mg/L	%	%	%	%	kg H_2SO_4/tonne			pH Units	kg H_2SO_4/tonne					Ratio	
KEGR14 52-55	1	Fresh	Mafic	N.D.	N.D.	N.D.	<0.01	N.D.	0.04	N.D.	40	<0.3	-40	N.D.	N.D.	N.D.	<0.3	3	-40	40.0	NAF
KEGR14 83-88	1	Fresh	Mafic	N.D.	N.D.	N.D.	0.1	N.D.	0.2	N.D.	62	3.1	-59	N.D.	N.D.	N.D.	3.1	16	-13	20.3	NAF
KEGM036 122-123	2	Fresh	Mafic volcanic	9.8	94	60	0.08	N.D.	0.03	N.D.	31	2.4	-29	N.D.	N.D.	N.D.	2.4	2	0	12.7	NAF
KEGM036 126-127	2	Fresh	Mafic volcanic	9.2	88	56	0.46	0.02	0.005	N.D.	25	13.5	-12	3.8	<1	2	14.1	0	13	1.9	Uncertain
KEGM036 135-136	2	Fresh	Mafic volcanic	9.6	102	65	0.04	N.D.	0.11	N.D.	33	1.2	-32	N.D.	N.D.	N.D.	1.2	9	-8	27.0	NAF
KEGM036 167-168	2	Fresh	Fresh Ultramafic	9.5	106	68	0.005	N.D.	0.05	N.D.	47	0.2	-47	N.D.	N.D.	N.D.	0.2	4	-4	307.2	NAF
KEGM045 059-60	2	Fresh	Mafic volcanic	7.7	93	60	0.42	0.03	0.2	N.D.	22	11.9	-10	4.2	<1	2	12.9	16	-4	1.8	Uncertain
KEGM045 064-65	2	Fresh	Mafic Schist	4.5	266	170	1.92	0.12	0.27	N.D.	22	55.1	33	2.4	37	45	58.8	22	33	0.4	PAF
KEGM045 069-70	2	Fresh	Fresh Mafic	5.3	341	218	2.74	0.19	0.33	N.D.	16	78.0	62	2.5	28	52	83.8	27	51	0.2	PAF
KEGM045 126-127	2	Fresh	Mafic volcanic	9.5	98	63	0.97	0.04	1.26	N.D.	130	28.5	-102	8.7	<1	<1	29.7	103	-74	4.6	NAF (AC)
KEGM045 149-150	2	Fresh	Mafic volcanic	9.7	105	67	0.03	N.D.	0.07	N.D.	30	0.9	-29	N.D.	N.D.	N.D.	0.9	6	-5	32.7	NAF
KEGM045 170-171	2	Fresh	Mafic volcanic	9.6	123	79	0.11	N.D.	1.51	N.D.	155	3.4	-152	N.D.	N.D.	N.D.	3.4	123	-120	46.0	NAF (AC)
KEGM049 151-152	2	Fresh	Fresh Ultramafic	9.3	81	52	0.09	N.D.	0.02	N.D.	48	2.8	-45	N.D.	N.D.	N.D.	2.8	2	1	17.4	NAF
KEGM049 153-154.34	2	Fresh	Fresh Ultramafic	9.2	154	99	0.29	0.005	0.08	N.D.	54	8.7	-45	8.5	<1	<1	8.9	7	2	6.2	NAF
KEGM049 272-273	2	Fresh	Mafic volcanic	9.6	97	62	0.04	N.D.	0.02	N.D.	21	1.2	-20	N.D.	N.D.	N.D.	1.2	2	0	17.2	NAF
KEGM049 276-277	2	Fresh	Mafic volcanic	9.6	62	40	0.08	N.D.	0.04	N.D.	23	2.4	-21	N.D.	N.D.	N.D.	2.4	3	-1	9.4	NAF
KEGM052 175-176	2	Fresh	Mafic volcanic	9.3	73	47	0.04	N.D.	0.02	N.D.	18	1.2	-17	N.D.	N.D.	N.D.	1.2	2	0	14.7	NAF
KEGM052 196-197	2	Fresh	Mafic volcanic	9.5	91	58	0.2	0.005	0.03	N.D.	26	6.0	-20	6.7	<1	<1	6.1	2	4	4.4	NAF
KEGM052 219-220	2	Fresh	Dolerite	9.7	94	60	0.12	N.D.	0.02	N.D.	31	3.7	-27	N.D.	N.D.	N.D.	3.7	2	2	8.4	NAF
KEGM052 272-273	2	Fresh	Fresh Ultramafic	9.5	137	88	0.28	0.01	0.15	N.D.	52	8.3	-44	9.2	<1	<1	8.6	12	-4	6.3	NAF
KEGM052 289-290	2	Fresh	Mafic volcanic	9.7	93	60	0.02	N.D.	0.23	N.D.	38	0.6	-37	N.D.	N.D.	N.D.	0.6	19	-18	62.1	NAF
KEGM054 012-13	2	Oxide	Clay	6.8	1134	726	0.02	N.D.	0.03	N.D.	5	0.6	-4	N.D.	N.D.	N.D.	0.6	2	-2	8.2	NAF
KEGM054 065-66	2	Saprolite	Clay	6.7	1311	839	0.08	N.D.	0.01	N.D.	7	2.4	-5	N.D.	N.D.	N.D.	2.4	1	2	2.9	NAF
KEGM054 270-271	2	Fresh	Mafic	9.4	130	83	0.74	0.02	1.1	N.D.	119	22.0	-97	9.3	<1	<1	22.6	90	-68	5.4	NAF
KEGM054 273-274	2	Fresh	Mafic	8.9	163	104	3.83	0.1	0.1	N.D.	23	114.1	91	2.4	37	60	117.2	8	106	0.2	PAF
KEGM054 306-307	2	Fresh	Fresh Ultramafic	9.5	114	73	0.09	N.D.	0.03	N.D.	46	2.8	-43	N.D.	N.D.	N.D.	2.8	2	0	16.7	NAF
KEGM056 242-243	2	Fresh	Mafic volcanic	7.5	183	117	0.06	N.D.	0.005	N.D.	29	1.8	-27	N.D.	N.D.	N.D.	1.8	0	1	15.8	NAF
KEGM056 254-255	2	Fresh	Mafic volcanic	9.6	75	48	0.5	0.005	0.28	N.D.	41	15.1	-26	7.7	<1	<1	15.3	23	-8	2.7	NAF
KEGM056 317-318	2	Fresh	Mafic Schist	7.2	154	99	0.42	0.03	0.05	N.D.	22	11.9	-10	3.9	<1	2	12.9	4	8	1.8	NAF
KEGM056 328-329	2	Fresh	Mafic volcanic	9.5	169	108	0.02	N.D.	0.02	N.D.	26	0.6	-25	N.D.	N.D.	N.D.	0.6	2	-1	42.5	NAF
KEGM058 010-11	2	Oxide	Clay	6.9	969	620	0.03	N.D.	0.06	N.D.	7	0.9	-6	N.D.	N.D.	N.D.	0.9	5	-4	7.6	NAF
KEGM058 030-31	2	Saprolite	Mafic Volcanic	8.2	613	392	0.02	N.D.	0.02	N.D.	26	0.6	-25	N.D.	N.D.	N.D.	0.6	2	-1	42.5	NAF
KEGM058 145-146	2	Fresh	Fresh Ultramafic	9	395	253	0.12	N.D.	0.42	N.D.	89	3.7	-85	N.D.	N.D.	N.D.	3.7	34	-31	24.2	NAF
KEGM058 153-154	2	Fresh	Fresh Ultramafic	9.4	98	63	0.2	0.005	0.53	N.D.	122	6.0	-116	9.4	<1	<1	6.1	43	-37	20.4	NAF (AC)
KEGM058 162-163	2	Fresh	Fresh Ultramafic	8.3	2250	1,440	0.17	0.01	0.13	N.D.	56	4.9	-51	7.8	<1	<1	5.2	11	-6	11.4	NAF
KEGM058 171-172	2	Fresh	Fresh Ultramafic	9	188	120	0.17	0.005	0.11	N.D.	57	5.0	-52	8.4	<1	<1	5.2	9	-4	11.3	NAF
KEGM059 016-17	2	Oxide	Clay	6.8	642	411	0.02	N.D.	0.03	N.D.	6	0.6	-5	N.D.	N.D.	N.D.	0.6	2	-2	9.8	NAF
KEGM059 037-38	2	Saprolite	Clay	8.1	343	220	0.02	N.D.	0.02	N.D.	36	0.6	-35	N.D.	N.D.	N.D.	0.6	2	-1	58.8	NAF
KEGM059 095-96	2	Fresh	Fresh Ultramafic	9.1	226	145	0.04	N.D.	0.43	N.D.	110	1.2	-109	N.D.	N.D.	N.D.	1.2	35	-34	89.9	NAF (AC)
KEGM059 104-105	2	Fresh	Fresh Ultramafic	8.5	933	597	0.17	0.005	0.12	N.D.	62	5.0	-57	8.5	<1	<1	5.2	10	-5	12.3	NAF
KEGM059 127-128	2	Fresh	Fresh Ultramafic	9.5	88	56	0.23	0.005	0.12	N.D.	59	6.9	-52	9.1	<1	<1	7.0	10	-3	8.6	NAF
KEGM059 133-133.72	2	Fresh	Fresh Ultramafic	9.6	138	88	0.04	N.D.	0.53	N.D.	120	1.2	-119	N.D.	N.D.	N.D.	1.2	43	-42	98.0	NAF (AC)
KEGM065 160-161	2	Fresh	Fresh Ultramafic	9.6	141	90	0.08	N.D.	1.82	N.D.	209	2.4	-207	N.D.	N.D.	N.D.	2.4	149	-146	85.4	NAF (AC)
KEGM065 167-168	2	Fresh	Fresh Ultramafic	9.5	94	60	0.32	0.005	0.39	N.D.	144	9.6	-134	9.3	<1	<1	9.8	32	-22	14.9	NAF (AC)
KEGM065 171-172	2	Fresh	Fresh Ultramafic	9.4	132	84	0.15	0.005	0.2	N.D.	74	4.4	-70	8.6	<1	<1	4.6	16	-12	16.7	NAF
KEGM065 177-178	2	Fresh	Fresh Ultramafic	9.6	99	63	0.04	N.D.	0.13	N.D.	76	1.2	-75	N.D.	N.D.	N.D.	1.2	11	-9	62.1	NAF
KEGM152 090-91	2	Fresh	Mafic volcanic	8.9	66	42	0.02	N.D.	0.03	N.D.	12	0.6	-11	N.D.	N.D.	N.D.	0.6	2	-2	19.6	NAF
KEGR152 068-69	2	Fresh	Mafic volcanic	4.5	1971	1,261	1.89	0.42	0.39	N.D.	14	45.0	31	2.7	15	29	57.8	32	13	0.3	PAF
KEGR152 078-79	2	Fresh	Fresh Ultramafic	7.2	183	117	0.16	0.03	0.33	N.D.	88	4.0	-84	7.8	<1	<1	4.9	27	-23	22.1	NAF
KEGR152 094-95	2	Fresh	Mafic volcanic	7.8	195	125	0.13	0.03	0.37	N.D.	23	3.1	-20	7.2	<1	<1	4.0	30	-27	7.5	NAF
KEGR152 104-105	2	Fresh	Mafic volcanic	7.4	2250	1,440	3.28	0.64	1.01	N.D.	67	80.8	14	3.4	3	16	100.4	83	-2	0.8	PAF
KEGR152 118-119	2	Fresh	Mafic volcanic	9.6	120	77	0.05	N.D.	0.19	N.D.	53	1.5	-51	N.D.	N.D.	N.D.	1.5	16	-14	34.6	NAF
WC001	3	Fresh	KOM BASALT	9.8	48	31	0.04	N.D	0.1	N.D	49	1.2	-48	8.8	0	0	1.2	8	-7	40.0	NAF
WC002	3	Fresh	KOM BASALT	9.9	85	54	0.02	N.D	0.02	N.D	28	0.6	-27	8.1	0	0	0.6	2	-1	45.8	NAF
WC003	3	Fresh	KOM BASALT	9.9	83	53	0.03	N.D	0.02	N.D	29	0.9	-28	8.8	0	0	0.9	2	-1	31.6	NAF
WC004	3	Fresh	KOM BASALT	9.8	92	59	0.02	N.D	0.02	N.D	29	0.6	-28	8.1	0	0	0.6	2	-1	47.4	NAF
WC005	3	Fresh	KOM BASALT	10	84	54	0.05	N.D	0.06	N.D	27	1.5	-25	8.3	0	0	1.5	5	-3	17.6	NAF
WC006	3	Fresh	KOM BASALT	9.8	98	63	0.03	N.D	0.03	N.D	29	0.9	-28	8.1	0	0	0.9	2	-2	31.6	NAF
WC007	3	Fresh	KOM BASALT	9.9	59	38	0.06	N.D	0.01	N.D	20	1.8	-18	7.6	0	0	1.8	1	1	10.9	NAF
WC008	3	Fresh	KOM BASALT	9.9	90	58	0.05	N.D	0.02	N.D	22	1.5	-20	7.8	0	0	1.5	2	0	14.4	NAF
WC011	3	Fresh	KOM BASALT	9.8	148	95	0.02	N.D	0.04	N.D	28	0.6	-27	8.5	0	0	0.6	3	-3	45.8	NAF
WC012	3	Fresh	KOM BASALT	9.9	95	61	0.05	N.D	0.03	N.D	23	1.5	-21	8.1	0	0	1.5	2	-1	15.0	NAF
WC013	3	Fresh	KOM BASALT	9.9	91	58	0.05	N.D	0.01	N.D	22	1.5	-20	7.7	0	0	1.5	1	1	14.4	NAF

Table A2-2: Acid Base Accounting (ABA) Summary

Sample ID	Phase	Weathering	Lithology	pH	EC	TDS	Total S	SO4_S	Total C	Acid Insoluble C	ANC	AP	NAPP	NAG pH	NAG (pH 4.5)	NAG (pH 7)	MPA	CC-ANC	Eff. NAPP (CC-ANC)	NPR	Classification
				pH Units	uS/cm	mg/L	%	%	%	%	kg H_2SO_4/tonne			pH Units	kg H_2SO_4/tonne					Ratio	
WC014	3	Fresh	KOM BASALT	9.9	113	72	0.02	N.D	0.08	N.D	45	0.6	-44	8.4	0	0	0.6	7	-6	73.5	NAF
WC015	3	Fresh	KOM BASALT	9.6	179	115	0.24	N.D	0.17	N.D	71	7.3	-64	9.7	0	0	7.3	14	-7	9.7	NAF
WC016	3	Fresh	KOM BASALT	9.7	99	63	0.06	N.D	0.02	N.D	32	1.8	-30	8.4	0	0	1.8	2	0	17.4	NAF
WC017	3	Fresh	KOM BASALT	9.8	91	58	0.09	N.D	0.1	N.D	26	2.8	-23	9.9	0	0	2.8	8	-5	9.4	NAF
WC018	3	Fresh	KOM BASALT	9.8	68	44	0.05	N.D	0.04	N.D	23	1.5	-21	8.2	0	0	1.5	3	-2	15.0	NAF
WC022	3	Fresh	CAL-ALK BASALT	9.4	58	37	3.34	N.D	0.07	N.D	25	102.2	77	2	70	77	102.2	6	96	0.2	PAF
WC023	3	Fresh	CAL-ALK BASALT	9.4	79	51	1.11	N.D	0.03	N.D	45	34.0	-11	3.2	5	12	34.0	2	32	1.3	Uncertain
WC024	3	Fresh	CAL-ALK BASALT	9.4	64	41	1.43	N.D	0.08	N.D	30	43.8	14	2.8	13	24	43.8	7	37	0.7	PAF
WC025	3	Fresh	CAL-ALK BASALT	9.3	216	138	0.85	N.D	0.71	N.D	46	26.0	-20	3.9	1	2	26.0	58	-32	1.8	Uncertain
WC026	3	Fresh	CAL-ALK BASALT	9.9	105	67	0.07	N.D	0.09	N.D	27	2.1	-25	8.8	0	0	2.1	7	-5	12.6	NAF
WC027	3	Fresh	CAL-ALK BASALT	9.8	91	58	0.46	N.D	0.11	N.D	25	14.1	-11	5.6	0	0	14.1	9	5	1.8	NAF
WC028	3	Fresh	CAL-ALK BASALT	9.9	60	38	0.03	N.D	0.04	N.D	27	0.9	-26	7.7	0	0	0.9	3	-2	29.4	NAF
WC029	3	Fresh	CAL-ALK BASALT	9.9	79	51	0.08	N.D	0.02	N.D	26	2.4	-24	7.8	0	0	2.4	2	1	10.6	NAF
WC030	3	Fresh	CAL-ALK BASALT	9.8	65	42	0.13	N.D	0.03	N.D	22	4.0	-18	7.4	0	0	4.0	2	2	5.5	NAF
WC031	3	Fresh	CAL-ALK BASALT	9.8	51	33	0.02	N.D	0.02	N.D	22	0.6	-21	10	0	0	0.6	2	-1	35.9	NAF
WC032	3	Fresh	CAL-ALK BASALT	9.8	74	47	0.08	N.D	0.2	N.D	32	2.4	-30	8.7	0	0	2.4	16	-14	13.1	NAF
WC036	3	Fresh	CAL-ALK BASALT	9.9	74	47	0.03	N.D	1.43	N.D	136	0.9	-135	11.6	0	0	0.9	117	-116	148.1	NAF (AC)
WC037	3	Fresh	CAL-ALK BASALT	10	142	91	0.08	N.D	0.02	N.D	28	2.4	-26	7.8	0	0	2.4	2	1	11.4	NAF
WC038	3	Fresh	CAL-ALK BASALT	9.7	103	66	0.84	N.D	2.82	N.D	252	25.7	-226	8.7	0	0	25.7	230	-205	9.8	NAF (AC)
WC039	3	Fresh	CAL-ALK BASALT	9.5	95	61	0.74	N.D	0.19	N.D	94	22.6	-71	7.6	0	0	22.6	16	7	4.2	NAF
WC063	3	Fresh	CAL-ALK BASALT	9.8	74	47	0.03	N.D	0.01	N.D	17	0.9	-16	7.8	0	0	0.9	1	0	18.5	NAF
WC064	3	Fresh	CAL-ALK BASALT	9.8	84	54	0.46	N.D	0.04	N.D	57	14.1	-43	4.9	0	1	14.1	3	11	4.0	NAF
WC065	3	Fresh	CAL-ALK BASALT	9.9	77	49	0.46	N.D	0.04	N.D	18	14.1	-4	3.8	1	3	14.1	3	11	1.3	PAF-LC
WC066	3	Fresh	CAL-ALK BASALT	9.7	85	54	0.55	N.D	0.04	N.D	57	16.8	-40	4.4	0	1	16.8	3	14	3.4	NAF
WC067	3	Fresh	CAL-ALK BASALT	9.6	55	35	0.37	N.D	0.01	N.D	61	11.3	-50	5.6	0	0	11.3	1	11	5.4	NAF
WC068	3	Fresh	CAL-ALK BASALT	9.8	86	55	0.57	N.D	0.07	N.D	59	17.4	-42	4.7	0	1	17.4	6	12	3.4	NAF
WC069	3	Fresh	CAL-ALK BASALT	9.7	95	61	0.42	N.D	0.13	N.D	68	12.9	-55	7.2	0	0	12.9	11	2	5.3	NAF
WC070	3	Fresh	CAL-ALK BASALT	9.3	101	65	0.25	N.D	0.06	N.D	45	7.7	-37	6.9	0	0	7.7	5	3	5.9	NAF
WC075	3	Fresh	CAL-ALK BASALT	9.5	61	39	0.15	N.D	0.04	N.D	83	4.6	-78	6.8	0	0	4.6	3	1	18.1	NAF
WC076	3	Fresh	CAL-ALK BASALT	9.5	69	44	0.27	N.D	0.04	N.D	22	8.3	-14	5.3	0	0	8.3	3	5	2.7	NAF
WC077	3	Fresh	CAL-ALK BASALT	9.6	39	25	0.22	N.D	0.02	N.D	18	6.7	-11	4.7	0	0	6.7	2	5	2.7	NAF
WC078	3	Fresh	CAL-ALK BASALT	9.8	55	35	0.09	N.D	0.08	N.D	24	2.8	-21	8.8	0	0	2.8	7	-4	8.7	NAF
WC079	3	Fresh	CAL-ALK BASALT	9.7	108	69	0.27	N.D	0.47	N.D	50	8.3	-42	10.7	0	0	8.3	38	-30	6.1	NAF
WC080	3	Fresh	CAL-ALK BASALT	9.7	61	39	0.12	N.D	0.02	N.D	83	3.7	-79	7.6	0	0	3.7	2	2	22.6	NAF
WC043	3	Fresh	HIGH MG BASALT	9.6	55	35	0.07	N.D	0.4	N.D	64	2.1	-62	9.6	0	0	2.1	33	-31	29.9	NAF
WC044	3	Fresh	HIGH MG BASALT	9.6	97	62	0.19	N.D	0.88	N.D	100	5.8	-94	10.7	0	0	5.8	72	-66	17.2	NAF
WC045	3	Fresh	HIGH MG BASALT	9.8	101	65	0.08	N.D	0.06	N.D	64	2.4	-62	8.3	0	0	2.4	5	-2	26.1	NAF
WC046	3	Fresh	HIGH MG BASALT	9.9	98	63	0.05	N.D	0.24	N.D	61	1.5	-59	10	0	0	1.5	20	-18	39.9	NAF
WC047	3	Fresh	HIGH MG BASALT	9.8	112	72	0.37	N.D	1.37	N.D	143	11.3	-132	11.2	0	0	11.3	112	-101	12.6	NAF (AC)
WC048	3	Fresh	HIGH MG BASALT	9.4	141	90	0.38	N.D	0.1	N.D	53	11.6	-41	8	0	0	11.6	8	3	4.6	NAF
WC049	3	Fresh	HIGH MG BASALT	9.8	137	88	0.65	N.D	0.59	N.D	92	19.9	-72	10.2	0	0	19.9	48	-28	4.6	NAF
WC050	3	Fresh	HIGH MG BASALT	9.8	69	44	0.12	N.D	0.03	N.D	73	3.7	-69	7.9	0	0	3.7	2	1	19.9	NAF
WC051	3	Fresh	MW Petalite Peg	10.1	133	85	0.18	N.D	0.06	N.D	60	5.5	-54	8	0	0	5.5	5	1	10.9	NAF
WC053	3	Fresh	MW Petalite Peg	9.8	67	43	0.13	N.D	0.05	N.D	105	4.0	-101	7.7	0	0	4.0	4	0	26.4	NAF (AC)
WC056	3	Fresh	MW Petalite Peg	9.7	78	50	0.2	N.D	0.03	N.D	37	6.1	-31	6.9	0	0	6.1	2	4	6.0	NAF
WC058	3	Fresh	MW Petalite Peg	9.8	58	37	0.07	N.D	0.11	N.D	27	2.1	-25	8.6	0	0	2.1	9	-7	12.6	NAF
WC081	3	Fresh	BIF	9.7	74	47	0.36	N.D	0.57	N.D	69	11.0	-58	11.2	0	0	11.0	47	-36	6.3	NAF
WC082	3	Fresh	BIF	9.6	84	54	0.22	N.D	1.87	N.D	189	6.7	-182	11.4	0	0	6.7	153	-146	28.1	NAF (AC)
WC083	3	Fresh	BIF	9.7	83	53	0.18	N.D	1.03	N.D	116	5.5	-110	11.4	0	0	5.5	84	-79	21.1	NAF (AC)
WC084	3	Fresh	BIF	9.8	137	88	0.31	N.D	0.85	N.D	98	9.5	-89	11.4	0	0	9.5	69	-60	10.3	NAF
WC085	3	Fresh	BIF	9.5	78	50	0.2	N.D	1.66	N.D	164	6.1	-158	11.6	0	0	6.1	136	-130	26.8	NAF (AC)
WC086	3	Fresh	DYKE	10	142	91	0.11	N.D	0.03	N.D	68	3.4	-65	8	0	0	3.4	2	1	20.2	NAF
WC087	3	Fresh	DYKE	9.6	130	83	0.09	N.D	0.02	N.D	61	2.8	-58	7.8	0	0	2.8	2	1	22.1	NAF
WC009	3	Transitional	KOM BASALT	9.7	131	84	0.01	N.D	0.01	N.D	21	0.3	-21	7.4	0	0	0.3	1	-1	68.6	NAF
WC010	3	Transitional	KOM BASALT	9.4	206	132	0.01	N.D	<0.01	N.D	18	0.3	-18	7	0	0	0.3	<0.8	-18	58.8	NAF
WC019	3	Transitional	QTZ/PEG	5.3	307	196	0.13	N.D	<0.01	N.D	2	4.0	2	3.6	1	3	4.0	<0.8	2	0.5	PAF-LC
WC020	3	Transitional	CAL-ALK BASALT	5.1	162	104	3.85	N.D	0.15	N.D	33	117.8	85	2.4	40	77	117.8	12	106	0.3	PAF
WC021	3	Transitional	CAL-ALK BASALT	5.6	144	92	3.03	N.D	0.06	N.D	37	92.7	56	2.7	21	62	92.7	5	88	0.4	PAF
WC034	3	Transitional	CAL-ALK BASALT	8.7	139	89	0.03	N.D	0.01	N.D	14	0.9	-13	6.9	0	1	0.9	1	0	15.3	NAF
WC035	3	Transitional	CAL-ALK BASALT	9.2	55	35	0.02	N.D	0.02	N.D	17	0.6	-16	7	0	0	0.6	2	-1	27.8	NAF
WC040	3	Transitional	HIGH MG BASALT	9.5	77	49	0.02	N.D	<0.01	N.D	10	0.6	-9	6.8	0	1	0.6	<0.8	-9	16.3	NAF
WC041	3	Transitional	HIGH MG BASALT	9.4	55	35	0.01	N.D	0.01	N.D	11	0.3	-11	7	0	0	0.3	1	-1	35.9	NAF
WC042	3	Transitional	HIGH MG BASALT	9.6	51	33	0.06	N.D	<0.01	N.D	20	1.8	-18	7.2	0	0	1.8	<0.8	-18	10.9	NAF

Table A2-2: Acid Base Accounting (ABA) Summary

Sample ID	Phase	Weathering	Lithology	pH	EC	TDS	Total S	SO4_S	Total C	Acid Insoluble C	ANC	AP	NAPP	NAG pH	NAG (pH 4.5)	NAG (pH 7)	MPA	CC-ANC	Eff. NAPP (CC-ANC)	NPR	Classification
				pH Units	uS/cm	mg/L	%	%	%	%	kg H_2SO_4/tonne			pH Units	kg H_2SO_4/tonne					Ratio	
WC061	3	Transitional	CAL-ALK BASALT	8.9	67	43	0.01	N.D	0.01	N.D	9	0.3	-9	8.1	0	0	0.3	1	-1	29.4	NAF
WC062	3	Transitional	CAL-ALK BASALT	4.5	253	162	0.29	N.D	<0.01	N.D	9	8.9	0	3.8	1	3	8.9	<0.8	0	1.0	PAF-LC
WC073	3	Transitional	CAL-ALK BASALT	7.6	321	205	0.02	N.D	<0.01	N.D	39	0.6	-38	6.7	0	2	0.6	<0.8	-38	63.7	NAF
WC074	3	Transitional	CAL-ALK BASALT	N.D.	N.D.	N.D.	0.02	N.D	0.01	N.D	12	0.6	-11	8	0	0	0.6	1	0	19.6	NAF

Table A2-3: Summary of Elemental Composition Results

Sample ID	Phase	Weathering	Lithology	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Fe	Ga	Ge	Hf	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc
				mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg	%	mg/kg	mg/kg	%	mg/kg	mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
KEGM054 12-13	2		Oxide	0.07	8.14	98	22	0.42	0.21	0.04	0.03	N.D.	12.1	583	0.8	50	N.D.	4.5	N.D.	N.D.	N.D.	N.D.	0.02	N.D.	57	0.16	130	2.9	0.19	15.16	N.D.	N.D.	17.6	1	N.D.	N.D.	5.7	N.D.
KEGR22 3-11	1		Oxide	0.02	11.38	116	60	0.96	N.D.	0.02	<0.02	N.D.	24.3	520	N.D.	32	N.D.	4.9	N.D.	N.D.	N.D.	N.D.	0.15	N.D.	64	0.10	25	3.1	0.21	10.43	N.D.	N.D.	10.6	14	N.D.	N.D.	1.5	N.D.
KEGR25 15-18	1		Oxide	0.11	18.31	9	6	0.63	N.D.	0.03	<0.02	N.D.	4.3	188	N.D.	12	N.D.	0.5	N.D.	N.D.	N.D.	N.D.	0.04	N.D.	103	0.08	112	0.3	0.30	3.24	N.D.	N.D.	9.0	4	N.D.	N.D.	6.1	N.D.
KEGM058 30-31	2		Transitional	0.03	3.90	132	74	1.77	0.02	1.39	0.32	N.D.	268	2688	2.1	361	N.D.	10.6	N.D.	N.D.	N.D.	N.D.	0.06	N.D.	78	11.02	3169	0.3	0.87	0.97	N.D.	N.D.	0.9	3	N.D.	N.D.	2.0	N.D.
KEGR27 60-67	1		Transitional	0.13	7.09	87	148	11.06	N.D.	8.62	0.33	N.D.	38.5	67	N.D.	39	N.D.	7.3	N.D.	N.D.	N.D.	N.D.	0.76	N.D.	739	4.55	1481	0.6	0.75	3.15	N.D.	N.D.	6.0	378	N.D.	N.D.	0.6	N.D.
KEGR32 34-36	1		Transitional	0.08	7.83	73	28	130	N.D.	0.11	0.01	N.D.	20.2	129	N.D.	55	N.D.	4.1	N.D.	N.D.	N.D.	N.D.	0.91	N.D.	2,569	0.71	647	0.7	1.22	43.23	N.D.	N.D.	4.2	1341	N.D.	N.D.	1.9	N.D.
KEGM059 37-38	2		Transitional	0.03	3.70	167	11	1.42	0.04	2.97	0.18	N.D.	141	2627	7.5	40	N.D.	9.0	N.D.	N.D.	N.D.	N.D.	0.06	N.D.	105	10.91	1016	0.3	0.84	1.00	N.D.	N.D.	2.0	8	N.D.	N.D.	4.3	N.D.
KEGM045 64-65	2		Fresh Mafic	0.02	0.34	17	1	0.29	0.11	0.71	0.11	N.D.	4.8	213	2.1	20	N.D.	4.6	N.D.	N.D.	N.D.	N.D.	0.00	N.D.	27	0.49	413	5.5	0.02	0.36	N.D.	N.D.	3.1	1	N.D.	N.D.	1.2	N.D.
KEGM036 126-127	2		Fresh Mafic	0.08	7.88	7	101	1.28	0.04	5.47	0.09	N.D.	44.1	94	53.4	125	N.D.	9.4	N.D.	N.D.	N.D.	N.D.	0.52	N.D.	994	4.17	1357	0.2	2.28	1.15	N.D.	N.D.	3.0	59	N.D.	N.D.	0.7	N.D.
KEGM036 167-168	2		Fresh Mafic	0.15	5.85	1279	19	6.52	0.57	4.78	0.10	N.D.	72.4	1244	640	32	N.D.	8.5	N.D.	N.D.	N.D.	N.D.	0.25	N.D.	2,574	9.75	1362	0.5	0.40	0.82	N.D.	N.D.	1.1	300	N.D.	N.D.	1.1	N.D.
KEGM045 170-171	2		Fresh Mafic	0.03	6.24	16	20	0.11	0.02	7.62	0.10	N.D.	49.8	654	24.2	64	N.D.	7.8	N.D.	N.D.	N.D.	N.D.	0.09	N.D.	1,563	6.11	1370	0.1	1.07	0.42	N.D.	N.D.	1.9	35	N.D.	N.D.	2.7	N.D.
KEGM049 153-154.34	2		Fresh Mafic	0.06	4.31	533	1	2.12	0.16	5.10	0.13	N.D.	98.0	3218	12.3	103	N.D.	9.2	N.D.	N.D.	N.D.	N.D.	0.01	N.D.	46	12.48	1455	0.1	0.16	0.61	N.D.	N.D.	<0.5	7	N.D.	N.D.	2.6	N.D.
KEGM049 276-277	2		Fresh Mafic	0.03	6.67	46	28	0.11	0.03	6.13	0.08	N.D.	52.3	694	3.9	71	N.D.	8.5	N.D.	N.D.	N.D.	N.D.	0.05	N.D.	237	6.88	1354	0.2	1.89	0.50	N.D.	N.D.	2.9	10	N.D.	N.D.	0.8	N.D.
KEGM052 219-220	2		Fresh Mafic	0.03	7.82	2	54	0.88	0.03	8.27	0.09	N.D.	44.9	113	7.7	136	N.D.	8.4	N.D.	N.D.	N.D.	N.D.	0.26	N.D.	300	4.36	1313	0.8	1.63	4.22	N.D.	N.D.	1.2	73	N.D.	N.D.	0.4	N.D.
KEGM052 272-273	2		Fresh Mafic	0.07	3.97	917	0	1.80	0.28	5.47	0.11	N.D.	97.5	3210	8.9	148	N.D.	9.6	N.D.	N.D.	N.D.	N.D.	0.00	N.D.	115	12.56	1462	0.1	0.05	0.31	N.D.	N.D.	<0.5	5	N.D.	N.D.	2.8	N.D.
KEGM054 270-271	2		Fresh Mafic	0.09	6.66	16	541	0.77	0.16	8.11	0.31	N.D.	39.8	270	39.1	82	N.D.	8.3	N.D.	N.D.	N.D.	N.D.	2.41	N.D.	591	3.41	1592	1.2	0.18	4.25	N.D.	N.D.	7.3	163	N.D.	N.D.	2.1	N.D.
KEGM054 273-274	2		Fresh Mafic	0.18	7.50	15	173	0.66	0.48	7.02	0.32	N.D.	76.8	360	44.4	160	N.D.	12.2	N.D.	N.D.	N.D.	N.D.	2.29	N.D.	824	3.64	1510	0.6	0.28	1.41	N.D.	N.D.	8.6	296	N.D.	N.D.	5.7	N.D.
KEGM054 306-307	2		Fresh Mafic	0.03	5.90	561	71	1.27	0.24	5.17	0.11	N.D.	90.5	2208	21.9	71	N.D.	9.5	N.D.	N.D.	N.D.	N.D.	0.09	N.D.	776	10.57	1578	0.1	0.24	0.46	N.D.	N.D.	0.7	62	N.D.	N.D.	1.6	N.D.
KEGM056 242-243	2		Fresh Mafic	0.025	4.90	534	2	0.53	0.10	2.98	0.07	N.D.	88.8	2220	6.2	17	N.D.	9.6	N.D.	N.D.	N.D.	N.D.	0.01	N.D.	142.1	12.95	1115	0.1	0.14	0.39	N.D.	N.D.	<0.5	3	N.D.	N.D.	1.6	N.D.
KEGM056 254-255	2		Fresh Mafic	0.03	4.82	270	129	2.11	0.14	12.83	0.20	N.D.	77.7	1581	21.9	78	N.D.	8.3	N.D.	N.D.	N.D.	N.D.	0.77	N.D.	498	6.45	1571	0.2	0.22	0.51	N.D.	N.D.	0.8	131	N.D.	N.D.	0.6	N.D.
KEGM056 317-318	2		Fresh Mafic	0.10	4.88	68	69	1.35	0.19	4.15	0.22	N.D.	59.7	715	164	311	N.D.	12.4	N.D.	N.D.	N.D.	N.D.	0.10	N.D.	1,440	8.29	1301	0.4	0.51	0.92	N.D.	N.D.	0.6	100	N.D.	N.D.	0.3	N.D.
KEGM058 153-154	2		Fresh Mafic	0.08	3.14	223	5	3.21	0.17	6.46	0.09	N.D.	79.2	2232	4.8	41	N.D.	9.2	N.D.	N.D.	N.D.	N.D.	0.01	N.D.	60	12.69	1399	1.3	0.22	1.10	N.D.	N.D.	1.1	6	N.D.	N.D.	3.3	N.D.
KEGM059 127-128	2		Fresh Mafic	0.025	3.39	2	1	0.43	0.04	3.79	0.08	N.D.	78.7	2556	11.7	114	N.D.	9.6	N.D.	N.D.	N.D.	N.D.	0.00	N.D.	50.7	14.36	1268	0.1	0.21	0.86	N.D.	N.D.	1.1	4	N.D.	N.D.	0.2	N.D.
KEGM065 167-168	2		Fresh Mafic	0.03	3.05	10	0	2.45	0.25	3.08	0.12	N.D.	92.2	2623	14.7	170	N.D.	8.5	N.D.	N.D.	N.D.	N.D.	0.00	N.D.	37	16.54	1158	0.2	0.03	0.86	N.D.	N.D.	<0.5	6	N.D.	N.D.	0.4	N.D.
KEGM065 171-172	2		Fresh Mafic	0.03	3.16	5	0	1.19	0.19	2.42	0.04	N.D.	91.3	2679	18.3	76	N.D.	8.7	N.D.	N.D.	N.D.	N.D.	0.00	N.D.	36	16.74	1044	0.1	0.02	0.80	N.D.	N.D.	<0.5	5	N.D.	N.D.	0.5	N.D.
KEGR152 78-79	2		Fresh Mafic	0.07	4.97	151	32	1.98	0.11	4.12	0.27	N.D.	62.4	404	23.4	60	N.D.	17.1	N.D.	N.D.	N.D.	N.D.	0.13	N.D.	586	2.47	2097	1.8	0.76	3.01	N.D.	N.D.	4.5	113	N.D.	N.D.	1.6	N.D.
KEGR152 104-105	2		Fresh Mafic	0.12	2.47	208	20	1.33	0.50	8.62	1.05	N.D.	28.3	320	10.2	101	N.D.	18.5	N.D.	N.D.	N.D.	N.D.	0.05	N.D.	214	0.97	1844	4.4	0.38	1.99	N.D.	N.D.	17.2	23	N.D.	N.D.	1.2	N.D.
KEGR152 90-91	1		Fresh Mafic	0.02	3.48	230	0	1.22	0.10	4.23	0.08	N.D.	82.1	2622	6.2	96	N.D.	8.2	N.D.	N.D.	N.D.	N.D.	0.00	N.D.	48	14.74	1322	0.4	0.05	0.66	N.D.	N.D.	0.3	5	N.D.	N.D.	7.4	N.D.
KEGR22 55-60	1		Fresh Mafic	0.11	6.88	108	393	2.07	N.D.	8.33	0.14	N.D.	39.5	762	N.D.	49	N.D.	8.7	N.D.	N.D.	N.D.	N.D.	0.56	N.D.	354	6.60	1428	1.5	0.82	2.61	N.D.	N.D.	6.7	137	N.D.	N.D.	0.8	N.D.
KEGR22 90-99	1		Fresh Mafic	0.11	6.72	59	450	5.36	N.D.	5.58	0.08	N.D.	58.9	973	N.D.	76	N.D.	8.4	N.D.	N.D.	N.D.	N.D.	0.90	N.D.	1,737	7.63	1447	0.9	1.25	2.10	N.D.	N.D.	2.6	326	N.D.	N.D.	0.6	N.D.
KEGR25 195-200	1		Fresh Mafic	0.10	5.78	333	28	1.98	N.D.	10.59	0.07	N.D.	45.3	1101	N.D.	48	N.D.	7.8	N.D.	N.D.	N.D.	N.D.	0.44	N.D.	410	5.56	1445	2.3	1.01	0.86	N.D.	N.D.	2.2	78	N.D.	N.D.	0.9	N.D.
KEGR25 90-95	1		Fresh Mafic	0.1	7.69	129	247	34	N.D.	5.59	0.13	N.D.	35.7	10	N.D.	90	N.D.	7.2	N.D.	N.D.	N.D.	N.D.	1.54	N.D.	2150	2.33	1531	1.3	1.36	13.98	N.D.	N.D.	2.6	1142	N.D.	N.D.	0.8	N.D.
KEGR27 81-84	1		Fresh Mafic	0.21	7.87	74	400	4.51	N.D.	5.93	0.14	N.D.	47.2	75	N.D.	79	N.D.	8.9	N.D.	N.D.	N.D.	N.D.	1.63	N.D.	526	4.16	1333	0.3	1.14	1.39	N.D.	N.D.	2.5	450	N.D.	N.D.	1.2	N.D.
KEGR32 86-102	1		Fresh Mafic	0.12	7.69	183	160	9.29	N.D.	6.51	0.09	N.D.	39.5	159	N.D.	91	N.D.	6.9	N.D.	N.D.	N.D.	N.D.	0.48	N.D.	1027	4.12	1796	1.2	1.51	5.16	N.D.	N.D.	1.6	343	N.D.	N.D.	0.9	N.D.
KEGR50 70-75	1		Fresh Mafic	0.10	6.71	158	55	5.23	N.D.	6.19	1.24	N.D.	51.5	947	N.D.	46	N.D.	7.5	N.D.	N.D.	N.D.	N.D.	0.26	N.D.	459	6.20	1146	1.9	1.38	2.99	N.D.	N.D.	1.9	137	N.D.	N.D.	1.7	N.D.
KEGR90 52-56	1		Fresh Mafic	0.07	7.78	66	37	8.40	N.D.	5.10	0.16	N.D.	69.8	509	N.D.	145	N.D.	8.8	N.D.	N.D.	N.D.	N.D.	0.13	N.D.	1,593	4.31	1271	0.5	1.89	1.43	N.D.	N.D.	1.4	152	N.D.	N.D.	1.2	N.D.
KEGR96 44-50	1		Fresh Mafic	0.07	7.79	277	134	3.90	N.D.	5.47	0.16	N.D.	38.7	182	N.D.	93	N.D.	7.2	N.D.	N.D.	N.D.	N.D.	0.70	N.D.	872	4.18	1415	3.0	1.74	3.35	N.D.	N.D.	1.0	313	N.D.	N.D.	0.5	N.D.
KEGM045 69-70	2		Fresh Shear/Contact Zone	0.14	2.99	18	61	2.45	0.30	1.07	0.22	N.D.	13.8	194	9.8	42	N.D.	7.3	N.D.	N.D.	N.D.	N.D.	0.42	N.D.	97	1.13	1880	3.5	0.26	1.92	N.D.	N.D.	6.7	24	N.D.	N.D.	0.7	N.D.
KEGR26 152-153	1		Fresh Shear/Contact Zone	0.08	4.36	224	6	167	N.D.	0.23	0.64	N.D.	1.6	17	N.D.	6	N.D.	0.5	N.D.	N.D.	N.D.	N.D.	2.01	N.D.	6,426	0.05	1169	2.9	2.78	78.60	N.D.	N.D.	6.9	2985	N.D.	N.D.	0.7	N.D.
KEGR26 50-52	1		Fresh Shear/Contact Zone	0.02	7.93	147	175	11.90	N.D.	3.97	0.40	N.D.	117	23	N.D.	189	N.D.	10.9	N.D.	N.D.	N.D.	N.D.	0.49	N.D.	1,075	2.31	2107	0.4	2.00	2.10	N.D.	N.D.	0.9	267	N.D.	N.D.	1.5	N.D.
KEGR22 140-145	1		Pegmatite Ore	0.07	6.71	106	11	124	N.D.	0.41	0.30	N.D.	2.9	56	N.D.	5	N.D.	0.7	N.D.	N.D.	N.D.	N.D.	1.52	N.D.	8018	0.25	773	2.6	2.53	60.24	N.D.	N.D.	7.1	1154	N.D.	N.D.	0.5	N.D.
KEGR25 150-155	1		Pegmatite Ore	0.07	3.80	310	3	136	N.D.	0.14	0.18	N.D.	2.4	23	N.D.	5	N.D.	0.6	N.D.	N.D.	N.D.	N.D.	1.74	N.D.	9,391	0.03	750	4.6	2.16	74.87	N.D.	N.D.	6.0	1884	N.D.	N.D.	0.7	N.D.
KEGR50 64-66	1		Pegmatite Ore	0.11	7.84	16	33	98	N.D.	2.00	0.25	N.D.	13.9	196	N.D.	21	N.D.	2.3	N.D.	N.D.	N.D.	N.D.	1.81	N.D.	4,226	1.61	952	2.4	2.58	48.31	N.D.	N.D.	5.9	2758	N.D.	N.D.	0.5	N.D.
KEGR60 50-53	1		Pegmatite Ore	0.05	6.49	22	1	129	N.D.	0.12	0.28	N.D.	0.4	16	N.D.	3	N.D.	0.5	N.D.	N.D.	N.D.	N.D.	2.33	N.D.	7078	0.03	1274	2.7	2.49	67.57	N.D.	N.D.	7.7	3274	N.D.	N.D.	0.3	N.D.
KEGR77 110-115	1		Pegmatite Ore	0.10	4.19	186	2	151	N.D.	0.11	0.15	N.D.	0.7	14	N.D.	3	N.D.	0.5	N.D.	N.D.	N.D.	N.D.	2.04	N.D.	7,948	0.03	886	3.4	2.30	69.66	N.D.	N.D.	6.3	2581	N.D.	N.D.	0.9	N.D.
KEGR96 60-65	1		Pegmatite Ore	0.09	5.32	6	8	115	N.D.	0.41	0.41	N.D.	1.7	21	N.D.	7	N.D.	0.5	N.D.	N.D.	N.D.	N.D.	1.77	N.D.	8,606	0.06	1354	3.6	2.28	53.42	N.D.	N.D.	5.9	2689	N.D.	N.D.	0.2	N.D.
WC002	3	Fresh	KOM BASALT	<0.05	5.13	153	41	1.09	0.14	6.57	0.07	2.14	76.4	1584	100	37	8.02	8.0	10.2	1.8	0.38	0.06	0.16	0.82	789	9.00	1607	0.23	0.93	0.49	547	143	1.2	99	<0.002	120	1.90	33.81
WC003	3	Fresh	KOM BASALT	0.12	5.12	251	37	1.01	0.13	5.94	0.09	2.08	77.4	1673	244	165	8.36	8.4	10.9	1.6	0.37	0.04	0.18	0.73	2,331	9.55	1504	0.18	0.47	0.41	566	180	1.0	186	<0.002	240	1.19	34.54
WC004	3	Fresh	KOM BASALT	<0.05	5.08	275	21	0.60	0.10	6.09	0.09	2.04	74.2	1733	88.7	25	8.05	8.1	10.6	1.5	0.33	0.03	0.11	0.79	1,739	9.37	1350	0.19	0.49	0.39	614	138	0.7	84	<0.002	180	1.56	32.04
WC005	3	Fresh	KOM BASALT	<0.05	5.34	28	63	0.18	0.03	6.66	0.06	2.29	71.2	1414	6.9	58	8.08	8.1	10.8	1.5	0.37	0.04	0.08	0.87	342	8.44	1353	0.23	1.15	0.43	495	158	1.1	14	<0.002	470	1.13	37.18
WC013	3	Fresh	KOM BASALT	<0.05	6.01	4	64	0.10	0.05	6.43	0.06	2.28	52.2	661	16.2	65	7.55	7.6	12.0	1.6	0.59	0.04	0.17	0.86	310	6.17	1326	0.79	1.91	0.72	219	150	1.0	68	0.004	450	0.52	39.09
WC015	3	Fresh	KOM BASALT	<0.05	3.90	604	8	5.67	1.56	4.50	0.15	1.39	92.9	2018	61.0	65	8.04	8.0	11.2	2.7	0.63	0.03	0.09	0.55	89	11.66	1427	0.14	0.58	8.32	764	509	1.5	120	<0.002	2,260	3.30	20.44
WC018	3	Fresh	KOM BASALT	<0.05	7.47	3	116	0.17	0.04	5.61	0.07	3.65	46.9	294	6.8	63	7.97	8.0	13.8	1.7	1.22	0.04	0.13	1.34	158	5.20	1367	0.79	2.65	0.79	122	213	2.2	11	0.002	400	0.45	43.75
WC022	3	Fresh	CAL-ALK BASALT	0.16	1.06	16	6	0.40	0.28	7.61	1.40	17.41	21.4	25	3.0	82	13.02	13.0	3.9	2.8	0.34	0.35	0.01	9.17	25	3.23	4366	1.48	0.06	1.11	76	412	12.3	1	0.004	32,330	1.36	5.47
WC023	3	Fresh	CAL-ALK BASALT	0.06	7.79	5	158	0.54	0.06	5.09	0.14	13.37	54.6	126	40.2	82	12.98	13.0	18.0	1.4	2.30	0.06	1.90	5.31	251	3.03	3295	0.40	0.36	3.72	138	401	9.4	66	0.002	10,600	1.07	38.70
WC024	3	Fresh	CAL-ALK BASALT	0.06	2.77	12	46	0.51	0.07	1.62	0.23	8.77	12.5	67	33.5	42	6.19	6.2	8.1	3.0	0.96	0.06	0.85	3.19	176	0.90	864	2.67	0.28	1.55	40	312	9.4	31	0.002	13,970	1.56	14.99
WC026	3	Fresh	CAL-ALK BASALT	0.08	7.05	30	60	0.83	0.08	7.52	0.09	2.96	66.5	784	30.1	80	9.70	9.7	15.1	1.9	0.67	0.05	0.21	1.11	1,469	6.83	1703	0.50	1.89	0.66	210	203	2.1	102	<0.002	650	1.60	47.45
WC027	3	Fresh	CAL-ALK BASALT	0.07	8.38	14	158	0.58	0.04	4.18	0.16	12.68	68.6	150	16.8	187	5.73	5.7	18.8	1.5	2.36	0.09	0.38	4.99	631	2.94	1085	0.49	3.87	3.29	190	507	1.9	90	0.003	4,410	2.17	43.20
WC028	3	Fresh	CAL-ALK BASALT	<0.05	6.00	22	39	0.42	0.02	5.55	0.05	2.74	58.7	740	17.2	21	8.25	8.2	11.7	1.4	0.49	0.04	0.06	1.10	240	7.67	1397	0.24	2.07	0.57	230	178	1.4	11	0.002	190	1.08	40.10
WC037	3	Fresh	CAL-ALK BASALT	0.10	5.22	821	47	4.66	0.26	5.90	0.19	3.46	69.6	1361	548	70	8.48	8.5	11.3	2.6	0.64	0.1	0.49	1.35	1,260	9.47	1488	0.21	0.40	0.85	438	166	5.6	373	<0.002	780	0.81	35.21
WC038	3	Fresh	CAL-ALK BASALT	0.11	3.14	1115	4	1.46	0.32	4.36	0.14	3.08	85.2	1949	37.3	37	7.74	7.7	7.4	1.6	0.37	0.05	0.03	1.07	219	13.01	2464	0.12	0.04	0.99	1,118	60	1.6	86	<0.002	8,300	4.58	23.48
WC063	3	Fresh	CAL-ALK BASALT	<0.05	6.18	123	29	0.45	0.03	5.63	0.12	12.10	57.4	574	10.0	125	7.82	7.8	16.3	1.7	1.77	0.08	0.08	4.76	559	6.20	1557	0.77	1.77	2.98	174	390	1.6	17	<0.002	270	6.33	43.24
WC065	3	Fresh	CAL-ALK BASALT	0.06	7.72	18	88	0.36	0.04	4.53	0.17	12.17	58.0	142	8.4	150	6.99	7.0	17.8	1.6	2.12	0.07	0.20	4.61	774	3.80	1362	0.79	3.25	3.13	139	477	1.6	45	0.003	4,370	1.41	40.78
WC068	3	Fresh	CAL-ALK BASALT	0.08	7.95	4	136	0.60	0.08	6.25	0.24	14.19	68.5	136	32.1	206	5.55	5.5	18.1	1.7	2.17	0.10	1.30	5.64	1,173	2.43	1415	0.62	0.77	3.41	133	503	3.5	214	0.004	5,080	2.22	41.47
WC076	3	Fresh	CAL-ALK BASALT	<0.05	7.56	12	23	0.50	0.16	7.74	0.20	13.90	60.6	124	22.5	171	8.21	8.2	17.9	1.7	1.97	0.08	0.06	5.44	254	2.93	2218	0.93	2.06	3.49	144	483	2.5	9	0.003	2,400	0.33	41.33
WC078	3	Fresh	CAL-ALK BASALT	<0.05	6.66	3	101	0.58	0.05	6.96	0.11	13.92	54.2	310	5.2	169	10.01	10.0	17.8	1.6	1.89	0.08	0.25	5.33	66	4.19	1581	0.94	2.22	3.45	114	431	4.8	23	<0.002	950	0.73	41.26
WC046	3	Fresh	HIGH MG BASALT	0.08	5.63	359	122	0.40	0.06	8.46	0.10	2.70	79.0	1390	16.4	85	8.03	8.0	11.6	2.0	0.66	0.05	0.33	1.02	575	8.18	1531	0.19	0.33	0.49	461	140	1.4	130	<0.002	430	3.41	38.00
WC047	3	Fresh	HIGH MG BASALT	0.31	5.94	980	137	5.59	0.28	9.03	0.35	31.08	67.8	136	432	105	4.11	4.1	13.7	4.2	1.44	<0.01	2.26	16.24	575	3.66	873	3.45	0.33	1.73	313	284	88.4	668	0.012	3390	1.24	25.81
WC049	3	Fresh	HIGH MG BASALT	0.14	5.84	213	5	0.93	0.17	4.61	0.06	5.73	61.0	66	104	162	7.67	7.7	13.0	4.2	1.00	0.04	0.20	2.78	1,069	8.30	925	0.65	0.24	0.54	244	185	1.8	58	0.006	6,260	0.38	35.75
WC050	3	Fresh	HIGH MG BASALT	<0.05	7.19	4	195	4.77	0.03	5.16	0.08	5.79	45.9	65	37.0	116	8.74	8.7	16.4	2.0	1.70	0.04	0.94	2.33	502	5.53	1585	0.44	0.46	3.59	78	295	4.5	161	0.003	980	1.61	40.04
WC051	3	Fresh	MW Petalite Peg	0.08	7.22	7	137	0.79	0.05	5.22	0.11	16.39	46.3	171	29.2	90	9.93	9.9	15.6	1.8	2.48	0.07	1.10	6.95	1,105	4.93	1318	0.64	1.90	5.11	79	502	2.8	78	0.002	1,730	0.13	40.06
WC053	3	Fresh	MW Petalite Peg	<0.05	3.03	122	1	0.33	0.10	5.11	0.10	4.16	82.5	1973	7.8	95	7.38	7.4	6.1	1.5	0.37	0.02	0.01	1.66	19	14.49	1367	0.08	0.09	1.00	1,122	184	0.7	2	<0.002	1300	1.76	21.92
WC056	3	Fresh	MW Petalite Peg	0.15	6.90	16	219	2.01	0.07	6.03	0.11	15.94	44.2	236	35.1	109	8.74	8.7	15.8	1.5	2.25	0.06	0.70	6.82	623	3.95	1351	1.05	2.39	4.45	88	525	3.3	83	0.003	1840	0.22	38.67
WC058	3	Fresh	MW Petalite Peg	0.07	6.64	17	78	0.43	0.02	4.84	0.19	17.04	43.1	168	1.9	96	8.65	8.6	14.9	1.3	2.24	0.05	0.03	7.65	166	3.89	1453	1.74	3.75	4.11	75	443	2.8	2	0.002	680	0.48	36.28
WC082	3	Fresh	BIF	<0.05	5.46	154	108	2.46	0.30	8.50	0.18	2.03	61.7	1486	20.3	80	7.79	7.8	12.7	1.7	0.46	0.04	0.82	0.73	315	5.58	1676	0.11	0.23	0.94	306	133	1.3	138	<0.002	2,440	1.00	37.18
WC083	3	Fresh	BIF	0.10	7.93	40	90	2.00	0.28	3.84	0.25	13.57	57.9	156	30.6	135	5.26	5.3	18.0	1.6	2.27	0.08	0.56	5.29	482	2.53	1147	0.51	2.92	3.29	149	509	3.0	83	0.003	2,580	4.79	40.21
WC084	3	Fresh	BIF	0.14	8.50	24	127	25	0.19	4.41	0.72	13.09	64.6	163	43.8	217	6.48	6.5	23.4	1.9	2.08	0.13	0.84	5.32	870	3.04	1454	0.27	2.38	3.84	158	540	3.9	137	<0.002	3100	1.68	45.91
WC086	3	Fresh	DYKE	0.11	7.81	3	68	0.48	0.03	8.47	0.11	14.15	47.4	113	8.7	170	8.30	8.3	16.1	1.5	1.68	0.05	0.24	6.04	295	4.11	1299	0.44	1.50	4.06	106	356	2.3	56	0.002	1020	0.25	38.92
WC087	3	Fresh	DYKE	0.07	7.06	2	60	1.08	0.04	8.80	0.14	13.96	45.0	182	7.8	117	7.58	7.6	14.5	1.6	1.82	0.06	0.22	5.93	247	4.71	1378	0.38	1.55	4.30	124	343	2.6	54	<0.002	810	0.33	41.56
WC009	3	Transitional	KOM BASALT	<0.05	6.36	7	39	0.14	<0.01	6.43	0.07	2.32	70.4	1111	4.7	99	9.27	9.3	13.8	1.6	0.46	0.04	0.09	0.86	41	7.94	1598	0.24	1.07	0.53	373	86	0.6	4	<0.002	30	2.03	41.39
WC019	3	Transitional	QTZ/PEG	0.19	0.26	23	24	0.44	0.06	0.32	0.10	3.04	2.8	17	2.3	27	5.45	5.4	1.0	1.6	0.07	0.02	0.01	1.22	7	0.24	1519	0.67	0.05	0.43	20	108	0.6	1	<0.002	1,130	0.19	1.38
WC020	3	Transitional	CAL-ALK BASALT	0.14	5.51	3	64	0.62	0.33	2.86	0.36	11.23	30.8	176	259.2	81	13.32	13.3	14.9	2.1	1.60	0.08	0.86	4.50	308	2.16	4289	0.60	0.86	2.74	106	332	9.0	173	0.002	37500	0.46	31.28
WC021	3	Transitional	CAL-ALK BASALT	0.12	8.67	3	186	1.67	0.26	1.12	0.26	22.37	29.8	465	70.7	50	15.32	15.3	28.9	2.5	2.92	0.17	1.86	9.34	382	1.96	2141	2.80	0.62	4.95	67	407	46.5	71	0.007	30900	0.37	44.46
WC034	3	Transitional	CAL-ALK BASALT	<0.05	7.38	9	151	0.84	0.01	7.23	0.08	3.91	39.8	357	12.3	61	6.41	6.4	12.6	1.8	0.42	0.03	0.51	1.85	93	5.08	1202	0.12	2.16	0.85	245	<50	0.8	107	<0.002	200	3.22	42.12
WC042	3	Transitional	HIGH MG BASALT	<0.05	6.62	12	36	1.38	0.03	5.32	0.10	2.95	48.8	388	13.1	91	8.52	8.5	14.0	1.7	0.82	0.05	0.12	1.10	124	6.60	1304	0.46	1.72	0.62	111	192	1.1	46	<0.002	530	1.03	46.40

Table A2-3: Summary of Elemental Composition Results

Sample ID	Phase	Weathering	Lithology	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
KEGM054 12-13	2		Oxide	N.D.	N.D.	8.2	5.31	N.D.	2.94	0.04	0.04	3.08	295	26	N.D.	9	N.D.
KEGR22 3-11	1		Oxide	N.D.	N.D.	N.D.	2.20	N.D.	16.39	N.D.	N.D.	2.87	310	N.D.	N.D.	6	N.D.
KEGR25 15-18	1		Oxide	N.D.	N.D.	N.D.	1.20	N.D.	2.57	N.D.	N.D.	1.11	389	N.D.	N.D.	10	N.D.
KEGM058 30-31	2		Transitional	N.D.	N.D.	12.8	0.08	N.D.	0.19	0.41	0.41	0.55	130	6	N.D.	226	N.D.
KEGR27 60-67	1		Transitional	N.D.	N.D.	N.D.	6.17	N.D.	0.47	N.D.	N.D.	0.31	239	N.D.	N.D.	89	N.D.
KEGR32 34-36	1		Transitional	N.D.	N.D.	N.D.	31.90	N.D.	2.02	N.D.	N.D.	2.22	153	N.D.	N.D.	116	N.D.
KEGM059 37-38	2		Transitional	N.D.	N.D.	10.6	0.09	N.D.	0.27	0.05	0.05	0.26	136	4	N.D.	114	N.D.
KEGM045 64-65	2		Fresh Mafic	N.D.	N.D.	2.9	2.93	N.D.	0.33	0.02	0.02	0.15	14	3	N.D.	27	N.D.
KEGM036 126-127	2		Fresh Mafic	N.D.	N.D.	67.2	0.09	N.D.	0.37	0.74	0.74	0.13	340	1	N.D.	75	N.D.
KEGM036 167-168	2		Fresh Mafic	N.D.	N.D.	24.4	0.12	N.D.	0.17	2.15	2.15	0.05	205	199	N.D.	69	N.D.
KEGM045 170-171	2		Fresh Mafic	N.D.	N.D.	136.6	0.03	N.D.	0.14	0.33	0.33	0.08	206	1	N.D.	69	N.D.
KEGM049 153-154.34	2		Fresh Mafic	N.D.	N.D.	2.9	0.70	N.D.	0.10	0.19	0.19	0.13	163	2	N.D.	72	N.D.
KEGM049 276-277	2		Fresh Mafic	N.D.	N.D.	58.3	0.03	N.D.	0.14	0.13	0.13	0.05	233	0	N.D.	66	N.D.
KEGM052 219-220	2		Fresh Mafic	N.D.	N.D.	169.6	0.28	N.D.	1.11	0.44	0.44	0.44	289	1	N.D.	59	N.D.
KEGM052 272-273	2		Fresh Mafic	N.D.	N.D.	1.6	0.03	N.D.	0.09	0.27	0.27	0.03	172	0	N.D.	71	N.D.
KEGM054 270-271	2		Fresh Mafic	N.D.	N.D.	85.5	0.23	N.D.	14.61	1.50	1.50	2.66	184	12	N.D.	67	N.D.
KEGM054 273-274	2		Fresh Mafic	N.D.	N.D.	77.5	0.10	N.D.	0.47	2.85	2.85	0.21	218	26	N.D.	62	N.D.
KEGM054 306-307	2		Fresh Mafic	N.D.	N.D.	20.0	0.04	N.D.	0.17	0.59	0.59	0.27	218	1	N.D.	75	N.D.
KEGM056 242-243	2		Fresh Mafic	N.D.	N.D.	19.7	0.03	N.D.	0.12	0.07	0.07	0.04	191	0	N.D.	77	N.D.
KEGM056 254-255	2		Fresh Mafic	N.D.	N.D.	58.6	0.03	N.D.	0.11	1.30	1.30	0.04	175	4	N.D.	56	N.D.
KEGM056 317-318	2		Fresh Mafic	N.D.	N.D.	28.4	0.06	N.D.	0.33	1.09	1.09	0.09	166	0	N.D.	172	N.D.
KEGM058 153-154	2		Fresh Mafic	N.D.	N.D.	94.5	0.44	N.D.	0.15	0.19	0.19	0.08	122	28	N.D.	89	N.D.
KEGM059 127-128	2		Fresh Mafic	N.D.	N.D.	37.8	0.07	N.D.	0.16	0.52	0.52	0.06	131	1	N.D.	71	N.D.
KEGM065 167-168	2		Fresh Mafic	N.D.	N.D.	11.8	0.06	N.D.	0.12	0.58	0.58	0.03	118	2	N.D.	58	N.D.
KEGM065 171-172	2		Fresh Mafic	N.D.	N.D.	10.9	0.09	N.D.	0.12	0.46	0.46	0.04	123	2	N.D.	57	N.D.
KEGR152 78-79	2		Fresh Mafic	N.D.	N.D.	55.6	0.21	N.D.	1.00	1.30	1.30	0.89	201	5	N.D.	145	N.D.
KEGR152 104-105	2		Fresh Mafic	N.D.	N.D.	79.4	0.66	N.D.	0.90	0.51	0.51	0.35	76	13	N.D.	177	N.D.
KEGR152 90-91	1		Fresh Mafic	N.D.	N.D.	23.9	0.11	N.D.	0.09	0.36	0.36	0.06	132	37	N.D.	58	N.D.
KEGR22 55-60	1		Fresh Mafic	N.D.	N.D.	N.D.	0.24	N.D.	7.97	N.D.	N.D.	1.39	251	N.D.	N.D.	95	N.D.
KEGR22 90-99	1		Fresh Mafic	N.D.	N.D.	N.D.	1.71	N.D.	0.33	N.D.	N.D.	0.24	215	N.D.	N.D.	76	N.D.
KEGR25 195-200	1		Fresh Mafic	N.D.	N.D.	N.D.	0.53	N.D.	0.16	N.D.	N.D.	0.16	215	N.D.	N.D.	89	N.D.
KEGR25 90-95	1		Fresh Mafic	N.D.	N.D.	N.D.	9.53	N.D.	1.04	N.D.	N.D.	1.77	204	N.D.	N.D.	92	N.D.
KEGR27 81-84	1		Fresh Mafic	N.D.	N.D.	N.D.	0.20	N.D.	0.31	N.D.	N.D.	0.33	289	N.D.	N.D.	84	N.D.
KEGR32 86-102	1		Fresh Mafic	N.D.	N.D.	N.D.	6.42	N.D.	0.51	N.D.	N.D.	2.40	241	N.D.	N.D.	89	N.D.
KEGR50 70-75	1		Fresh Mafic	N.D.	N.D.	N.D.	1.46	N.D.	0.60	N.D.	N.D.	0.86	201	N.D.	N.D.	74	N.D.
KEGR90 52-56	1		Fresh Mafic	N.D.	N.D.	N.D.	0.79	N.D.	0.39	N.D.	N.D.	2.93	215	N.D.	N.D.	198	N.D.
KEGR96 44-50	1		Fresh Mafic	N.D.	N.D.	N.D.	6.95	N.D.	0.31	N.D.	N.D.	0.28	251	N.D.	N.D.	73	N.D.
KEGM045 69-70	2		Fresh Shear/Contact Zone	N.D.	N.D.	12.0	0.12	N.D.	0.52	0.26	0.26	0.37	154	79	N.D.	84	N.D.
KEGR26 152-153	1		Fresh Shear/Contact Zone	N.D.	N.D.	N.D.	50.97	N.D.	2.35	N.D.	N.D.	5.48	3	N.D.	N.D.	148	N.D.
KEGR26 50-52	1		Fresh Shear/Contact Zone	N.D.	N.D.	N.D.	0.46	N.D.	0.52	N.D.	N.D.	4.17	295	N.D.	N.D.	179	N.D.
KEGR22 140-145	1		Pegmatite Ore	N.D.	N.D.	N.D.	37.21	N.D.	1.81	N.D.	N.D.	4.05	7	N.D.	N.D.	78	N.D.
KEGR25 150-155	1		Pegmatite Ore	N.D.	N.D.	N.D.	50.13	N.D.	1.25	N.D.	N.D.	2.42	6	N.D.	N.D.	99	N.D.
KEGR50 64-66	1		Pegmatite Ore	N.D.	N.D.	N.D.	46.78	N.D.	2.51	N.D.	N.D.	3.25	54	N.D.	N.D.	95	N.D.
KEGR60 50-53	1		Pegmatite Ore	N.D.	N.D.	N.D.	72.14	N.D.	1.93	N.D.	N.D.	3.32	3	N.D.	N.D.	96	N.D.
KEGR77 110-115	1		Pegmatite Ore	N.D.	N.D.	N.D.	52.45	N.D.	1.97	N.D.	N.D.	2.84	1	N.D.	N.D.	85	N.D.
KEGR96 60-65	1		Pegmatite Ore	N.D.	N.D.	N.D.	56.18	N.D.	1.21	N.D.	N.D.	3.05	8	N.D.	N.D.	75	N.D.
WC002	3	Fresh	KOM BASALT	0.10	3.90	31.8	0.32	<0.1	0.14	2539	0.90	0.23	193	0	11.25	69	12.18
WC003	3	Fresh	KOM BASALT	0.30	8.40	6.9	0.05	<0.1	0.12	2456	1.50	0.04	196	0	11.47	69	7.95
WC004	3	Fresh	KOM BASALT	0.20	2.60	14.6	0.04	<0.1	0.12	2275	0.70	0.04	194	0	10.67	70	7.97
WC005	3	Fresh	KOM BASALT	0.40	0.60	34.3	0.04	<0.1	0.12	2701	0.19	0.04	215	1	12.30	63	7.70
WC013	3	Fresh	KOM BASALT	0.20	0.60	84.9	0.18	<0.1	0.13	2902	0.50	0.04	223	1	13.23	60	10.28
WC015	3	Fresh	KOM BASALT	0.10	13.00	18.4	8.51	<0.1	0.46	1741	1.43	2.73	125	2	6.64	78	8.13
WC018	3	Fresh	KOM BASALT	0.10	0.30	104.8	0.09	<0.1	0.24	3775	0.10	0.08	254	1	16.46	64	17.95
WC022	3	Fresh	CAL-ALK BASALT	0.90	3.00	16.8	0.09	0.20	1.03	449	0.02	0.49	26	24	14.23	386	12.78
WC023	3	Fresh	CAL-ALK BASALT	<0.1	0.90	36.0	0.21	0.20	0.67	7625	0.69	0.30	344	26	21.84	95	76.80
WC024	3	Fresh	CAL-ALK BASALT	0.30	1.10	13.5	0.10	<0.1	0.43	3123	0.49	0.19	137	27	5.49	96	34.44
WC026	3	Fresh	CAL-ALK BASALT	0.10	0.80	145.2	0.06	<0.1	0.13	3348	0.95	0.04	275	1	16.16	84	18.59
WC027	3	Fresh	CAL-ALK BASALT	0.70	0.80	145.5	0.23	<0.1	0.62	7658	0.89	0.31	381	2	20.65	97	79.55
WC028	3	Fresh	CAL-ALK BASALT	<0.1	0.50	51.1	0.03	<0.1	0.15	2980	0.09	0.04	235	0	13.62	76	15.38
WC037	3	Fresh	CAL-ALK BASALT	0.30	30.10	15.8	0.13	<0.1	0.17	2563	3.59	0.07	204	1	12.78	81	20.74
WC038	3	Fresh	CAL-ALK BASALT	0.50	7.60	50.8	0.39	0.10	0.14	1868	0.67	0.04	142	2	6.69	75	12.07
WC063	3	Fresh	CAL-ALK BASALT	0.10	1.10	75.7	0.19	<0.1	0.56	6426	0.18	0.15	309	1	17.78	88	60.15
WC065	3	Fresh	CAL-ALK BASALT	0.50	0.90	107.9	0.17	<0.1	0.61	7056	0.49	0.23	357	1	23.13	122	76.94
WC068	3	Fresh	CAL-ALK BASALT	0.40	1.20	83.7	0.25	<0.1	0.67	7587	2.02	0.44	349	12	22.23	82	65.17
WC076	3	Fresh	CAL-ALK BASALT	0.60	1.20	87.8	0.25	<0.1	0.62	7308	0.13	0.17	331	1	26.06	118	53.88
WC078	3	Fresh	CAL-ALK BASALT	0.40	1.60	130.3	0.23	<0.1	0.64	7502	0.22	0.18	308	1	20.11	108	65.77
WC046	3	Fresh	HIGH MG BASALT	0.20	1.40	71.1	0.04	<0.1	0.17	2723	1.04	0.05	217	4	12.31	63	20.99
WC047	3	Fresh	HIGH MG BASALT	0.40	46.30	28.9	0.11	<0.1	3.69	3477	5.67	0.93	175	62	16.21	60	47.16
WC049	3	Fresh	HIGH MG BASALT	1.20	17.60	4.8	0.06	<0.1	0.28	2553	0.67	0.10	228	294	10.27	50	34.64
WC050	3	Fresh	HIGH MG BASALT	0.50	8.20	63.3	2.76	<0.1	0.48	4324	1.36	0.30	265	3	11.84	69	41.94
WC051	3	Fresh	MW Petalite Peg	0.20	1.10	74.6	0.50	<0.1	1.74	6491	0.59	0.45	303	3	25.06	102	90.44
WC053	3	Fresh	MW Petalite Peg	0.40	2.70	45.6	0.09	<0.1	0.16	1980	0.11	0.05	127	1	7.35	60	11.52
WC056	3	Fresh	MW Petalite Peg	0.20	7.00	86.8	0.44	<0.1	1.58	6145	0.79	0.40	283	15	22.33	88	81.39
WC058	3	Fresh	MW Petalite Peg	0.10	0.80	108.0	0.29	<0.1	1.60	5912	0.04	0.41	272	2	22.58	92	82.21
WC082	3	Fresh	BIF	0.20	8.70	45.4	0.10	<0.1	0.09	2511	1.14	0.02	211	11	12.16	89	15.77
WC083	3	Fresh	BIF	0.20	8.70	122.2	0.21	<0.1	0.66	6657	0.64	0.25	337	4	16.52	115	84.32
WC084	3	Fresh	BIF	0.40	8.50	121.0	0.22	<0.1	0.69	8122	1.11	0.23	355	5	21.50	304	75.22
WC086	3	Fresh	DYKE	0.40	0.80	196.0	0.29	<0.1	1.03	6585	0.36	0.27	309	1	15.17	80	60.84
WC087	3	Fresh	DYKE	0.30	1.30	168.9	0.29	<0.1	1.10	5736	0.32	0.34	266	0	15.24	72	63.03
WC009	3	Transitional	KOM BASALT	<0.1	0.30	28.2	0.05	<0.1	0.14	2831	0.02	0.07	235	1	14.17	82	9.81
WC019	3	Transitional	QTZ/PEG	0.20	0.90	4.1	<0.01	<0.1	0.15	104	0.01	0.08	23	2	6.42	20	2.71
WC020	3	Transitional	CAL-ALK BASALT	1.40	1.30	28.4	0.16	<0.1	0.65	5628	1.97	0.30	260	5	17.61	199	62.03
WC021	3	Transitional	CAL-ALK BASALT	2.30	3.60	29.4	0.33	<0.1	0.94	10310	1.36	0.50	424	22	13.29	252	108.87
WC034	3	Transitional	CAL-ALK BASALT	<0.1	1.60	151.7	0.21	<0.1	0.22	2584	0.72	0.39	208	3	11.81	59	10.02
WC042	3	Transitional	HIGH MG BASALT	0.40	1.60	74.3	0.05	<0.1	0.17	3558	0.33	0.05	259	0	15.34	75	24.04

Table A1-4: Global Abundance Indices (GAIs)

Sample ID	Weathering	Lithology	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Fe	Ga	Ge	Hf	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb
			mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg	%	mg/kg	mg/kg	%	mg/kg	mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg
KEGM054 012-13	Oxide	Clay	0	0	1	0	0	0	0	0		0	1	0	0		0					0		0	0	0	0	0	0			0
KEGR22 3-11	Clay	Weathered Mafic	0	0	2	0	0		0	0		0	1		0		0					0		0	0	0	0	0	0			0
KEGR25 15-18	Clay	Weathered Pegmatite	0	1	0	0	0		0	0		0	0		0		0					0		1	0	0	0	0	0			0
KEGM058 30-31	Saprolite	Mafic Volcanic	0	0	2	0	0	0	0	0		3	3	0	2		1					0		1	2	1	0	0	0			0
KEGR27 60-67	Oxide/transition	Mafic	0	0	1	0	1		1	0		0	0		0		0					0		4	1	0	0	0	0			0
KEGR32 34-36	Oxide/transition	Pegmatite	0	0	1	0	5		0	0		0	0		0		0					0		6	0	0	0	0	1			0
KEGM059 37-38	Saprolite	Clay	0	0	2	0	0	0	0	0		2	3	1	0		0					0		1	2	0	0	0	0			0
KEGM045 64-65	Fresh	Mafic Schist	0	0	0	0	0	0	0	0		0	0	0	0		0					0		0	0	0	1	0	0			0
KEGM036 126-127	Fresh	Mafic volcanic	0	0	0	0	0	0	0	0		0	0	4	0		0					0		4	0	0	0	0	0			0
KEGM036 167-168	Fresh	Fresh Ultramafic	1	0	5	0	1	1	0	0		1	2	6	0		0					0		6	2	0	0	0	0			0
KEGM045 170-171	Fresh	Mafic volcanic	0	0	0	0	0	0	1	0		0	1	2	0		0					0		5	1	0	0	0	0			0
KEGM049 153-154.34	Fresh	Fresh Ultramafic	0	0	4	0	0	0	0	0		1	3	1	0		0					0		0	2	0	0	0	0			0
KEGM049 276-277	Fresh	Mafic volcanic	0	0	0	0	0	0	0	0		0	1	0	0		0					0		2	1	0	0	0	0			0
KEGM052 219-220	Fresh	Dolerite	0	0	0	0	0	0	1	0		0	0	1	1		0					0		3	0	0	0	0	0			0
KEGM052 272-273	Fresh	Fresh Ultramafic	0	0	5	0	0	0	0	0		1	3	1	1		0					0		1	2	0	0	0	0			0
KEGM054 270-271	Fresh	Mafic	0	0	0	0	0	0	1	0		0	0	3	0		0					0		4	0	0	0	0	0			0
KEGM054 273-274	Fresh	Mafic	1	0	0	0	0	1	1	0		1	0	3	1		1					0		4	0	0	0	0	0			0
KEGM054 306-307	Fresh	Fresh Ultramafic	0	0	4	0	0	0	0	0		1	3	2	0		0					0		4	2	0	0	0	0			0
KEGM056 242-243	Fresh	Mafic volcanic	0	0	4	0	0	0	0	0		1	3	0	0		0					0		2	2	0	0	0	0			0
KEGM056 254-255	Fresh	Mafic volcanic	0	0	3	0	0	0	2	0		1	2	2	0		0					0		3	1	0	0	0	0			0
KEGM056 317-318	Fresh	Mafic Schist	0	0	1	0	0	0	0	0		1	1	5	2		1					0		5	1	0	0	0	0			0
KEGM058 153-154	Fresh	Fresh Ultramafic	0	0	3	0	0	0	1	0		1	3	0	0		0					0		0	2	0	0	0	0			0
KEGM059 127-128	Fresh	Fresh Ultramafic	0	0	0	0	0	0	0	0		1	3	1	0		0					0		0	2	0	0	0	0			0
KEGM065 167-168	Fresh	Fresh Ultramafic	0	0	0	0	0	0	0	0		1	3	2	1		0					0		0	2	0	0	0	0			0
KEGM065 171-172	Fresh	Fresh Ultramafic	0	0	0	0	0	0	0	0		1	3	2	0		0					0		0	2	0	0	0	0			0
KEGR152 78-79	Fresh	Fresh Ultramafic	0	0	2	0	0	0	0	0		1	0	2	0		1					0		4	0	1	0	0	0			0
KEGR152 104-105	Fresh	Mafic volcanic	0	0	2	0	0	1	1	2		0	0	1	0		1					0		2	0	0	1	0	0			0
KEGR152 90-91	Fresh	Mafic volcanic	0	0	3	0	0	0	0	0		1	3	0	0		0					0		0	2	0	0	0	0			0
KEGR22 55-60	Fresh	Mafic	0	0	2	0	0		1	0		0	1		0		0					0		3	1	0	0	0	0			0
KEGR22 90-99	Fresh	Mafic	0	0	1	0	0		0	0		1	2		0		0					0		5	1	0	0	0	0			0
KEGR25 195-200	Fresh	Mafic	0	0	3	0	0		1	0		0	2		0		0					0		3	1	0	0	0	0			0
KEGR25 90-95	Fresh	Mafic	0	0	2	0	3		0	0		0	0		0		0					0		6	0	0	0	0	0			0
KEGR27 81-84	Fresh	Mafic	1	0	1	0	0		0	0		0	0		0		0					0		4	0	0	0	0	0			0
KEGR32 86-102	Fresh	Mafic	0	0	2	0	1		1	0		0	0		0		0					0		5	0	0	0	0	0			0
KEGR50 70-75	Fresh	Mafic	0	0	2	0	0		0	2		0	2		0		0					0		3	1	0	0	0	0			0
KEGR90 52-56	Fresh	Mafic	0	0	1	0	1		0	0		1	1		1		0					0		5	0	0	0	0	0			0
KEGR96 44-50	Fresh	Mafic	0	0	3	0	0		0	0		0	0		0		0					0		4	0	0	0	0	0			0
KEGM045 69-70	Fresh	Fresh Mafic	0	0	0	0	0	0	0	0		0	0	1	0		0					0		1	0	0	0	0	0			0
KEGR26 152-153	Fresh	Contact zone	0	0	3	0	5		0	1		0	0		0		0					0		6	0	0	0	0	1			0
KEGR26 50-52	Fresh	Contact zone	0	0	2	0	1		0	1		2	0		1		1					0		5	0	1	0	0	0			0
KEGR22 140-145	Ore	Pegmatite Ore	0	0	1	0	5		0	0		0	0		0		0					0		6	0	0	0	0	1			0
KEGR25 150-155	Ore	Pegmatite Ore	0	0	3	0	5		0	0		0	0		0		0					0		6	0	0	1	0	1			0
KEGR50 64-66	Ore	Pegmatite Ore	0	0	0	0	4		0	0		0	0		0		0					0		6	0	0	0	0	1			0
KEGR60 50-53	Ore	Pegmatite Ore	0	0	0	0	5		0	0		0	0		0		0					0		6	0	0	0	0	1			0
KEGR77 110-115	Ore	Pegmatite Ore	0	0	2	0	5		0	0		0	0		0		0					0		6	0	0	0	0	1			0
KEGR96 60-65	Ore	Pegmatite Ore	0	0	0	0	5		0	1		0	0		0		0					0		6	0	0	0	0	1			0
WC002	Fresh	KOM BASALT	0	0	2	0	0	0	1	0	0	1	2	4	0	0	0	0	0	0	0	0	0	4	2	0	0	0	0	2	0	0
WC003	Fresh	KOM BASALT	0	0	3	0	0	0	0	0	0	1	2	6	1	0	0	0	0	0	0	0	0	6	2	0	0	0	0	2	0	0
WC004	Fresh	KOM BASALT	0	0	3	0	0	0	0	0	0	1	3	4	0	0	0	0	0	0	0	0	0	5	2	0	0	0	0	2	0	0
WC005	Fresh	KOM BASALT	0	0	0	0	0	0	1	0	0	1	2	1	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	2	0	0
WC013	Fresh	KOM BASALT	0	0	0	0	0	0	1	0	0	0	1	2	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	1	0	0
WC015	Fresh	KOM BASALT	0	0	4	0	0	2	0	0	0	1	3	4	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	3	0	0
WC018	Fresh	KOM BASALT	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0
WC022	Fresh	CAL-ALK BASALT	1	0	0	0	0	0	1	2	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0
WC023	Fresh	CAL-ALK BASALT	0	0	0	0	0	0	0	0	0	1	0	3	0	1	1	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0
WC024	Fresh	CAL-ALK BASALT	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
WC026	Fresh	CAL-ALK BASALT	0	0	0	0	0	0	1	0	0	1	1	3	0	1	0	0	0	0	0	0	0	5	1	0	0	0	0	1	0	0
WC027	Fresh	CAL-ALK BASALT	0	0	0	0	0	0	0	0	0	1	0	2	1	0	0	0	0	0	0	0	0	4	0	0	0	0	0	1	0	0
WC028	Fresh	CAL-ALK BASALT	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	1	0	0
WC037	Fresh	CAL-ALK BASALT	0	0	4	0	0	0	0	0	0	1	2	6	0	0	0	0	0	0	0	0	0	5	2	0	0	0	0	2	0	0
WC038	Fresh	CAL-ALK BASALT	0	0	5	0	0	0	0	0	0	1	3	3	0	0	0	0	0	0	0	0	0	2	2	1	0	0	0	3	0	0
WC063	Fresh	CAL-ALK BASALT	0	0	2	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	4	1	0	0	0	0	1	0	0
WC065	Fresh	CAL-ALK BASALT	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
WC068	Fresh	CAL-ALK BASALT	0	0	0	0	0	0	0	0	0	1	0	3	1	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0
WC076	Fresh	CAL-ALK BASALT	0	0	0	0	0	0	1	0	0	1	0	2	1	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0
WC078	Fresh	CAL-ALK BASALT	0	0	0	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
WC046	Fresh	HIGH MG BASALT	0	0	3	0	0	0	1	0	0	1	2	2	0	0	0	0	0	0	0	0	0	4	1	0	0	0	0	2	0	0
WC047	Fresh	HIGH MG BASALT	2	0	5	0	0	0	1	0	0	1	0	6	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	1	0	2
WC049	Fresh	HIGH MG BASALT	0	0	3	0	0	0	0	0	0	1	0	5	1	0	0	0	0	0	0	0	0	5	1	0	0	0	0	1	0	0
WC050	Fresh	HIGH MG BASALT	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0
WC051	Fresh	MW Petalite Peg	0	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0
WC053	Fresh	MW Petalite Peg	0	0	2	0	0	0	0	0	0	1	3	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	3	0	0
WC056	Fresh	MW Petalite Peg	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
WC058	Fresh	MW Petalite Peg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
WC082	Fresh	BIF	0	0	2	0	0	0	1	0	0	1	2	2	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	1	0	0
WC083	Fresh	BIF	0	0	0	0	0	0	0	0	0	1	0	3	1	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
WC084	Fresh	BIF	0	0	0	0	2	0	0	1	0	1	0	3	1	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
WC086	Fresh	DYKE	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
WC087	Fresh	DYKE	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0
WC009	Transitional	KOM BASALT	0	0	0	0	0	0	1	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0
WC019	Transitional	QTZ/PEG	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WC020	Transitional	CAL-ALK BASALT	0	0	0	0	0	0	0	0	0	0	0	6	0	1	1	0	0	0	0	0	0	3	0	2	0	0	0	0	0	0
WC021	Transitional	CAL-ALK BASALT	0	0	0	0	0	0	0	0	0	0	1	4	0	1	1	0	0	0	0	0	0	3	0	1	0	0	0	0	0	1
WC034	Transitional	CAL-ALK BASALT	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0
WC042	Transitional	HIGH MG BASALT	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Average Crustal Abundance			0.07	8	25	430	3	0.2	3	0.18	45	25	200	3	60	4.5	5	17	15	3	0.1	2.6	30	30	2.1	900	2	2.4	20	80	1000	16

Values of three of higher are highlighted.

Where elemental concentrations were below laboratory limit of reporting (<LOR), a GAI of zero was assigned.

0.60

Table A1-4: Global Abundance Indices (GAIs)

Sample ID	Weathering	Lithology	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
KEGM054 012-13	Oxide	Clay	0			4				0	1		0	0	0	0	0	4		0	
KEGR22 3-11	Clay	Weathered Mafic	0			2					0		0			0	0			0	
KEGR25 15-18	Clay	Weathered Pegmatite	0			4					0		0			0	1			0	
KEGM058 30-31	Saprolite	Mafic Volcanic	0			3				0	0		0	0	0	0	0	2		1	
KEGR27 60-67	Oxide/transition	Mafic	1			1					1		0			0	0			0	
KEGR32 34-36	Oxide/transition	Pegmatite	3			3					3		0			0	0			0	
KEGM059 37-38	Saprolite	Clay	0			4				0	0		0	0	0	0	0	1		0	
KEGM045 64-65	Fresh	Mafic Schist	0			2				0	0		0	0	0	0	0	1		0	
KEGM036 126-127	Fresh	Mafic volcanic	0			1				0	0		0	0	0	0	1	0		0	
KEGM036 167-168	Fresh	Fresh Ultramafic	1			2				0	0		0	0	1	0	0	6		0	
KEGM045 170-171	Fresh	Mafic volcanic	0			3				0	0		0	0	0	0	0	0		0	
KEGM049 153-154.34	Fresh	Fresh Ultramafic	0			3				0	0		0	0	0	0	0	1		0	
KEGM049 276-277	Fresh	Mafic volcanic	0			1				0	0		0	0	0	0	0	0		0	
KEGM052 219-220	Fresh	Dolerite	0			0				0	0		0	0	0	0	0	0		0	
KEGM052 272-273	Fresh	Fresh Ultramafic	0			3				0	0		0	0	0	0	0	0		0	
KEGM054 270-271	Fresh	Mafic	0			3				0	0		0	0	0	0	0	3		0	
KEGM054 273-274	Fresh	Mafic	1			4				0	0		0	0	1	0	0	4		0	
KEGM054 306-307	Fresh	Fresh Ultramafic	0			2				0	0		0	0	0	0	0	0		0	
KEGM056 242-243	Fresh	Mafic volcanic	0			2				0	0		0	0	0	0	0	0		0	
KEGM056 254-255	Fresh	Mafic volcanic	0			1				0	0		0	0	0	0	0	2		0	
KEGM056 317-318	Fresh	Mafic Schist	0			0				0	0		0	0	0	0	0	0		1	
KEGM058 153-154	Fresh	Fresh Ultramafic	0			3				0	0		0	0	0	0	0	4		0	
KEGM059 127-128	Fresh	Fresh Ultramafic	0			0				0	0		0	0	0	0	0	0		0	
KEGM065 167-168	Fresh	Fresh Ultramafic	0			0				0	0		0	0	0	0	0	0		0	
KEGM065 171-172	Fresh	Fresh Ultramafic	0			1				0	0		0	0	0	0	0	0		0	
KEGR152 78-79	Fresh	Fresh Ultramafic	0			2				0	0		0	0	0	0	0	2		0	
KEGR152 104-105	Fresh	Mafic volcanic	0			2				0	0		0	0	0	0	0	3		1	
KEGR152 90-91	Fresh	Mafic volcanic	0			5				0	0		0	0	0	0	0	5		0	
KEGR22 55-60	Fresh	Mafic	0			1					0		0			0	0			0	
KEGR22 90-99	Fresh	Mafic	1			1					0		0			0	0			0	
KEGR25 195-200	Fresh	Mafic	0			2					0		0			0	0			0	
KEGR25 90-95	Fresh	Mafic	3			1					2		0			0	0			0	
KEGR27 81-84	Fresh	Mafic	1			2					0		0			0	0			0	
KEGR32 86-102	Fresh	Mafic	1			2					1		0			0	0			0	
KEGR50 70-75	Fresh	Mafic	0			3					0		0			0	0			0	
KEGR90 52-56	Fresh	Mafic	0			2					0		0			0	0			1	
KEGR96 44-50	Fresh	Mafic	1			1					1		0			0	0			0	
KEGM045 69-70	Fresh	Fresh Mafic	0			1				0	0		0	0	0	0	0	6		0	
KEGR26 152-153	Fresh	Contact zone	4			1					4		0			0	0			0	
KEGR26 50-52	Fresh	Contact zone	1			2					0		0			0	0			1	
KEGR22 140-145	Ore	Pegmatite Ore	3			1					4		0			0	0			0	
KEGR25 150-155	Ore	Pegmatite Ore	3			1					4		0			0	0			0	
KEGR50 64-66	Ore	Pegmatite Ore	4			1					4		0			0	0			0	
KEGR60 50-53	Ore	Pegmatite Ore	4			0					5		0			0	0			0	
KEGR77 110-115	Ore	Pegmatite Ore	4			2					4		0			0	0			0	
KEGR96 60-65	Ore	Pegmatite Ore	4			0					4		0			0	0			0	
WC002	Fresh	KOM BASALT	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WC003	Fresh	KOM BASALT	0	0	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
WC004	Fresh	KOM BASALT	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WC005	Fresh	KOM BASALT	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WC013	Fresh	KOM BASALT	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WC015	Fresh	KOM BASALT	0	0	2	3	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0
WC018	Fresh	KOM BASALT	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WC022	Fresh	CAL-ALK BASALT	0	1	5	2	0	2	0	0	0	6	0	0	0	0	0	4	0	2	0
WC023	Fresh	CAL-ALK BASALT	0	0	4	2	1	0	0	0	0	6	0	0	0	0	1	4	0	0	0
WC024	Fresh	CAL-ALK BASALT	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0
WC026	Fresh	CAL-ALK BASALT	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WC027	Fresh	CAL-ALK BASALT	0	1	3	3	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0
WC028	Fresh	CAL-ALK BASALT	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WC037	Fresh	CAL-ALK BASALT	1	0	0	1	1	0	3	0	0	0	0	0	1	0	0	0	0	0	0
WC038	Fresh	CAL-ALK BASALT	0	0	3	4	0	1	1	0	0	6	0	0	0	0	0	0	0	0	0
WC063	Fresh	CAL-ALK BASALT	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WC065	Fresh	CAL-ALK BASALT	0	1	3	2	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0
WC068	Fresh	CAL-ALK BASALT	0	1	3	3	1	0	0	0	0	0	0	0	0	0	1	3	0	0	0
WC076	Fresh	CAL-ALK BASALT	0	1	2	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0
WC078	Fresh	CAL-ALK BASALT	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WC046	Fresh	HIGH MG BASALT	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
WC047	Fresh	HIGH MG BASALT	2	3	2	2	0	0	4	0	0	0	0	0	2	0	0	5	0	0	0
WC049	Fresh	HIGH MG BASALT	0	2	3	0	1	2	2	0	0	0	0	0	0	0	0	6	0	0	0
WC050	Fresh	HIGH MG BASALT	0	1	0	2	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0
WC051	Fresh	MW Petalite Peg	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
WC053	Fresh	MW Petalite Peg	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WC056	Fresh	MW Petalite Peg	0	1	1	0	1	0	1	0	0	0	0	0	0	0	0	3	0	0	0
WC058	Fresh	MW Petalite Peg	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WC082	Fresh	BIF	0	0	2	2	1	0	1	0	0	0	0	0	0	0	0	3	0	0	0
WC083	Fresh	BIF	0	1	2	4	1	0	1	0	0	0	0	0	0	0	1	1	0	0	0
WC084	Fresh	BIF	0	0	2	2	1	0	1	0	0	0	0	0	0	0	1	2	0	2	0
WC086	Fresh	DYKE	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WC087	Fresh	DYKE	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WC009	Transitional	KOM BASALT	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WC019	Transitional	QTZ/PEG	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WC020	Transitional	CAL-ALK BASALT	0	0	6	1	0	2	0	0	0	0	0	0	0	0	0	2	0	1	0
WC021	Transitional	CAL-ALK BASALT	0	2	5	0	1	3	0	0	0	0	0	0	0	0	1	4	0	1	0
WC034	Transitional	CAL-ALK BASALT	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
WC042	Transitional	HIGH MG BASALT	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average Crustal Abundance			120	0.001	500	0.2	16	0.2	2.5	350	2	0.001	10	5000	1	3	150	1	30	70	160

Values of three of higher are highlighted.

Where elemental concentrations were below laboratory limit of reporting (<LOR), a GAI of zero was a

Table A2-5: Summary of Aqua Regia Analysis

Sample ID	Phase	Weathering	Lithology	Au	Ag	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cr(VI)	Ex. Cr(VI)	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na
				ug/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	mg/kg	mg/kg	%	mg/kg	mg/kg	%
B1	1 extended	Oxide	Oxide Gravel	17.5	0.04	75	43	43	4.9	0.685	0.006	0.008	50	18	851	1	<0.1	3.1	24	10	25	<0.01	1.84	0.19	0.15	0.11	13	43	0.28	51	1.29	0.19
B2	1 extended	Oxide	Oxide Silty Gravel	4.3	0.11	14	14	13	0.8	0.358	0.005	0.003	12	5.5	268	1	<0.1	1.3	13	6.0	22	<0.01	1.29	0.06	0.10	0.05	5.47	22	0.04	14	1.45	0.02
B3	1 extended	Oxide	Oxide Gravelly Clay	13.8	0.01	10	50	123	1.1	0.280	0.011	0.005	37	8.2	156	<1	<0.1	1.9	26	2.6	11	0.01	0.61	0.07	0.07	0.12	13	19	0.23	52	0.50	0.23
B4	1 extended	Oxide	Oxide Silty Sand	6.5	0.02	16	38	62	1.6	0.348	0.005	0.003	46	9.1	277	<1	<0.1	3.5	25	4.4	16	0.01	0.86	0.07	0.09	0.10	12	20	0.18	28	0.92	0.18
B5	1 extended	Oxide	Oxide Clays	26.9	0.03	54	147	81	2.8	0.282	5.189	0.035	27	15	373	<1	<0.1	12	40	4.1	14	0.02	0.55	0.16	0.06	0.48	11	78	3.05	368	0.48	0.46
SLP1	1 extended	Oxide	Pegmatite Laterite Gravel-clay-colluvium	6.8	0.02	37	35	53	1.4	0.374	0.093	0.009	5.5	5.8	227	NA	NA	3.6	24	4.4	17	0.06	0.60	0.02	0.07	0.07	2.71	56	0.14	87	1.20	0.15
SLP2	1 extended	Oxide	Pegmatite Laterite Gravel-clay-colluvium	7.2	0.02	48	36	32	1.6	0.625	0.046	0.007	5.8	6.2	510	NA	NA	6.6	16	6.0	35	0.06	0.90	0.05	0.08	0.08	2.19	74	0.09	58	1.13	0.14
SLP3	1 extended	Oxide	Pegmatite Laterite Gravel-clay-colluvium	4.1	0.02	17	30	26	1.2	0.255	0.022	0.005	1.2	3.5	158	NA	NA	4.6	9	2.0	14	0.06	0.35	0.04	0.03	0.05	0.57	51	0.06	47	0.46	0.13
SLPComp	1 extended	Oxide	Pegmatite Laterite Gravel-clay-colluvium	8.3	0.02	40	28	42	0.9	0.394	0.036	0.004	4.8	3.7	319	<1	<0.1	2.6	17	4.6	18	0.03	0.63	0.04	0.06	0.04	2.09	32	0.08	46	1.04	0.12
SML1	1 extended	Oxide	Mafic Laterite-clay	18.3	0.03	59	43	53	2.1	0.385	0.065	0.006	14	12	813	<1	<0.1	5.2	25	8.1	24	0.03	1.00	0.07	0.10	0.07	5.01	45	0.13	56	1.13	0.16
SML2	1 extended	Oxide	Mafic Laterite-clay	27.0	0.06	92	32	29	1.9	0.463	0.020	0.004	8.8	8.7	1,573	1[1]	<0.1	2.7	34	12	27	0.04	1.12	0.05	0.12	0.04	3.26	39	0.07	34	0.90	0.12
SML3	1 extended	Oxide	Mafic Laterite-clay	27.7	0.03	77	26	25	1.3	0.344	0.017	0.011	6.3	8.2	1,305	2[1]	<0.1	3.6	67	12	25	0.05	0.87	0.06	0.10	0.04	2.50	33	0.06	35	0.76	0.11
SMLComp	1 extended	Oxide	Mafic Laterite-clay	36.1	0.04	78	30	40	1.6	0.418	0.028	0.005	9.4	8.8	1,217	1	<0.1	3.1	45	11	23	0.02	1.08	0.05	0.12	0.04	3.64	29	0.08	38	0.93	0.12
MDUSComp	1 extended	Transitional	Transitional Mafic	9.9	0.01	52	6	128	7.4	0.060	0.537	0.069	13	153	243	<1	<0.1	75	240	4.6	8.1	0.11	0.23	0.03	0.03	0.17	5.93	137	0.92	1,284	0.35	0.34
PDUSComp	1 extended	Transitional	Transitional Pegmatite-clay/mafic	43.6	0.04	36	11	189	7.1	0.126	0.436	0.112	13	147	245	<1	<0.1	67	120	2.6	8.5	0.06	0.64	0.01	0.02	0.15	14	227	0.73	2,245	0.80	0.30
MDTLSS1	1 extended	Transitional	Transitional Mafic	299.0	0.04	47	10	23	10	0.111	1.399	0.098	4.1	48	332	<1	<0.1	65	137	4.5	10	0.14	0.15	0.03	0.04	0.09	9.00	162	1.49	553	0.27	0.41
MDTLSS2	1 extended	Transitional	Transitional Mafic	137.0	0.04	27	8.8	12	3.9	0.071	1.342	0.083	5.2	37	287	<1	<0.1	16	100	3.7	8.1	0.12	0.22	0.02	0.02	0.05	4.14	174	1.29	529	0.35	0.33
MDTLSS3	1 extended	Transitional	Transitional Mafic	44.0	0.03	51	7.3	31	8.8	0.070	1.536	0.231	5.0	85	234	<1	<0.1	61	104	3.6	7.8	0.18	0.15	0.01	0.03	0.06	5.27	113	0.93	1,390	0.52	0.28
MDTLSSComp	1 extended	Transitional	Transitional Mafic	199.0	0.03	41	7.1	19	7.9	0.078	1.055	0.131	4.6	53	257	<1	<0.1	43	114	3.6	7.4	0.16	0.15	0.03	0.03	0.06	6.31	136	1.14	713	0.27	0.30
TP1	1 extended	Transitional	Transitional Pegmatite	NA	<0.05	10	NA	10	2.8	1.700	0.008	<0.05	1.2	16	6.6	NA	NA	23	26	0.3	3.8	0.12	0.38	NA	<0.05	0.031	2	49	0.037	210	0.1	0.041
TP2	1 extended	Transitional	Transitional Pegmatite	NA	<0.05	42	NA	5.6	2.1	1.500	0.041	0.130	0.59	6.6	3.8	NA	NA	49	12	0.3	2.9	0.07	0.54	NA	<0.05	0.05	0.5	71	0.061	580	0.61	0.052
TP3	1 extended	Transitional	Transitional Pegmatite	NA	<0.05	61	NA	2.4	4.7	0.980	0.005	<0.05	6.8	10	24	NA	NA	17	79	1.7	6.4	0.11	0.23	NA	<0.05	0.042	3.3	94	0.14	33	0.68	0.12
TP4	1 extended	Transitional	Transitional Pegmatite	NA	<0.05	18	NA	7.6	11	1.800	0.058	<0.05	1.6	7.8	34	NA	NA	19	9.2	0.46	3.2	<0.05	0.34	NA	<0.05	0.036	0.9	130	0.054	280	1.2	0.049
TPComp	1 extended	Transitional	Transitional Pegmatite	NA	<0.05	31	NA	6.5	4.8	1.900	0.024	<0.05	2.4	9.1	17	NA	NA	27	28	0.64	3.2	0.07	0.27	NA	<0.05	0.035	1.5	69	0.066	250	0.71	0.062
PET1	1 extended	Fresh	Subgrade Pegmatite/Petalite	8.4	0.02	17	22	24	3.7	0.394	0.317	0.037	3.6	23	114	NA	NA	29	36	1.3	5.3	0.04	0.24	0.01	0.01	0.14	1.81	1,234	0.24	658	0.60	0.15
PET2	1 extended	Fresh	Subgrade Pegmatite/Petalite	3.7	0.01	12	6	16	2.5	0.665	0.243	0.194	1.8	23	39	NA	NA	23	36	1.2	4.4	0.03	0.36	0.02	0.01	0.12	1.31	390	0.24	331	0.49	0.13
PET3	1 extended	Fresh	Subgrade Pegmatite/Petalite	3.8	0.06	14	13	3.4	3.0	0.137	0.244	0.292	0.63	3.5	42	NA	NA	36	8.9	0.5	9.4	0.02	0.14	0.01	0.00	0.49	0.33	416	0.04	984	0.30	0.17
PET4	1 extended	Fresh	Subgrade Pegmatite/Petalite	6.8	0.03	6.8	21	3.5	4.7	3.529	0.208	0.058	2.0	4.8	16	NA	NA	15	7.3	0.7	5.0	0.01	0.08	0.02	0.01	0.19	0.89	842	0.07	183	0.31	0.06
PETComp	1 extended	Fresh	Subgrade Pegmatite/Petalite	8.9	0.02	11	15	12	3.7	0.990	0.224	0.130	2.0	16	73	<1	<0.1	24	27	1.0	5.5	0.02	0.20	0.01	0.01	0.21	0.97	589	0.16	438	0.29	0.13
PETG	1 extended	Fresh	Galaxy subgrade petalite	9.9	0.02	29	28	29	5.8	4.905	0.282	0.037	0.86	2.3	57	<1	<0.1	181	7.8	0.9	16	0.02	1.23	0.00	0.02	0.72	0.46	628	0.33	523	0.32	0.18
WC002	3	Fresh	KOM BASALT	6.0	0.06	151	0.6	21	0.2	0.082	0.480	0.023	0.4	33	519	N/A	N/A	97.4	35	2.0	3.4	0.04	0.02	<0.002	0.006	0.12	0.2	133	2.08	216	0.2	0.06
WC003	3	Fresh	KOM BASALT	2.6	0.14	238	<0.5	26	0.1	0.097	0.354	0.041	0.5	46	666	N/A	N/A	238	159	2.6	4.8	0.04	0.03	0.003	0.011	0.17	0.2	238	2.75	307	0.1	0.03
WC004	3	Fresh	KOM BASALT	1.3	0.03	250	2.9	11	0.1	0.067	0.477	0.017	0.6	41	549	N/A	N/A	87.3	24	2.3	4.2	0.03	0.02	0.004	0.004	0.07	0.3	187	2.41	232	0.1	0.04
WC005	3	Fresh	KOM BASALT	1.1	0.06	31	<0.5	10	0.0	0.013	0.651	0.020	0.5	27	405	N/A	N/A	6.3	58	1.9	3.1	0.04	0.03	0.003	0.007	0.02	0.2	116	1.79	196	0.3	0.07
WC013	3	Fresh	KOM BASALT	2.2	0.04	3	1.2	10	0.0	0.025	0.734	0.014	0.7	13	159	N/A	N/A	13.7	64	1.5	2.7	0.04	0.03	<0.002	0.006	0.04	0.3	87	1.05	220	0.8	0.10
WC015	3	Fresh	KOM BASALT	41.0	0.07	570	2.2	4	1.3	1.541	0.664	0.089	0.5	61	1568	N/A	N/A	57.9	61	3.6	6.1	0.12	0.09	<0.002	0.009	0.07	0.3	65	4.18	274	0.1	0.02
WC026	3	Fresh	KOM BASALT	1.0	0.08	24	2.5	6	0.1	0.050	0.905	0.031	0.9	20	180	N/A	N/A	20.8	68	1.9	3.4	0.05	0.04	<0.002	0.006	0.02	0.4	266	1.10	244	0.5	0.09
WC037	3	Fresh	CAL-ALK BASALT	19.8	0.09	816	11.5	33	1.4	0.213	0.468	0.053	1.4	44	340	N/A	N/A	530.7	65	2.5	4.3	0.08	0.03	0.002	0.004	0.45	0.7	318	2.34	226	0.2	0.04
WC063	3	Fresh	CAL-ALK BASALT	4.7	0.05	117	1.7	5	0.1	0.015	0.598	0.041	9.7	35	71	N/A	N/A	8.9	124	1.3	3.0	0.04	0.10	<0.002	0.010	0.02	4.0	209	0.72	159	0.9	0.10
WC076	3	Fresh	CAL-ALK BASALT	4.0	0.06	12	2.2	6	0.2	0.090	1.675	0.089	10.8	25	31	N/A	N/A	21.9	166	1.9	4.4	0.07	0.12	<0.002	0.013	0.02	4.6	94	0.52	402	1.0	0.23
WC078	3	Fresh	CAL-ALK BASALT	4.8	0.06	2	3.3	12	0.1	0.025	1.265	0.048	10.5	13	80	N/A	N/A	3.6	158	1.7	3.3	0.04	0.13	0.003	0.013	0.05	4.3	35	0.64	207	0.8	0.12
WC046	3	Fresh	CAL-ALK BASALT	61.9	0.09	343	3.1	15	0.1	0.044	1.916	0.039	1.4	48	426	N/A	N/A	10.3	80	2.0	4.6	0.05	0.03	0.002	0.006	0.04	0.6	262	1.82	311	0.3	0.04
WC047	3	Fresh	CAL-ALK BASALT	6.5	0.32	964	4.8	27	3.4	0.282	5.677	0.214	21.4	65	75	N/A	N/A	413	101	2.5	8.0	0.13	0.23	0.004	0.007	1.23	11.2	289	2.08	441	3.0	0.14
WC049	3	Fresh	CAL-ALK BASALT	4.7	0.14	197	13.5	4	0.4	0.150	2.390	0.022	4.1	46	26	N/A	N/A	107	155	3.2	6.7	0.13	0.04	0.010	0.011	0.20	2.0	143	2.71	229	0.8	0.05
WC050	3	Fresh	CAL-ALK BASALT	8.3	0.07	4	1.5	187	1.5	0.022	3.593	0.030	4.1	20	41	N/A	N/A	32.9	112	2.5	13.0	0.05	0.06	0.003	0.021	0.86	1.7	243	1.59	147	0.5	0.26
WC053	3	Fresh	CAL-ALK BASALT	24.3	0.05	117	6.6	1	0.1	0.093	0.167	0.018	0.8	52	1306	N/A	N/A	7.9	92	4.0	3.4	0.07	0.01	0.002	0.012	0.00	0.5	13	5.62	559	0.1	0.01
WC056	3	Fresh	CAL-ALK BASALT	58.2	0.11	14	1.5	174	0.3	0.063	0.794	0.033	13.4	19	98	N/A	N/A	34.8	103	2.7	5.0	0.06	0.18	<0.002	0.012	0.66	6.0	297	1.02	260	0.8	0.11
WC058	3	Fresh	CAL-ALK BASALT	10.3	0.08	14	0.9	9	0.1	0.014	0.951	0.083	13.9	15	56	N/A	N/A	1.8	92	1.6	2.6	0.05	0.18	<0.002	0.014	0.01	6.6	52	0.65	189	1.5	0.15
WC009	3	Fresh	CAL-ALK BASALT	10.0	<0.01	6	1.1	8	0.1	<0.005	0.768	0.017	0.5	22	321	N/A	N/A	4.3	87	2.5	4.3	0.05	0.03	0.002	0.008	0.03	0.2	28	2.22	268	0.3	0.16
WC010	3	Fresh	CAL-ALK BASALT	95.4	0.01	3	1.0	37	0.1	<0.005	1.160	0.019	0.9	9	138	N/A	N/A	4.2	42	1.2	2.7	0.04	0.03	<0.002	0.006	0.04	3.8	8	0.65	209	0.5	0.17
WC019	3	Fresh	HIGH MG BASALT	20.5	0.16	21	<0.5	23	0.4	0.052	0.084	0.056	2.7	2	12	N/A	N/A	1.9	25	4.9	0.9	0.07	0.01	0.003	0.015	0.01	1.1	3	0.06	345	0.4	0.03
WC020	3	Fresh	HIGH MG BASALT	6.6	0.16	3	4.6	33	0.2	0.302	0.666	0.210	9.5	28	142	N/A	N/A	245	76	10.0	8.5	0.11	0.10	0.004	0.023	0.60	3.8	160	1.19	1245	0.7	0.10
WC021	3	Fresh	HIGH MG BASALT	3.5	0.16	1	12.6	23	1.0	0.241	0.578	0.227	17.1	28	256	N/A	N/A	53.5	46	12.6	14.1	0.07	0.23	0.008	0.063	0.37	7.3	164	1.46	1003	2.2	0.04
WC034	3	Fresh	HIGH MG BASALT	15.3	0.03	6	2.2	9	0.5	0.008	1.043	0.034	2.8	11	79	N/A	N/A	7.8	56	1.7	2.9	0.06	0.04	0.002	0.006	0.08	1.5	59	0.91	223	0.1	0.17
WC035	3	Fresh	MW Petalite Peg	16.2	0.02	13	2.0	23	0.7	0.013	1.018	0.052	1.4	16	163	N/A	N/A	11.8	63	2.4	4.2	0.07	0.05	<0.002	0.011	0.08	0.6	51	1.31	312	0.2	0.22
WC040	3	Fresh	MW Petalite Peg	5.5	0.04	10	0.5	8	0.3	<0.005	0.734	0.029	1.9	10	75	N/A	N/A	4.9	57	1.6	2.3	0.06	0.07	<0.002	0.011	0.03	0.8	8	0.71	176	0.2	0.17
WC041	3	Fresh	MW Petalite Peg	6.2	0.06	12	1.4	9	0.3	0.007	0.854	0.044	5.2	17	32	N/A	N/A	9.5	68	2.1	3.4	0.07	0.07	<0.002	0.012	0.04	2.3	12	0.79	303	0.2	0.19
WC042	3	Fresh	MW Petalite Peg	8.1	0.04	11	1.4	5	0.5	0.024	0.665	0.030	1.9	16	97	N/A	N/A	9.6	88	1.6	3.7	0.04	0.04	0.003	0.009	0.03	0.8	51	1.11	164	0.5	0.12
WC082	3	Fresh	BIF	0.6	0.05	133	1.1	12	1.0	0.080	0.361	0.138	9.8	48	38	N/A	N/A	12.2	82	1.7	2.5	0.06	0.26	<0.002	0.018	0.05	3.8	14	0.30	519	0.4	0.13
WC083	3	Fresh	BIF	4.1	0.06	1884	18.1	16	0.5	0.112	0.372	0.166	8.0	60	21	N/A	N/A	1.7	128	1.4	1.8	0.04	0.14	0.005	0.011	0.03	3.2	28	0.18	201	0.8	0.08
WC084	3	Fresh	BIF	0.7	0.09	8	1.8	67	0.4	0.018	2.390	0.029	13.2	12	41	N/A	N/A	4.2	45	2.5	5.8	0.07	0.06	<0.002	0.019	0.03	5.7	17	0.80	268	0.4	0.35
WC086	3	Fresh	DYKE	0.5	0.07	51	2.4	113	0.7	0.097	0.591	0.071	13.6	123	69	N/A	N/A	14.4	184	3.7	4.3	0.07	0.17	<0.002	0.027	0.14	5.7	16	0.58	1678	0.4	0.27
WC087	3	Fresh	DYKE	2.6	0.07	25	2.5	20	1.0	<0.005	0.788	0.032	4.3	24	80	N/A	N/A	5.9	50	1.8	2.8	0.03	0.04	<0.002	0.008	0.09	7.7	31	0.75	247	0.2	0.20
WC059	3	Transitional	KOM BASALT	0.2	0.01	51	2.8	157	1.2	0.036	0.208	0.013	112	11	57	N/A	N/A	8.1	68	1.9	2.7	0.05	0.14	<0.002	0.030	0.06	68.6	4	0.21	94	0.3	0.14
WC060	3	Transitional	KOM BASALT	1.4	<0.01	77	10.1	57	0.7	0.045	0.037	0.020	15.7	22	120	N/A	N/A	2.9	96	4.0	5.8	0.02	0.12	<0.002	0.045	0.09	8.1	5	0.17	32	0.1	0.24
WC071	3	Transitional	QTZ/PEG	1.1	0.14	53	10.9	22	0.3	0.180	0.016	0.002	3.1	5	352	N/A	N/A	0.8	36	5.3	7.4	0.02	0.37	<0.002	0.067	0.04	1.4	8	0.08	17	1.0	0.13
WC072	3	Transitional	CAL-ALK BASALT	3.1	0.02	74	25.4	30	0.9	0.149	0.008	0.009	5.7	8	794	N/A	N/A	0.6	142	15.0	14.9	0.03	0.41	<0.002	0.121	0.05	2.5	19	0.09	10	1.2	0.29
WC088	3	Transitional	CAL-ALK BASALT	0.2	<0.01	17	5.7	42	0.3	0.054	0.003	0.004	2.7	3	103	N/A	N/A	0.3	42	1.3	4.0	0.02	0.23	<0.002	0.029	0.03	1.2	5	0.04	8	0.2	0.15
WC089	3	Transitional	CAL-ALK BASALT	0.7	<0.01	33	6.2	16	0.5	0.042	0.016	0.004	3.0	57	740	N/A	N/A	1.1	161	4.6	7.0	0.04	0.10	<0.002	0.042	0.06	1.8	19	0.77	38	0.2	0.45
WC090	3	Transitional	CAL-ALK BASALT	2.5	<0.01	54	5.7	45	1.6	0.082	0.015	0.019	16.7	61	1509	N/A	N/A	3.7	35	4.3	5.7	0.04	0.07	0.003	0.029	0.06	2.4	23	1.40	260	0.4	0.50
WC091	3	Transitional	HIGH MG BASALT	3.3	0.01	136	17.6	29	0.4	0.217	0.025	0.006	15.6	5	266	N/A	N/A	0.9	63	7.6	10.6	0.02	0.58	<0.002	0.076	0.04	5.3	7	0.11	29	0.8	0.16
WC092	3	Transitional	HIGH MG BASALT	1.5	<0.01	8	9.6	18	0.1	0.125	0.003	<0.002	1.4	3	142	N/A	N/A	0.8	14	1.2	5.2	0.02	0.24	<0.002	0.032	0.03	0.5	5	0.05	10	0.5	0.13
WC093	3	Transitional	HIGH MG BASALT	12.1	<0.01	351	11.6	34	0.4	0.101	0.006	0.006	6.0	10	252	N/A	N/A	1.7	101	5.8	5.3	0.03	0.13	0.003	0.037	0.07	3.0	8	0.13	32	0.6	0.26
WC094	3	Transitional	CAL-ALK BASALT	0.1	<0.01	9	7.4	29	0.1	0.202	0.003	<0.002	0.9	2	107	N/A	N/A	1.5	9	1.4	5.8	0.01	0.31	<0.002	0.034	0.03	0.4	6	0.04	13	0.6	0.09
WC095	3	Transitional	CAL-ALK BASALT	1.8	<0.01	28	9.5	56	0.2	0.262	0.002	0.003	1.6	2	246	N/A	N/A	1.4	14	3.4	9.4	0.02	0.53	<0.002	0.058	0.03	0.7	8	0.04	8	1.0	0.10
WC096	3	Transitional	CAL-ALK BASALT	0.7	<0.01	39	12.8	28	0.2	0.150	0.004	0.002	1.4	2	181	N/A	N/A	1.0	23	2.5	6.0	0.02	0.23	<0.002	0.034	0.05	0.9	6	0.07	18	0.6	0.16
EIL / ACL (DEC 2010 / NEPM 2013) - Ecological Significance				N/G	N/G	40	N/G	300	N/G	N/G	N/G	3	N/G	50	180	100	100	N/G	85	N/G	N/G	N/G	N/G	1	N/G	N/G	N/G	N/G	N/G	500	40	N/G
EIL / ACL (DEC 2010 / NEPM 2013) - Urban / Residential / POS				N/G	N/G	100	N/G	300	N/G	N/G	N/G	3	N/G	50	530	300	300	N/G	210	N/G	N/G	N/G	N/G	1	N/G	N/G	N/G	N/G	N/G	500	40	N/G
EIL / ACL (DEC 2010 / NEPM 2013) - Commercial / Industrial				N/G	N/G	160	N/G	300	N/G	N/G	N/G	3	N/G	50	870	870	870	N/G	310	N/G	N/G	N/G	N/G	1	N/G	N/G	N/G	N/G	N/G	500	40	N/G

EIL - Ecological Investigation Limit, ACL - Added Contaminant Limit

N/G : No applicable guideline value.

NEPM 2013 fixed guidelines for arsenic and lead, and calculated ACL values for zinc, copper, nickel and chromium assume material is aged (2 years) contamination.

Table A2-5: Summary of Aqua Regia Analysis

Sample ID	Phase	Weathering	Lithology	Nb	Ni	P	Pb	Pd	Pt	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
				mg/kg	mg/kg	mg/kg	mg/kg	ug/kg	ug/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
B1	1 extended	Oxide	Oxide Gravel	0.02	53	21	23	0.018	0.012	19	<0.0002	208	0.88	79	2.8	5.6	5.3	<0.005	0.06	51	108	0.24	4.57	314	0.07	12	4.8	56
B2	1 extended	Oxide	Oxide Silty Gravel	0.03	32	18	17	0.005	0.005	7.2	<0.0002	521	0.17	27	2.64	1.7	2.3	<0.005	0.06	29	91	0.10	3.89	188	<0.01	3.9	4.3	42
B3	1 extended	Oxide	Oxide Gravelly Clay	0.03	30	16	15	0.010	0.004	14	<0.0002	169	0.20	18	0.39	1.4	13	<0.005	0.03	13	86	0.15	1.26	85	0.03	8.0	7.0	18
B4	1 extended	Oxide	Oxide Silty Sand	0.01	45	18	17	0.006	0.004	17	<0.0002	151	0.25	29	0.96	1.4	6.4	<0.005	0.06	27	75	0.15	2.38	154	0.03	10	6.4	28
B5	1 extended	Oxide	Oxide Clays	0.05	82	26	10	0.025	0.020	61	<0.0002	737	0.47	37	0.75	4.4	218	<0.005	0.01	9.0	168	0.48	1.81	124	0.06	12	20	17
SLP1	1 extended	Oxide	Pegmatite Laterite Gravel-clay-colluvium	0.05	42	34	11	0.009	0.006	15	0.0002	275	0.48	18	0.5	6.8	4.7	<0.005	0.06	7.8	155	0.11	2.00	186	0.28	1.8	9.4	16
SLP2	1 extended	Oxide	Pegmatite Laterite Gravel-clay-colluvium	0.06	64	39	13	0.007	0.007	46	<0.0002	373	1.13	19	0.9	13	2.5	<0.005	0.06	14	180	0.32	1.24	369	0.19	1.4	8.5	27
SLP3	1 extended	Oxide	Pegmatite Laterite Gravel-clay-colluvium	0.05	36	12	3	0.005	0.002	12	<0.0002	239	0.22	11	0.15	7.6	1.9	<0.005	0.01	2.7	85	0.08	0.54	95	0.11	0.37	3.1	9.2
SLPComp	1 extended	Oxide	Pegmatite Laterite Gravel-clay-colluvium	0.06	28	23	11	0.006	0.004	7.2	<0.0002	283	0.75	14	0.95	6.8	3.0	<0.005	0.06	9.1	117	0.06	1.35	253	0.28	1.2	6.4	18
SML1	1 extended	Oxide	Mafic Laterite-clay	0.04	50	28	14	0.018	0.012	17	<0.0002	292	0.96	45	1.7	5.1	4.5	<0.005	0.06	16	197	0.28	3.69	320	0.09	4.0	5.5	34
SML2	1 extended	Oxide	Mafic Laterite-clay	0.03	70	31	16	0.015	0.012	8.5	<0.0002	344	0.94	55	0.71	6.3	3.1	<0.005	0.05	17	260	0.16	2.74	549	0.08	2.2	4.5	36
SML3	1 extended	Oxide	Mafic Laterite-clay	0.03	66	28	12	0.017	0.011	21	<0.0002	425	0.76	52	1.2	10	2.4	<0.005	0.04	10	264	0.22	1.84	385	0.08	1.8	8.4	26
SMLComp	1 extended	Oxide	Mafic Laterite-clay	0.03	50	28	14	0.016	0.012	10	<0.0002	353	0.81	49	1.1	6.0	3.4	<0.005	0.05	15	238	0.18	2.99	418	0.09	2.8	5.6	32
MDUSComp	1 extended	Transitional	Transitional Mafic	0.01	320	73	0.9	0.014	0.020	115	<0.0002	68	0.47	26	0.07	3.9	4.0	<0.005	0.01	0.7	786	3.25	1.47	105	0.04	17	164	3.7
PDUSComp	1 extended	Transitional	Transitional Pegmatite-clay/mafic	0.05	202	147	2.7	0.010	0.021	288	<0.0002	90	0.40	14	0.07	11.8	5.8	0.01	0.01	2.0	382	5.61	1.58	89	0.16	34	103	5.4
MDTLSS1	1 extended	Transitional	Transitional Mafic	0.01	278	49	1.8	0.017	0.013	20	<0.0002	71	0.40	23	0.23	2.6	8.9	<0.005	0.02	1.3	855	0.33	0.65	136	0.05	23	184	4.5
MDTLSS2	1 extended	Transitional	Transitional Mafic	0.02	209	56	1.4	0.016	0.013	26	0.0002	61	0.55	19	0.14	1.9	8.0	<0.005	0.02	1.2	779	0.35	0.68	108	0.14	10	105	4.7
MDTLSS3	1 extended	Transitional	Transitional Mafic	0.01	275	67	1.0	0.020	0.017	14	<0.0002	56	0.69	22	0.07	1.3	6.6	<0.005	0.01	0.5	728	0.50	0.79	117	0.16	15	118	3.5
MDTLSSComp	1 extended	Transitional	Transitional Mafic	0.01	258	56	1.1	0.015	0.014	16	0.0004	55	0.34	19	0.13	1.6	6.3	<0.005	0.01	0.9	651	0.31	0.70	103	0.05	16	152	1.0
TP1	1 extended	Transitional	Transitional Pegmatite	<0.05	37	18	2	NA	NA	59	<0.05	17	0.09	0.8	<0.05	21	2.2	<0.05	<0.05	2.2	9.8	0.68	0.67	6.4	0.9	7.8	25	2.3
TP2	1 extended	Transitional	Transitional Pegmatite	0.09	41	60	3.7	NA	NA	55	<0.05	28	0.36	1.2	<0.05	8.8	7.3	<0.05	<0.05	2.3	68	0.49	0.72	8.2	1.4	2.1	23	3.1
TP3	1 extended	Transitional	Transitional Pegmatite	<0.05	51	77	1.8	NA	NA	94	<0.05	78	0.49	14	0.14	12	1.2	<0.05	<0.05	1.7	10	0.67	1.4	77	0.8	22	46	2
TP4	1 extended	Transitional	Transitional Pegmatite	0.12	21	220	5.7	NA	NA	61	<0.05	11	0.59	4.4	<0.05	5.4	7.1	<0.05	<0.05	2	13	0.6	1.1	10	1.2	3.1	36	2.2
TPComp	1 extended	Transitional	Transitional Pegmatite	0.05	34	93	3.4	NA	NA	63	<0.05	31	0.41	6	<0.05	10	3.7	<0.05	<0.05	2.2	14	0.56	0.92	24	0.9	8.8	31	1.9
PET1	1 extended	Fresh	Subgrade Pegmatite/Petalite	0.20	50	694	2.0	0.002	0.003	152	0.0002	55	0.22	4.7	0.05	5.5	16	<0.005	<0.01	1.7	193	1.29	1.54	20	0.12	3.3	34	2.7
PET2	1 extended	Fresh	Subgrade Pegmatite/Petalite	0.10	51	206	1.4	0.002	0.004	139	<0.0002	61	0.18	4.9	<0.02	4.9	3.1	<0.005	<0.01	1.6	206	1.09	1.79	22	0.05	4.1	56	3.7
PET3	1 extended	Fresh	Subgrade Pegmatite/Petalite	0.64	10	1,199	2.6	0.001	<0.002	666	<0.0002	20	1.10	0.8	<0.02	19	7.2	0.03	<0.01	2.0	17	4.11	2.98	3.8	0.44	1.1	42	1.8
PET4	1 extended	Fresh	Subgrade Pegmatite/Petalite	0.63	12	533	0.9	0.001	<0.002	185	<0.0002	20	0.12	1.3	<0.02	5.9	14	<0.005	<0.01	1.4	39	1.13	1.26	5.9	0.19	2.2	17	1.1
PETComp	1 extended	Fresh	Subgrade Pegmatite/Petalite	0.27	37	471	2.3	0.001	0.003	258	<0.0002	36	0.36	3.4	<0.02	7.6	6.8	<0.005	<0.01	1.8	109	1.79	2.68	14	0.09	2.6	40	2.2
PETG	1 extended	Fresh	Galaxy subgrade petalite	0.55	7	863	1.8	<0.001	0.003	3215	0.0025	431	1.21	0.6	0.11	37	5.0	0.11	<0.01	1.2	42	8.22	2.58	4.8	0.83	1.1	73	7.4
WC002	3	Fresh	KOM BASALT	0.008	237	108	0.4	12.0	6.0	87	0.0004	104	1.3	3	0.09	0.4	3	<0.005	0.03	0.05	434	0.83	0.21	34	0.3	1.0	20	0.6
WC003	3	Fresh	KOM BASALT	0.006	299	156	0.7	15.0	7.0	182	0.0005	232	0.9	2	0.18	1.0	1	<0.005	0.03	0.05	537	1.51	0.02	41	0.1	1.6	23	0.6
WC004	3	Fresh	KOM BASALT	0.012	315	115	0.3	14.0	7.0	66	0.0005	159	1.2	2	0.10	0.3	5	<0.005	0.03	0.06	406	0.60	0.02	32	0.1	1.2	21	0.5
WC005	3	Fresh	KOM BASALT	0.008	188	136	0.3	14.0	7.0	6.4	0.0009	482	0.4	3	0.37	0.1	3	<0.005	0.02	0.06	497	0.13	0.03	34	1.0	1.6	15	0.4
WC013	3	Fresh	KOM BASALT	0.016	61	138	0.4	17.0	12.0	18	0.0028	469	0.2	4	0.26	0.3	5	<0.005	0.02	0.07	586	0.17	0.03	35	0.4	2.0	12	0.8
WC015	3	Fresh	KOM BASALT	0.069	606	468	0.8	10.0	7.0	109	0.0005	2378	2.6	4	0.22	5.7	2	0.080	0.03	0.38	176	1.33	2.60	71	1.1	0.7	26	0.6
WC026	3	Fresh	KOM BASALT	0.014	60	174	1.0	18.0	11.0	12	0.0009	597	0.3	5	0.11	0.2	9	<0.005	<0.01	0.06	680	0.18	0.02	40	0.6	2.3	17	0.9
WC037	3	Fresh	CAL-ALK BASALT	0.028	286	155	5.0	18.0	7.0	330	0.0010	766	0.6	2	0.31	3.2	3	<0.005	0.03	0.12	632	3.44	0.03	33	0.6	1.1	29	0.8
WC063	3	Fresh	CAL-ALK BASALT	0.058	61	385	0.8	13.0	12.0	4.0	0.0007	268	3.1	3	0.09	0.4	6	<0.005	0.01	0.49	997	0.07	0.06	25	0.6	2.0	16	2.2
WC076	3	Fresh	CAL-ALK BASALT	0.161	70	477	1.4	1.0	<2	1.2	0.0020	2652	0.1	7	0.50	0.6	16	<0.005	0.01	0.55	2003	0.05	0.07	64	0.4	9.1	26	2.4
WC078	3	Fresh	CAL-ALK BASALT	0.083	30	394	1.1	12.0	9.0	5.7	0.0012	922	0.2	7	0.27	0.3	12	<0.005	<0.01	0.52	1272	0.07	0.07	56	0.4	5.5	26	3.7
WC046	3	Fresh	CAL-ALK BASALT	0.019	272	125	1.0	20.0	15.0	15	0.0009	452	2.4	3	0.18	0.3	35	<0.005	0.04	0.13	609	0.21	0.02	32	3.3	1.5	16	0.7
WC047	3	Fresh	CAL-ALK BASALT	0.071	281	271	79.5	20.0	13.0	433	0.0100	3752	0.8	12	0.38	21.3	19	<0.005	0.02	2.74	1216	4.28	0.71	84	47.9	8.7	34	7.1
WC049	3	Fresh	CAL-ALK BASALT	0.013	188	166	0.9	17.0	13.0	54	0.0054	6312	0.2	4	1.33	1.6	3	<0.005	0.04	0.23	353	0.66	0.03	67	222.2	2.6	16	1.4
WC050	3	Fresh	CAL-ALK BASALT	0.019	37	259	4.3	28.0	15.0	103	0.0014	1120	0.6	8	0.30	4.2	59	<0.005	0.02	0.41	1355	1.07	0.17	139	1.6	2.8	19	1.3
WC053	3	Fresh	CAL-ALK BASALT	0.013	731	166	0.3	9.0	6.0	1.8	0.0007	1393	1.4	6	0.29	1.0	5	<0.005	0.01	0.10	198	0.10	0.03	57	0.8	0.7	29	0.2
WC056	3	Fresh	CAL-ALK BASALT	0.101	44	465	1.0	6.0	4.0	69	0.0014	1959	0.1	8	0.22	2.1	7	<0.005	0.01	1.42	1698	0.73	0.14	89	11.2	5.5	29	5.5
WC058	3	Fresh	CAL-ALK BASALT	0.059	24	398	1.4	5.0	5.0	1.1	0.0013	686	0.2	7	0.07	0.2	4	<0.005	<0.01	1.23	838	0.03	0.16	56	1.1	6.0	19	5.7
WC009	3	Fresh	CAL-ALK BASALT	0.008	163	66	0.2	12.0	7.0	3.2	0.0002	18	0.5	5	<0.02	0.2	5	<0.005	0.02	0.06	428	0.01	0.04	37	0.4	2.1	25	0.8
WC010	3	Fresh	CAL-ALK BASALT	0.010	53	38	0.4	10.0	4.0	4.0	0.0003	34	0.4	4	0.04	0.1	19	<0.005	0.02	0.07	510	0.02	0.08	24	0.2	10.7	9	0.6
WC019	3	Fresh	HIGH MG BASALT	0.068	18	88	0.4	1.0	<2	0.91	0.0003	1235	0.2	1	0.21	1.0	3	<0.005	0.03	0.14	51	0.01	0.07	21	1.8	5.0	12	0.5
WC020	3	Fresh	HIGH MG BASALT	0.074	97	283	5.1	5.0	4.0	124	0.0015	35931	0.2	10	1.33	0.7	4	<0.005	0.07	0.61	1879	1.48	0.12	177	1.1	5.7	130	2.9
WC021	3	Fresh	HIGH MG BASALT	0.056	61	332	24.6	22.0	10.0	25	0.0053	25465	0.2	15	1.81	1.5	5	<0.005	0.07	0.77	2208	0.71	0.19	252	5.3	9.8	194	7.1
WC034	3	Fresh	HIGH MG BASALT	0.015	145	16	0.4	9.0	10.0	13	0.0003	185	0.5	7	0.02	0.8	11	<0.005	<0.01	0.17	665	0.08	0.20	45	0.2	5.2	19	0.8
WC035	3	Fresh	MW Petalite Peg	0.012	196	56	0.4	8.0	8.0	11	0.0002	138	0.2	8	0.03	0.8	7	<0.005	<0.01	0.16	625	0.06	0.08	58	0.8	4.2	16	1.1
WC040	3	Fresh	MW Petalite Peg	0.006	57	51	0.3	14.0	11.0	3.7	0.0002	80	0.9	9	0.07	0.1	4	<0.005	0.02	0.14	399	0.01	0.05	54	0.1	5.8	12	1.8
WC041	3	Fresh	MW Petalite Peg	0.012	96	82	0.3	17.0	13.0	6.5	0.0003	25	0.5	9	0.05	0.5	5	<0.005	0.02	0.17	504	0.05	0.07	57	0.1	6.6	18	1.6
WC042	3	Fresh	MW Petalite Peg	0.014	36	172	0.5	22.0	14.0	11	0.0008	527	0.3	5	0.28	0.3	13	<0.005	0.02	0.11	499	0.10	0.03	44	0.2	2.3	14	0.9
WC082	3	Fresh	BIF	0.039	53	134	0.6	2.0	<2	10	0.0004	25	0.4	9	0.08	0.9	4	<0.005	<0.01	0.44	970	0.07	0.10	78	0.4	10.9	22	7.0
WC083	3	Fresh	BIF	0.081	129	328	0.8	1.0	<2	5.4	0.0027	2720	1.5	3	0.49	1.1	8	<0.005	0.05	0.41	555	0.04	0.06	29	0.8	4.3	9	3.6
WC084	3	Fresh	BIF	0.034	33	296	0.7	<1	<2	2.8	0.0004	62	0.2	10	0.08	0.4	141	<0.005	<0.01	0.51	608	0.01	0.10	79	0.1	15.2	20	1.5
WC086	3	Fresh	DYKE	0.020	139	153	0.4	2.0	3.0	19	0.0005	93	0.1	17	0.08	0.4	9	<0.005	<0.01	0.60	952	0.27	0.20	130	0.5	22.8	43	4.8
WC087	3	Fresh	DYKE	0.014	146	21	0.2	6.0	6.0	14	<0.0002	43	0.3	10	0.05	0.4	9	<0.005	<0.01	0.18	337	0.10	0.35	45	0.4	10.4	28	0.9
WC059	3	Transitional	KOM BASALT	0.030	44	202	0.6	1.0	5.0	8.8	0.0008	94	0.4	17	0.11	0.6	8	<0.005	<0.01	0.55	548	0.03	0.62	101	0.1	111.7	12	3.9
WC060	3	Transitional	KOM BASALT	0.010	55	31	2.6	4.0	4.0	3.4	<0.0002	126	0.3	36	0.17	0.7	5	<0.005	<0.01	0.99	193	0.02	0.75	202	0.1	6.2	12	2.8
WC071	3	Transitional	QTZ/PEG	0.023	24	6	7.6	3.0	2.0	2.6	<0.0002	144	0.7	21	0.24	1.1	2	<0.005	0.08	5.01	55	0.03	1.11	280	0.3	1.0	3	12.7
WC072	3	Transitional	CAL-ALK BASALT	0.012	66	13	14.5	8.0	8.0	1.7	<0.0002	281	0.7	91	0.17	1.3	3	<0.005	0.04	3.55	113	0.03	2.88	695	0.1	2.5	1	12.3
WC088	3	Transitional	CAL-ALK BASALT	0.006	20	16	3.1	3.0	3.0	0.96	<0.0002	162	0.3	12	0.05	0.4	1	<0.005	<0.01	1.25	138	0.01	0.55	151	0.0	0.8	3	7.0
WC089	3	Transitional	CAL-ALK BASALT	0.003	261	6	3.4	4.0	4.0	2.3	<0.0002	189	1.0	36	0.11	0.5	2	<0.005	0.02	1.63	100	0.01	0.59	168	0.2	0.8	85	2.0
WC090	3	Transitional	CAL-ALK BASALT	0.008	508	9	4.5	3.0	6.0	6.1	<0.0002	130	1.6	18	0.15	2.8	2	<0.005	0.04	0.95	95	0.17	0.54	94	0.3	1.2	41	1.5
WC091	3	Transitional	HIGH MG BASALT	0.016	34	9	9.3	9.0	4.0	3.0	<0.0002	441	0.3	30	0.97	0.9	4	<0.005	0.04	13.47	137	0.04	2.17	258	0.1	3.4	3	18.1
WC092	3	Transitional	HIGH MG BASALT	0.017	17	<5	4.4	3.0	<2	1.7	<0.0002	157	0.2	8	0.14	0.9	1	<0.005	0.01	2.84	41	0.02	0.46	106	0.1	0.3	3	7.0
WC093	3	Transitional	HIGH MG BASALT	0.009	82	5	7.4	8.0	6.0	3.4	<0.0002	166	0.3	35	0.11	1.6	2	<0.005	0.02	2.02	95	0.04	1.46	179	0.2	1.9	15	3.7
WC094	3	Transitional	CAL-ALK BASALT	0.018	17	<5	3.0	2.0	<2	2.6	<0.0002	130	0.1	6	0.07	0.9	1	<0.005	0.02	4.66	28	0.05	0.31	79	0.1	0.2	1	9.2
WC095	3	Transitional	CAL-ALK BASALT	0.034	17	<5	5.0	3.0	<2	3.0	<0.0002	275	0.3	8	0.47	1.2	1	<0.005	0.05	8.46	44	0.04	0.65	133	0.1	0.4	1	16.5
WC096	3	Transitional	CAL-ALK BASALT	0.022	23	<5	3.8	3.0	<2	2.8	<0.0002	64	0.1	11	0.22	1.0	1	<0.005	0.03	3.70	35	0.03	0.55	111	0.1	0.6	3	7.5
EIL / ACL (DEC 2010 / NEPM 2013) - Ecological Significance				N/G	40	2,000	470	N/G	N/G	N/G	N/G	600	N/G	N/G	N/G	50	N/G	N/G	N/G	N/G	N/G	N/G	N/G	50	N/G	N/G	160	N/G
EIL / ACL (DEC 2010 / NEPM 2013) - Urban / Residential / POS				N/G	200	2,000	1,100	N/G	N/G	N/G	N/G	600	N/G	N/G	N/G	50	N/G	N/G	N/G	N/G	N/G	N/G	N/G	50	N/G	N/G	540	N/G
EIL / ACL (DEC 2010 / NEPM 2013) - Commercial / Industrial				N/G	340	2,000	1,800	N/G	N/G	N/G	N/G	600	N/G	N/G	N/G	50	N/G	N/G	N/G	N/G	N/G	N/G	N/G	50	N/G	N/G	800	N/G

EIL - Ecological Investigation Limit, ACL - Added Contaminant Limit

N/G : No applicable guideline value.

NEPM 2013 fixed guidelines for arsenic and lead, and calculated ACL values for zinc, copper, nickel and chromium as

Table A2-6: ASLP Water Majors

Sample ID	Lithology	pH	EC	TDS	Ca	K	Mg	Na	Sulfate	Fluoride	Chloride	Alkalinity (mg $CaCO_3$/L)			
			µs/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	OH-	HCO3-	CO32-	Total
KEGR22 3-11	Oxide	5.5	1,130	723	0.4	10.4	11	211	86.6	<0.1	313	N/A	3	<1	3
KEGR22 55-60	Fresh Mafic	8.0	290	186	9.1	2.9	3.17	40.3	97.2	0.40	9.0	N/A	17	<1	17
KEGR22 90-99	Fresh Mafic	9.7	110	70	3.5	5.4	1.61	11.7	3.7	0.20	3.0	N/A	11	29	40
KEGR25 15-18	Oxide	6.1	2,907	1,860	2.8	26.5	63	511	192	0.30	825	N/A	8	<1	8
KEGR25 195-200	Fresh Mafic	8.8	3,264	2,089	104	9.5	66	507	212	<0.1	730	N/A	8	8	16
KEGR26 50-52	Fresh Contact Zone	7.8	540	346	0.3	1.8	1.85	101.9	17.9	0.90	131	N/A	7	<1	7
KEGR27 60-67	Transitional	9.3	60	38	0.2	0.4	0.49	10.7	5.5	0.40	5.0	N/A	5	4	9
KEGR32 34-36	Transitional	7.9	250	160	0.1	0.9	0.33	31.1	15.1	0.80	44	N/A	14	<1	14
KEGR50 64-66	Pegmatite Ore	9.4	60	38	0.5	0.9	4.12	13.9	4.1	1.00	7.0	N/A	8	8	16
KEGR50 70-75	Fresh Mafic	9.6	150	96	0.7	1.2	3.94	30.8	13.6	0.60	9.0	N/A	19	22	41
KEGR77 110-115	Pegmatite Ore	9.2	210	134	0.3	3.0	1.25	31.0	3.3	0.20	46	N/A	12	<1	12
KEGR96 44-50	Fresh Mafic	9.5	190	122	1.0	2.8	0.82	30.5	31.2	0.20	7.0	N/A	19	22	41
KEGR96 60-65	Pegmatite Ore	9.8	130	83	1.2	2.7	0.37	17.5	2.9	0.30	9.0	N/A	10	29	39
SLP1	Pegmatite Laterite Gravel-clay-colluviun	6.8	1,030	659	3.2	8.6	8.46	188.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SLP2	Pegmatite Laterite Gravel-clay-colluviun	5.7	1,030	659	2.1	10.4	9.09	193.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SLP3	Pegmatite Laterite Gravel-clay-colluviun	5.9	940	602	1.0	10.8	6.19	169.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SLPComp	Pegmatite Laterite Gravel-clay-colluviun	6.2	990	634	2.1	9.4	8.09	182.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SML1	Mafic Laterite-clay	7.1	720	461	0.7	3.1	1.86	154.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SML2	Mafic Laterite-clay	6.1	700	448	0.4	3.4	1.85	140.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SML3	Mafic Laterite-clay	5.3	730	467	1.3	5.5	5.50	146.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SMLComp	Mafic Laterite-clay	6.3	720	461	0.8	3.9	2.79	150.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
B1	Oxide Gravel	8.1	500	320	0.1	1.1	3.27	123.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A
B3	Oxide Gravelly Clay	6.9	940	602	0.3	0.6	2.67	213.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
B4	Oxide Silty Sand	6.2	450	288	0.1	0.7	3.42	109.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
B2	Oxide Silty Gravel	4.4	60	38	0.3	1.5	1.23	4.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A
B5	Oxide Clays	8.9	2,780	1,779	11.1	4.7	18.72	588.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MDTLSS1	Transitional Mafic	7.4	420	269	0.2	1.7	1.38	86.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MDTLSS2	Transitional Mafic	8.2	190	122	0.3	0.9	1.27	43.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MDTLSS3	Transitional Mafic	7.6	260	166	0.2	1.2	1.12	56.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MDTLSSComp	Transitional Mafic	7.7	300	192	0.2	1.3	1.18	63.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PDUSComp	Transitional Pegmatite-clay/mafic	7.3	760	486	0.1	2.5	1.07	150.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MDUSComp	Transitional Mafic	7.2	720	461	0.4	3.2	4.58	151.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PET1	Subgrade Pegmatite/Petalite	8.3	30	19	<0.01	0.3	0.03	6.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PET2	Subgrade Pegmatite/Petalite	8.8	30	19	0.9	0.4	0.17	7.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PET3	Subgrade Pegmatite/Petalite	7.7	20	13	1.0	1.1	0.61	2.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PET4	Subgrade Pegmatite/Petalite	9.4	80	51	2.1	0.4	0.52	14.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PETComp	Subgrade Pegmatite/Petalite	8.8	40	26	0.9	0.4	0.47	8.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PETG	Galaxy subgrade petalite	7.3	320	205	1.5	2.5	2.62	63.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A
KEGM054 012-13	Oxide	6.8	1,134	726	0.5	5.3	4.22	237	53.6	2.34	345	N/A	10	<5	10
KEGM058 030-31	Transitional	8.2	613	392	1.0	6.9	37	146	28.2	0.32	189	N/A	20	<5	20
KEGM059 37-38	Transitional	7.3	363	232	1.0	5.3	42	89.6	22.2	0.27	103	N/A	28	<5	28
KEGM036 126-127	Fresh Mafic	9.2	88	56	0.0	1.3	0.03	22.3	75.6	0.14	11	N/A	15	13	28
KEGM036 167-168	Fresh Mafic	9.5	106	68	4.5	3.9	1.81	13.0	3.4	0.28	14	N/A	16	17	33
KEGM045 064-65	Fresh Mafic	4.5	266	170	14.8	0.7	12	5.0	141	0.03	6.0	N/A	<5	<5	<5
KEGM045 170-171	Fresh Mafic	9.6	123	79	3.3	1.4	0.85	22.0	4.0	0.07	10.0	N/A	20	30	50
KEGM045 64-65	Fresh Mafic	4.3	282	180	14.8	0.7	12	5.0	141	0.03	6.0	N/A	<5	<5	<5
KEGM045 69-70	Fresh Contact Zone	5.5	402	257	13.0	3.5	24	23.4	191	0.04	20	N/A	<5	<5	<5
KEGM049 153-154.34	Fresh Mafic	9.2	154	99	10.5	0.8	3.55	17.3	24.7	0.10	28	N/A	16	8	24
KEGM049 276-277	Fresh Mafic	9.6	62	40	2.4	0.5	1.00	10.0	3.1	0.04	3.0	N/A	<5	29	29
KEGM052 219-220	Fresh Mafic	9.7	94	60	0.2	1.4	0.05	27.8	27.2	0.07	12.0	N/A	8	47	55
KEGM052 272-273	Fresh Mafic	9.5	137	88	5.9	1.0	3.01	22.9	22.6	0.24	23	N/A	9	29	38
KEGM054 270-271	Fresh Mafic	9.4	130	83	6.0	3.7	0.89	20.6	20.8	0.13	25	N/A	15	21	36
KEGM054 273-274	Fresh Mafic	8.9	163	104	11.1	3.2	2.49	23.5	101.3	0.13	44	N/A	36	<5	36
KEGM054 306-307	Fresh Mafic	9.5	114	73	4.4	1.3	1.48	19.6	15.0	0.16	19	N/A	7	24	31
KEGM056 242-243	Fresh Mafic	7.5	183	117	3.4	0.7	4.94	27.4	18.4	0.10	44	N/A	<5	<5	<5
KEGM056 254-255	Fresh Mafic	9.6	75	48	4.7	2.0	0.98	9.4	11.3	0.06	6.0	N/A	<5	32	32
KEGM056 317-318	Fresh Mafic	7.2	154	99	2.5	1.5	4.57	22.5	39.5	0.08	38	N/A	<5	<5	<5
KEGM058 153-154	Fresh Mafic	9.4	98	63	8.3	1.2	5.23	8.1	9.7	0.06	9.0	N/A	16	24	40
KEGM059 127-128	Fresh Mafic	9.5	88	56	5.1	0.9	4.05	7.4	5.6	0.05	6.0	N/A	<5	35	35
KEGM065 167-168	Fresh Mafic	9.5	94	60	4.8	0.6	6.54	10.2	8.1	0.20	11	N/A	20	24	44
KEGM065 171-172	Fresh Mafic	9.4	132	84	4.9	1.0	6.23	17.9	16.5	0.09	26	N/A	16	21	37
KEGR152 078-79	Fresh Mafic	4.5	1,971	1,261	99	0.7	166	49.6	1,233	0.05	8.0	N/A	<5	<5	<5
KEGR152 90-91	Fresh Mafic	7.7	217	139	19	1.9	12	3.5	86.0	0.06	6.0	N/A	12	<5	12
KEGR152 104-105	Fresh Mafic	7.4	2,250	1,440	632	1.2	7.99	7.9	1,512	0.08	19	N/A	52	<5	52
WC002	Fresh Mafic	9.8	52	33	4.3	1.1	0.70	3.3	1.9	<0.1	<2	6	<2	14	20
WC003	Fresh Mafic	9.8	41	26	2.5	0.9	0.53	3.3	1.2	<0.1	<2	<1	2	14	16
WC004	Fresh Mafic	9.8	36	23	1.6	0.5	0.57	3.4	1.6	<0.1	2.0	6	<2	7	13
WC005	Fresh Mafic	9.9	56	36	5.0	0.4	0.71	3.8	1.5	<0.1	3.0	10	<2	12	22
WC013	Fresh Mafic	9.9	42	27	2.8	0.3	0.69	3.6	1.2	<0.1	3.0	6	<2	10	17
WC015	Fresh Mafic	9.7	80	51	7.4	0.5	1.27	4.5	13.0	<0.1	7.0	8	<2	10	18
WC018	Fresh Mafic	9.9	48	31	5.6	0.3	0.60	1.8	1.0	<0.1	<2	3	<2	18	21
WC023	Fresh Mafic	9.4	52	33	4.6	6.2	0.44	1.5	34.6	<0.1	4.0	<1	13	10	23
WC024	Fresh Mafic	9.5	42	27	5.8	1.8	0.28	1.0	28.1	<0.1	4.0	<1	4	15	18
WC026	Fresh Mafic	9.9	60	38	4.8	0.5	0.59	5.0	1.9	<0.1	3.0	6	<2	19	25
WC027	Fresh Mafic	9.8	54	35	5.4	0.4	0.43	4.0	4.6	<0.1	3.0	1	<2	22	23
WC028	Fresh Mafic	9.8	44	28	4.5	0.2	0.81	2.1	0.9	<0.1	<2	9	<2	12	20
WC037	Fresh Mafic	9.8	55	35	1.6	1.8	0.33	7.1	3.4	<0.1	3.0	5	<2	15	20
WC038	Fresh Mafic	9.6	74	47	5.7	0.4	2.84	4.8	6.6	<0.1	3.0	<1	3	24	27
WC063	Fresh Mafic	9.8	39	25	3.0	0.3	0.89	2.6	1.2	<0.1	<2	3	<2	14	17
WC065	Fresh Mafic	9.9	53	34	4.2	0.6	0.44	4.8	2.3	<0.1	3.0	4	<2	18	23
WC068	Fresh Mafic	9.8	56	36	5.8	1.7	0.28	3.8	5.4	<0.1	3.0	1	<2	23	24
WC076	Fresh Mafic	9.6	41	26	3.0	0.4	0.76	4.4	8.9	<0.1	4.0	<1	<2	15	17
WC078	Fresh Mafic	9.9	47	30	6.2	0.3	0.67	1.3	2.1	<0.1	<2	4	<2	17	22
WC046	Fresh Ultramafic	9.9	59	38	5.1	0.7	0.66	5.0	2.0	<0.1	<2	3	<2	22	24
WC047	Fresh Ultramafic	9.7	69	44	5.9	3.6	0.29	5.0	5.3	0.30	3.0	<1	6	19	25
WC049	Fresh Ultramafic	9.7	73	47	5.9	1.3	0.73	6.8	11.3	<0.1	6.0	<1	2	21	23
WC050	Fresh Ultramafic	9.8	51	33	3.7	5.3	0.11	1.9	1.9	<0.1	<2	<1	7	19	26
WC051	Pegmatite Ore	10.0	73	47	2.4	4.9	0.10	7.5	2.6	<0.1	2.0	<1	<2	30	31
WC053	Pegmatite Ore	9.9	47	30	4.3	0.2	1.20	1.1	1.4	<0.1	<2	10	<2	6	16
WC056	Pegmatite Ore	9.7	48	31	4.3	3.2	0.33	1.6	5.7	<0.1	<2	<1	<2	19	21
WC058	Pegmatite Ore	9.9	48	31	5.9	0.2	0.47	1.9	0.9	<0.1	<2	1	<2	22	23
WC082	Fresh BIF	9.7	54	35	6.1	1.0	0.57	2.3	2.8	<0.1	3.0	<1	2	19	21
WC083	Fresh BIF	9.6	57	36	5.7	1.0	0.45	4.1	4.7	<0.1	2.0	<1	7	19	26
WC084	Fresh BIF	9.6	76	49	5.3	1.5	0.41	8.2	9.2	<0.1	4.0	<1	8	18	26
WC086	Fresh Dyke	10.0	88	56	1.3	0.7	0.12	16.5	2.5	<0.1	4.0	<1	7	33	41
WC087	Fresh Dyke	10.0	78	50	0.2	0.5	0.07	15.8	1.5	<0.1	6.0	<1	4	29	33
WC009	Transitional	9.9	55	35	0.1	0.2	0.14	10.2	1.1	<0.1	7.0	3	<2	14	18
WC019	Transitional	5.7	87	56	0.7	0.6	1.91	11.7	19	<0.1	12	<1	2	<1	<5
WC020	Transitional	5.7	78	50	4.0	3.3	3.05	1.8	31.1	<0.1	5.0	<1	3	<1	<5
WC021	Transitional	5.9	58	37	2.1	3.3	2.19	1.6	20	<0.1	7.0	<1	3	<1	<5
WC034	Transitional	9.4	45	29	0.1	0.1	0.10	9.2	3.0	<0.1	9.0	<1	3	9	12
WC042	Transitional	9.6	25	16	0.1	0.5	0.17	4.3	1.6	<0.1	<2	<1	<2	13	13
Livestock Drinking Water DGV (ANZECC 2000/ANZG 2018)		6.5-8.5	5970	4000	1000	N/G	No limit	N/G	1000	2	N/G	N/G	N/G	N/G	N/G
NPUG (DER 2014)		N/G	N/G	N/G	N/G	N/G	N/G	N/G	1000	15	250	N/G	N/G	N/G	N/G
Freshwater Protection 80% DGV (ANZECC 2000/ANZG 2018)		N/G	N/G	N/G	N/G	N/G	N/G	N/G	N/G	N/G	N/G	N/G	N/G	N/G	N/G
Freshwater Protection 95% DGV (ANZECC 2000/ANZG 2018)		6.5-8.5	N/G	N/G	N/G	N/G	N/G	N/G	N/G	N/G	N/G	N/G	N/G	N/G	N/G

N/G : No applicable guideline value.

Table A2-6: ASLP Water Metals

Sample ID	Lithology	pH	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Hg	Li	Mg
		SU	µg/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	mg/L	µg/L	mg/L	mg/L	µg/L	µg/L	mg/L
SLP1	Pegmatite Laterite Gravel-clay-colluvium	6.8	0.08	<0.01	0.8	0.60	45	<0.1	<0.005	N/A	<0.02	0.776	0.3	<0.01	0.143	0.002	<0.01	<0.1	13.2	N/A
SLP2	Pegmatite Laterite Gravel-clay-colluvium	5.7	0.07	<0.01	0.4	0.63	41	<0.1	<0.005	N/A	<0.02	0.469	1.2	<0.01	0.142	<0.001	<0.01	<0.1	42.8	N/A
SLP3	Pegmatite Laterite Gravel-clay-colluvium	5.9	0.07	<0.01	1.0	0.38	34	<0.1	<0.005	N/A	<0.02	0.071	0.5	<0.01	0.406	<0.001	<0.01	<0.1	42.6	N/A
SLPComp	Pegmatite Laterite Gravel-clay-colluvium	6.2	0.07	<0.01	0.7	0.55	44	<0.1	<0.005	N/A	<0.02	0.601	0.6	<0.01	0.184	<0.001	<0.01	<0.1	28.1	N/A
SML1	Mafic Laterite-clay	7.1	0.06	0.38	1.9	0.76	15	<0.1	<0.005	N/A	<0.02	2.164	0.5	<0.01	0.332	0.003	0.23	<0.1	5.3	N/A
SML2	Mafic Laterite-clay	6.1	0.06	<0.01	1.3	0.69	13	<0.1	<0.005	N/A	<0.02	0.379	0.4	<0.01	0.091	0.001	0.01	<0.1	11.3	N/A
SML3	Mafic Laterite-clay	5.3	0.06	<0.01	0.4	0.52	33	<0.1	<0.005	N/A	<0.02	0.063	3.1	<0.01	0.190	<0.001	<0.01	<0.1	24.2	N/A
SMLComp	Mafic Laterite-clay	6.3	0.06	<0.01	0.6	0.64	30	<0.1	<0.005	N/A	<0.02	0.459	0.6	<0.01	0.188	0.001	<0.01	<0.1	10.0	N/A
B1	Oxide Gravel	8.1	0.10	1.89	6.8	0.92	6	1.2	0.011	N/A	<0.02	10.4	1.2	<0.01	0.415	0.007	0.93	<0.1	3.9	N/A
B3	Oxide Gravelly Clay	6.9	0.08	1.07	7.8	1.26	117	0.3	0.031	N/A	<0.02	106	2.6	<0.01	0.181	0.022	0.69	<0.1	3.3	N/A
B4	Oxide Silty Sand	6.2	0.07	2.56	5.4	0.66	138	1.6	0.012	N/A	<0.02	66.7	2.8	<0.01	1.015	0.01	1.40	<0.1	5.4	N/A
B2	Oxide Silty Gravel	4.4	0.01	0.13	<0.1	0.08	16	0.4	<0.005	N/A	<0.02	1.239	1.2	<0.01	0.073	<0.001	<0.01	<0.1	15.4	N/A
B5	Oxide Clays	8.9	<0.01	0.01	7.7	4.45	13	<0.1	<0.005	N/A	<0.02	0.018	<0.1	<0.01	0.020	0.003	<0.01	<0.1	19.9	N/A
MDTLSS1	Transitional Mafic	7.4	0.06	1.49	40	0.07	1.34	4.2	<0.005	N/A	<0.02	0.321	6.8	<0.01	5.6	0.016	2.32	<0.1	33.7	N/A
MDTLSS2	Transitional Mafic	8.2	0.04	1.87	67	0.05	1.48	2.4	0.007	N/A	<0.02	0.654	7.5	<0.01	2.6	0.015	2.98	<0.1	21.8	N/A
MDTLSS3	Transitional Mafic	7.6	0.05	1.69	56	0.07	1.10	3	<0.005	N/A	0.04	0.391	7.1	<0.01	6.5	0.009	2.55	<0.1	16.0	N/A
MDTLSSComp	Transitional Mafic	7.7	0.09	1.64	58	0.06	1.13	3.2	<0.005	N/A	<0.02	0.370	7.0	<0.01	5.0	0.013	2.70	<0.1	23.9	N/A
PDUSComp	Transitional Pegmatite-clay/mafic	7.3	0.11	0.52	25	0.09	2.36	0.8	0.005	N/A	<0.02	0.361	7.5	<0.01	3.2	0.014	1.17	<0.1	172	N/A
MDUSComp	Transitional Mafic	7.2	0.08	5.32	24	0.09	6.01	7.3	0.009	N/A	<0.02	2.094	52.9	<0.01	18	0.076	11.37	<0.1	93.6	N/A
TP1	Transitional Pegmatite	N/A	<0.1	0.29	7.0	0.66	1.30	0.1	<0.1	N/A	0.2	<0.5	0.1	0.00	1.8	0.01	0.09	<0.1	14.0	N/A
TP2	Transitional Pegmatite	N/A	<0.1	0.30	16	0.08	1.10	<0.1	<0.1	N/A	<0.1	<0.5	0.1	0.00	1.3	0.002	0.09	<0.1	430	N/A
TP3	Transitional Pegmatite	N/A	<0.1	0.07	<1	4.45	2.20	0.2	<0.1	N/A	0.4	<0.5	0.3	0.00	5.700	0.0011	0.05	<0.1	160	N/A
TP4	Transitional Pegmatite	N/A	<0.1	0.29	46	<0.01	0.30	0.4	<0.1	N/A	<0.1	<0.5	0.2	0.00	0.500	0.0011	0.12	0.2	110	N/A
TPComp	Transitional Pegmatite	8.8	<0.1	0.02	3.0	0.09	1.10	<0.1	<0.1	N/A	<0.1	<0.5	<0.1	<0.0001	0.600	0.0003	0.01	<0.1	200	N/A
PETComp	Subgrade Pegmatite/Petalite	7.3	0.04	0.07	9.7	<0.01	0.06	<0.1	0.013	N/A	<0.02	0.010	<0.1	<0.01	4.5	<0.001	0.02	<0.1	413	N/A
PETG	Galaxy subgrade petalite	8.3	0.05	<0.01	14	0.09	1.27	0.2	0.009	N/A	<0.02	0.005	0.3	<0.01	3.2	<0.001	<0.01	<0.1	120	N/A
PET1	Subgrade Pegmatite/Petalite	8.8	0.04	0.10	10.4	<0.01	0.12	<0.1	0.007	N/A	<0.02	0.020	<0.1	<0.01	2.7	<0.001	0.06	<0.1	525	N/A
PET2	Subgrade Pegmatite/Petalite	7.7	0.07	0.19	3.0	<0.01	<0.05	<0.1	0.005	N/A	<0.02	0.009	<0.1	<0.01	2.9	<0.001	<0.01	<0.1	340	N/A
PET3	Subgrade Pegmatite/Petalite	9.4	0.04	0.01	40	<0.01	<0.05	<0.1	<0.005	N/A	0.02	<0.002	<0.1	<0.01	12	<0.001	<0.01	<0.1	190	N/A
PET4	Subgrade Pegmatite/Petalite	N/A	0.05	0.37	9.6	<0.01	<0.05	<0.1	0.058	N/A	<0.02	0.006	<0.1	<0.01	3.0	<0.001	<0.01	<0.1	806	N/A
KEGR22 3-11	Oxide	5.5	0.02	0.01	1.8	N/A	20	<0.1	N/A	0.41	<0.02	N/A	0.9	<0.01	N/A	<0.01	N/A	<0.1	15.2	11
KEGR22 55-60	Fresh Mafic	8.0	0.02	0.61	99	N/A	2.53	<0.1	N/A	9.08	<0.02	N/A	0.5	<0.01	N/A	<0.01	N/A	<0.1	211	3.2
KEGR22 90-99	Fresh Mafic	9.7	0.02	1.28	156	N/A	11	<0.1	N/A	3.49	<0.02	N/A	1.1	0.02	N/A	<0.01	N/A	<0.1	1209	1.6
KEGR25 15-18	Oxide	6.1	<0.01	0.05	0.5	N/A	1.90	<0.1	N/A	2.78	<0.02	N/A	1.1	<0.01	N/A	<0.01	N/A	<0.1	45.0	63
KEGR25 195-200	Fresh Mafic	8.8	0.02	<0.01	46	N/A	2.11	<0.1	N/A	104	<0.02	N/A	3.9	<0.01	N/A	<0.01	N/A	<0.1	333.4	66
KEGR26 50-52	Fresh Shear/Contact Zone	7.8	<0.01	5.19	36	N/A	1.39	1.7	N/A	0.29	0	N/A	14.1	0.01	N/A	0.1	N/A	<0.1	53.1	1.9
KEGR27 60-67	Transitional	9.3	0.44	4.71	86	N/A	1.29	2.0	N/A	0.21	<0.02	N/A	2.3	0.01	N/A	<0.01	N/A	0.4	53.7	0.5
KEGR32 34-36	Transitional Pegmatite	7.9	0.01	0.63	1017	N/A	0.22	0.3	N/A	0.09	<0.02	N/A	1.8	<0.01	N/A	<0.01	N/A	<0.1	118	0.3
KEGR50 64-66	Pegmatite Ore	9.4	0.02	11.59	35	N/A	1.22	3.9	N/A	0.53	0	N/A	3.6	0.01	N/A	0.0	N/A	<0.1	261	4.1
KEGR50 70-75	Fresh Mafic	9.6	0.02	7.51	585	N/A	0.62	1.9	N/A	0.74	0	N/A	13.3	0.11	N/A	<0.01	N/A	<0.1	136	3.9
KEGR77 110-115	Pegmatite Ore	9.2	<0.01	3.54	41	N/A	0.19	1.4	N/A	0.29	<0.02	N/A	0.3	<0.01	N/A	<0.01	N/A	<0.1	1618	1.3
KEGR96 44-50	Fresh Mafic	9.5	0.02	1.45	255.7	N/A	1.14	0.2	N/A	1.04	<0.02	N/A	1.2	<0.01	N/A	<0.01	N/A	<0.1	569	0.8
KEGR96 60-65	Pegmatite Ore	9.8	<0.01	2.89	10.1	N/A	0.29	2.9	N/A	1.17	<0.02	N/A	0.1	<0.01	N/A	<0.01	N/A	<0.1	1354	0.4
KEGM054 012-13	Oxide	6.8	0.02	<0.01	26	0.42	2.24	<0.1	<0.005	0.53	<0.02	N/A	0.50	<0.01	0.106	<0.01	<0.01	0.1	7.6	4.2
KEGM058 030-31	Transitional 0.45 micron	8.2	0.03	101.37	592	0.14	14	5.3	0.089	1.03	0.4	N/A	697	10.39	22	1.7	346.03	<0.1	72.9	37
KEGM058 030-31	Transitional 0.2 micron	8.8	<0.1	0.08	90	<0.005	0.20	<0.1	<0.1	0.20	<2	N/A	0.8	0.02	0.200	0.0	0.13	<0.1	17.0	0.2
KEGM059 37-38	Transitional 0.45 micron	7.3	0.05	93.73	279	0.10	11.36	2.4	0.110	1.02	0.3	N/A	437	11.38	30	0.2	325.69	<0.1	88.9	42
KEGM059 37-38	Transitional 0.2 micron	8.9	<0.1	0.02	41	0.02	1.50	<0.1	<0.1	0.40	<2	N/A	0.20	0.01	<0.1	0.0	0.03	<0.1	4.3	0.3
KEGM036 126-127	Fresh Mafic	9.2	0.09	0.34	47	0.03	0.74	<0.1	<0.005	0.04	<0.02	N/A	<0.1	<0.01	3.8	<0.01	0.03	<0.1	202	0.0
KEGM036 167-168	Fresh Mafic	9.5	<0.01	0.12	201	0.09	0.98	<0.1	0.006	4.52	<0.02	N/A	<0.1	<0.01	211	<0.01	<0.01	0.1	486	1.8
KEGM045 064-65	Fresh Mafic	4.5	0.02	0.26	0.8	<0.01	3.02	3.1	<0.005	14.81	1	N/A	17.00	<0.01	2.8	<0.01	20.61	<0.1	66.3	12
KEGM045 170-171	Fresh Mafic	9.6	<0.01	0.49	6.8	0.02	1.17	<0.1	<0.005	3.26	<0.02	N/A	<0.1	<0.01	25	<0.01	<0.01	<0.1	488	0.9
KEGM045 64-65	Fresh Mafic	4.3	0.02	0.26	0.8	<0.01	3.02	3.1	<0.005	14.8	1	N/A	17.00	<0.01	2.8	<0.01	20.61	<0.1	66.3	11.7
KEGM045 69-70	Fresh Shear/Contact Zone	5.5	0.03	0.06	1.3	0.21	3.10	1.3	<0.005	13.0	1	N/A	57.10	<0.01	4.5	<0.01	0.66	<0.1	150	24
KEGM049 153-154.34	Fresh Mafic	9.2	<0.01	0.05	2204	<0.01	0.37	<0.1	<0.005	10.5	<0.02	N/A	<0.1	<0.01	41	<0.01	<0.01	0.4	1.0	3.6
KEGM049 276-277	Fresh Mafic	9.6	<0.01	0.42	170	<0.01	2.32	<0.1	<0.005	2.35	<0.02	N/A	0.1	<0.01	19	<0.01	0.03	<0.1	135	1.0
KEGM052 219-220	Fresh Mafic	9.7	<0.01	1.26	<0.1	0.03	<0.05	<0.1	<0.005	0.15	<0.02	N/A	<0.1	<0.01	<0.001	<0.01	0.02	<0.1	0.2	0.1
KEGM052 272-273	Fresh Mafic	9.5	<0.01	0.04	1948	0.03	0.29	<0.1	0.006	5.89	<0.02	N/A	<0.1	<0.01	71	<0.01	<0.01	0.3	6.7	3.0
KEGM054 270-271	Fresh Mafic	9.4	0.07	0.60	5.8	0.02	0.45	<0.1	<0.005	6.01	<0.02	N/A	<0.1	<0.01	54	<0.01	0.06	<0.1	219	0.9
KEGM054 273-274	Fresh Mafic	8.9	0.06	0.27	1.0	0.02	0.37	<0.1	<0.005	11.1	<0.02	N/A	0.1	<0.01	52	<0.01	0.01	<0.1	477	2.5
KEGM054 306-307	Fresh Mafic	9.5	<0.01	0.24	644	0.02	0.45	<0.1	<0.005	4.39	<0.02	N/A	<0.1	<0.01	115	<0.01	<0.01	0.2	167	1.5
KEGM056 242-243	Fresh Mafic	7.5	<0.01	0.05	1198	0.04	0.46	<0.1	<0.005	3.35	<0.02	N/A	<0.1	<0.01	60	<0.01	<0.01	<0.1	7.7	4.9
KEGM056 254-255	Fresh Mafic	9.6	0.02	0.36	540	0.04	2.15	<0.1	<0.005	4.68	<0.02	N/A	<0.1	<0.01	19	<0.01	<0.01	<0.1	307	1.0
KEGM056 317-318	Fresh Mafic	7.2	0.03	0.10	52.4	0.09	1.12	<0.1	0.006	2.45	<0.02	N/A	0.2	<0.01	188	<0.01	<0.01	<0.1	177	4.6
KEGM058 153-154	Fresh Mafic	9.4	<0.01	0.01	3396	0.01	0.32	<0.1	<0.005	8.32	<0.02	N/A	0.1	<0.01	12	<0.01	<0.01	0.1	14.2	5.2
KEGM059 127-128	Fresh Mafic	9.5	0.02	0.01	5.4	0.03	0.41	<0.1	<0.005	5.12	<0.02	N/A	<0.1	<0.01	55	<0.01	<0.01	<0.1	9.9	4.1
KEGM065 167-168	Fresh Mafic	9.5	0.02	0.01	7.9	0.03	0.67	<0.1	<0.005	4.79	<0.02	N/A	<0.1	<0.01	49	<0.01	<0.01	<0.1	25.0	6.5
KEGM065 171-172	Fresh Mafic	9.4	0.10	<0.01	5.0	0.04	1.58	<0.1	<0.005	4.89	<0.02	N/A	<0.1	<0.01	101	<0.01	0.03	0.1	19.4	6.2
KEGR152 078-79	Fresh Mafic	4.5	<0.01	0.58	6.5	0.04	2.04	4.6	<0.005	99.0	9	N/A	935	<0.01	10	<0.01	12.86	<0.1	490	166
KEGR152 90-91	Fresh Mafic	7.7	0.01	<0.01	366	<0.01	0.34	<0.1	<0.005	18.62	<0.02	N/A	0.3	<0.01	19	<0.01	<0.01	<0.1	20.9	11.8
KEGR152 104-105	Fresh Mafic	7.4	0.07	0.16	2.4	0.02	2.48	<0.1	<0.005	632	0	N/A	4.0	<0.01	8.8	<0.01	<0.01	<0.1	249	8.0
WC002	Fresh Mafic	9.8	0.02	0.35	158	<0.01	2.57	N/A	<0.005	4.32	<0.02	0.002	<0.1	<0.01	0.087	<0.01	<0.01	<0.1	51.6	0.7
WC003	Fresh Mafic	9.8	0.02	0.36	136	0.01	0.87	N/A	<0.005	2.53	<0.02	0.006	<0.1	<0.01	0.173	<0.01	<0.01	<0.1	119	0.5
WC004	Fresh Mafic	9.8	0.10	0.34	308	<0.01	0.67	N/A	<0.005	1.61	0	<0.002	<0.1	<0.01	0.113	<0.01	0.01	<0.1	77.7	0.6
WC005	Fresh Mafic	9.9	0.03	0.41	24.4	<0.01	1.46	N/A	<0.005	4.95	<0.02	0.002	<0.1	<0.01	0.015	<0.01	<0.01	<0.1	27.1	0.7
WC013	Fresh Mafic	9.9	0.01	0.56	9.5	<0.01	1.56	N/A	<0.005	2.80	<0.02	0.002	<0.1	<0.01	0.011	<0.01	0.04	<0.1	30.9	0.7
WC015	Fresh Mafic	9.7	0.02	0.08	463	<0.01	2.22	N/A	0.034	7.37	<0.02	<0.002	<0.1	<0.01	0.018	<0.01	<0.01	<0.1	3.5	1.3
WC018	Fresh Mafic	9.9	0.01	0.76	4.0	<0.01	2.16	N/A	<0.005	5.61	<0.02	0.002	<0.1	<0.01	0.016	<0.01	0.02	<0.1	20.1	0.6
WC023	Fresh Mafic	9.4	0.02	0.85	0.5	0.02	0.90	N/A	<0.005	4.58	<0.02	0.011	<0.1	<0.01	0.002	<0.01	0.06	<0.1	28.9	0.4
WC024	Fresh Mafic	9.5	6.24	0.54	1.0	<0.01	0.69	N/A	<0.005	5.77	<0.02	0.021	<0.1	<0.01	0.004	<0.01	0.01	0.1	19.2	0.3
WC026	Fresh Mafic	9.9	16.44	0.66	37.6	0.01	3.76	N/A	<0.005	4.76	<0.02	0.056	<0.1	<0.01	0.046	<0.01	0.01	0.2	144	0.6
Livestock Drinking Water DGV (ANZECC 2000/ANZG 2018)		6.5-8.5	N/G	5.00	500	5	N/G	N/G	N/G	1000	10	N/G	1000	1	N/G	1	No limit	2	N/G	No limit
NPUG (DER 2014)		N/G	1000	0.2	100	40	20000	600	N/G	N/G	20	N/G	N/G	0.5	N/G	20	0.3	10	N/G	N/G
Freshwater Protection 80% DGV (ANZECC 2000/ANZG 2018)		N/G	0.2	0.15	140	2.5	N/G	N/G	N/G	N/G	0.8	N/G	N/G	0.04	N/G	0.0025	N/G	5.4	N/G	N/G
Freshwater Protection 95% DGV (ANZECC 2000/ANZG 2018)		6.5-8.5	0.05	0.055	13	0.94	N/G	N/G	N/G	N/G	0.2	N/G	1.4	0.0033	N/G	0.0014	0.3	0.6	N/G	N/G

Table A2-6: ASLP Water Metals

Sample ID	Lithology	pH	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Hg	Li	Mg
		SU	µg/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	mg/L	µg/L	mg/L	mg/L	µg/L	µg/L	mg/L
WC027	Fresh Mafic	9.8	12.66	0.81	7.9	0.01	1.00	N/A	<0.005	5.41	<0.02	0.020	<0.1	<0.01	0.023	<0.01	0.01	0.1	98.6	0.4
WC028	Fresh Mafic	9.8	23.82	0.37	27	<0.01	5.58	N/A	<0.005	4.52	<0.02	0.008	<0.1	<0.01	0.029	<0.01	<0.01	<0.1	27.0	0.8
WC037	Fresh Mafic	9.8	16.98	0.38	500	0.04	1.98	N/A	<0.005	1.58	<0.02	0.048	<0.1	<0.01	0.084	<0.01	0.03	0.1	115	0.3
WC038	Fresh Mafic	9.6	16.27	0.04	461	<0.01	3.77	N/A	<0.005	5.65	<0.02	0.011	<0.1	<0.01	0.025	<0.01	<0.01	0.1	25.1	2.8
WC063	Fresh Mafic	9.8	15.87	0.58	117	<0.01	3.83	N/A	<0.005	3.00	<0.02	0.019	<0.1	<0.01	0.009	<0.01	0.03	<0.1	56.1	0.9
WC065	Fresh Mafic	9.9	5.65	0.86	7.4	<0.01	0.68	N/A	<0.005	4.20	<0.02	0.012	<0.1	<0.01	0.014	<0.01	0.03	<0.1	85.6	0.4
WC068	Fresh Mafic	9.8	2.69	1.30	2.3	0.02	0.98	N/A	<0.005	5.75	<0.02	0.007	<0.1	<0.01	0.010	<0.01	0.02	<0.1	169	0.3
WC076	Fresh Mafic	9.6	3.79	0.76	5.6	<0.01	1.76	N/A	<0.005	2.95	<0.02	0.020	<0.1	<0.01	<0.001	<0.01	0.06	<0.1	26.9	0.8
WC078	Fresh Mafic	9.9	0.88	0.74	3.0	<0.01	2.98	N/A	<0.005	6.18	<0.02	0.003	<0.1	<0.01	0.002	<0.01	0.01	<0.1	7.8	0.7
WC046	Fresh Ultramafic	9.9	0.84	0.50	291	<0.01	1.24	N/A	<0.005	5.05	<0.02	<0.002	<0.1	<0.01	0.015	<0.01	<0.01	<0.1	93.8	0.7
WC047	Fresh Ultramafic	9.7	1.77	0.83	672	0.02	0.42	N/A	<0.005	5.90	<0.02	<0.002	<0.1	<0.01	0.031	<0.01	<0.01	<0.1	113	0.3
WC049	Fresh Ultramafic	9.7	0.73	0.31	62	0.04	0.61	N/A	<0.005	5.92	<0.02	<0.002	<0.1	<0.01	0.052	<0.01	<0.01	<0.1	57.1	0.7
WC050	Fresh Ultramafic	9.8	0.68	0.99	7.1	<0.01	4.06	N/A	<0.005	3.67	<0.02	0.002	<0.1	<0.01	0.001	<0.01	0.02	<0.1	193	0.1
WC051	Pegmatite Ore	10.0	0.82	0.82	4.2	<0.01	1.17	N/A	<0.005	2.36	<0.02	0.017	<0.1	<0.01	0.006	<0.01	0.04	<0.1	350	0.1
WC053	Pegmatite Ore	9.9	5.23	0.01	5.4	<0.01	3.87	N/A	<0.005	4.31	<0.02	0.054	<0.1	<0.01	0.023	<0.01	<0.01	0.4	0.7	1.2
WC056	Pegmatite Ore	9.7	6.23	0.49	11.5	<0.01	4.51	N/A	<0.005	4.29	<0.02	0.050	<0.1	<0.01	0.012	<0.01	0.03	<0.1	169	0.3
WC058	Pegmatite Ore	9.9	3.15	0.63	11.0	<0.01	2.98	N/A	<0.005	5.89	<0.02	0.007	<0.1	<0.01	0.007	<0.01	0.01	<0.1	24.6	0.5
WC082	Fresh BIF	9.7	0.23	0.60	65	0.01	0.50	N/A	<0.005	6.12	<0.02	<0.002	<0.1	<0.01	0.010	<0.01	<0.01	<0.1	13.4	0.6
WC083	Fresh BIF	9.6	7.39	1.01	12.2	<0.01	0.75	N/A	<0.005	5.71	<0.02	0.032	<0.1	<0.01	0.028	<0.01	<0.01	0.2	26.4	0.5
WC084	Fresh BIF	9.6	1.66	0.77	21	0.01	0.52	N/A	<0.005	5.27	<0.02	0.005	<0.1	<0.01	0.027	<0.01	<0.01	<0.1	79.6	0.4
WC086	Fresh Dyke	10.0	0.73	1.25	9.4	<0.01	0.36	N/A	<0.005	1.26	<0.02	0.012	<0.1	<0.01	0.006	<0.01	0.03	<0.1	49.9	0.1
WC087	Fresh Dyke	10.0	0.39	1.41	3.2	<0.01	0.25	N/A	<0.005	0.21	<0.02	0.020	<0.1	<0.01	0.004	<0.01	0.08	<0.1	47.2	0.1
WC009	Transitional Kom Basalt	9.9	0.25	1.09	3.9	<0.01	0.44	N/A	<0.005	0.08	<0.02	0.007	<0.1	<0.01	<0.001	<0.01	0.40	<0.1	1.3	0.1
WC019	Transitional Pegmatite	5.7	0.12	<0.01	0.5	<0.01	11.58	N/A	<0.005	0.68	0	0.004	5.6	<0.01	<0.001	<0.01	0.04	<0.1	8.5	1.9
WC020	Transitional Mafic	5.7	0.15	<0.01	0.1	0.03	3.01	N/A	<0.005	4.04	0	0.020	5.7	<0.01	0.043	<0.01	1.19	<0.1	83.5	3.1
WC021	Transitional Mafic	5.9	0.12	<0.01	0.1	0.12	1.60	N/A	<0.005	2.14	<0.02	0.011	0.9	<0.01	0.009	<0.01	0.47	<0.1	43.2	2.2
WC034	Transitional Mafic	9.4	0.16	0.55	6.2	<0.01	0.40	N/A	<0.005	0.07	<0.02	0.024	0.2	<0.01	<0.001	<0.01	0.58	<0.1	4.8	0.1
WC042	Transitional Ultramafic	9.6	0.10	0.74	20	<0.01	0.37	N/A	<0.005	0.08	<0.02	0.003	<0.1	<0.01	<0.001	<0.01	0.11	<0.1	9.6	0.2
Livestock Drinking Water DGV (ANZECC 2000/ANZG 2018)		6.5-8.5	N/G	5.00	500	5	N/G	N/G	N/G	1000	10	N/G	1000	1	N/G	1	No limit	2	N/G	No limit
NPUG (DER 2014)		N/G	1000	0.2	100	40	20000	600	N/G	N/G	20	N/G	N/G	0.5	N/G	20	0.3	10	N/G	N/G
Freshwater Protection 80% DGV (ANZECC 2000/ANZG 2018)		N/G	0.2	0.15	140	2.5	N/G	N/G	N/G	N/G	0.8	N/G	N/G	0.04	N/G	0.0025	N/G	5.4	N/G	N/G
Freshwater Protection 95% DGV (ANZECC 2000/ANZG 2018)		6.5-8.5	0.05	0.055	13	0.94	N/G	N/G	N/G	N/G	0.2	N/G	1.4	0.0033	N/G	0.0014	0.3	0.6	N/G	N/G
N/G : No applicable guideline value.																				

Table A2-6: ASLP Water Metals

Sample ID	Lithology	pH	Ag	Mn	Mo	Nb	Ni	Pb	Rb	S	Sb	Se	Sn	Sr	Ta	Th	Tl	U	V	W	Zn
		SU	µg/L	mg/L	µg/L	µg/L	mg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	mg/L
SLP1	Pegmatite Laterite Gravel-clay-colluvium	6.8	0.08	0.040	5.99	0.035	0.004	<0.5	7.7	36.2	0.23	0.8	<0.1	32.82	0.026	0.021	0.03	0.096	<0.01	0.20	<0.01
SLP2	Pegmatite Laterite Gravel-clay-colluvium	5.7	0.07	0.048	<0.05	0.006	0.005	<0.5	8.1	44.2	0.07	<0.5	<0.1	26.48	<0.001	<0.005	0.03	0.012	<0.01	<0.02	<0.01
SLP3	Pegmatite Laterite Gravel-clay-colluvium	5.9	0.07	0.029	0.26	<0.005	0.007	<0.5	11	32.2	0.24	<0.5	<0.1	11.67	<0.001	<0.005	0.02	0.015	<0.01	0.02	<0.01
SLPComp	Pegmatite Laterite Gravel-clay-colluvium	6.2	0.07	0.050	0.28	0.005	0.005	<0.5	8.2	39.0	0.15	0.6	<0.1	24.97	<0.001	<0.005	0.03	0.036	<0.01	0.02	<0.01
SML1	Mafic Laterite-clay	7.1	0.06	0.006	0.79	0.115	0.002	<0.5	4.3	26.1	0.29	0.9	<0.1	5.84	0.023	0.522	0.07	0.312	<0.01	0.14	<0.01
SML2	Mafic Laterite-clay	6.1	0.06	0.012	<0.05	0.061	0.001	<0.5	3.7	30.5	0.18	<0.5	<0.1	7.49	0.031	0.069	0.05	0.076	<0.01	0.02	<0.01
SML3	Mafic Laterite-clay	5.3	0.06	0.087	<0.05	<0.005	0.005	<0.5	5.7	26.8	0.04	<0.5	<0.1	21.67	<0.001	<0.005	0.07	0.027	<0.01	<0.02	<0.01
SMLComp	Mafic Laterite-clay	6.3	0.06	0.019	<0.05	0.014	0.001	<0.5	4.5	32.1	0.11	0.5	<0.1	10.85	0.007	0.019	0.07	0.042	<0.01	<0.02	<0.01
B1	Oxide Gravel	8.1	0.10	<0.001	1.11	0.013	0.006	2.1	3.8	14.4	0.36	2.6	0.2	4.07	0.002	5.674	0.05	1.848	0.02	0.12	<0.01
B3	Oxide Gravelly Clay	6.9	0.08	0.004	0.56	0.012	0.006	7.2	1.7	26.9	0.19	2.3	<0.1	27.8	0.001	6.210	0.03	2.169	0.02	0.03	<0.01
B4	Oxide Silty Sand	6.2	0.07	0.002	0.05	0.008	0.004	6.7	5.6	19.2	0.06	1.8	<0.1	16.35	<0.001	9.623	0.05	2.716	<0.01	0.02	<0.01
B2	Oxide Silty Gravel	4.4	0.01	0.005	<0.05	<0.005	0.002	1.6	3.1	2.30	0.01	<0.5	<0.1	25.73	<0.001	0.067	0.11	0.538	<0.01	<0.02	<0.01
B5	Oxide Clays	8.9	<0.01	<0.001	11.57	<0.005	0.001	<0.5	1.4	115	0.23	1.3	<0.1	111.04	<0.001	0.024	0.01	3.496	0.03	0.17	<0.01
MDTLSS1	Transitional Mafic	7.4	0.06	0.042	15.26	0.009	0.031	<0.5	4.1	7.40	3.56	<0.5	1.5	0.81	0.002	0.043	0.02	0.104	0.03	0.94	0.02
MDTLSS2	Transitional Mafic	8.2	0.04	0.046	15.5	0.015	0.029	<0.5	1.6	3.10	3.22	<0.5	0.3	1.09	0.009	0.066	0.02	0.137	0.05	4.06	0.02
MDTLSS3	Transitional Mafic	7.6	0.05	0.085	45.85	0.014	0.027	<0.5	2.4	4.70	2.73	<0.5	0.3	0.69	<0.001	0.026	0.01	0.068	0.06	3.51	0.01
MDTLSSComp	Transitional Mafic	7.7	0.09	0.056	27.73	0.009	0.030	<0.5	2.7	5.00	3.54	<0.5	0.7	0.74	0.003	0.045	0.01	0.088	0.05	2.95	0.02
PDUSComp	Transitional Pegmatite-clay/mafic	7.3	0.11	0.038	33.34	0.12	0.023	<0.5	21	13.8	2.48	<0.5	1.2	0.46	0.215	0.095	0.09	0.182	<0.01	4.64	<0.01
MDUSComp	Transitional Mafic	7.2	0.08	0.129	10.34	0.022	0.058	0.9	17	12.4	1.98	<0.5	0.5	2.14	0.012	0.068	0.17	0.730	0.02	0.49	0.05
TP1	Transitional Pegmatite	N/A	<0.1	3.6	2	<0.2	0.003	0.9	21	2.50	1.2	<1	1.4	2.1	NA	<0.1	<0.1	<0.1	0.00	7.00	0.10
TP2	Transitional Pegmatite	N/A	<0.1	5.0	15	<0.2	0.003	0.4	13	4.00	0.9	<1	1.4	1.5	NA	<0.1	<0.1	<0.1	0.00	14.0	0.01
TP3	Transitional Pegmatite	N/A	<0.1	10.0	8	<0.2	0.003	<0.1	33	10.0	0.2	<1	0.4	3.8	NA	<0.1	0.10	<0.1	0.00	<2	0.01
TP4	Transitional Pegmatite	N/A	<0.1	2.6	6	<0.2	0.002	0.1	4.2	0.90	7.9	<1	0.6	0.7	NA	<0.1	<0.1	<0.1	0.02	5.00	0.00
TPComp	Transitional Pegmatite	8.8	<0.1	1.700	8	<0.2	<0.001	<0.1	17	5.40	3	<1	<0.1	5.1	NA	<0.1	<0.1	<0.1	0.00	2.00	0.00
PETComp	Subgrade Pegmatite/Petalite	7.3	0.04	0.016	0.62	0.044	0.001	<0.5	5.0	0.70	2.93	<0.5	<0.1	2.65	0.017	0.008	0.04	4.481	<0.01	0.56	<0.01
PETG	Galaxy subgrade petalite	8.3	0.05	0.108	1.3	0.006	0.003	<0.5	27	17.9	10.27	0.8	<0.1	5.77	0.012	0.005	0.08	0.792	<0.01	1.16	<0.01
PET1	Subgrade Pegmatite/Petalite	8.8	0.04	0.002	0.13	0.234	0.001	<0.5	2.4	1.10	0.62	<0.5	<0.1	<0.02	0.094	0.057	0.01	2.995	<0.01	0.65	<0.01
PET2	Subgrade Pegmatite/Petalite	7.7	0.07	0.002	0.2	0.057	<0.001	<0.5	3.3	0.40	0.95	<0.5	<0.1	1.25	0.038	<0.005	0.07	12.877	<0.01	2.11	<0.01
PET3	Subgrade Pegmatite/Petalite	9.4	0.04	0.227	0.18	0.035	0.002	<0.5	48	0.50	46.09	<0.5	<0.1	2.09	0.014	<0.005	0.15	0.183	<0.01	0.26	<0.01
PET4	Subgrade Pegmatite/Petalite	N/A	0.05	0.001	2.57	0.13	<0.001	<0.5	5.4	0.80	1.22	<0.5	<0.1	3.57	0.040	0.011	0.02	8.725	<0.01	0.43	<0.01
KEGR22 3-11	Oxide	5.5	0.02	0.014	<0.05	<0.005	<0.01	0.80	N/A	28.9	<0.01	<0.5	<0.1	N/A	0.002	<0.005	N/A	0.069	<0.01	N/A	<0.01
KEGR22 55-60	Fresh Mafic	8.0	0.02	0.011	8.5	0.01	<0.01	<0.5	N/A	32.5	0.6	0.7	<0.1	N/A	0.002	0.040	N/A	0.020	<0.01	N/A	<0.01
KEGR22 90-99	Fresh Mafic	9.7	0.02	0.023	1.6	0.09	<0.01	<0.5	N/A	1.23	0.8	0.6	<0.1	N/A	0.063	0.030	N/A	0.036	<0.01	N/A	<0.01
KEGR25 15-18	Oxide	6.1	<0.01	0.010	0.3	<0.005	<0.01	<0.5	N/A	64.2	0.8	<0.5	<0.1	N/A	0.001	<0.005	N/A	<0.005	<0.01	N/A	0.05
KEGR25 195-200	Fresh Mafic	8.8	0.02	0.019	25.2	<0.005	0.010	0.70	N/A	70.8	3.9	<0.5	<0.1	N/A	0.002	<0.005	N/A	<0.005	<0.01	N/A	<0.01
KEGR26 50-52	Fresh Shear/Contact Zone	7.8	<0.01	0.112	1.8	0.13	0.160	0.60	N/A	5.97	0.7	<0.5	3.3	N/A	0.038	0.048	N/A	0.297	0.03	N/A	0.04
KEGR27 60-67	Transitional	9.3	0.44	0.034	6.2	0.12	0.020	1.00	N/A	1.83	0.4	<0.5	6.8	N/A	0.240	0.036	N/A	0.119	0.04	N/A	<0.01
KEGR32 34-36	Transitional Pegmatite	7.9	0.01	0.002	89.2	0.06	<0.01	<0.5	N/A	5.04	11.5	10.3	1.2	N/A	0.023	<0.005	N/A	0.195	0.04	N/A	<0.01
KEGR50 64-66	Pegmatite Ore	9.4	0.02	0.183	42.5	3.28	0.020	1.60	N/A	1.35	0.4	<0.5	4.6	N/A	3.122	0.103	N/A	1.164	0.01	N/A	0.20
KEGR50 70-75	Fresh Mafic	9.6	0.02	0.041	80.7	0.22	0.090	<0.5	N/A	4.53	7.1	6.7	0.7	N/A	0.114	0.024	N/A	0.217	0.08	N/A	0.02
KEGR77 110-115	Pegmatite Ore	9.2	<0.01	0.238	28.1	2.78	<0.01	0.90	N/A	1.11	1.7	<0.5	1.6	N/A	1.696	0.155	N/A	2.293	<0.01	N/A	0.01
KEGR96 44-50	Fresh Mafic	9.5	0.02	0.015	93.7	0.03	<0.01	<0.5	N/A	10.4	0.3	0.6	<0.1	N/A	0.038	<0.005	N/A	0.007	0.01	N/A	<0.01
KEGR96 60-65	Pegmatite Ore	9.8	<0.01	0.281	15.7	0.93	<0.01	<0.5	N/A	0.96	0.2	1.1	2.4	N/A	0.793	0.093	N/A	3.297	<0.01	N/A	<0.01
KEGM054 012-13	Oxide	6.8	0.02	0.002	1.0	<0.05	<0.01	<0.5	4.4	17.9	0.1	0.9	0.1	17.6	<0.001	<0.005	<0.01	0.005	0.01	2.08	<0.01
KEGM058 030-31	Transitional 0.45 micron	8.2	0.03	0.663	8.4	0.79	9.490	2.70	34	9.41	7.5	0.7	5.5	24.0	0.080	0.865	0.06	4.464	0.25	24.0	0.46
KEGM058 030-31	Transitional 0.2 micron	8.8	<0.1	0.001	4.0	<0.2	12.000	0.10	1.4	N/A	13.0	<1	0.2	0.6	<0.1	<0.1	<0.1	<0.1	0.02	2.00	0.01
KEGM059 37-38	Transitional 0.45 micron	7.3	0.05	0.333	6.1	0.44	10.960	5.90	36	7.42	7.3	<0.5	6	10.5	0.061	0.746	0.06	1.216	0.32	11.9	0.20
KEGM059 37-38	Transitional 0.2 micron	8.9	<0.1	0.003	3.0	<0.2	1.000	<0.1	1.7	N/A	0.9	<1	<0.1	3.00	<0.1	<0.1	<0.1	<0.1	0.00	<2	0.00
KEGM036 126-127	Fresh Mafic	9.2	0.09	<0.001	0	<0.05	<0.01	<0.5	2.8	25.2	1	1.7	0.3	0.1	<0.001	<0.005	<0.01	0.016	0.03	2.79	<0.01
KEGM036 167-168	Fresh Mafic	9.5	<0.01	<0.001	0.4	<0.05	<0.01	<0.5	293	1.12	2.9	<0.5	<0.1	5.2	<0.001	<0.005	0.50	<0.005	<0.01	91.8	<0.01
KEGM045 064-65	Fresh Mafic	4.5	0.02	2.7	<0.05	<0.05	0.240	<0.5	2.9	47.1	<0.01	<0.5	<0.1	8.09	<0.001	<0.005	0.02	0.388	<0.01	0.13	0.12
KEGM045 170-171	Fresh Mafic	9.6	<0.01	<0.001	0.2	<0.05	<0.01	<0.5	11.7	1.35	5.6	0.9	<0.1	7.8	<0.001	<0.005	0.05	<0.005	<0.01	3.55	<0.01
KEGM045 64-65	Fresh Mafic	4.3	0.02	2.7	<0.05	<0.05	0.240	<0.5	2.9	47.1	<0.01	<0.5	<0.1	8.09	<0.001	<0.005	0.02	0.388	<0.01	0.13	0.12
KEGM045 69-70	Fresh Shear/Contact Zone	5.5	0.03	3.9	<0.05	<0.05	0.280	<0.5	9.1	63.9	0.0	<0.5	<0.1	17.32	<0.001	<0.005	0.02	0.045	<0.01	0.47	0.06
KEGM049 153-154.34	Fresh Mafic	9.2	<0.01	<0.001	0.4	<0.05	<0.01	<0.5	29	8.24	18.4	0.5	<0.1	10.33	0.002	<0.005	0.08	<0.005	<0.01	1.96	<0.01
KEGM049 276-277	Fresh Mafic	9.6	<0.01	<0.001	0.2	<0.05	<0.01	0.50	9.8	1.05	4.3	<0.5	0.2	2.69	<0.001	<0.005	0.02	<0.005	0.02	2.85	<0.01
KEGM052 219-220	Fresh Mafic	9.7	<0.01	<0.001	<0.05	<0.05	<0.01	<0.5	<0.02	9.07	<0.01	0.8	<0.1	<0.02	<0.001	<0.005	<0.01	<0.005	0.03	0.04	<0.01
KEGM052 272-273	Fresh Mafic	9.5	<0.01	<0.001	0.3	<0.05	<0.01	<0.5	62	7.53	12.2	0.8	<0.1	4.79	<0.001	<0.005	0.13	<0.005	0.02	2.35	<0.01
KEGM054 270-271	Fresh Mafic	9.4	0.07	<0.001	0.5	<0.05	<0.01	<0.5	28	6.93	1.1	<0.5	<0.1	7.58	<0.001	<0.005	0.02	0.010	<0.01	8.33	<0.01
KEGM054 273-274	Fresh Mafic	8.9	0.06	0.001	0.3	<0.05	<0.01	<0.5	39	33.8	1.7	0.9	0.1	7.19	<0.001	<0.005	0.01	<0.005	<0.01	16.6	<0.01
KEGM054 306-307	Fresh Mafic	9.5	<0.01	<0.001	0.3	<0.05	<0.01	<0.5	59	5.02	7.6	0.6	<0.1	5.38	<0.001	<0.005	0.15	0.007	<0.01	1.78	<0.01
KEGM056 242-243	Fresh Mafic	7.5	<0.01	<0.001	0.1	<0.05	<0.01	<0.5	28	6.13	6.9	0.6	<0.1	5.27	<0.001	<0.005	0.06	<0.005	<0.01	2.32	<0.01
KEGM056 254-255	Fresh Mafic	9.6	0.02	<0.001	0.3	<0.05	<0.01	<0.5	19	3.79	1.3	0.6	<0.1	3.87	<0.001	<0.005	0.01	<0.005	0.02	3.65	<0.01
KEGM056 317-318	Fresh Mafic	7.2	0.03	0.003	0.5	<0.05	<0.01	<0.5	121	13.2	1.4	1.2	<0.1	4.01	<0.001	<0.005	0.20	<0.005	<0.01	0.86	<0.01
KEGM058 153-154	Fresh Mafic	9.4	<0.01	<0.001	14.6	<0.05	0.020	<0.5	19	3.25	35.3	<0.5	<0.1	23.55	<0.001	<0.005	0.02	<0.005	<0.01	7.96	<0.01
KEGM059 127-128	Fresh Mafic	9.5	0.02	<0.001	0.2	<0.05	<0.01	<0.5	28	1.86	0.5	<0.5	0.3	10.56	<0.001	<0.005	0.12	<0.005	<0.01	4.62	<0.01
KEGM065 167-168	Fresh Mafic	9.5	0.02	<0.001	0.1	<0.05	<0.01	<0.5	35	2.71	1.3	<0.5	<0.1	5.49	<0.001	<0.005	0.08	<0.005	<0.01	6.19	<0.01
KEGM065 171-172	Fresh Mafic	9.4	0.10	0.001	0.2	<0.05	<0.01	0.70	39	5.52	1.5	<0.5	<0.1	6.33	<0.001	<0.005	0.08	<0.005	<0.01	6.54	<0.01
KEGR152 078-79	Fresh Mafic	4.5	<0.01	119	<0.05	<0.05	5.410	<0.5	67	411	<0.01	2.8	<0.1	39.42	<0.001	<0.005	0.70	2.187	<0.01	0.20	0.30
KEGR152 90-91	Fresh Mafic	7.7	0.01	0.012	2.6	<0.05	0.020	<0.5	35	28.7	26.2	1.1	<0.1	23.45	<0.001	<0.005	0.21	<0.005	<0.01	6.04	<0.01
KEGR152 104-105	Fresh Mafic	7.4	0.07	0.530	3.9	<0.05	0.060	<0.5	9.9	505	0.4	4.0	0.2	524.68	<0.001	<0.005	<0.01	0.364	<0.01	1.18	<0.01
WC002	Fresh Mafic	9.8	0.02	<0.001	0.6	<0.05	<0.01	<0.5	48	0.60	2.2	<0.5	<0.1	5.00	<0.001	<0.005	0.15	0.018	<0.01	0.19	<0.01
WC003	Fresh Mafic	9.8	0.02	<0.001	0.1	<0.05	<0.01	<0.5	90	0.40	1.1	<0.5	<0.1	2.76	<0.001	<0.005	0.30	<0.005	<0.01	0.27	<0.01
WC004	Fresh Mafic	9.8	0.10	<0.001	0.1	<0.05	<0.01	<0.5	42	0.50	2.5	<0.5	<0.1	2.39	<0.001	<0.005	0.19	<0.005	<0.01	0.29	<0.01
WC005	Fresh Mafic	9.9	0.03	<0.001	0.3	<0.05	<0.01	<0.5	7.0	0.50	1.0	<0.5	0.1	4.84	<0.001	<0.005	0.07	<0.005	<0.01	0.10	<0.01
WC013	Fresh Mafic	9.9	0.01	0.001	1.1	<0.05	<0.01	<0.5	7.1	0.40	0.8	<0.5	<0.1	3.63	<0.001	<0.005	0.02	<0.005	<0.01	0.37	<0.01
WC015	Fresh Mafic	9.7	0.02	<0.001	0.7	<0.05	<0.01	<0.5	44	4.30	4.5	0.7	<0.1	7.87	<0.001	<0.005	0.07	0.050	<0.01	1.25	<0.01
WC018	Fresh Mafic	9.9	0.01	<0.001	1.0	<0.05	<0.01	<0.5	3.1	0.30	0.3	<0.5	<0.1	5.34	<0.001	<0.005	0.01	0.008	<0.01	0.18	<0.01
WC023	Fresh Mafic	9.4	0.02	0.002	1.0	<0.05	<0.01	<0.5	6.6	11.60	0.2	<0.5	<0.1	2.15	<0.001	<0.005	<0.01	0.013	<0.01	8.11	<0.01
WC024	Fresh Mafic	9.5	6.24	<0.001	0.3	<0.05	<0.01	<0.5	3.9	9.40	0.5	0.8	0.1	1.98	<0.001	<0.005	<0.01	0.007	<0.01	2.77	<0.01
WC026	Fresh Mafic	9.9	16.44	<0.001	0.8	<0.05	<0.01	<0.5	14	0.60	0.4	1.0	<0.1	6.82	<0.001	0.005	0.04	0.007	<0.01	0.60	<0.01
Livestock Drinking Water DGV (ANZECC 2000/ANZG 2018)		6.5-8.5	N/G	N/G	150	N/G	1	100	N/G	333	N/G	20	N/G	N/G	N/G	N/G	N/G	200	N/G	N/G	20
NPUG (DER 2014)		N/G	1000	5	500	N/G	0.20	100	N/G	333	30	100	N/G	N/G	N/G	N/G	N/G	170	N/G	N/G	3
Freshwater Protection 80% DGV (ANZECC 2000/ANZG 2018)		N/G	0.2	3.6	N/G	N/G	0.017	9.4	N/G	N/G	9	34	N/G	N/G	N/G	N/G	N/G	0.5	0.006	N/G	0.031
Freshwater Protection 95% DGV (ANZECC 2000/ANZG 2018)		6.5-8.5	0.05	1.9	N/G	N/G	0.011	3.4	N/G	N/G	9	11	N/G	N/G	N/G	N/G	0.03	0.5	0.006	N/G	0.008

Table A2-6: ASLP Water Metals

Sample ID	Lithology	pH	Ag	Mn	Mo	Nb	Ni	Pb	Rb	S	Sb	Se	Sn	Sr	Ta	Th	Tl	U	V	W	Zn
		SU	µg/L	mg/L	µg/L	µg/L	mg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	mg/L
WC027	Fresh Mafic	9.8	12.66	<0.001	2.1	<0.05	<0.01	<0.5	6.5	1.50	0.8	0.7	<0.1	5.58	<0.001	<0.005	<0.01	0.011	<0.01	0.32	<0.01
WC028	Fresh Mafic	9.8	23.82	<0.001	0.2	<0.05	<0.01	<0.5	7.5	0.30	2.5	<0.5	<0.1	5.88	<0.001	<0.005	0.02	<0.005	<0.01	0.32	<0.01
WC037	Fresh Mafic	9.8	16.98	<0.001	0.4	<0.05	<0.01	<0.5	99	1.10	1.1	0.7	<0.1	3.09	<0.001	<0.005	0.27	<0.005	<0.01	0.55	<0.01
WC038	Fresh Mafic	9.6	16.27	<0.001	0.3	<0.05	<0.01	<0.5	19	2.20	6.0	0.9	<0.1	11.16	<0.001	<0.005	0.03	<0.005	<0.01	1.35	<0.01
WC063	Fresh Mafic	9.8	15.87	<0.001	0.6	<0.05	<0.01	<0.5	4.6	0.40	5.3	0.6	<0.1	3.63	<0.001	<0.005	0.02	0.009	<0.01	0.44	<0.01
WC065	Fresh Mafic	9.9	5.65	<0.001	0.8	<0.05	<0.01	<0.5	5.3	0.80	0.5	<0.5	<0.1	4.02	<0.001	<0.005	<0.01	0.024	<0.01	0.11	<0.01
WC068	Fresh Mafic	9.8	2.69	<0.001	1.0	<0.05	<0.01	<0.5	12	1.80	0.5	<0.5	<0.1	5.29	<0.001	<0.005	<0.01	0.009	0.01	2.60	<0.01
WC076	Fresh Mafic	9.6	3.79	0.002	2.3	<0.05	<0.01	<0.5	0.5	3.00	0.1	<0.5	<0.1	1.92	<0.001	<0.005	<0.01	<0.005	<0.01	0.14	<0.01
WC078	Fresh Mafic	9.9	0.88	<0.001	0.6	<0.05	<0.01	<0.5	2.2	0.70	0.3	<0.5	<0.1	6.91	<0.001	<0.005	0.01	0.009	<0.01	0.17	<0.01
WC046	Fresh Ultramafic	9.9	0.84	<0.001	0.2	<0.05	<0.01	<0.5	8.3	0.70	3.8	<0.5	<0.1	5.74	<0.001	<0.005	0.05	<0.005	<0.01	0.38	<0.01
WC047	Fresh Ultramafic	9.7	1.77	<0.001	0.8	<0.05	<0.01	<0.5	58	1.80	1.1	1.1	0.5	4.13	<0.001	<0.005	0.09	0.061	<0.01	2.73	<0.01
WC049	Fresh Ultramafic	9.7	0.73	<0.001	0.3	<0.05	<0.01	<0.5	24	3.80	0.6	1.0	<0.1	4.02	<0.001	<0.005	0.02	<0.005	<0.01	39.8	<0.01
WC050	Fresh Ultramafic	9.8	0.68	<0.001	0.4	<0.05	<0.01	<0.5	22	0.60	3.0	<0.5	<0.1	2.91	0.002	<0.005	0.05	0.050	<0.01	1.23	<0.01
WC051	Pegmatite Ore	10.0	0.82	<0.001	0.4	<0.05	<0.01	<0.5	19	0.90	0.2	<0.5	<0.1	3.60	<0.001	<0.005	0.02	0.016	<0.01	1.44	<0.01
WC053	Pegmatite Ore	9.9	5.23	<0.001	0.1	<0.05	<0.01	<0.5	7.0	0.50	0.8	<0.5	<0.1	8.26	<0.001	0.006	0.02	<0.005	<0.01	1.24	<0.01
WC056	Pegmatite Ore	9.7	6.23	<0.001	1.3	<0.05	<0.01	<0.5	24	1.90	0.3	<0.5	0.2	6.06	<0.001	<0.005	0.03	0.009	<0.01	2.94	<0.01
WC058	Pegmatite Ore	9.9	3.15	<0.001	0.4	<0.05	<0.01	<0.5	2.9	0.30	0.7	<0.5	<0.1	6.64	<0.001	<0.005	<0.01	0.019	<0.01	0.49	<0.01
WC082	Fresh BIF	9.7	0.23	<0.001	0.3	<0.05	<0.01	<0.5	8.7	1.00	1.0	0.7	<0.1	7.59	<0.001	<0.005	<0.01	<0.005	<0.01	3.29	<0.01
WC083	Fresh BIF	9.6	7.39	<0.001	0.3	<0.05	<0.01	<0.5	11	1.60	2.8	<0.5	0.1	8.41	<0.001	<0.005	0.02	<0.005	<0.01	0.46	<0.01
WC084	Fresh BIF	9.6	1.66	<0.001	0.7	<0.05	<0.01	<0.5	17	3.10	1.4	<0.5	0.2	7.02	<0.001	<0.005	0.05	<0.005	0.01	0.51	<0.01
WC086	Fresh Dyke	10.0	0.73	<0.001	0.8	<0.05	<0.01	<0.5	4.1	0.80	0.1	<0.5	<0.1	1.81	<0.001	<0.005	<0.01	0.010	<0.01	0.27	<0.01
WC087	Fresh Dyke	10.0	0.39	<0.001	0.5	<0.05	<0.01	<0.5	2.8	0.50	0.1	<0.5	0.3	0.46	<0.001	<0.005	<0.01	0.054	<0.01	0.20	<0.01
WC009	Transitional Kom Basalt	9.9	0.25	0.003	0.6	<0.05	<0.01	<0.5	0.2	0.40	0.4	<0.5	0.2	0.17	<0.001	<0.005	<0.01	0.007	<0.01	0.59	<0.01
WC019	Transitional Pegmatite	5.7	0.12	0.180	<0.05	<0.05	0.030	<0.5	0.8	6.30	0.0	<0.5	<0.1	3.94	<0.001	<0.005	<0.01	0.016	<0.01	0.02	<0.01
WC020	Transitional Mafic	5.7	0.15	0.458	<0.05	<0.05	0.050	<0.5	38	10.4	<0.01	<0.5	<0.1	2.75	<0.001	<0.005	0.09	<0.005	<0.01	0.02	0.01
WC021	Transitional Mafic	5.9	0.12	0.237	<0.05	<0.05	<0.01	1.40	9.2	6.80	0.0	<0.5	<0.1	1.93	<0.001	<0.005	0.03	<0.005	<0.01	0.39	<0.01
WC034	Transitional Mafic	9.4	0.16	0.003	0.4	<0.05	<0.01	<0.5	0.3	1.00	0.3	<0.5	0.2	0.27	0.002	<0.005	<0.01	0.016	<0.01	0.71	<0.01
WC042	Transitional Ultramafic	9.6	0.10	0.005	0.6	<0.05	<0.01	<0.5	1.7	0.50	0.7	0.9	<0.1	0.16	<0.001	<0.005	<0.01	<0.005	<0.01	0.11	<0.01
Livestock Drinking Water DGV (ANZECC 2000/ANZG 2018)		6.5-8.5	N/G	N/G	150	N/G	1	100	N/G	333	N/G	20	N/G	N/G	N/G	N/G	N/G	200	N/G	N/G	20
NPUG (DER 2014)		N/G	1000	5	500	N/G	0.20	100	N/G	333	30	100	N/G	N/G	N/G	N/G	N/G	170	N/G	N/G	3
Freshwater Protection 80% DGV (ANZECC 2000/ANZG 2018)		N/G	0.2	3.6	N/G	N/G	0.017	9.4	N/G	N/G	9	34	N/G	N/G	N/G	N/G	N/G	0.5	0.006	N/G	0.031
Freshwater Protection 95% DGV (ANZECC 2000/ANZG 2018)		6.5-8.5	0.05	1.9	N/G	N/G	0.011	3.4	N/G	N/G	9	11	N/G	N/G	N/G	N/G	0.03	0.5	0.006	N/G	0.008
N/G : No applicable guideline value.																					

Table A2-7: ASLP Acid Leachate - Metals

Sample ID	Lithology	pH	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	K	La	Li	Mg	Mn	Mo	Na
		SU	µg/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	mg/L	µg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	mg/L	mg/L	µg/L	mg/L
SLPComp	Pegmatite Laterite Gravel-clay-colluvium	3.2	<0.01	1.84	1.9	0.34	206	3.2	0.255	5.50	0.06	8.751	14.8	0.016	0.200	0.015	2.56	N/A	N/A	0.016	<0.1	5.0	2.534	53	14.2	0.235	<0.05	55.6
SMLComp	Mafic Laterite-clay	3.2	<0.01	1.85	1.5	0.37	295	9.6	0.144	7.06	0.05	11.134	50.1	0.019	0.323	0.012	1.4	N/A	N/A	0.014	<0.1	3.2	3.352	51	15.4	0.433	<0.05	53.7
B1	Oxide Gravel	3.4	<0.01	0.98	0.3	0.66	64.6	14	0.083	0.94	0.02	11.93	59.3	0.02	0.046	<0.001	<0.01	N/A	N/A	0.019	<0.1	1.6	4.493	63	36.7	0.298	<0.05	75.5
B3	Oxide Gravelly Clay	3.3	<0.01	0.31	0.5	0.54	440	2.7	0.079	1.07	<0.02	8.073	22.5	<0.01	0.043	0.002	0.05	N/A	N/A	0.008	<0.1	<0.1	1.831	27	16.3	0.110	<0.05	100
B4	Oxide Silty Sand	3.3	<0.01	0.55	0.4	0.25	368	6.9	0.074	0.17	<0.02	7.08	11.3	<0.01	0.056	0.002	0.1	N/A	N/A	0.013	<0.1	<0.1	1.306	34	11.7	0.018	<0.05	70.6
B2	Oxide Silty Gravel	3	<0.01	13.3	0.6	0.05	43.3	3.2	0.062	0.53	<0.02	143.363	3.8	0.029	0.100	0.011	0.46	N/A	N/A	0.009	<0.1	<0.1	70.58	21	1.9	0.012	<0.05	1.5
B5	Oxide Clays	5.9	<0.01	0.10	18.9	3.11	271	0.1	0.309	1069	0.11	2.684	6.7	0.016	0.038	0.006	0.04	N/A	N/A	0.009	<0.1	8.6	2.301	134	563	1.368	0.36	242
MDTLSSComp	Transitional Mafic	3.3	<0.01	0.18	2.4	0.03	17.2	56	0.113	3.59	0.36	0.04	145	<0.01	36.9	0.018	0.03	N/A	N/A	<0.005	<0.1	3.5	0.050	93	11.3	1.397	<0.05	76.8
PDUSComp	Transitional Pegmatite-clay/mafic	3.3	<0.01	0.31	15.5	0.04	64.3	39	0.113	3.53	0.15	0.086	240	<0.01	5.11	0.049	0.02	N/A	N/A	0.007	<0.1	3.4	0.057	219	10.5	1.541	0.10	94.6
MDUSComp	Transitional Mafic	3.3	<0.01	0.16	3.7	0.03	19.6	22	0.117	1.00	0.03	0.066	164	<0.01	11.3	0.049	0.06	N/A	N/A	<0.005	<0.1	4.5	0.033	145	7.4	0.579	<0.05	114
TPComp	Transitional Pegmatite	3.2	<0.1	0.51	17.0	0.07	43.0	0.1	<0.1	6.60	0.4	0.8	49.0	0.002	5.00	0.029	0.23	N/A	N/A	0.300	<0.1	6.2	0.300	240	14.4	1.800	<1	85.4
PETComp	Subgrade Pegmatite/Petalite	3.1	<0.01	1.86	22.1	<0.01	2.9	5.4	0.218	30.0	0.35	1.269	13.9	<0.01	12.1	0.012	1.82	N/A	N/A	<0.005	<0.1	0.2	0.454	765	1.4	8.474	0.08	3.9
PETG	Galaxy subgrade petalite	3.2	<0.01	6.28	97.6	0.05	59.5	61	0.145	38.0	0.78	3.106	23.5	<0.01	17.6	0.019	3.09	N/A	N/A	0.007	<0.1	3.4	1.839	236	8.2	3.908	0.11	24.0
KEGR22 3-11	Oxide	3.2	0.03	0.56	23.2	0.27	162	0.9	N/A	0.72	<0.02	N/A	7.2	<0.01	N/A	<0.01	0.28	N/A	N/A	N/A	<0.1	6.9	N/A	18	11.5	0.065	<0.05	60.3
KEGR25 15-18	Oxide	3.1	0.02	0.69	1.2	0.16	2.8	4.5	N/A	1.08	0.03	N/A	1.7	<0.01	N/A	0.0	0.07	N/A	N/A	N/A	<0.1	9.1	N/A	26	21.9	0.016	<0.05	135
KEGR27 60-67	Transitional	3.4	0.12	2.53	52.2	<0.01	15.5	19	N/A	10.81	0.35	N/A	46.8	<0.01	N/A	0.0	0.15	N/A	N/A	N/A	<0.1	2.3	N/A	67	7.3	0.639	0.12	19.2
KEGR32 34-36	Transitional	3.4	<0.01	0.64	4.5	<0.01	0.3	4.9	N/A	0.13	<0.02	N/A	2.0	<0.01	N/A	<0.01	0.67	N/A	N/A	N/A	<0.1	3.8	N/A	158	1.7	0.045	<0.05	69.7
KEGM045 64-65	Fresh Mafic	3.2	0.07	1.23	2.7	0.15	6.7	1.9	N/A	8.37	0.43	N/A	7.1	0.17	1.34	<0.01	60.70	N/A	N/A	N/A	<0.1	0.3	N/A	24	4.3	1.316	0.33	1.3
KEGR22 55-60	Fresh Mafic	3.6	<0.01	10.6	99.8	0.05	137	1.7	N/A	37.4	0.44	N/A	126	0.09	N/A	0.100	20.42	N/A	N/A	N/A	<0.1	5.7	N/A	221	10.7	0.705	3.48	12.9
KEGR22 90-99	Fresh Mafic	3.7	<0.01	9.25	127	<0.01	382	5.0	N/A	61.1	0.04	N/A	79.1	0.19	N/A	0.020	25.65	N/A	N/A	N/A	<0.1	9.8	N/A	1007	15.1	1.957	2.90	4.9
KEGR25 195-200	Fresh Mafic	4.3	0.01	3.54	170	<0.01	13.5	0.7	N/A	486	0.28	N/A	44.9	0.05	N/A	0.050	7.04	N/A	N/A	N/A	<0.1	3.8	N/A	122	20.8	2.846	0.24	84.1
KEGR50 70-75	Fresh Mafic	3.7	<0.01	2.99	531.2	0.02	8.0	29	N/A	22.4	7.94	N/A	180	0.04	N/A	0.120	21.13	N/A	N/A	N/A	<0.1	5.4	N/A	216	28.2	1.149	5.89	36.9
KEGR96 44-50	Fresh Mafic	3.7	0.02	11.6	311	0.03	99.3	18	N/A	48.8	0.42	N/A	168	0.07	N/A	0.090	29.11	N/A	N/A	N/A	<0.1	8.5	N/A	526	16.6	2.146	6.81	15.1
KEGR26 50-52	Fresh Shear/Contact Zone	3.4	0.04	0.06	6.5	0.01	1.0	13	N/A	1.21	0.50	N/A	21.2	<0.01	N/A	<0.01	0.05	N/A	N/A	N/A	<0.1	5.6	N/A	42	6.0	0.260	<0.05	79.8
KEGR50 64-66	Pegmatite Ore	3.5	0.02	3.01	86.5	0.01	9.6	69	N/A	30.2	1.50	N/A	27.1	0.02	N/A	0.05	18.23	N/A	N/A	N/A	<0.1	4.9	N/A	286	13.7	2.014	15.08	25.0
KEGR77 110-115	Pegmatite Ore	3.3	<0.01	3.19	296	0.04	11.2	25	N/A	24.8	0.51	N/A	5.7	0.03	N/A	<0.01	11.18	N/A	N/A	N/A	<0.1	4.3	N/A	1447	5.1	14.93	7.20	12.8
KEGR96 60-65	Pegmatite Ore	3.7	<0.01	21.5	11.0	0.03	15.8	123	N/A	41.7	0.59	N/A	6.5	0.03	N/A	0.02	7.07	N/A	N/A	N/A	<0.1	5.6	N/A	5597	2.9	19.43	3.90	11.7
KEGM152 104-105	Fresh Mafic	4.7	0.01	1.43	24.4	0.16	20.5	0.3	<0.005	1309	5.64	N/A	69.4	0.02	18.1	0.05	9.55	N/A	N/A	N/A	<0.1	0.9	N/A	115	3.1	5.712	<0.05	2.6
KEGM036 126-127	Fresh Mafic	3.4	<0.01	6.41	8.6	0.15	69.7	18	<0.005	18.1	0.35	N/A	66.3	<0.01	130	0.24	9.67	N/A	N/A	N/A	<0.1	10.4	N/A	412	15.9	0.339	0.07	18.3
KEGM045 064-65	Fresh Mafic	3.2	0.07	1.23	2.7	0.15	6.7	1.9	0.039	8.37	0.43	N/A	7.1	0.17	1.34	<0.01	60.70	N/A	N/A	N/A	<0.1	0.3	N/A	24	4.3	1.316	0.33	1.3
KEGM045 59-60	Fresh Mafic	3.4	<0.01	11.4	16.5	0.16	29.7	0.5	0.006	12.23	0.37	N/A	69.6	0.06	5.77	0.030	15.68	N/A	N/A	N/A	<0.1	4.5	N/A	110	9.5	0.516	0.32	6.8
KEGM054 273-274	Fresh Mafic	3.7	<0.01	13.1	1.3	0.15	11.2	0.8	0.034	103	0.31	N/A	13.2	0.07	154	<0.01	44.75	N/A	N/A	N/A	<0.1	2.9	N/A	413	8.6	0.742	<0.05	8.1
KEGM056 254-255	Fresh Mafic	4.2	0.03	6.14	415	0.18	16.6	0.7	0.028	406	0.22	N/A	71.0	0.12	63.2	0.020	10.30	N/A	N/A	N/A	<0.1	1.6	N/A	230	8.6	1.420	0.08	3.3
KEGM059 127-128	Fresh Ultramafic	3.8	0.01	7.31	4.9	0.18	5.4	0.6	0.027	81.3	0.11	N/A	28.8	0.55	142	0.090	27.17	N/A	N/A	N/A	<0.1	0.6	N/A	38	56.4	6.116	<0.05	2.4
KEGM065 167-168	Fresh Ultramafic	4.1	<0.01	5.44	42.9	0.17	6.8	4.5	0.212	153	0.11	N/A	20.0	0.7	118	0.130	54.16	N/A	N/A	N/A	<0.1	0.4	N/A	42	105	7.418	<0.05	3.1
KEGM056 317-318	Fresh Mafic	3.5	1.15	6.86	148	0.22	56.0	1.0	0.025	6.90	0.53	N/A	118.7	0.10	709	0.260	29.80	N/A	N/A	N/A	<0.1	1.7	N/A	178	13.9	1.543	0.11	6.6
WC002	KOM BASALT	N/A	0.01	2.19	615	<0.01	18.5	3.2	<0.005	10.2	0.05	0.86	29.5	0.06	0.232	<0.01	4.17	0.0	<0.1	<0.005	<0.1	1.0	0.497	84	5.2	0.206	0.21	3.1
WC004	KOM BASALT	N/A	<0.01	2.58	901	<0.01	11.7	0.2	<0.005	10.9	0.05	1.94	49.0	0.06	0.347	<0.01	3.79	0.0	<0.1	<0.005	<0.1	0.7	1.130	157	5.3	0.398	0.05	3.8
WC005	KOM BASALT	N/A	0.02	2.60	24.6	<0.01	20.3	<0.1	<0.005	44.2	0.03	1.14	12.5	0.07	0.035	0.020	4.78	0.0	<0.1	<0.005	<0.1	0.5	0.589	55	5.5	0.241	0.43	3.6
WC013	KOM BASALT	N/A	<0.01	3.77	39.3	0.01	70.5	<0.1	<0.005	14.9	0.06	4.36	14.5	0.18	0.087	0.020	24.22	0.1	<0.1	<0.005	<0.1	1.0	2.413	82	5.1	2.676	6.18	4.4
WC015	KOM BASALT	N/A	<0.01	2.79	4994	0.01	15.4	10.8	0.297	163	0.04	5.40	49.4	0.20	0.090	0.020	6.81	0.0	<0.1	<0.005	<0.1	1.1	3.966	30	11.5	2.031	0.25	5.6
WC023	CAL-ALK BASALT	N/A	<0.01	9.67	9.1	0.02	79.3	0.3	<0.005	30.9	0.06	28.92	11.6	0.030	0.039	<0.01	29.91	0.1	<0.1	<0.005	<0.1	12.0	12.30	117	5.4	0.644	0.76	1.5
WC026	CAL-ALK BASALT	N/A	<0.01	5.18	32.6	0.03	94.3	1.1	0.015	135	0.10	4.29	31.4	0.090	0.157	0.02	11.77	0.1	<0.1	<0.005	<0.1	0.7	2.637	447	6.5	0.654	2.56	5.7
WC027	CAL-ALK BASALT	N/A	<0.01	2.65	4.3	0.01	11.3	0.3	<0.005	80.4	0.04	58.26	8.7	0.010	0.047	<0.01	4.51	0.1	<0.1	<0.005	<0.1	0.4	25.15	100	2.4	0.251	0.59	2.8
WC037	CAL-ALK BASALT	N/A	<0.01	3.21	2596	0.04	44.4	12.7	0.038	14.8	0.12	2.26	77.5	0.040	0.664	0.020	6.45	0.0	<0.1	<0.005	<0.1	2.5	0.901	245	7.3	0.206	0.32	7.2
WC063	CAL-ALK BASALT	N/A	<0.01	2.40	99.1	<0.01	28.8	0.2	<0.005	7.77	0.05	65.48	25.7	0.050	0.027	0.020	5.87	0.1	<0.1	<0.005	<0.1	0.4	28.17	79	3.1	0.134	2.75	2.2
WC068	CAL-ALK BASALT	N/A	<0.01	6.96	3.7	0.12	27.8	0.3	<0.005	70.0	0.18	29.63	10.6	0.030	0.054	<0.01	6.41	0.1	<0.1	<0.005	<0.1	2.1	16.34	203	2.4	0.519	1.76	2.9
WC076	CAL-ALK BASALT	N/A	<0.01	3.10	5.6	<0.01	12.1	0.2	<0.005	9.72	0.25	15.19	10.2	<0.01	0.022	0.030	4.28	0.2	<0.1	<0.005	<0.1	0.4	6.829	22	1.6	0.180	0.27	3.7
WC078	CAL-ALK BASALT	N/A	<0.01	1.80	2.8	<0.01	19.3	0.3	<0.005	90.2	0.20	122.44	9.2	<0.01	0.010	0.090	3.52	0.2	<0.1	<0.005	<0.1	0.4	55.04	12	2.1	0.412	0.25	1.3
WC046	HIGH MG BASALT	N/A	<0.01	3.78	605	<0.01	30.7	0.4	0.011	193	0.07	4.66	36.5	0.1	0.048	0.010	4.13	0.0	<0.1	<0.005	<0.1	0.9	2.749	137	6.0	0.924	0.26	4.6
WC047	HIGH MG BASALT	N/A	0.43	1.34	1180	0.02	17.7	0.9	0.019	1483	3.01	154.86	79.3	<0.01	0.256	<0.01	11.31	0.1	<0.1	<0.005	<0.1	5.5	89.94	136	22.5	7.370	1.16	4.4
WC049	HIGH MG BASALT	N/A	0.30	2.79	121	0.04	11.9	1.5	0.076	874	0.34	88.56	32.2	<0.01	0.234	0.030	10.20	0.1	<0.1	<0.005	<0.1	2.0	47.37	134	44.5	5.375	0.25	6.9
WC050	HIGH MG BASALT	N/A	<0.01	14.3	6.7	<0.01	200	3.6	<0.005	34.4	0.06	19.08	8.2	0.0	0.028	<0.01	7.21	0.2	<0.1	0.005	<0.1	7.2	7.910	294	4.1	0.503	1.67	1.6
WC051	MW Petalite Peg	N/A	<0.01	2.67	5.8	<0.01	60.0	0.4	<0.005	48.5	0.03	19.12	13.1	<0.01	0.081	<0.01	8.13	0.0	<0.1	<0.005	<0.1	6.3	8.176	463	4.3	0.229	0.36	6.8
WC053	MW Petalite Peg	N/A	<0.01	2.71	1126	<0.01	5.7	0.1	0.037	19.9	0.03	5.32	31.2	0.2	0.051	0.020	14.36	<0.02	<0.1	<0.005	<0.1	0.2	3.371	11	22.3	0.575	<0.05	1.0
WC056	MW Petalite Peg	N/A	<0.01	3.67	65.2	<0.01	151	0.6	<0.005	33.57	0.21	76.26	23.1	0.1	0.108	<0.01	18.90	0.1	<0.1	0.006	<0.1	4.7	34.73	386	5.2	1.652	2.42	1.8
WC082	BIF	N/A	0.35	0.95	31.5	<0.01	24.9	5.5	0.009	1776	0.10	12.76	18.6	0.0	0.038	<0.01	5.61	0.0	<0.1	0.013	<0.1	0.8	5.411	33	5.8	9.612	0.27	2.2
WC083	BIF	N/A	0.30	3.25	4.5	<0.01	29.9	7.4	0.095	791	0.14	42.34	8.4	0.0	0.124	0.010	11.78	0.1	<0.1	0.006	<0.1	1.2	17.32	74	6.2	8.911	0.33	3.4
WC084	BIF	N/A	0.30	2.94	20.9	<0.01	22.4	52.8	0.012	643	0.26	29.62	52.4	0.0	0.093	0.020	5.65	0.0	<0.1	0.012	<0.1	2.1	15.06	129	4.4	2.231	0.18	7.2
WC086	DYKE	N/A	0.01	6.46	2.0	<0.01	16.0	0.2	<0.005	14.4	0.03	19.05	6.1	<0.01	0.033	0.010	12.49	0.1	<0.1	<0.005	<0.1	1.3	7.632	99	5.6	0.338	0.14	12.1
WC087	DYKE	N/A	0.02	5.09	1.6	<0.01	9.4	2.2	<0.005	16.4	0.03	15.21	6.8	<0.01	0.034	<0.01	11.87	0.1	<0.1	<0.005	<0.1	1.1	6.024	107	5.1	0.335	0.14	14.9
WC010	KOM BASALT	N/A	0.02	1.55	2.4	<0.01	38.2	0.6	<0.005	5.2	0.03	0.12	20.2	0.0	<0.001	0.010	3.65	<0.02	<0.1	<0.005	<0.1	1.2	0.132	4.2	4.2	0.376	0.35	15.2
WC035	CAL-ALK BASALT	N/A	<0.01	0.07	4.3	<0.01	4.5	1.4	<0.005	1.69	0.04	0.01	5.0	<0.01	<0.001	<0.01	0.48	<0.02	<0.1	<0.005	<0.1	1.8	0.006	15	3.5	0.067	<0.05	30.9
WC040	HIGH MG BASALT	N/A	0.01	0.31	7.1	<0.01	27.8	1.2	<0.005	2.73	0.04	0.07	35.0	<0.01	<0.001	0.040	1.78	<0.02	<0.1	<0.005	<0.1	1.1	0.027	5.4	4.0	0.177	0.20	12.1
WC041	HIGH MG BASALT	N/A	0.03	0.34	5.3	<0.01	21.1	1.3	<0.005	3.21	0.10	0.12	62.3	0.04	<0.001	0.040	8.60	<0.02	<0.1	<0.005	<0.1	1.8	0.025	6.7	5.5	1.566	0.92	16.3
WC061	CAL-ALK BASALT	N/A	0.03	0.26	4.8	<0.01	35.0	5.3	<0.005	2.87	0.38	0.33	427	0.03	<0.001	0.090	4.48	<0.02	<0.1	<0.005	<0.1	1.6	0.045	16	6.5	3.479	0.24	15.4
WC062	CAL-ALK BASALT	N/A	0.03	1.51	967	0.05	0.1	1.0	<0.005	3.11	0.77	1.04	523	<0.01	<0.001	1.1	8.78	0.1	<0.1	<0.005	<0.1	0.7	0.360	16	2.1	0.273	0.08	5.7
WC073	CAL-ALK BASALT	N/A	<0.01	6.25	20.3	<0.01	419	1.4	<0.005	8.39	0.03	3.02	12.5	0.06	<0.001	0.060	10.51	0.1	<0.1	0.005	<0.1	1.5	1.114	6.1	3.8	1.044	0.77	15.6
WC074	CAL-ALK BASALT	N/A	0.03	0.08	10.7	0.01	45.2	1.5	<0.005	2.25	0.11	0.03	164	<0.01	<0.001	0.050	0.06	<0.02	<0.1	<0.005	<0.1	2.9	0.008	21	7.9	1.043	0.08	72.1
WC033	CAL-ALK BASALT	N/A	0.02	0.02	5.8	<0.01	9.0	4.2	<0.005	1.38	0.03	0.01	44.2	<0.01	<0.001	<0.01	0.08	<0.02	<0.1	<0.005	<0.1	2.9	0.006	14	4.6	0.173	<0.05	31.7
WC059	CAL-ALK BASALT	N/A	<0.01	0.13	9.9	0.02	154	1.7	<0.005	0.95	<0.02	0.12	1.6	<0.01	<0.001	<0.01	0.38	<0.02	<0.1	<0.005	<0.1	2.6	0.060	1.6	3.8	0.015	<0.05	19.8
WC060	CAL-ALK BASALT	N/A	<0.01	0.08	3.7	0.14	12.1	0.7	<0.005	0.33	<0.02	0.02	1.0	<0.01	<0.001	<0.01	0.02	<0.02	<0.1	<0.005	<0.1	6.9	0.011	3.5	6.4	0.003	<0.05	73.8
WC071	CAL-ALK BASALT	N/A	0.04	0.51	1.1	0.14	17.4	0.2	<0.005	2.25	<0.02	0.07	2.0	<0.01	<0.001	<0.01	0.04	<0.02	<0.1	0.009	<0.1	4.3	0.043	7.4	9.8	0.023	<0.05	55.3
WC072	CAL-ALK BASALT	N/A	<0.01	0.71	0.5	0.39	17.0	0.7	<0.005	0.89	0.03	0.08	2.1	<0.01	<0.001	<0.01	0.03	<0.02	<0.1	<0.005	<0.1	7.8	0.048	17	11.2	0.010	<0.05	118
WC088	SAPROLITE	N/A	<0.01	0.22	3.7	0.08	97.0	1.1	<0.005	0.39	<0.02	0.20	1.3	<0.01	<0.001	0.010	0.01	<0.02	<0.1	<0.005	<0.1	5.3	0.044	12	7.4	0.005	<0.05	67.3
WC089	SAPROLITE	N/A	<0.01	<0.01	1.3	0.09	2.2	<0.1	<0.005	0.03	<0.02	<0.002	0.4	<0.01	<0.001	<0.01	<0.01	<0.02	<0.1	<0.005	<0.1	5.2	<0.002	13	1.2	<0.001	<0.05	131
WC090	SAPROLITE	N/A	<0.01	<0.01	2.1	0.07	3.4	0.9	<0.005	0.03	<0.02	<0.002	1.9	<0.01	<0.001	<0.01	0.03	<0.02	<0.1	<0.005	<0.1	4.8	<0.002	24	1.4	0.006	<0.05	138
WC091	SAPROLITE	N/A	<0.01	0.28	0.4	0.36	124	1.6	<0.005	7.09	<0.02	1.19	10.6	<0.01	<0.001	<0.01	0.01	<0.02	<0.1	0.013	<0.1	6.5	1.647	6.3	17.4	0.146	<0.05	78.2
WC092	SAPROLITE	N/A	<0.01	0.07	0.8	0.19	50.8	0.7	<0.005	0.21	<0.02	0.04	1.2	<0.01	<0.001	<0.01	0.05	<0.02	<0.1	0.006	<0.1	5.5	0.015	3.6	5.7	0.005	<0.05	58.6
WC093	SAPROLITE	N/A	<0.01	0.20	9.6	0.17	46.1	0.6	<0.005	0.34	<0.02	0.08	1.6	<0.01	<0.001	<0.01	0.01	<0.02	<0.1	0.006	<0.1	7.2	0.107	5.6	9.4	0.008	<0.05	113
WC094	SAPROLITE	N/A	<0.01	0.15	0.6	0.11	97.6	0.6	<0.005	0.31	<0.02	0.05	2.7	<0.01	<0.001	<0.01	0.12	<0.02	<0.1	<0.005	<0.1	3.1	0.020	5.7	7.1	0.011	<0.05	41.2
WC095	SAPROLITE	N/A	<0.01	0.19	0.4	0.15	182	0.4	<0.005	0.20	<0.02	0.20	1.4	<0.01	<0.001	<0.01	0.10	<0.02	<0.1	0.009	<0.1	3.9	0.079	6.0	7.9	0.006	<0.05	45.7
WC096	SAPROLITE	N/A	<0.01	0.30	1.1	0.22	69.8	0.3	<0.005	0.12	<0.02	0.05	1.2	<0.01	<0.001	<0.01	0.01	<0.02	<0.1	<0.005	<0.1	6.0	0.036	5.8	7.6	0.007	<0.05	65.3
Livestock Drinking Water DGV (ANZECC 2000/ANZG 2018)		6.5-8.5	N/G	5	500	5	N/G	N/G	N/G	1000	10	N/G	1000	1	N/G	1	No limit	N/G	N/G	N/G	2	N/G	N/G	N/G	No limit	N/G	150	N/G
NPUG (DER 2014)		N/G	1000	0.2	100	40	20000	600	N/G	N/G	20	N/G	N/G	0.5	N/G	20	0.3	N/G	N/G	N/G	10	N/G	N/G	N/G	N/G	5	500	N/G
Freshwater Protection 80% DGV (ANZECC 2000/ANZG 2018)		N/G	0.2	0.15	140	2.5	N/G	N/G	N/G	N/G	0.8	N/G	N/G	0.04	N/G	0.0025	N/G	N/G	N/G	N/G	5.4	N/G	N/G	N/G	N/G	3.6	N/G	N/G
Freshwater Protection 95% DGV (ANZECC 2000/ANZG 2018)		6.5-8.5	0.05	0.055	13	0.94	N/G	N/G	N/G	N/G	0.2	N/G	1.4	0.0033	N/G	0.0014	0.3	N/G	N/G	N/G	0.6	N/G	N/G	N/G	N/G	1.9	N/G	N/G

N/G : No applicable guideline value.

Table A2-7: ASLP Acid Leachate - Metals

Sample ID	Lithology	Nb	Ni	P	Pb	Rb	S	Sulfate	Sb	Sc	Se	Si	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn
		µg/L	mg/L	mg/L	µg/L	µg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	mg/L	µg/L	µg/L	mg/L
SLPComp	Pegmatite Laterite Gravel-clay-colluvium	<0.005	0.05	<0.05	3.6	11	5.5	N/A	0.03	N/A	<0.5	N/A	<0.1	57	0.005	<0.1	0.198	<0.01	0.06	9.2	<0.01	<0.02	2.08	0.02
SMLComp	Mafic Laterite-clay	<0.005	0.04	<0.05	2.5	9.7	3.1	N/A	0.02	N/A	<0.5	N/A	<0.1	77	0.001	<0.1	0.136	<0.01	0.17	15	<0.01	<0.02	2.86	0.01
B1	Oxide Gravel	<0.005	0.07	<0.05	1.2	5.8	1.5	N/A	0.03	N/A	0.6	N/A	<0.1	47	0.001	<0.1	0.561	<0.01	0.08	11	<0.01	<0.02	5.57	<0.01
B3	Oxide Gravelly Clay	<0.005	0.02	<0.05	4.8	2.8	4.6	N/A	0.02	N/A	<0.5	N/A	<0.1	132	<0.001	<0.1	0.616	<0.01	0.05	3.3	<0.01	<0.02	1.89	<0.01
B4	Oxide Silty Sand	<0.005	0.02	0.05	2.9	3.5	2.8	N/A	<0.01	N/A	0.6	N/A	<0.1	58	<0.001	<0.1	0.448	<0.01	0.04	9.8	<0.01	<0.02	1.39	<0.01
B2	Oxide Silty Gravel	0.005	0.01	<0.05	36	4.6	0.7	N/A	<0.01	N/A	2.1	N/A	<0.1	43	<0.001	<0.1	0.977	<0.01	0.11	26	<0.01	<0.02	54.3	<0.01
B5	Oxide Clays	0.062	0.04	0.28	<0.5	5.6	29	N/A	0.12	N/A	1.9	N/A	<0.1	4822	0.002	<0.1	0.030	<0.01	0.09	23	<0.01	0.37	3.88	<0.01
MDTLSSComp	Transitional Mafic	<0.005	0.21	0.05	<0.5	15	1.1	N/A	0.05	N/A	<0.5	N/A	0.3	14	0.006	<0.1	<0.005	<0.01	0.08	2.4	<0.01	<0.02	0.238	0.04
PDUSComp	Transitional Pegmatite-clay/mafic	0.008	0.12	1.2	<0.5	80	3.7	N/A	0.07	N/A	<0.5	N/A	0.4	19	0.173	<0.1	<0.005	<0.01	0.41	8.7	<0.01	<0.02	0.249	0.04
MDUSComp	Transitional Mafic	<0.005	0.08	0.06	<0.5	30	2.7	N/A	0.05	N/A	<0.5	N/A	0.2	4.9	0.017	<0.1	<0.005	<0.01	0.40	9.6	<0.01	<0.02	0.089	0.02
TPComp	Transitional Pegmatite	<0.2	0.06	NA	6.9	110	4.4	N/A	0.40	N/A	<1	N/A	0.1	68	0.300	<0.1	<0.1	<0.5	0.50	5.0	<0.01	<2	NA	0.12
PETComp	Subgrade Pegmatite/Petalite	0.052	0.03	14.6	4.6	114	0.3	N/A	0.80	N/A	<0.5	N/A	<0.1	138	0.084	<0.1	<0.005	<0.01	0.46	21	<0.01	<0.02	2.92	0.05
PETG	Galaxy subgrade petalite	0.039	0.11	12.5	1.6	241	5.6	N/A	1.40	N/A	1.0	N/A	<0.1	73	0.303	<0.1	<0.005	<0.01	0.92	35	<0.01	0.11	6.64	0.16
KEGR22 3-11	Oxide	<0.005	0.03	N/A	4.5	N/A	N/A	N/A	<0.01	N/A	<0.5	8.3	<0.1	N/A	0.003	N/A	0.468	N/A	N/A	30	<0.01	N/A	N/A	0.02
KEGR25 15-18	Oxide	<0.005	<0.01	N/A	11	N/A	N/A	N/A	0.20	N/A	<0.5	6.3	<0.1	N/A	0.001	N/A	0.006	N/A	N/A	8.6	<0.01	N/A	N/A	0.23
KEGR27 60-67	Transitional	<0.005	0.03	N/A	1.2	N/A	N/A	N/A	0.04	N/A	<0.5	13	<0.1	N/A	0.014	N/A	<0.005	N/A	N/A	1.1	<0.01	N/A	N/A	<0.01
KEGR32 34-36	Transitional	0.047	<0.01	N/A	<0.5	N/A	N/A	N/A	0.02	N/A	<0.5	13	<0.1	N/A	0.201	N/A	<0.005	N/A	N/A	1.0	<0.01	N/A	N/A	<0.01
KEGM045 64-65	Fresh Mafic	<0.005	0.09	N/A	3.4	1.5	N/A	N/A	0.20	N/A	<0.5	N/A	<0.1	3.0	<0.001	N/A	0.112	N/A	0.02	0.44	<0.01	0.19	N/A	0.09
KEGR22 55-60	Fresh Mafic	<0.005	0.20	N/A	1.7	N/A	N/A	N/A	0.25	N/A	0.9	19	<0.1	N/A	0.002	N/A	0.017	N/A	N/A	3.0	0.02	N/A	N/A	0.45
KEGR22 90-99	Fresh Mafic	<0.005	0.23	N/A	2.6	N/A	N/A	N/A	0.54	N/A	<0.5	12	<0.1	N/A	0.020	N/A	0.025	N/A	N/A	2.6	<0.01	N/A	N/A	0.46
KEGR25 195-200	Fresh Mafic	<0.005	0.19	N/A	1.8	N/A	N/A	N/A	2.08	N/A	<0.5	4.9	<0.1	N/A	0.001	N/A	0.023	N/A	N/A	1.3	<0.01	N/A	N/A	0.74
KEGR50 70-75	Fresh Mafic	<0.005	0.56	N/A	0.7	N/A	N/A	N/A	1.46	N/A	2.1	17	<0.1	N/A	0.008	N/A	<0.005	N/A	N/A	5.3	0.02	N/A	N/A	0.17
KEGR96 44-50	Fresh Mafic	<0.005	0.37	N/A	1.3	N/A	N/A	N/A	0.26	N/A	0.7	21	<0.1	N/A	0.032	N/A	0.030	N/A	N/A	1.2	0.02	N/A	N/A	0.18
KEGR26 50-52	Fresh Shear/Contact Zone	<0.005	0.06	N/A	<0.5	N/A	N/A	N/A	0.03	N/A	<0.5	15	<0.1	N/A	0.002	N/A	<0.005	N/A	N/A	7.1	<0.01	N/A	N/A	<0.01
KEGR50 64-66	Pegmatite Ore	0.041	0.07	N/A	<0.5	N/A	N/A	N/A	0.21	N/A	<0.5	9.4	0.2	N/A	0.085	N/A	<0.005	N/A	N/A	32	0.02	N/A	N/A	0.26
KEGR77 110-115	Pegmatite Ore	0.031	0.01	N/A	4.0	N/A	N/A	N/A	0.82	N/A	<0.5	5.0	<0.1	N/A	0.207	N/A	<0.005	N/A	N/A	52	<0.01	N/A	N/A	0.27
KEGR96 60-65	Pegmatite Ore	0.009	0.03	N/A	7.0	N/A	N/A	N/A	0.19	N/A	0.6	29	<0.1	N/A	0.271	N/A	<0.005	N/A	N/A	47	<0.01	N/A	N/A	0.21
KEGM152 104-105	Fresh Mafic	<0.005	0.40	N/A	<0.5	12	N/A	N/A	0.21	N/A	1.7	N/A	<0.1	1438	<0.001	N/A	0.014	N/A	0.03	0.90	<0.01	0.28	N/A	0.16
KEGM036 126-127	Fresh Mafic	<0.005	0.15	N/A	<0.5	57	N/A	N/A	0.15	N/A	<0.5	N/A	0.1	23	<0.001	N/A	0.005	N/A	0.83	0.97	0.02	0.21	N/A	0.06
KEGM045 064-65	Fresh Mafic	<0.005	0.09	N/A	3.4	1.5	N/A	N/A	0.20	N/A	<0.5	N/A	<0.1	3.0	<0.001	N/A	0.112	N/A	0.02	0.44	<0.01	0.19	N/A	0.09
KEGM045 59-60	Fresh Mafic	<0.005	0.39	N/A	1.7	15	N/A	N/A	0.27	N/A	<0.5	N/A	0.4	22	<0.001	N/A	0.021	N/A	0.13	0.22	0.02	0.11	N/A	0.15
KEGM054 273-274	Fresh Mafic	<0.005	0.11	N/A	1.2	63	N/A	N/A	0.78	N/A	<0.5	N/A	<0.1	30	<0.001	N/A	0.152	N/A	0.52	0.34	<0.01	0.10	N/A	0.04
KEGM056 254-255	Fresh Mafic	<0.005	0.42	N/A	<0.5	30	N/A	N/A	0.37	N/A	<0.5	N/A	<0.1	105	<0.001	N/A	0.021	N/A	0.51	0.02	<0.01	0.24	N/A	0.02
KEGM059 127-128	Fresh Ultramafic	<0.005	0.58	N/A	2.3	40	N/A	N/A	0.09	N/A	<0.5	N/A	0.3	73	<0.001	N/A	0.120	N/A	2.36	0.22	<0.01	0.27	N/A	0.07
KEGM065 167-168	Fresh Ultramafic	<0.005	0.46	N/A	<0.5	46	N/A	N/A	0.34	N/A	<0.5	N/A	<0.1	81	<0.001	N/A	0.149	N/A	1.49	0.14	<0.01	0.07	N/A	0.03
KEGM056 317-318	Fresh Mafic	<0.005	0.55	N/A	0.7	227	N/A	N/A	0.22	N/A	<0.5	N/A	0.4	9.9	<0.001	N/A	0.048	N/A	2.65	0.41	<0.01	0.09	N/A	0.16
WC002	KOM BASALT	<0.05	0.51	1.26	0.7	78	0.5	1.6	1.43	<0.01	<0.5	N/A	<0.1	10	0.001	<0.1	0.007	<0.01	0.82	4.4	<0.01	0.05	0.966	0.07
WC004	KOM BASALT	<0.05	0.63	1.42	0.5	97	0.4	1.2	1.36	<0.01	<0.5	N/A	<0.1	9.8	<0.001	0.1	0.010	<0.01	0.98	0.32	<0.01	0.05	1.62	0.02
WC005	KOM BASALT	<0.05	0.07	1.03	0.6	14	0.2	0.7	0.45	<0.01	<0.5	N/A	<0.1	28	<0.001	<0.1	0.008	<0.01	0.31	0.23	<0.01	0.07	1.94	<0.01
WC013	KOM BASALT	<0.05	0.09	1.80	1.7	48	0.5	1.4	0.86	<0.01	<0.5	N/A	<0.1	16	<0.001	<0.1	0.010	<0.01	0.45	0.44	0.02	0.08	3.36	0.04
WC015	KOM BASALT	<0.05	4.14	0.24	1.8	154	2.3	7.0	5.72	<0.01	<0.5	N/A	<0.1	40	0.026	<0.1	0.024	<0.01	1.73	25	<0.01	0.05	5.78	0.02
WC023	CAL-ALK BASALT	<0.05	0.06	2.02	2.4	34	0.9	2.6	0.10	<0.01	<0.5	N/A	<0.1	12	0.003	<0.1	<0.005	<0.01	0.24	0.37	0.05	0.14	10.1	0.04
WC026	CAL-ALK BASALT	<0.05	0.05	0.11	6.9	40	0.6	1.9	0.46	<0.01	<0.5	N/A	<0.1	67	<0.001	<0.1	0.032	<0.01	0.50	0.28	<0.01	0.15	4.64	0.05
WC027	CAL-ALK BASALT	<0.05	0.03	1.52	0.8	11	0.5	1.5	0.43	<0.01	<0.5	N/A	<0.1	26	0.001	<0.1	0.022	<0.01	0.23	0.29	0.01	0.10	7.64	0.03
WC037	CAL-ALK BASALT	<0.05	1.40	1.94	15	260	0.9	2.6	1.02	<0.01	<0.5	N/A	<0.1	14	0.002	<0.1	0.006	<0.01	2.46	0.29	<0.01	0.05	1.39	0.04
WC063	CAL-ALK BASALT	<0.05	0.06	1.54	2.0	9.8	0.2	0.6	1.14	<0.01	<0.5	N/A	<0.1	8.6	0.002	<0.1	0.023	<0.01	0.18	0.36	<0.01	0.09	2.76	0.02
WC068	CAL-ALK BASALT	<0.05	0.03	2.12	1.8	27	0.6	1.8	0.37	<0.01	<0.5	N/A	<0.1	23.8	<0.001	<0.1	0.017	<0.01	0.41	0.43	0.02	0.16	3.79	0.03
WC076	CAL-ALK BASALT	<0.05	0.04	1.89	1.0	1.1	0.4	1.1	0.05	<0.01	<0.5	N/A	<0.1	6.3	<0.001	<0.1	0.009	<0.01	0.03	0.09	0.01	0.04	2.31	0.02
WC078	CAL-ALK BASALT	<0.05	0.02	1.24	0.8	7.3	0.2	0.7	0.14	<0.01	<0.5	N/A	<0.1	60	<0.001	<0.1	0.021	<0.01	0.10	0.29	<0.01	0.06	7.88	0.22
WC046	HIGH MG BASALT	<0.05	0.36	0.16	1.1	16	0.5	1.4	2.16	<0.01	<0.5	N/A	<0.1	105	<0.001	<0.1	0.021	<0.01	0.24	0.13	<0.01	0.04	3.49	0.02
WC047	HIGH MG BASALT	<0.05	0.89	0.07	56	175	1.2	3.5	3.10	<0.01	0.5	N/A	1.1	245	0.007	<0.1	0.142	<0.01	1.12	2.5	<0.01	2.60	81.3	0.01
WC049	HIGH MG BASALT	<0.05	0.13	N/A	2.9	65	1.5	4.5	0.53	<0.01	<0.5	N/A	0.7	35	<0.001	<0.1	0.224	<0.01	0.95	0.35	<0.01	0.63	45.2	0.02
WC050	HIGH MG BASALT	<0.05	0.02	1.41	3.2	96	0.4	1.1	1.11	<0.01	<0.5	N/A	<0.1	27	0.010	<0.1	0.022	<0.01	0.67	1.1	0.02	0.06	7.96	0.02
WC051	MW Petalite Peg	<0.05	0.03	3.06	1.4	57	0.5	1.5	0.07	<0.01	<0.5	N/A	<0.1	50	0.001	<0.1	0.024	<0.01	0.40	0.67	0.02	0.07	5.04	0.02
WC053	MW Petalite Peg	<0.05	1.05	0.69	0.9	9.3	0.2	0.7	1.19	<0.01	<0.5	N/A	<0.1	59	<0.001	<0.1	0.012	<0.01	0.25	0.16	<0.01	0.08	3.49	0.02
WC056	MW Petalite Peg	<0.05	0.08	4.94	1.6	71	0.7	2.0	0.37	<0.01	<0.5	N/A	<0.1	32	0.003	<0.1	0.021	<0.01	0.52	0.78	0.02	0.23	8.95	0.06
WC082	BIF	<0.05	0.05	0.08	2.8	14	0.6	1.9	0.74	0.01	<0.5	N/A	1.0	766	<0.001	<0.1	0.008	<0.01	0.15	0.02	<0.01	1.21	38.7	<0.01
WC083	BIF	<0.05	0.02	0.06	6.8	24	0.3	0.9	3.19	0.04	<0.5	N/A	0.9	666	<0.001	<0.1	0.067	<0.01	0.18	0.11	<0.01	0.04	69.0	0.02
WC084	BIF	<0.05	0.07	0.09	2.5	40	1.2	3.6	0.98	0.01	0.5	N/A	1.0	395	<0.001	<0.1	0.072	<0.01	0.31	0.15	<0.01	<0.02	29.4	0.07
WC086	DYKE	<0.05	0.01	2.06	<0.5	14	0.1	0.4	0.03	<0.01	<0.5	N/A	<0.1	30	<0.001	<0.1	0.005	<0.01	0.12	0.20	0.02	<0.02	13.7	0.01
WC087	DYKE	<0.05	0.01	2.21	0.7	13	0.2	0.6	0.03	<0.01	<0.5	N/A	<0.1	25	0.001	<0.1	<0.005	<0.01	0.09	1.1	0.02	<0.02	11.9	0.01
WC010	KOM BASALT	<0.05	0.03	0.16	<0.5	5.1	0.5	1.6	0.10	<0.01	<0.5	N/A	<0.1	13	<0.001	<0.1	<0.005	<0.01	0.01	0.41	<0.01	<0.02	0.586	0.01
WC035	CAL-ALK BASALT	<0.05	0.03	0.46	<0.5	4.5	0.3	1.0	0.04	<0.01	<0.5	N/A	<0.1	6.1	<0.001	<0.1	<0.005	<0.01	0.02	0.52	<0.01	<0.02	0.016	<0.01
WC040	HIGH MG BASALT	<0.05	0.04	0.28	<0.5	3.6	0.8	2.3	0.13	<0.01	<0.5	N/A	<0.1	8.3	<0.001	<0.1	<0.005	<0.01	0.01	0.31	<0.01	<0.02	0.144	<0.01
WC041	HIGH MG BASALT	<0.05	0.07	0.34	<0.5	5.2	0.2	0.7	0.08	<0.01	<0.5	N/A	<0.1	8.0	<0.001	<0.1	<0.005	<0.01	0.04	0.36	0.01	0.03	0.130	<0.01
WC061	CAL-ALK BASALT	<0.05	0.14	<0.05	<0.5	2.9	0.3	1.0	0.09	<0.01	<0.5	N/A	<0.1	19	<0.001	<0.1	<0.005	<0.01	0.05	0.19	<0.01	0.03	0.247	0.02
WC062	CAL-ALK BASALT	<0.05	0.55	0.32	<0.5	1.3	8.9	27	0.38	<0.01	2.1	N/A	<0.1	9.7	<0.001	<0.1	<0.005	<0.01	<0.01	0.11	0.01	0.03	2.43	0.02
WC073	CAL-ALK BASALT	<0.05	0.02	0.33	<0.5	2.6	0.8	2.4	0.06	<0.01	<0.5	N/A	<0.1	64	<0.001	<0.1	0.021	<0.01	<0.01	0.31	0.01	0.04	5.15	0.02
WC074	CAL-ALK BASALT	<0.05	0.06	0.43	<0.5	2.4	3.0	8.9	0.05	<0.01	<0.5	N/A	<0.1	19	<0.001	<0.1	<0.005	<0.01	0.03	0.42	<0.01	<0.02	0.055	<0.01
WC033	CAL-ALK BASALT	<0.05	0.05	0.05	<0.5	4.6	1.0	3.1	0.10	<0.01	<0.5	N/A	<0.1	9.1	<0.001	<0.1	<0.005	<0.01	0.03	2.2	<0.01	0.03	0.026	0.02
WC059	CAL-ALK BASALT	<0.05	<0.01	0.28	<0.5	2.1	1.1	3.2	0.04	<0.01	<0.5	N/A	<0.1	13	<0.001	<0.1	<0.005	<0.01	<0.01	1.8	0.02	<0.02	0.234	<0.01
WC060	CAL-ALK BASALT	<0.05	<0.01	<0.05	<0.5	3.2	4.0	12	0.02	<0.01	<0.5	N/A	<0.1	11	<0.001	<0.1	<0.005	<0.01	<0.01	4.3	<0.01	<0.02	0.012	<0.01
WC071	CAL-ALK BASALT	<0.05	<0.01	<0.05	0.5	5.0	2.9	8.7	0.03	<0.01	<0.5	N/A	<0.1	28	<0.001	<0.1	0.109	<0.01	0.02	5.7	<0.01	<0.02	0.036	0.02
WC072	CAL-ALK BASALT	<0.05	<0.01	<0.05	0.5	8.5	5.3	16	0.02	<0.01	<0.5	N/A	<0.1	25	<0.001	<0.1	0.010	<0.01	<0.01	11	<0.01	<0.02	0.071	<0.01
WC088	SAPROLITE	<0.05	<0.01	<0.05	0.9	7.1	4.6	14	<0.01	<0.01	<0.5	N/A	<0.1	11	<0.001	<0.1	<0.005	<0.01	0.02	2.4	<0.01	<0.02	0.054	<0.01
WC089	SAPROLITE	<0.05	<0.01	<0.05	<0.5	3.5	6.3	19	0.02	<0.01	<0.5	N/A	<0.1	0.8	<0.001	<0.1	<0.005	<0.01	<0.01	0.44	<0.01	<0.02	<0.005	<0.01
WC090	SAPROLITE	<0.05	<0.01	<0.05	<0.5	7.3	5.0	15	0.05	<0.01	<0.5	N/A	<0.1	0.6	<0.001	<0.1	<0.005	<0.01	0.01	0.46	<0.01	0.02	<0.005	<0.01
WC091	SAPROLITE	<0.05	0.02	<0.05	3.4	9.5	7.4	22	<0.01	<0.01	<0.5	N/A	<0.1	65	<0.001	<0.1	0.422	<0.01	0.05	25	<0.01	0.03	1.20	<0.01
WC092	SAPROLITE	<0.05	<0.01	<0.05	2.3	8.2	3.8	12	0.02	<0.01	<0.5	N/A	<0.1	11	<0.001	<0.1	0.025	<0.01	0.02	2.0	<0.01	<0.02	0.012	<0.01
WC093	SAPROLITE	<0.05	<0.01	<0.05	0.6	8.4	4.4	13	0.03	<0.01	<0.5	N/A	<0.1	13	<0.001	<0.1	0.005	<0.01	0.01	11	<0.01	<0.02	0.057	<0.01
WC094	SAPROLITE	<0.05	0.02	<0.05	1.1	7.1	1.5	4.5	0.02	<0.01	<0.5	N/A	<0.1	7.3	<0.001	<0.1	0.064	<0.01	0.03	1.4	<0.01	0.02	0.021	<0.01
WC095	SAPROLITE	<0.05	0.01	<0.05	1.6	9.3	3.0	9.1	0.01	<0.01	<0.5	N/A	<0.1	13	<0.001	<0.1	0.238	<0.01	0.03	2.1	<0.01	<0.02	0.075	<0.01
WC096	SAPROLITE	<0.05	<0.01	<0.05	<0.5	9.9	0.7	2.2	0.01	<0.01	<0.5	N/A	<0.1	7.5	0.001	<0.1	0.017	<0.01	0.02	4.3	<0.01	<0.02	0.037	<0.01
Livestock Drinking Water DGV (ANZECC 2000/ANZG 2018)		N/G	1	N/G	100	N/G	333	1000	N/G	N/G	20	N/G	N/G	N/G	N/G	N/G	N/G	N/G	N/G	200	N/G	N/G	N/G	20
NPUG (DER 2014)		N/G	0.2	N/G	100	N/G	333	1000	30	N/G	100	N/G	N/G	N/G	N/G	N/G	N/G	N/G	N/G	170	N/G	N/G	N/G	3
Freshwater Protection 80% DGV (ANZECC 2000/ANZG 2018)		N/G	0.017	N/G	9.4	N/G	N/G	N/G	9	N/G	34	N/G	N/G	N/G	N/G	N/G	N/G	N/G	N/G	0.5	0.006	N/G	N/G	0.031
Freshwater Protection 95% DGV (ANZECC 2000/ANZG 2018)		N/G	0.011	Refer to guidelin	3.4	N/G	N/G	N/G	9	N/G	11	N/G	N/G	N/G	N/G	N/G	N/G	N/G	0.03	0.5	0.006	N/G	N/G	0.008

N/G : No applicable guideline value.

Table A2-8: Cation Exchange Capacity, Particle Size Distribution and Erosion/Dispersion Risk

Sample ID	Depth	Lithology	EC	TDS	pH	Exchangeable Cations (cmol(+)/kg)									Proportion of Fines (% < 2mm)			Emerson Class
			uS/cm	mg/L	SU	Al	Mn	Li	Ca	K	Mg	Na	ECEC	ESP (%)	Sand	Silt	Clay	
B1	-	Oxide Gravel	740	473.6	8.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	11.9	1.5	5.4	N/A
B3	-	Oxide Gravelly Clay	890	569.6	8	N/A	N/A	<0.02	0.19	0.14	5.4	5.5	11.23	48.9	43.6	3.5	13	1
B4	-	Oxide Silty Sand	440	281.6	5.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	34.2	0	12.3	N/A
B2	-	Oxide Silty Gravel	60	38.4	4.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	35.3	2.1	15.8	N/A
B5	-	Oxide Clays	270	172.8	8.9	N/A	N/A	<0.02	2.3	1	9	9.1	21.4	42.7	22.7	10.4	23.2	4
SLPComp	0 - 8	Pegmatite Laterite Gravel-clay-colluvium	990	633.6	6.3	0.12	<0.02	<0.02	0.38	0.35	1.7	2.1	4.53	36.7	N/A	N/A	N/A	1
SMLComp	0 - 9	Mafic Laterite-clay	690	441.6	6.5	0.13	<0.02	<0.02	0.62	0.25	2.8	2.6	6.27	40.6	N/A	N/A	N/A	1
MDUSComp	15 - 30	Transitional Mafic	750	480	7.5	N/A	N/A	<0.02	0.54	0.36	7.2	7	15.1	46.5	N/A	N/A	N/A	N/A
MDTLSSComp	40 - 54	Transitional Mafic	360	230.4	8.2	N/A	N/A	<0.02	0.8	0.29	3.8	5.8	10.69	54.5	N/A	N/A	N/A	1
PDUSComp	19 - 29	Transitional Pegmatite-clay/mafic	830	531.2	7.7	N/A	N/A	<0.02	0.34	0.23	3.8	4.8	9.17	51.3	N/A	N/A	N/A	N/A
TPComp	-	Transitional Pegmatite	280	179.2	7	N/A	N/A	0.02	0.23	0.15	2	1.5	3.88	38.6	N/A	N/A	N/A	N/A
TP1	-	Transitional Pegmatite	210	134.4	8	N/A	N/A	<0.02	0.17	0.17	1.3	1	2.64	38.2	N/A	N/A	N/A	N/A
TP2	-	Transitional Pegmatite	370	236.8	7.5	N/A	N/A	0.02	0.22	0.08	1.2	0.88	2.38	41.8	N/A	N/A	N/A	N/A
TP3	-	Transitional Pegmatite	660	422.4	5.9	0.11	0.03	0.03	0.27	0.29	4.6	3.3	8.46	38.4	N/A	N/A	N/A	N/A
TP4	-	Transitional Pegmatite	60	38.4	8.8	N/A	N/A	<0.02	0.32	0.18	1.1	1.7	3.3	51.5	N/A	N/A	N/A	N/A
PETG	-	Galaxy subgrade petalite	660	422.4	7.9	N/A	N/A	0.03	0.53	0.5	0.59	0.93	2.55	36.6	10.3	0.1	0.2	N/A
TRANS KOM BASALT		Transitional	230	147	9.7	N/A	N/A	N/A	0.47	0.04	1.1	3.4	5.01	67.9	N.D.	N.D.	N.D.	N.D.
TRANS QTZ/PEG		Transitional	350	224	6.8	N/A	N/A	N/A	0.45	0.09	1.3	1.1	2.94	37.4	N.D.	N.D.	N.D.	N.D.
TRANS CAL-ALK BASALT 1		Transitional	210	134	7.3	N/A	N/A	N/A	0.94	0.15	1.8	1.8	4.69	38.4	N.D.	N.D.	N.D.	N.D.
TRANS HIGH MG BASALT		Transitional	80	51	9.8	N/A	N/A	N/A	0.38	0.02	1.1	0.88	2.38	37.0	N.D.	N.D.	N.D.	N.D.
TRANS CAL-ALK BASALT 2		Transitional	610	390	7.4	N/A	N/A	N/A	0.54	0.17	3.2	3.1	7.01	44.2	N.D.	N.D.	N.D.	N.D.
OX CAL-ALK BASALT 1		Oxide	620	397	7.8	N/A	N/A	N/A	0.3	0.95	7.5	6.4	15.15	42.2	N.D.	N.D.	N.D.	N.D.
OX CAL-ALK BASALT 2		Oxide	1000	640	7.7	N/A	N/A	N/A	0.5	0.5	4.2	4.6	9.8	46.9	N.D.	N.D.	N.D.	N.D.
OX- SAPROLITE 1		Oxide	1200	768	6.1	N/A	N/A	N/A	0.38	0.69	11	13	25.07	51.9	N.D.	N.D.	N.D.	N.D.
OX- SAPROLITE 2		Oxide	1100	704	6.3	N/A	N/A	N/A	0.09	0.29	3.8	3.5	7.68	45.6	N.D.	N.D.	N.D.	N.D.
OX- SAPROLITE 3		Oxide	690	442	5.8	N/A	N/A	N/A	<0.02	0.26	3.1	2.7	6.06	44.6	N.D.	N.D.	N.D.	N.D.
KEGR22 3-11	3 to 11	Oxide	1200	768	5.4	<0.02	<0.02	0.0016	0.01	0.01	0.15	0.09	0.26	34.6	71	11.5	17.5	2
KEGR32 3-7	3 to 7	Oxide	1600	1,024	3.9	0.73	<0.02	0.0034	0.03	0.28	2.5	1.4	4.21	33.3	61	8	31	6
KEGR25 6-11	6 to 11	Oxide	1800	1,152	4.5	0.2	<0.02	0.0068	0.05	0.39	4.3	1.9	6.64	28.6	68.5	12.5	19	6
KEGR96 6-10	6 to 10	Oxide	2100	1,344	4.4	0.61	<0.02	0.0109	0.11	0.26	3	7.5	10.87	69.0	42.5	23	34.5	5
KEGR14 15-20	15 to 20	Oxide	1400	896	4.9	0.49	<0.02	0.045	0.59	0.28	3.6	10	14.47	69.1	52.5	24	23.5	1
KEGR25 15-18	15 to 18	Oxide	2800	1,792	N.D.	0.08	<0.02	0.0045	0.09	0.29	3.4	0.71	4.49	15.8	N.D.	N.D.	N.D.	6
KEGR26 44-45	44 to 45	Transitional	230	147	7.7	N/A	N/A	0.0146	1.5	0.59	14	9.2	25.29	36.4	78	13.5	8.5	1
KEGR27 17-25	17 to 25	Oxide	780	499	4.2	0.05	0.09	0.0051	1.2	0.34	5.2	3.1	9.84	31.5	N.D.	N.D.	N.D.	
KEGR50 13-19	13 to 19	Oxide	1700	1,088	4	0.35	<0.02	0.0118	0.05	0.2	1.8	3.9	5.95	65.5	N.D.	N.D.	N.D.	6
KEGR32 34-36	34 to 36	Transitional	270	173	7.4	N/A	N/A	0.0456	0.77	0.55	12	9.2	22.52	40.9	N.D.	N.D.	N.D.	1
KEGM058 10-11	10 to 11	Oxide	54	35	N.D.	N/A	N/A	N/A	0.24	N.D.	3.6	4.5	8.34	54.0	72.5	12.5	15	1
KEGM059 16-17	16 to 17	Oxide	N.D.	N.D.	N.D.	N/A	N/A	N/A	0.24	N.D.	8.4	7.1	15.74	45.1	32	29	39	
KEGM059 37-38	37 to 38	Transitional	38	24	N.D.	N/A	N/A	N/A	0.81	N.D.	6.2	21	28.01	75.0	62	25	13	1
KEGM058 30-31	30 to 31	Transitional	67	43	N.D.	N/A	N/A	N/A	0.57	N.D.	6.3	27	33.87	79.7	61	25	14	1

Table A2-9: Mehlich Results

Sample ID	Lithology	Al	B	Ca	Co	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	S	Zn	Cd	As	Pb	Se
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
SLPComp	Pegmatite Laterite Gravel-clay-colluvium	N/A	5.3	110	0.16	0.6	97	140	320	3.6	<0.01	>1000	0.6	4	160	0.5	0.03	0.2	0.6	<0.1
SMLComp	Mafic Laterite-clay	N/A	5.4	140	0.43	0.7	65	120	370	5.8	<0.01	970	0.3	1	110	0.4	0.03	0.1	0.4	<0.1
B1	Oxide Gravel	N/A	11	31	1.3	1.1	92	180	>1000	6.3	<0.01	>1000	0.8	2	78	0.1	0.05	0.3	1.2	<0.1
B2	Oxide Silty Gravel	N/A	9.2	59	0.57	2	57	56	860	2.4	<0.01	>1000	0.3	<1	87	<0.1	0.04	0.2	3.3	<0.1
B3	Oxide Gravelly Clay	N/A	3.8	<10	0.27	0.9	67	64	690	0.7	<0.01	>1000	0.3	<1	67	<0.1	0.04	0.1	2	<0.1
B4	Oxide Silty Sand	N/A	1	<10	0.03	0.2	42	31	40	0.2	<0.01	21	<0.1	<1	170	<0.1	0.04	0.2	1.7	<0.1
B5	Oxide Clays	N/A	58	>5500	0.78	4.9	46	430	>1000	40	<0.01	>1000	1.7	1	>250	0.3	0.08	1.1	0.9	<0.1
TP1	Transitional Pegmatite	N/A	0.7	36	1.1	1.2	98	73	220	17	<0.01	370	0.9	2	15	0.5	0.03	0.3	0.1	<0.1
TP2	Transitional Pegmatite	N/A	0.5	61	1.2	0.9	>550	44	200	72	0.11	490	3.2	8	22	1.5	0.06	1	0.4	<0.1
TP3	Transitional Pegmatite	N/A	0.9	65	0.33	1.6	220	130	690	7.1	<0.01	>1000	2.9	3	66	0.8	0.05	1	0.2	<0.1
TP4	Transitional Pegmatite	N/A	1.7	260	2.9	0.9	>550	85	190	55	0.39	360	4.7	93	4	2.4	0.08	1.2	1.2	<0.1
TPComp	Transitional Pegmatite	N/A	0.9	110	1.6	1.3	350	87	330	51	0.12	640	3.2	31	26	1.5	0.06	1.2	0.5	<0.1
MDTLSSComp	Transitional Mafic	N/A	0.6	200	3.8	2.3	160	140	660	39	<0.01	>1000	4.3	4	30	2.2	0.05	0.5	0.1	<0.1
PDUSComp	Transitional Pegmatite-clay/mafic	N/A	0.5	180	8.8	3.5	220	120	620	63	<0.01	>1000	4.1	48	71	1.6	0.05	0.6	0.3	<0.1
MDUSComp	Transitional Mafic	N/A	0.4	150	8.1	7.2	190	210	>1000	35	<0.01	>1000	4.5	8	62	2.3	0.05	0.5	0.1	<0.1
PETG	Galaxy subgrade petalite	N/A	1.8	660	0.36	0.9	>550	280	180	66	0.02	520	2	270	130	3.1	0.14	1.6	1.2	<0.1
PETComp	Subgrade Pegmatite/Petalite	N/A	0.3	420	0.21	0.4	220	39	34	93	0.12	64	0.6	190	6	1	0.03	0.2	0.4	<0.1
TRANS KOM BASALT		240	0.1	180	0.63	1.9	390	57	270	23	0.11	730	2.1	3	19	0.7	<0.01	0.2	0.2	<0.1
TRANS QTZ/PEG		70	<0.1	83	0.5	1.3	150	30	140	15	<0.01	240	3.1	2	120	1.5	0.01	0.4	0.2	<0.1
TRANS CAL-ALK BASALT 1		340	0.9	170	0.84	0.4	>550	76	260	17	<0.01	420	2.1	2	88	1	0.01	<0.1	0.5	<0.1
TRANS HIGH MG BASALT		240	0.2	160	1.5	2.2	380	57	250	23	<0.01	310	2.5	4	13	0.7	<0.01	0.5	0.2	<0.1
TRANS CAL-ALK BASALT 2		220	0.8	170	6.3	8.9	360	71	370	39	<0.01	940	4.7	6	90	0.7	0.02	5.4	0.2	<0.1
OX CAL-ALK BASALT 1		220	1.8	68	0.14	0.8	130	300	730	1.6	<0.01	>1000	0.5	1	84	0.3	<0.01	0.4	0.2	<0.1
OX CAL-ALK BASALT 2		210	2	95	0.14	0.4	55	160	420	1.3	<0.01	>1000	0.7	<1	80	1.2	<0.01	0.2	0.1	<0.1
OX- SAPROLITE 1		310	2.6	51	0.33	0.4	58	320	>1000	2.8	<0.01	>1000	1.5	<1	160	0.2	<0.01	0.1	0.4	<0.1
OX- SAPROLITE 2		300	1.9	20	0.05	0.4	35	200	420	0.3	<0.01	>1000	0.5	<1	110	0.1	<0.01	0.4	0.4	<0.1
OX- SAPROLITE 3		340	2.1	10	<0.01	0.1	35	140	330	0.3	<0.01	920	0.5	<1	82	<0.1	<0.01	<0.1	0.2	<0.1
Low		N/A	<0.1	<50	<2	<0.1	<10	<10	<20	<5	<0.01	N/A	<1	<2	<5	<0.2	N/A	N/A	N/A	N/A
Med		N/A	0.1-2	50-5000	2-60	0.1-5	10-200	10-300	20-2000	5-100	0.01 - 0.05	N/A	1-20	2-10	5-200	0.2-5	N/A	N/A	N/A	N/A
High		>550	>2	>5000	>60	>5	>200	>300	>2000	>100	>0.05	>180	>20	>10	>200	>5	>1	>5	>35	>1.5

N/A : No applicable reference value.

APPENDIX 3: LABORATORY REPORTS PHASE 3

GOVERNMENT OF
WESTERN AUSTRALIA

ChemCentre
Scientific Services Division
Report of Examination

Purchase Order: CLMHWRC23
Your Reference:
ChemCentre Reference: 22S4296 R0

Resources and Chemistry Precinct
Cnr Manning Road and Towning Drive
Bentley
WA 6102
T +61 8 9422 9800
F +61 8 9422 9801
www.chemcentre.wa.gov.au
ABN 40 991 885 705

MBS Environmental
4 Cook St
West Perth WA 6005

Attention: Elliott Duncan

Final Report on 10 samples of rock received on 25/05/2023

LAB ID	**Client ID and Description**
22S4296 / 001	TRANS KOM BASALT WC009 WC010
22S4296 / 002	TRANS QTZ/PEG WC019
22S4296 / 003	TRANS CAL-ALK BASALT 1 WC020 WC021 WC034 WC035
22S4296 / 004	TRANS HIGH MG BASALT WC040 WC041 WC042
22S4296 / 005	TRANS CAL-ALK BASALT 2 WC061 WC062 WC073 WC074
22S4296 / 006	OX CAL-ALK BASALT 1 WC059 WC060
22S4296 / 007	OX CAL-ALK BASALT 2 WC033 WC071 WC072
22S4296 / 008	OX- SAPROLITE 1 WC089 WC090 WC091
22S4296 / 009	OX- SAPROLITE 2 WC088 WC092 WC093
22S4296 / 010	OX- SAPROLITE 3 WC094 WC095 WC096

Lab ID			22S4296/001	22S4296/002	22S4296/003	22S4296/004
Client ID			TRANS KOM BASALT	TRANS QTZ/PEG	TRANS CAL-ALK BASALT 1	TRANS HIGH MG BASALT
Sampled						
Analyte	**Method**	**Unit**				
EC	(1:5)	mS/m	23	35	21	8
pH	(H2O)		9.7	6.8	7.3	9.8
ESP *	(calc)	%	67.7	38.6	38.7	36.4
K	(exch)	cmol(+)/kg	0.04	0.09	0.15	0.02
Mg	(exch)	cmol(+)/kg	1.1	1.3	1.8	1.1
Na	(exch)	cmol(+)/kg	3.4	1.1	1.8	0.88
Ca	(exch)	cmol(+)/kg	0.47	0.45	0.94	0.38
Co *	(M3)	mg/kg	0.63	0.50	0.84	1.5
Cu *	(M3)	mg/kg	1.9	1.3	0.4	2.2
K *	(M3)	mg/kg	57	30	76	57
Fe *	(M3)	mg/kg	390	150	>550	380
Na *	(M3)	mg/kg	730	240	420	310
Ni *	(M3)	mg/kg	2.1	3.1	2.1	2.5
P *	(M3)	mg/kg	3	2	2	4
Mg *	(M3)	mg/kg	270	140	260	250
Mn *	(M3)	mg/kg	23	15	17	23
Mo *	(M3)	mg/kg	0.11	<0.01	<0.01	<0.01
S *	(M3)	mg/kg	19	120	88	13
Zn *	(M3)	mg/kg	0.7	1.5	1.0	0.7
Ca *	(M3)	mg/kg	180	83	170	160
Cd *	(M3)	mg/kg	<0.01	0.01	0.01	<0.01
B *	(M3)	mg/kg	0.1	<0.1	0.9	0.2
Al *	(M3)	mg/kg	240	70	340	240
Se *	(M3)	mg/kg	<0.1	<0.1	<0.1	<0.1
Pb *	(M3)	mg/kg	0.2	0.2	0.5	0.2
As *	(M3)	mg/kg	0.2	0.4	<0.1	0.5
Date Analysed	(1:5)		13/06/2023	13/06/2023	13/06/2023	13/06/2023
	(calc)		05/07/2023	05/07/2023	05/07/2023	05/07/2023
	(exch)		28/06/2023	30/06/2023	30/06/2023	28/06/2023
	(H2O)		13/06/2023	13/06/2023	13/06/2023	13/06/2023
	(M3)		16/06/2023	16/06/2023	16/06/2023	16/06/2023
Sample Condition			Ambient	Ambient	Ambient	Ambient

Lab ID			22S4296/005	22S4296/006	22S4296/007	22S4296/008
Client ID			TRANS CAL-ALK BASALT 2	OX CAL-ALK BASALT 1	OX CAL-ALK BASALT 2	OX- SAPROLITE 1
Sampled						
Analyte	**Method**	**Unit**				
EC	(1:5)	mS/m	61	62	100	120
pH	(H2O)		7.4	7.8	7.7	6.1
ESP *	(calc)	%	43.9	41.4	42.2	50.3
Mg	(exch)	cmol(+)/kg	3.2	7.5	4.2	11
Na	(exch)	cmol(+)/kg	3.1	6.4	4.6	13
K	(exch)	cmol(+)/kg	0.17	0.95	0.50	0.69
Ca	(exch)	cmol(+)/kg	0.54	0.30	0.50	0.38
B *	(M3)	mg/kg	0.8	1.8	2.0	2.6
Al *	(M3)	mg/kg	220	220	210	310
S *	(M3)	mg/kg	90	84	80	160
Zn *	(M3)	mg/kg	0.7	0.3	1.2	0.2
Na *	(M3)	mg/kg	940	>1000	>1000	>1000
Ni *	(M3)	mg/kg	4.7	0.5	0.7	1.5
P *	(M3)	mg/kg	6	1	<1	<1
Mg *	(M3)	mg/kg	370	730	420	>1000
Mn *	(M3)	mg/kg	39	1.6	1.3	2.8
Mo *	(M3)	mg/kg	<0.01	<0.01	<0.01	<0.01
K *	(M3)	mg/kg	71	300	160	320
Fe *	(M3)	mg/kg	360	130	55	58
Ca *	(M3)	mg/kg	170	68	95	51
Cd *	(M3)	mg/kg	0.02	<0.01	<0.01	<0.01
Co *	(M3)	mg/kg	6.3	0.14	0.14	0.33
Cu *	(M3)	mg/kg	8.9	0.8	0.4	0.4
As *	(M3)	mg/kg	5.4	0.4	0.2	0.1
Se *	(M3)	mg/kg	<0.1	<0.1	<0.1	<0.1
Pb *	(M3)	mg/kg	0.2	0.2	0.1	0.4
Date Analysed	(1:5)		13/06/2023	13/06/2023	13/06/2023	13/06/2023
	(calc)		05/07/2023	05/07/2023	05/07/2023	05/07/2023
	(exch)		30/06/2023	30/06/2023	30/06/2023	28/06/2023
	(H2O)		13/06/2023	13/06/2023	13/06/2023	13/06/2023
	(M3)		16/06/2023	16/06/2023	16/06/2023	16/06/2023
Sample Condition			Ambient	Ambient	Ambient	Ambient

Lab ID	22S4296/009	22S4296/010
Client ID	OX- SAPROLITE 2	OX- SAPROLITE 3

Sampled

Analyte	**Method**	**Unit**		
EC	(1:5)	mS/m	110	69
pH	(H2O)		6.3	5.8
ESP *	(calc)	%	43.8	42.3
K	(exch)	cmol(+)/kg	0.29	0.26
Ca	(exch)	cmol(+)/kg	0.09	<0.02
Mg	(exch)	cmol(+)/kg	3.8	3.1
Na	(exch)	cmol(+)/kg	3.5	2.7
S *	(M3)	mg/kg	110	82
B *	(M3)	mg/kg	1.9	2.1
Na *	(M3)	mg/kg	>1000	920
Ni *	(M3)	mg/kg	0.5	0.5
P *	(M3)	mg/kg	<1	<1
Mg *	(M3)	mg/kg	420	330
Mn *	(M3)	mg/kg	0.3	0.3
Mo *	(M3)	mg/kg	<0.01	<0.01
Ca *	(M3)	mg/kg	20	10
Cd *	(M3)	mg/kg	<0.01	<0.01
Co *	(M3)	mg/kg	0.05	<0.01
Cu *	(M3)	mg/kg	0.4	0.1
K *	(M3)	mg/kg	200	140
Fe *	(M3)	mg/kg	35	35
Al *	(M3)	mg/kg	300	340
Zn *	(M3)	mg/kg	0.1	<0.1
As *	(M3)	mg/kg	0.4	<0.1
Pb *	(M3)	mg/kg	0.4	0.2
Se *	(M3)	mg/kg	<0.1	<0.1
Date Analysed	(1:5)		13/06/2023	13/06/2023
	(calc)		05/07/2023	05/07/2023
	(exch)		28/06/2023	28/06/2023
	(H2O)		13/06/2023	13/06/2023
	(M3)		16/06/2023	16/06/2023
Sample Condition			Ambient	Ambient

Analyte	Method	Description
Electrical conductivity of 1:5 soil extract at 25 C by in-house method S02 EC	(1:5)	Electrical conductivity of 1:5 soil extract at 25 C by in-house method S02
Exchangeable Sodium Percentage (calculated) ESP *	(calc)	Exchangeable Sodium Percentage (calculated)
Potassium, K exchangeable (ref. Rayment & Lyons 2011) K	(exch)	Potassium, K exchangeable (ref. Rayment & Lyons 2011)
Magnesium, Mg exchangeable (ref. Rayment & Lyons 2011) Mg	(exch)	Magnesium, Mg exchangeable (ref. Rayment & Lyons 2011)
Sodium, Na exchangeable (ref. Rayment & Lyons 2011) Na	(exch)	Sodium, Na exchangeable (ref. Rayment & Lyons 2011)
Calcium, Ca exchangeable (ref. Rayment & Lyons 2011) Ca	(exch)	Calcium, Ca exchangeable (ref. Rayment & Lyons 2011)
pH of 1:5 soil extract in water by in-house method S01 pH	(H2O)	pH of 1:5 soil extract in water by in-house method S01
Sulphur, S extracted by Mehlich No 3 - method S42 S *	(M3)	Sulphur, S extracted by Mehlich No 3 - method S42
Selenium, Se extracted by Mehlich No 3 - method S42 Se *	(M3)	Selenium, Se extracted by Mehlich No 3 - method S42
Zinc, Zn extracted by Mehlich No 3 - method S42 Zn *	(M3)	Zinc, Zn extracted by Mehlich No 3 - method S42
Sodium, Na extracted by Mehlich No 3 - method S42 Na *	(M3)	Sodium, Na extracted by Mehlich No 3 - method S42
Nickel, Ni extracted by Mehlich No 3 - method S42 Ni *	(M3)	Nickel, Ni extracted by Mehlich No 3 - method S42
Phosphorus, P extracted by Mehlich No 3 - method S42 P *	(M3)	Phosphorus, P extracted by Mehlich No 3 - method S42

Analyte	Method	Description
Magnesium, Mg extracted by Mehlich No 3 - method S42 Mg *	(M3)	Magnesium, Mg extracted by Mehlich No 3 - method S42
Manganese, Mn extracted by Mehlich No 3 - method S42 Mn *	(M3)	Manganese, Mn extracted by Mehlich No 3 - method S42
Molybdenum, Mo extracted by Mehlich No 3 - method S42 Mo *	(M3)	Molybdenum, Mo extracted by Mehlich No 3 - method S42
Potassium, K extracted by Mehlich No 3 - method S42 K *	(M3)	Potassium, K extracted by Mehlich No 3 - method S42
Iron, Fe extracted by Mehlich No 3 - method S42 Fe *	(M3)	Iron, Fe extracted by Mehlich No 3 - method S42
Calcium,Ca extracted by Mehlich No 3 - method S42 Ca *	(M3)	Calcium,Ca extracted by Mehlich No 3 - method S42
Cadmium,Cd extracted by Mehlich No 3 - method S42 Cd *	(M3)	Cadmium,Cd extracted by Mehlich No 3 - method S42
Cobalt,Co extracted by Mehlich No 3 - method S42 Co *	(M3)	Cobalt,Co extracted by Mehlich No 3 - method S42
Copper,Cu extracted by Mehlich No 3 - method S42 Cu *	(M3)	Copper,Cu extracted by Mehlich No 3 - method S42
Aluminium,Al extracted by Mehlich No 3 - method S42 Al *	(M3)	Aluminium,Al extracted by Mehlich No 3 - method S42
Arsenic, As extracted by Mehlich No 3 - method S42 As *	(M3)	Arsenic, As extracted by Mehlich No 3 - method S42
Boron,B extracted by Mehlich No 3 - method S42 B *	(M3)	Boron,B extracted by Mehlich No 3 - method S42
Lead, Pb extracted by Mehlich No 3 - method S42 Pb *	(M3)	Lead, Pb extracted by Mehlich No 3 - method S42

Results are based on a air-dry (40C) , < 2 mm basis. Stones (>2mm) if present are reported on an air dry whole sample basis.The results apply only to samples as received. This report may only be reproduced in full. Unless otherwise advised, the samples in this job will be disposed of after a holding period of 30 days from the report date shown below.

Exchangeable Sodium Percentage (ESP)

The ESP is a measure of sodicity (i.e exchangeable Na+) based on a soils exchange complex . High levels of sodium can adversley effect plant growth and soil structure.
The table below (categorised by Northcote and Skene, 1972) relates % ESP to soil sodicity. This table should only be used as a guide as it tolerance can vary on soil type and plant species.

ESP<6	non-sodic
ESP6-15	sodic
ESP>15	strongly sodic

*Analysis not covered by scope of ChemCentre's NATA accreditation.

B. Price

Barry Price
Senior Scientist
Scientific Services Division
5-Jul-2023

T23-0103 TEM ANALYSIS REPORT

Transmission Electron Microscopy (TEM)

COHLABSTEM Ref:	T23-0103
Order No.	222366
Client:	Glossop Consultancy
Client Contact:	**Laurie Glossop**
Telephone:	+61 (0) 438 001955
Email:	Laurie.glossop@glossopconsultancy.com.au;
Client Address:	1 Cumnock Place, Duncraig, WA, 6023, AUSTRALIA
Site/ Sample Location:	Covalent Lithium
No. of Samples Received:	6
Sample Type:	6 Crushed Samples
Date Sample(s) Received:	31/05/2023
Date Sample(s) Analysed:	09/06/2023
Date Report Issued:	12/06/2023
TEM Analyst:	Jordan Ogor

Table of Contents

1 Introduction

1.1 Samples received

CLIENT ID	LAB ID	MASS (G)	POWDER COLOUR
COMP OF WC006, WC007 AND WC008	T23-0103-01	14.00	LIGHT GREY
COMP OF WC014, WC016 AND WC017	T23-0103-02	14.00	LIGHT GREY
COMP OF WC029, WC030 AND WC031	T23-0103-03	14.00	LIGHT GREY
COMP OF WC069, WC070 AND WC075	T23-0103-04	14.00	LIGHT GREY
COMP OF WC044, WC045 AND WC048	T23-0103-05	14.00	LIGHT GREY
COMP OF WC081 AND WC085	T23-0103-06	14.00	LIGHT GREY

1.2 Sample preparation and analysis

- Elutriation procedure: The samples were initially examined by stereomicroscopy to determine homogeneity. The samples were prepared as described herein. Approximately 20mg of sample was weighed with a microbalance and transferred into a 500mL beaker, diluted with distilled water and placed in a 100W ultrasonic bath. A surface aliquot of 10 mL was filtered on a polycarbonate membrane (25mm diameter, 0.2um pore size) and transferred onto TEM grids. A total of 50 grid openings were examined on 1 TEM grid.

- The TEM fibre identification analysis was based on three (3) criteria as per ISO22262-1:
    1. FIBRE DEFINITION AS PER ISO 22262-1: *"elongated particle which has parallel or stepped sides. For the purposes of this part of ISO 22262-1, a fibre is defined to have an aspect ratio equal to or greater than 3:1".* An Elongated Mineral Particle (EMP) is the same definition as a fibre with the exception that it has no parallel or stepped sides.
    2. QUALITATIVE ELECTRON DIFFRACTION DEFINITION AS PER ISO 22262-1: *"Qualitative ELECTRON DIFFRACTION (ED) consists of visual examination, without detailed measurement, of the general characteristics of the ED pattern obtained on the TEM viewing screen from a randomly oriented fibre. ED patterns obtained from fibres with cylindrical symmetry, such as chrysotile, do not change when the fibres are tilted about their axes, and patterns from randomly oriented fibres of these minerals can be interpreted quantitatively. For fibres which do not have cylindrical symmetry, only those ED patterns obtained when the fibre is oriented with a principal crystallographic axis closely parallel with the incident electron-beam direction can be interpreted quantitatively."*
    3. The chemical composition using Energy Dispersive X-Ray Spectroscopy (EDX).

2 Analysis results

2.1 Summary table

The purpose of the analysis was to find / observe fibres and EMPs (Elongated Mineral Particles), assess their crystallinity by electron diffraction and assess their chemical composition by EDX.

Table 1 Summary table of fibres and elongated mineral particles detected within the samples[1]

ID		DATA / PARAMETERS				#GO SCANNED		SUMMARY OF RESULTS	
LAB ID	CLIENT ID	WEIGHT BEFORE DILUTION IN 500ML WATER (G)	ALIQUOT VOLUME FILTERED V (ML)	EFA (MM2)	GOA (MM2)	G01	TOTAL AREA (MM2)	VARIETIES	#TOTAL
T23-0103-01	COMP OF WC006, WC007 AND WC008	0.019	10.0	299.9	0.008	50	0.400	MAGNESIOHORNBLENDE 7 ACTINOLITE 6 EDENITE 2 CUMMINGTONITE ANTHOPHYLLITE[2] 1	16
T23-0103-02	COMP OF WC014, WC016 AND WC017	0.021	10.0	299.9	0.008	50	0.400	MAGNESIOHORNBLENDE 2 ACTINOLITE 11 TREMOLITE 14 CUMMINGTONITE ANTHOPHYLLITE4	31
T23-0103-03	COMP OF WC029, WC030 AND WC031	0.021	10.0	299.9	0.008	50	0.400	MAGNESIOHORNBLENDE 9 ACTINOLITE 9 GRUNERITE 1	19
T23-0103-04	COMP OF WC069, WC070 AND WC075	0.020	10.0	299.9	0.008	50	0.400	MAGNESIOHORNBLENDE 7 ACTINOLITE 7 EDENITE 1	15
T23-0103-05	COMP OF WC044, WC045 AND WC048	0.021	10.0	299.9	0.008	50	0.400	MAGNESIOHORNBLENDE 1 ACTINOLITE 9 TREMOLITE 2 CUMMINGTONITE ANTHOPHYLLITE 2	14
T23-0103-06	COMP OF WC081 AND WC085	0.020	10.0	299.9	0.008	50	0.400	MAGNESIOHORNBLENDE 1 ACTINOLITE 5 EDENITE 1	7

---

[1] Explanatory notes to the table:

- EFA: Funnel Effective Filtration Area (in mm^2)
- GO: Grid Opening (or "field")
- GOA: Grid Opening Area (in mm^2)

[2] The analytical method employed does not enable a clear distinction between Cummingtonite and Anthophyllite. Both minerals share identical chemical compositions, and only quantitative electron diffraction using a double tilt specimen holder can provide differentiation.

Table 2 Representative fibres and elongated mineral particles within the samples[3]

CLIENT ID	LAB ID	MASS (g)	GRID#	GO#	LENGTH (um)	WIDTH (um)	RATIO L/W	COUNT	FIBRE, SAF or EMP	ELECTRON DIFFRACTION	EDX#	EDX COMPOSITION	N GO SCANNED	AREA SCANNED (mm2)
COMP OF WC006, WC007 AND WC008	T23-0103-01	0.0190	1	1	6.03	1.42	4.2	1.0	EMP	-	1	MAGNESIO HORNBLENDE	50	0.4
				1	6.48	1.97	3.3	1.0	EMP	-	2	MAGNESIO HORNBLENDE		
				2	7.37	2.05	3.6	1.0	EMP	-	3	MAGNESIO HORNBLENDE		
				3	6.12	1.89	3.2	1.0	EMP	-	4	ACTINOLITE		
				6	11.40	2.93	3.9	1.0	EMP	-	5	EDENITE		
				12	7.28	2.14	3.4	1.0	EMP	-	6	EDENITE		
				13	8.35	1.26	6.6	1.0	EMP	-	7	ACTINOLITE		
				16	5.21	1.59	3.3	1.0	EMP	-	8	ACTINOLITE		
				17	5.95	1.60	3.7	1.0	EMP	-	9	MAGNESIO HORNBLENDE		
				22	7.65	1.24	6.2	1.0	EMP	-	10	MAGNESIO HORNBLENDE		
				26	7.07	1.28	5.5	1.0	EMP	-	11	ACTINOLITE		
				27	8.00	1.94	4.1	1.0	EMP	-	12	ACTINOLITE		
				27	6.84	2.04	3.4	1.0	EMP	-	13	MAGNESIO HORNBLENDE		
				28	6.62	0.42	15.9	1.0	EMP	-	14	MAGNESIO HORNBLENDE		
				42	7.30	0.97	7.5	1.0	EMP	-	15	CUMMINGTONITE ANTHOPHYLLITE		
				49	5.47	1.32	4.1	1.0	EMP	-	16	ACTINOLITE		
COMP OF WC014, WC016 AND WC017	T23-0103-02	0.0210	1	2	8.40	0.59	14.4	1.0	EMP	AMPHIBOLE	1	TREMOLITE*	50	0.4
				3	6.19	0.45	13.6	1.0	EMP	-	2	TREMOLITE		
				4	11.30	1.92	5.9	1.0	EMP	-	3	TREMOLITE		
				5	5.66	0.82	6.9	1.0	EMP	-	4	ACTINOLITE		
				5	5.42	0.36	14.9	1.0	EMP	-	5	TREMOLITE		
				6	5.66	0.50	11.4	1.0	EMP	-	6	TREMOLITE		
				7	6.63	1.04	6.4	1.0	EMP	-	7	ACTINOLITE		
				8	10.10	1.03	9.8	1.0	EMP	-	8	ACTINOLITE		
				9	10.20	2.27	4.5	1.0	EMP	-	9	ACTINOLITE		
				13	11.30	1.05	10.8	1.0	EMP	-	10	CUMMINGTONITE ANTHOPHYLLITE		
				15	7.16	1.26	5.7	1.0	EMP	-	11	MAGNESIO HORNBLENDE		
				15	10.30	1.50	6.9	1.0	EMP	CRYSTALLINE	12	CUMMINGTONITE ANTHOPHYLLITE		
				16	7.07	0.66	10.7	1.0	EMP	-	13	CUMMINGTONITE ANTHOPHYLLITE		
				17	9.70	2.56	3.8	1.0	EMP	-	14	ACTINOLITE		
				18	9.20	0.84	11.0	1.0	EMP	-	15	MAGNESIO HORNBLENDE		
				20	9.58	1.16	8.3	1.0	EMP	-	16	TREMOLITE		
				22	7.82	0.84	9.3	1.0	EMP	-	17	TREMOLITE		
				23	15.20	1.24	12.3	1.0	EMP	-	18	TREMOLITE		
				26	8.80	0.71	12.5	1.0	EMP	-	19	TREMOLITE		
				28	6.56	1.27	5.2	1.0	EMP	-	20	ACTINOLITE		
				29	6.83	1.24	5.5	1.0	EMP	-	21	ACTINOLITE		
				30	6.64	0.67	10.0	1.0	EMP	-	22	ACTINOLITE		

---

[3] Explanatory notes to the table:

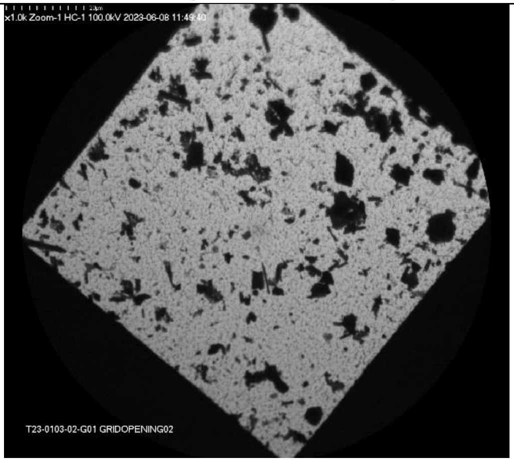
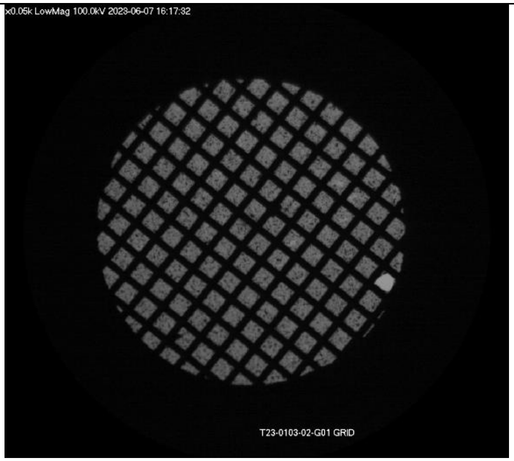
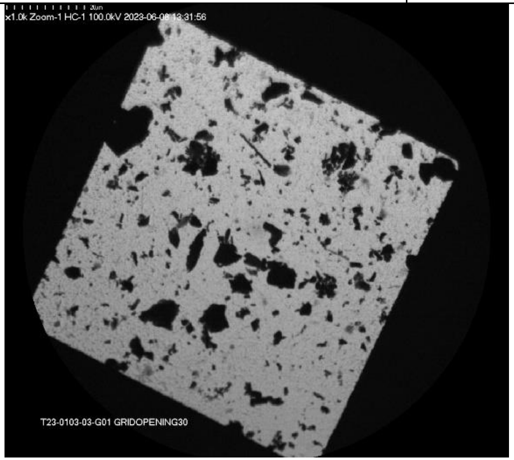
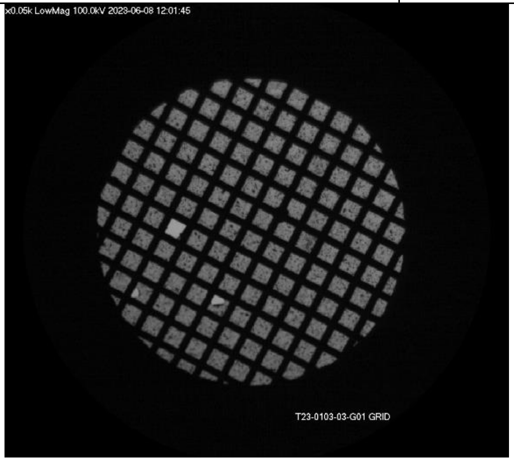
- Number of grid openings (GO) and total area scanned are detailed in the far right columns.
- A structure is labelled as “FIBRE”, “Short Asbestos Fibre SAF”, “Elongated Mineral Particle EMP” or “Short EMP” depending on its size/morphology parameters.
- No electron diffraction pattern recorded on structure that were unequivocally cleavage fragments.

CLIENT ID	LAB ID	MASS (g)	GRID#	GO#	LENGTH (um)	WIDTH (um)	RATIO L/W	COUNT	FIBRE, SAF or EMP	ELECTRON DIFFRACTION	EDX#	EDX COMPOSITION	N GO SCANNED	AREA SCANNED (mm2)
				31	8.49	0.34	25.0	1.0	FIBRE	AMPHIBOLE	23	CUMMINGTONITE ANTHOPHYLLITE*		
				34	8.16	1.80	4.5	1.0	EMP	-	24	ACTINOLITE		
				35	8.96	1.61	5.6	1.0	EMP	-	25	ACTINOLITE		
				38	7.95	0.78	10.2	1.0	EMP	-	26	TREMOLITE		
				39	8.49	0.70	12.1	1.0	EMP	-	27	TREMOLITE		
				40	9.64	1.30	7.4	1.0	EMP	-	28	TREMOLITE		
				41	13.80	0.94	14.7	1.0	EMP	-	29	TREMOLITE		
				43	10.50	0.70	15.0	2.0	EMP	-	30	TREMOLITE		
				45	11.50	1.99	5.8	1.0	EMP	-	31	ACTINOLITE		
COMP OF WC029, WC030 AND WC031	T23-0103-03	0.0210	1	1	8.27	2.28	3.6	1.0	EMP	-	1	GRUNERITE	50	0.4
				2	6.30	1.35	4.7	1.0	EMP	-	2	NO EDX		
				3	7.52	1.18	6.4	1.0	EMP	-	3	ACTINOLITE		
				8	12.30	2.40	5.1	1.0	EMP	-	4	MAGNESIO HORNBLENDE		
				9	5.10	1.36	3.8	1.0	EMP	-	5	MAGNESIO HORNBLENDE		
				11	8.70	1.05	8.3	1.0	EMP	-	6	ACTINOLITE		
				13	5.27	0.67	7.9	1.0	EMP	-	7	MAGNESIO HORNBLENDE		
				20	6.79	1.38	4.9	1.0	EMP	-	8	MAGNESIO HORNBLENDE		
				25	6.31	1.50	4.2	1.0	EMP	-	9	ACTINOLITE		
				28	7.82	2.10	3.7	1.0	EMP	-	10	ACTINOLITE		
				28	7.93	2.27	3.5	1.0	EMP	-	11	MAGNESIO HORNBLENDE		
				30	11.40	0.58	19.7	1.0	FIBRE	AMPHIBOLE	12	MAGNESIO HORNBLENDE*		
				32	6.85	0.49	14.1	1.0	EMP	-	13	ACTINOLITE		
				34	8.99	1.56	5.8	1.0	EMP	-	14	ACTINOLITE		
				35	7.47	0.73	10.2	1.0	EMP	-	15	MAGNESIO HORNBLENDE		
				38	9.80	2.74	3.6	1.0	EMP	-	16	ACTINOLITE		
				39	11.30	1.48	7.6	1.0	EMP	-	17	MAGNESIO HORNBLENDE		
				42	7.44	1.92	3.9	1.0	EMP	-	18	ACTINOLITE		
				45	6.16	1.09	5.7	1.0	EMP	-	19	ACTINOLITE		
				47	9.32	1.16	8.0	1.0	EMP	-	20	MAGNESIO HORNBLENDE		
COMP OF WC069, WC070 AND WC075	T23-0103-04	0.0200	1	3	6.33	0.86	7.3	1.0	EMP	-	1	MAGNESIO HORNBLENDE	50	0.4
				6	9.55	1.59	6.0	1.0	EMP	-	2	ACTINOLITE		
				10	7.58	1.94	3.9	1.0	EMP	-	3	ACTINOLITE		
				11	9.28	1.61	5.8	1.0	EMP	-	4	ACTINOLITE		
				11	9.02	1.34	6.7	1.0	EMP	-	5	MAGNESIO HORNBLENDE		
				12	6.71	1.04	6.5	1.0	EMP	-	6	ACTINOLITE		
				17	5.83	1.04	5.6	1.0	EMP	-	7	MAGNESIO HORNBLENDE		
				21	6.64	1.20	5.5	1.0	EMP	-	8	MAGNESIO HORNBLENDE		
				24	5.52	1.62	3.4	1.0	EMP	-	9	MAGNESIO HORNBLENDE		
				26	6.85	1.83	3.7	1.0	EMP	-	10	ACTINOLITE		
				28	7.87	1.28	6.1	1.0	EMP	-	11	EDENITE		
				30	5.71	0.86	6.7	1.0	EMP	-	12	MAGNESIO HORNBLENDE		
				34	7.26	1.99	3.6	1.0	EMP	-	13	MAGNESIO HORNBLENDE		
				45	7.00	1.98	3.5	1.0	EMP	-	14	ACTINOLITE		
				50	7.89	1.16	6.8	1.0	EMP	-	15	ACTINOLITE		
COMP OF WC044, WC045 AND WC048	T23-0103-05	0.0210	1	1	6.75	1.69	4.0	1.0	EMP	-	1	ACTINOLITE	50	0.4
				2	12.20	1.66	7.3	1.0	EMP	-	2	CUMMINGTONITE ANTHOPHYLLITE		

CLIENT ID	LAB ID	MASS (g)	GRID#	GO#	LENGTH (um)	WIDTH (um)	RATIO L/W	COUNT	FIBRE, SAF or EMP	ELECTRON DIFFRACTION	EDX#	EDX COMPOSITION	N GO SCANNED	AREA SCANNED (mm2)
				3	17.60	2.09	8.4	1.0	EMP	-	3	ACTINOLITE		
				4	7.79	1.28	6.1	1.0	EMP	-	4	ACTINOLITE		
				8	5.04	0.74	6.9	1.0	EMP	-	5	ACTINOLITE		
				10	6.59	1.07	6.2	1.0	EMP	-	6	ACTINOLITE		
				12	12.10	1.94	6.2	1.0	EMP	-	7	CUMMINGTONITE ANTHOPHYLLITE		
				18	6.95	1.42	4.9	1.0	EMP	-	8	ACTINOLITE		
				20	7.52	1.37	5.5	1.0	EMP	-	9	ACTINOLITE		
				23	7.69	1.31	5.9	1.0	EMP	-	10	TREMOLITE		
				30	5.02	0.81	6.2	1.0	EMP	-	11	ACTINOLITE		
				35	7.33	0.71	10.3	1.0	EMP	-	12	MAGNESIO HORNBLENDE		
				43	11.90	2.12	5.6	1.0	EMP	-	13	ACTINOLITE		
				48	9.29	0.76	12.3	1.0	EMP	-	14	TREMOLITE		
COMP OF WC081 AND WC085	T23-0103-06	0.0200	1	1	8.32	1.66	5.0	1.0	EMP	-	1	EDENITE		
				6	7.96	1.21	6.6	1.0	EMP	-	2	MAGNESIO HORNBLENDE		
				18	5.99	1.35	4.4	1.0	EMP	-	3	ACTINOLITE		
				24	8.42	0.98	8.6	1.0	EMP	-	4	ACTINOLITE		
				31	6.32	0.53	11.8	1.0	EMP	AMPHIBOLE	5	ACTINOLITE*		
				37	10.30	1.79	5.8	1.0	EMP	-	6	ACTINOLITE		
				45	6.49	1.45	4.5	1.0	EMP	-	7	ACTINOLITE		

* Details of fibres identification shown in pages below.

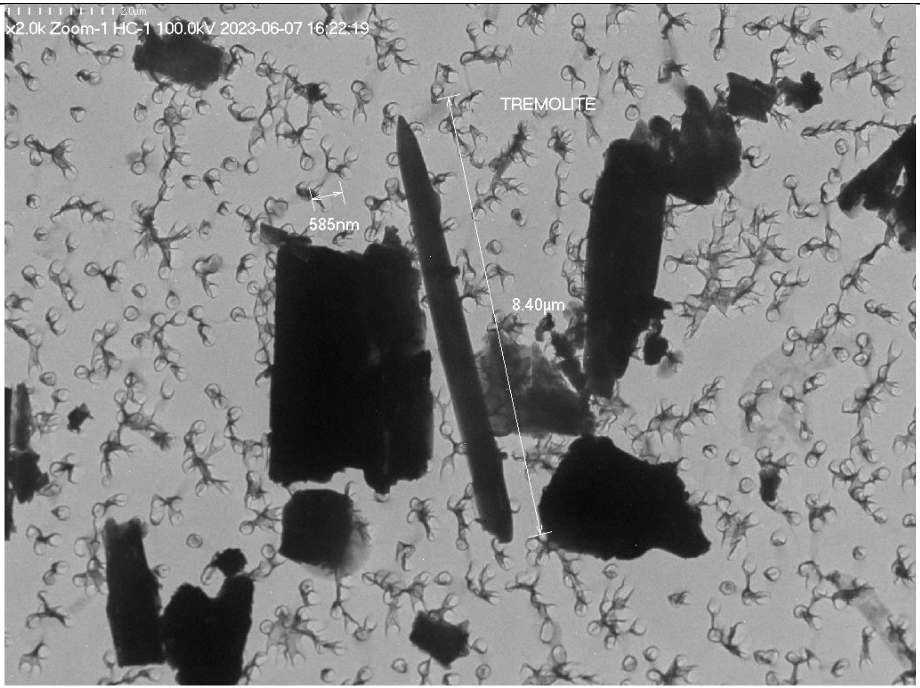
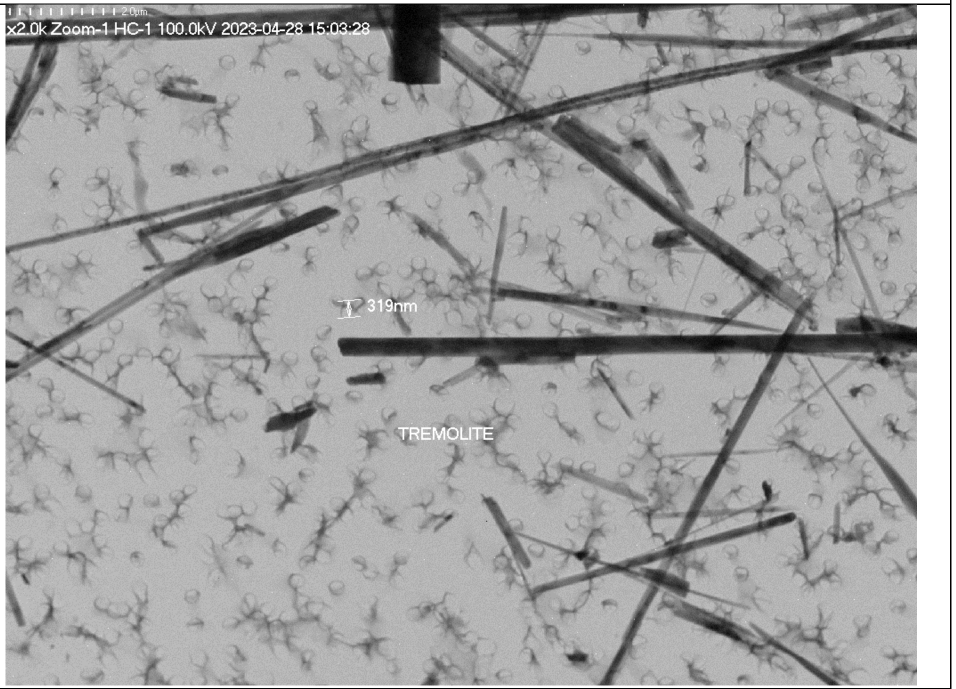
2.2 Low magnification TEM images of the TEM grids and a representative grid opening

<table>
<tr><td colspan="2"> </td><td colspan="2"> </td></tr>
<tr><td>Standard / Display Magnification:[4]</td><td>X01.0K / X02.0K</td><td>Standard / Display Magnification:</td><td>X0.05K / X0.10K</td></tr>
<tr><td>Reference:</td><td>T23-0103-02-G01</td><td>Reference:</td><td>T23-0103-02-G01</td></tr>
<tr><td colspan="2"> </td><td colspan="2"> </td></tr>
<tr><td>Standard / Display Magnification:</td><td>X01.0K / X02.0K</td><td>Standard / Display Magnification:</td><td>X0.05K / X0.10K</td></tr>
<tr><td>Reference:</td><td>T23-0103-03-G01</td><td>Reference:</td><td>T23-0103-03-G01</td></tr>
</table>

---

[4] Extracted from HT7700 Software Manual: *"Standard Magnification: in an instrument model equipped with the integration CCD camera, the magnification of an image projected at the CCD (scintillator) position is taken as a magnification standard.*
Display Magnification: Display magnification refers to a magnification factor on the display monitor."

2.3 Examples of structures detected

<table>
<tr><td colspan="2">2.3.1 Example of Tremolite Elongated Mineral Particle identified in sample T23-0103-02 [Client ID: Comp of WC014, WC016 and WC017]:</td><td colspan="2">REFERENCE HSE TREMOLITE (2023 APRIL UPDATE)</td></tr>
<tr><td colspan="4"><i>2.3.1.1 TEM OBSERVATION</i></td></tr>
<tr><td colspan="2">
</td><td colspan="2">
</td></tr>
<tr><td>Standard / Display Magnification:[5]</td><td>X02.0K / X15.0K</td><td>Standard / Display Magnification:</td><td>X02.0K / X15.0K</td></tr>
<tr><td>Emission current:</td><td>10 uA</td><td>Emission current:</td><td>10 uA</td></tr>
<tr><td>Acceleration voltage:</td><td>100 kV</td><td>Acceleration voltage:</td><td>100 kV</td></tr>
<tr><td colspan="4">FIBRE DEFINITION AS PER <u>ISO 22262-1:</u>
<i>“elongated particle which has parallel or stepped sides, For the purposes of this part of ISO 22262-1, a fibre is defined to have an aspect ratio equal to or greater than 3:1.”</i></td></tr>
<tr><td colspan="4">OBSERVATION: The structure DOES NOT meet the criteria of a fibre as per ISO 22262-1.</td></tr>
<tr><td colspan="4">RESULT: ELONGATED MINERAL PARTICLE MORPHOLOGY IDENTIFIED.</td></tr>
</table>

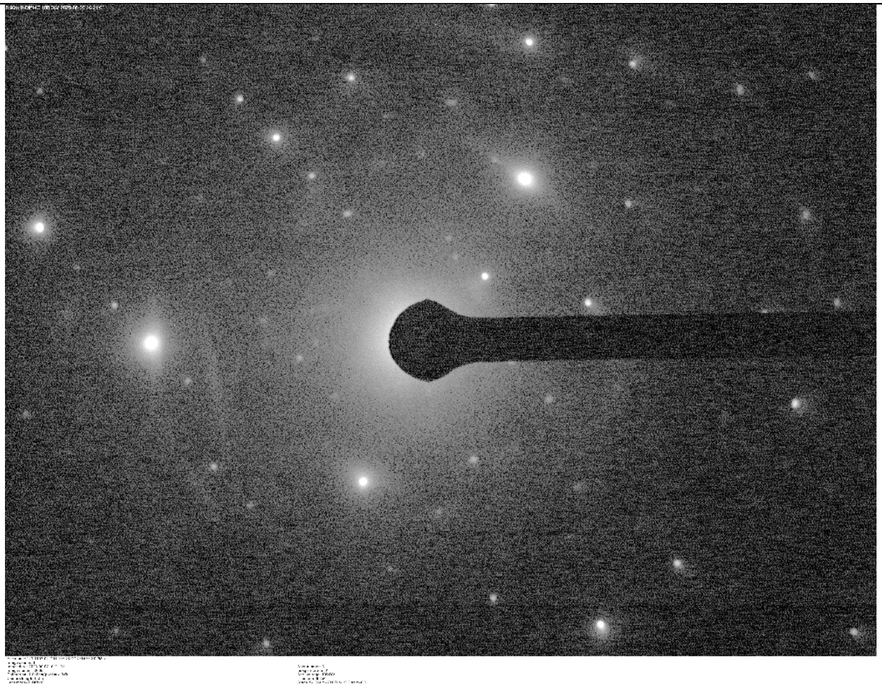
---

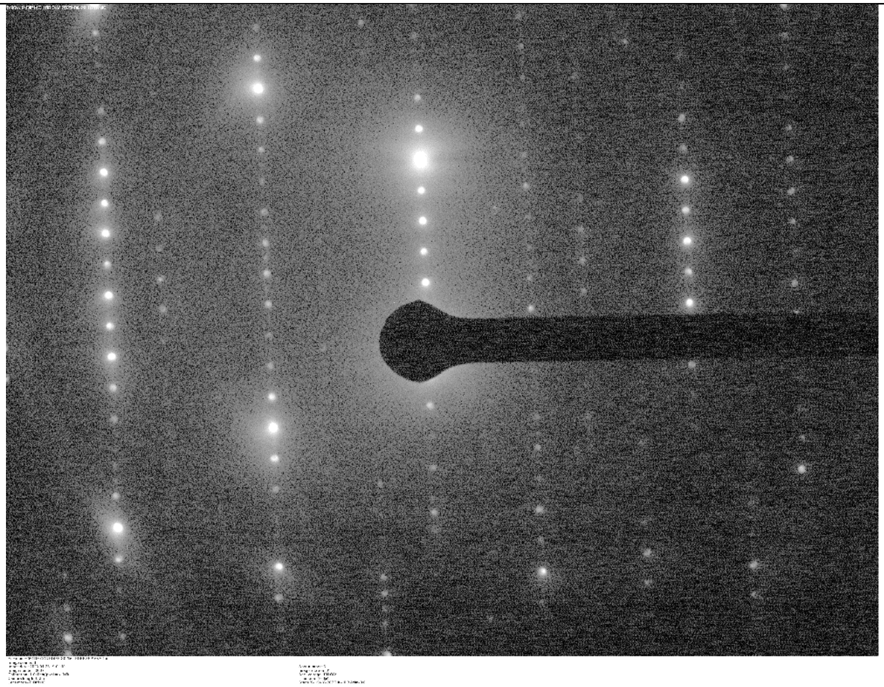
[5] Extracted from HT7700 Software Manual: *“Standard Magnification: in an instrument model equipped with the integration CCD camera, the magnification of an image projected at the CCD (scintillator) position is taken as a magnification standard.*
Display Magnification: Display magnification refers to a magnification factor on the display monitor.”

2.3.1 Example of Tremolite Elongated Mineral Particle identified in sample T23-0103-02 [Client ID: Comp of WC014, WC016 and WC017]:

REFERENCE HSE TREMOLITE (2023 APRIL UPDATE)

2.3.1.2 ELECTRON DIFFRACTION





Camera length:	0.3m	Camera length:	0.3m
Emission current:	10uA	Emission current:	10uA
Acceleration voltage:	100kV	Acceleration voltage:	100kV

QUALITATIVE ELECTRON DIFFRACTION DEFINITION AS PER ISO 22262-1:

“Qualitative ELECTRON DIFFRACTION (ED) consists of visual examination, without detailed measurement, of the general characteristics of the ED pattern obtained on the TEM viewing screen from a randomly oriented fibre. ED patterns obtained from fibres with cylindrical symmetry, such as chrysotile, do not change when the fibres are tilted about their axes, and patterns from randomly oriented fibres of these minerals can be interpreted quantitatively. For fibres which do not have cylindrical symmetry, only those ED patterns obtained when the fibre is oriented with a principal crystallographic axis closely parallel with the incident electron-beam direction can be interpreted quantitatively.”

Qualitative electron diffraction on amphiboles consists of observing rows of spots that allow to assess the crystallinity of the structure.

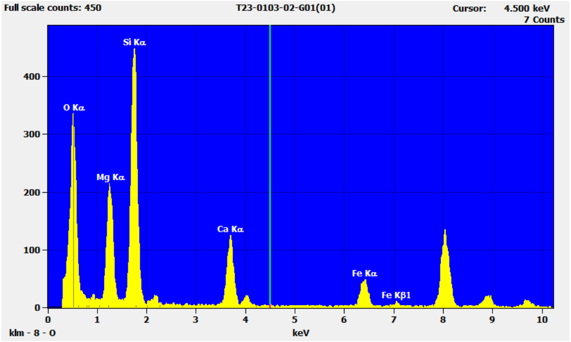
OBSERVATION: The rows of diffraction spots are qualitatively similar.

RESULT: CRYSTALLINE STRUCTURE IDENTIFIED.

2.3.1 Example of Tremolite Elongated Mineral Particle identified in sample T23-0103-02 [Client ID: Comp of WC014, WC016 and WC017]:

REFERENCE HSE TREMOLITE (2023 APRIL UPDATE)

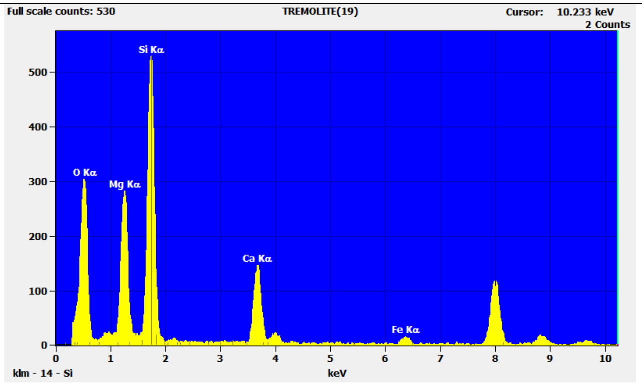
2.3.1.3 EDX SPECTRUM



Tilt angle	20 deg
Acquisition time	30-60 sec

Quantitative Results for: T23-0103-02-G01(01)

Element Line	*Net Counts*	*Net Counts Error*	*K-Factor*	*Weight %*	*Weight % Error*	*Atom %*	*Atom % Error*	*Formula*	*Compnd %*
O K	0	0	---	44.89S	---	60.25	± 0.00	(null)	---
Mg K	2900	± 57	1.150	14.02	---	12.38	± 0.24	MgO	23.25
Si K	6376	± 83	1.000	26.80	---	20.49	± 0.27	SiO2	57.33
Ca K	1976	± 48	1.100	9.14	---	4.89	± 0.12	CaO	12.78
Fe K	877	± 32	1.400	5.16	---	1.98	± 0.07	FeO	6.64
Total				100.00		100.00			100.00



Tilt angle	20 deg
Acquisition time	30-60 sec

Quantitative Results for: TREMOLITE(19)

Element Line	*Net Counts*	*Net Counts Error*	*K-Factor*	*Weight %*	*Weight % Error*	*Atom %*	*Atom % Error*	*Formula*	*Compnd %*
O K	0	0	---	45.58S	---	59.96	± 0.00	(null)	---
Na K	135	± 20	1.246	0.60	---	0.55	± 0.08	Na2O	0.81
Mg K	3776	± 65	1.150	15.50	---	13.42	± 0.23	MgO	25.70
Al K	150	± 19	0.975	0.52	---	0.41	± 0.05	Al2O3	0.99
Si K	7479	± 90	1.000	26.69	---	20.00	± 0.24	SiO2	57.10
Ca K	2533	± 53	1.100	9.94	---	5.22	± 0.11	CaO	13.91
Fe K	233	± 19	1.400	1.16	---	0.44	± 0.04	FeO	1.50
Total				100.00		100.00			100.00

QUALITATIVE/QUANTITATIVE EDXA AS PER ISO 22262-1:

"measurement of the energies and intensities of X-rays by use of a solid-state detector and multichannel analyser system"

TREMOLITE AS PER ISO 22262-1: *"Classify a fibre as tremolite if:*

- *the Mg, Ca and Fe peaks are comparable in ratio with those of the reference tremolite;*
- *no statistically significant peak from Al is present;*
- *any peak from either Na or K is small.*

NOTE Depending on the composition of any adjacent or attached particles, other peaks can also be visible."

OBSERVATION: The chemical compositions are qualitatively similar between the structure in the sample and the reference.

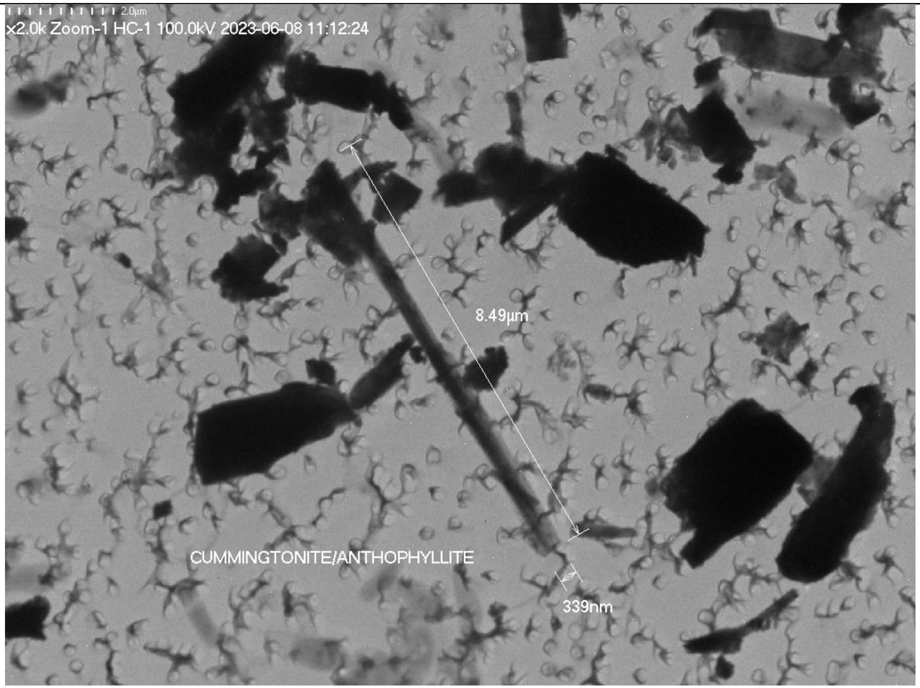
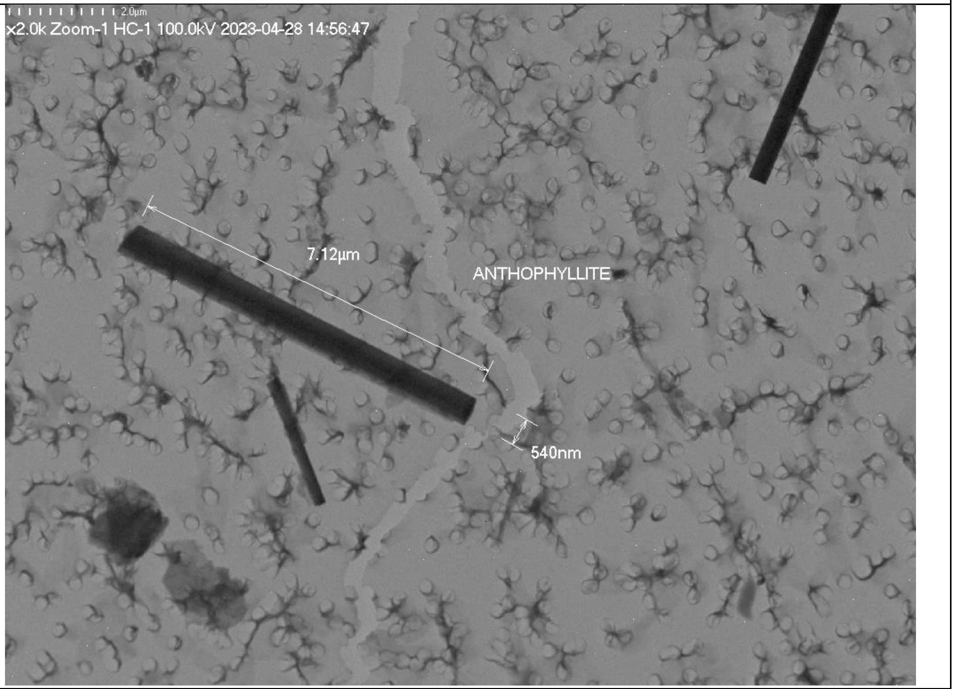
RESULT: TREMOLITE CHEMICAL COMPOSITION IDENTIFIED.

In accordance with Andrew J Locock classification of chemical analyses of orthorhombic and monoclinic amphiboles following the 2012 nomenclature recommended by the International Mineralogical Association.

2.3.2 Example of Cummingtonite/Anthophyllite Fibre identified in sample T23-0103-02 [Client ID: Comp of WC014, WC016 and WC017]:

REFERENCE HSE ANTHOPHYLLITE (MAR 2022 UPDATE)

2.3.2.1 TEM OBSERVATION

			
Standard / Display Magnification:[6]	X02.0K / X15.0K	Standard / Display Magnification:	X02.0K / X15.0K
Emission current:	10 uA	Emission current:	10 uA
Acceleration voltage:	100 kV	Acceleration voltage:	100 kV

FIBRE DEFINITION AS PER ISO 22262-1:

"elongated particle which has parallel or stepped sides, For the purposes of this part of ISO 22262-1, a fibre is defined to have an aspect ratio equal to or greater than 3:1."

OBSERVATION: The structures meet the criteria of a fibre as per ISO 22262-1.

RESULT: FIBRE MORPHOLOGY IDENTIFIED.

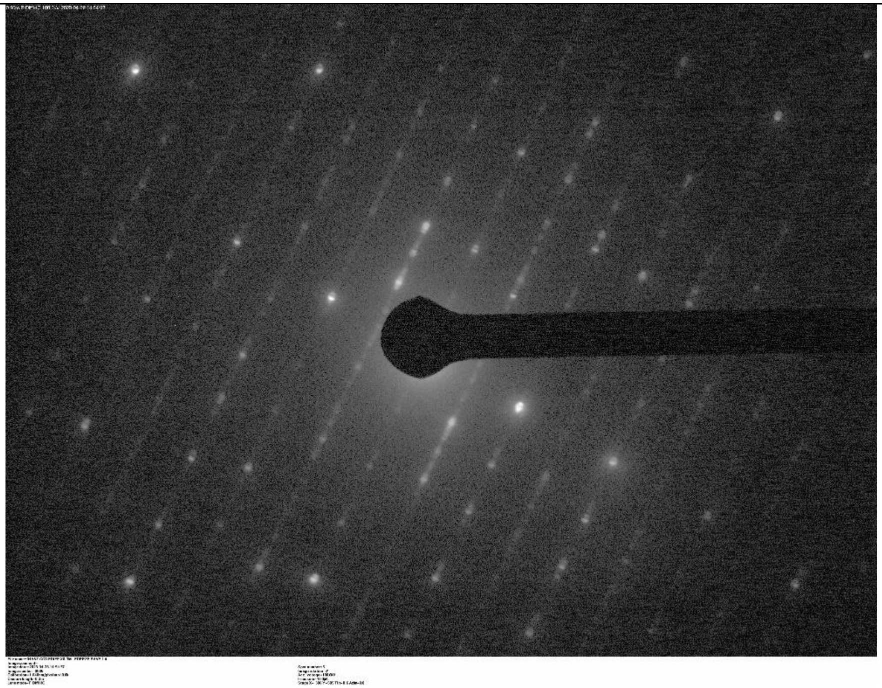
---

[6] Extracted from HT7700 Software Manual: *"Standard Magnification: in an instrument model equipped with the integration CCD camera, the magnification of an image projected at the CCD (scintillator) position is taken as a magnification standard.*
Display Magnification: Display magnification refers to a magnification factor on the display monitor."

2.3.2 Example of Cummingtonite/Anthophyllite Fibre identified in sample T23-0103-02 [Client ID: Comp of WC014, WC016 and WC017]:

REFERENCE HSE ANTHOPHYLLITE (MAR 2022 UPDATE)

2.3.2.2 ELECTRON DIFFRACTION



Camera length:	0.3m	Camera length:	0.3m
Emission current:	10uA	Emission current:	10uA
Acceleration voltage:	100kV	Acceleration voltage:	100kV

QUALITATIVE ELECTRON DIFFRACTION DEFINITION AS PER ISO 22262-1:

"Qualitative ELECTRON DIFFRACTION (ED) consists of visual examination, without detailed measurement, of the general characteristics of the ED pattern obtained on the TEM viewing screen from a randomly oriented fibre. ED patterns obtained from fibres with cylindrical symmetry, such as chrysotile, do not change when the fibres are tilted about their axes, and patterns from randomly oriented fibres of these minerals can be interpreted quantitatively. For fibres which do not have cylindrical symmetry, only those ED patterns obtained when the fibre is oriented with a principal crystallographic axis closely parallel with the incident electron-beam direction can be interpreted quantitatively."

Qualitative electron diffraction on amphiboles consists of observing rows of spots that allow to assess the crystallinity of the structure.

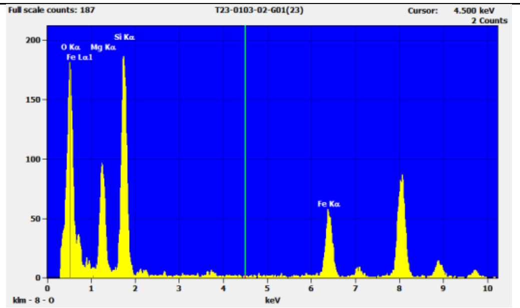
OBSERVATION: The rows of diffraction spots are qualitatively similar.

RESULT: CRYSTALLINE STRUCTURE IDENTIFIED.

2.3.2 Example of Cummingtonite/Anthophyllite Fibre identified in sample T23-0103-02 [Client ID: Comp of WC014, WC016 and WC017]:

REFERENCE HSE ANTHOPHYLLITE (MAR 2022 UPDATE)

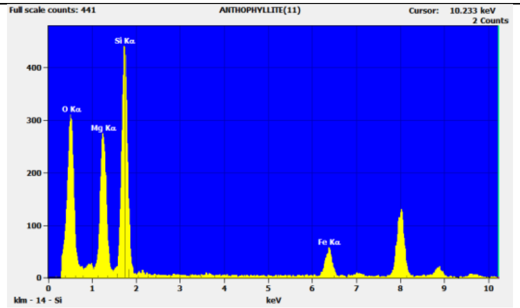
2.3.2.3 EDX SPECTRUM



Tilt angle	20 deg
Acquisition time	30-60 sec

Quantitative Results for: T23-0103-02-G01(23)

Element Line	*Net Counts*	*Net Counts Error*	*K-Factor*	*Weight %*	*Weight % Error*	*Atom %*	*Atom % Error*	*Formula*	*Compnd %*
O K	0	0	---	44.02S	---	60.35	± 0.00	(null)	---
Mg K	1261	± 37	1.150	14.49	---	13.08	± 0.38	MgO	24.04
Si K	2651	± 53	1.000	26.50	---	20.69	± 0.41	SiO2	56.68
Fe K	1071	± 34	1.400	14.99	---	5.89	± 0.19	FeO	19.28
Total				100.00		100.00			100.00



Tilt angle	20 deg
Acquisition time	30-60 sec

Quantitative Results for: ANTHOPHYLLITE(11)

Element Line	*Net Counts*	*Net Counts Error*	*K-Factor*	*Weight %*	*Weight % Error*	*Atom %*	*Atom % Error*	*Formula*	*Compnd %*
O K	0	0	---	46.11S	---	59.93	± 0.00	(null)	---
Na K	200	± 21	1.246	1.02	---	0.92	± 0.10	Na2O	1.38
Mg K	4050	± 67	1.150	19.09	---	16.33	± 0.27	MgO	31.66
Al K	122	± 18	0.975	0.49	---	0.38	± 0.06	Al2O3	0.92
Si K	6635	± 85	1.000	27.20	---	20.14	± 0.26	SiO2	58.18
Ca K	48	± 14	1.100	0.22	---	0.11	± 0.03	CaO	0.30
Fe K	1024	± 35	1.400	5.88	---	2.19	± 0.07	FeO	7.56
Total				100.00		100.00			100.00

QUALITATIVE/QUANTITATIVE EDXA AS PER ISO 22262-1:

"measurement of the energies and intensities of X-rays by use of a solid-state detector and multichannel analyser system"

ANTHOPHYLLITE AS PER ISO 22262-1: *"Classify a fibre as anthophyllite if:*

- *the fibre is straight and exhibits no evidence of a ribbon-like structure;*
- *the Mg and Si peaks are comparable in ratio to those of reference anthophyllite — anthophyllite from some sources may not exhibit a peak from Fe, although in commercial anthophyllite a peak from Fe will probably be observed;*
- *no statistically significant peaks from Na or Al are present;*
- *the Mn peak, if present, is small.*

NOTE Depending on the composition of any adjacent or attached particles, other peaks can also be visible."

OBSERVATION: The chemical compositions are qualitatively similar between the structure in the sample and the reference.

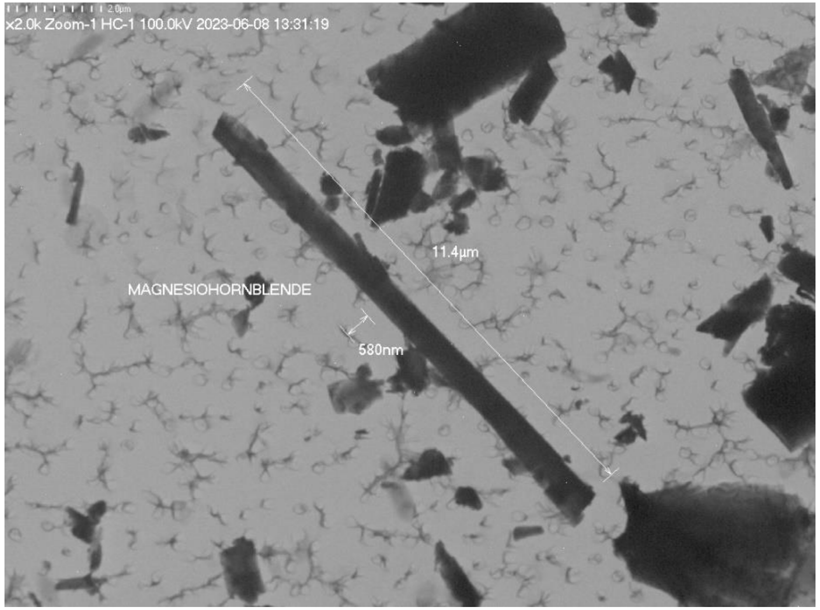
RESULT: CUMMINGTONITE/ANTHOPHYLLITE CHEMICAL COMPOSITION IDENTIFIED.

The analytical method employed does not enable a clear distinction between Cummingtonite and Anthophyllite. Both minerals share identical chemical compositions, and only quantitative electron diffraction using a double tilt specimen holder can provide differentiation.

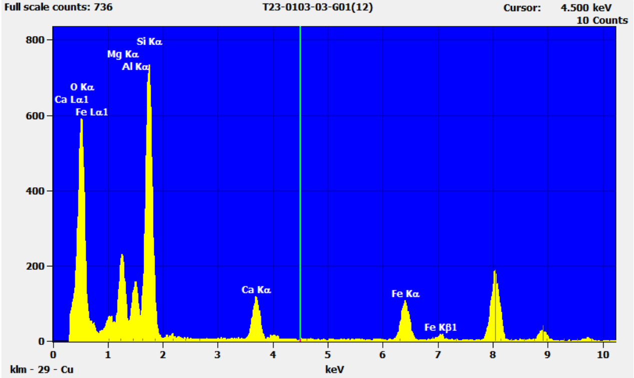
In accordance with Andrew J Locock classification of chemical analyses of orthorhombic and monoclinic amphiboles following the 2012 nomenclature recommended by the International Mineralogical Association.

2.3.3 Example of Magnesio-Hornblende Fibre identified in sample T23-0103-03 [Client ID: Comp of WC029, WC030 and WC031]:

2.3.3.1 TEM OBSERVATION



2.3.3.2 EDX SPECTRUM



Quantitative Results for: T23-0103-03-G01(12)

Element Line	*Net Counts*	*Net Counts Error*	*K-Factor*	*Weight %*	*Weight % Error*	*Atom %*	*Atom % Error*	*Formula*	*Compnd %*
O K	0	0	---	46.01S	---	61.49	± 0.00	(null)	---
Mg K	2947	± 59	1.150	9.07	---	7.98	± 0.16	MgO	15.05
Al K	2051	± 50	0.975	5.35	---	4.24	± 0.10	Al2O3	10.12
Si K	10230	± 107	1.000	27.39	---	20.85	± 0.22	SiO2	58.59
Ca K	1746	± 47	1.100	5.14	---	2.74	± 0.07	CaO	7.19
Fe K	1878	± 47	1.400	7.04	---	2.70	± 0.07	FeO	9.06
Total				100.00		100.00			100.00

Standard / Display Magnification:[7]	X02.0K / X15.0K	Tilt angle	20 deg
Emission current:	10 uA	Acquisition time	30-60 sec
Acceleration voltage:	100 kV		

FIBRE DEFINITION AS PER ISO 22262-1:

"elongated particle which has parallel or stepped sides, For the purposes of this part of ISO 22262-1, a fibre is defined to have an aspect ratio equal to or greater than 3:1."

OBSERVATION: The structure meets the criteria of fibre as per ISO 22262-1.

The EDX spectrum identifies the presence of OXYGEN, MAGNESIUM, ALUMINIUM, SILICON, CALCIUM and IRON and is qualitatively similar to the EDX spectrum of MAGNESIO-HORNBLENDE. When there is sufficient replacement of magnesium, silicon, calcium or iron with aluminium, the type of mineral changes from ACTINOLITE-TREMOLITE to MAGNESIO-HORNBLENDE (in accordance with Andrew J Locock classification of chemical analyses of orthorhombic and monoclinic amphiboles following the 2012 nomenclature recommended by the International Mineralogical Association).

RESULT: MAGNESIO-HORNBLENDE FIBRE IDENTIFIED.

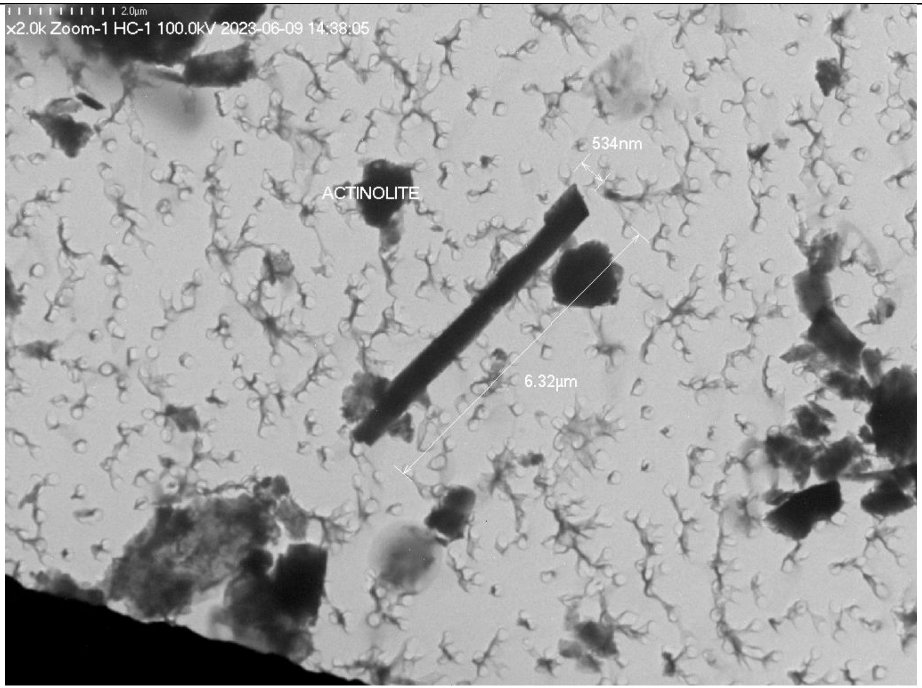
---

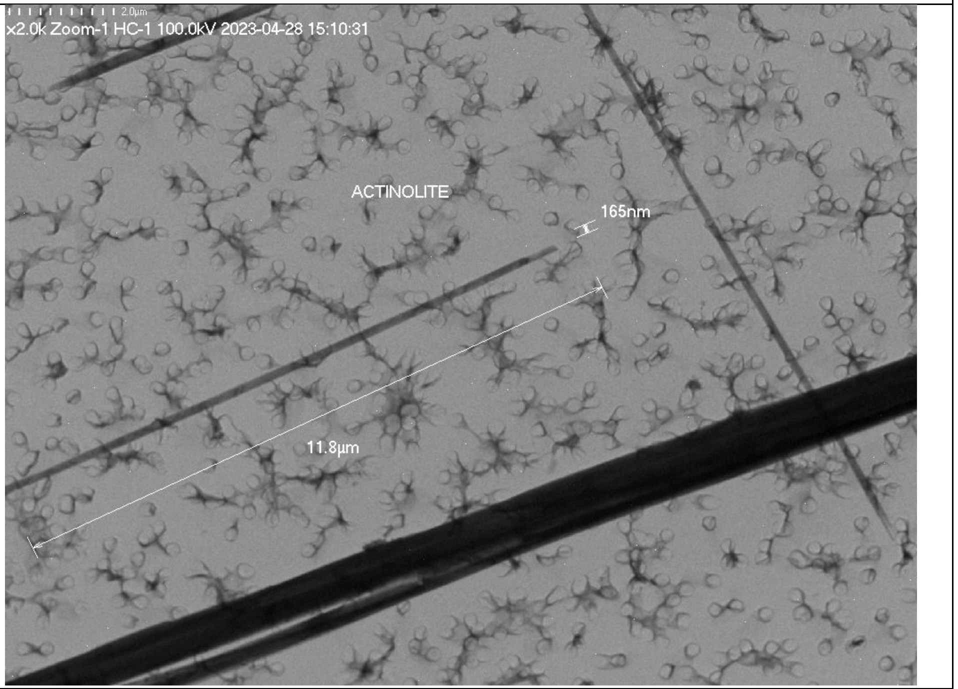
[7] Extracted from HT7700 Software Manual: *"Standard Magnification: in an instrument model equipped with the integration CCD camera, the magnification of an image projected at the CCD (scintillator) position is taken as a magnification standard.*
Display Magnification: Display magnification refers to a magnification factor on the display monitor."

2.3.4 Example of Actinolite Elongated Mineral Particle identified in sample T23-0103-06 [Client ID: Comp of WC081 and WC085]:

REFERENCE HSE ACTINOLITE (2023 APRIL UPDATE)

2.3.4.1 TEM OBSERVATION





Standard / Display Magnification:[8]	X02.0K / X15.0K	Standard / Display Magnification:	X02.0K / X15.0K
Emission current:	10 uA	Emission current:	10 uA
Acceleration voltage:	100 kV	Acceleration voltage:	100 kV

FIBRE DEFINITION AS PER ISO 22262-1:

“elongated particle which has parallel or stepped sides, For the purposes of this part of ISO 22262-1, a fibre is defined to have an aspect ratio equal to or greater than 3:1.”

OBSERVATION: The structure DOES NOT meet the criteria of a fibre as per ISO 22262-1.

RESULT: ELONGATED MINERAL PARTICLE MORPHOLOGY IDENTIFIED.

---

[8] Extracted from HT7700 Software Manual: *“Standard Magnification: in an instrument model equipped with the integration CCD camera, the magnification of an image projected at the CCD (scintillator) position is taken as a magnification standard.*
Display Magnification: Display magnification refers to a magnification factor on the display monitor.”

2.3.4 Example of Actinolite Elongated Mineral Particle identified in sample T23-0103-06 [Client ID: Comp of WC081 and WC085]:	**REFERENCE HSE ACTINOLITE (2023 APRIL UPDATE)**

2.3.4.2 ELECTRON DIFFRACTION

Camera length:	0.3m	Camera length:	0.3m
Emission current:	10uA	Emission current:	10uA
Acceleration voltage:	100kV	Acceleration voltage:	100kV

QUALITATIVE ELECTRON DIFFRACTION DEFINITION AS PER ISO 22262-1:

“Qualitative ELECTRON DIFFRACTION (ED) consists of visual examination, without detailed measurement, of the general characteristics of the ED pattern obtained on the TEM viewing screen from a randomly oriented fibre. ED patterns obtained from fibres with cylindrical symmetry, such as chrysotile, do not change when the fibres are tilted about their axes, and patterns from randomly oriented fibres of these minerals can be interpreted quantitatively. For fibres which do not have cylindrical symmetry, only those ED patterns obtained when the fibre is oriented with a principal crystallographic axis closely parallel with the incident electron-beam direction can be interpreted quantitatively.”

Qualitative electron diffraction on amphiboles consists of observing rows of spots that allow to assess the crystallinity of the structure.

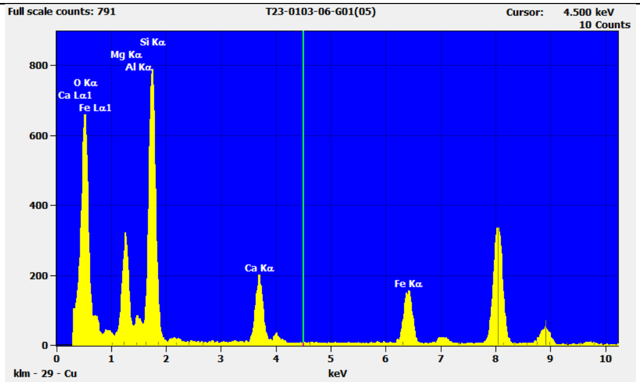
OBSERVATION: The rows of diffraction spots are qualitatively similar.

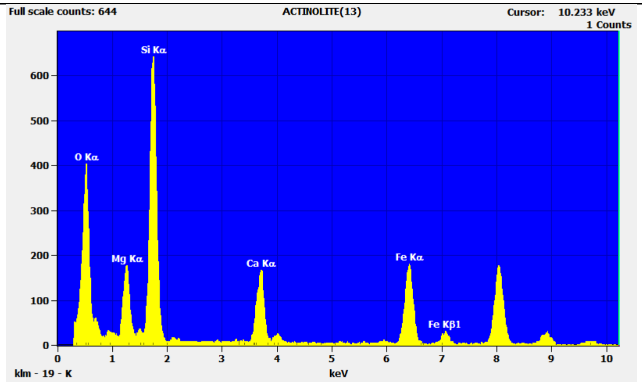
RESULT: CRYSTALLINE STRUCTURE IDENTIFIED.

2.3.4 Example of Actinolite Elongated Mineral Particle identified in sample T23-0103-06 [Client ID: Comp of WC081 and WC085]:

REFERENCE HSE ACTINOLITE (2023 APRIL UPDATE)

2.3.4.3 EDX SPECTRUM





Tilt angle	20 deg
Acquisition time	30-60 sec

Quantitative Results for: T23-0103-06-G01(05)

Element Line	*Net Counts*	*Net Counts Error*	*K-Factor*	*Weight %*	*Weight % Error*	*Atom %*	*Atom % Error*	*Formula*	*Compnd %*
O K	0	0	---	43.80S	---	60.39	± 0.00	(null)	---
Mg K	4024	± 69	1.150	10.41	---	9.44	± 0.16	MgO	17.26
Al K	997	± 39	0.975	2.19	---	1.79	± 0.07	Al2O3	4.13
Si K	11257	± 113	1.000	25.32	---	19.88	± 0.20	SiO2	54.16
Ca K	3329	± 62	1.100	8.24	---	4.53	± 0.08	CaO	11.52
Fe K	3193	± 60	1.400	10.05	---	3.97	± 0.07	FeO	12.93
Total				100.00		100.00			100.00

Tilt angle	20 deg
Acquisition time	30-60 sec

Quantitative Results for: ACTINOLITE(13)

Element Line	*Net Counts*	*Net Counts Error*	*K-Factor*	*Weight %*	*Weight % Error*	*Atom %*	*Atom % Error*	*Formula*	*Compnd %*
O K	0	0	---	42.68S	---	60.53	± 0.00	(null)	---
Na K	105	± 22	1.246	0.39	---	0.38	± 0.08	Na2O	0.52
Mg K	2129	± 51	1.150	7.22	---	6.74	± 0.16	MgO	11.98
Al K	254	± 25	0.975	0.73	---	0.61	± 0.06	Al2O3	1.38
Si K	8788	± 99	1.000	25.93	---	20.94	± 0.24	SiO2	55.46
Ca K	2747	± 56	1.100	8.91	---	5.05	± 0.10	CaO	12.47
Fe K	3423	± 62	1.400	14.14	---	5.74	± 0.10	FeO	18.19
Total				100.00		100.00			100.00

QUALITATIVE/QUANTITATIVE EDXA AS PER ISO 22262-1:

“measurement of the energies and intensities of X-rays by use of a solid-state detector and multichannel analyser system”

ACTINOLITE AS PER ISO 22262-1: *“Classify a fibre as actinolite if:*

- *the Mg, Si, Ca and Fe peaks are comparable in ratio to those of the reference actinolite;*
- *no statistically significant peaks from Na or Al are present;*
- *the Mn peak, if present, is small.*

NOTE Depending on the composition of any adjacent or attached particles, other peaks can also be visible.”

OBSERVATION: The chemical compositions are qualitatively similar between the structure in the sample and the reference.

RESULT: ACTINOLITE CHEMICAL COMPOSITION IDENTIFIED.

In accordance with Andrew J Locock classification of chemical analyses of orthorhombic and monoclinic amphiboles following the 2012 nomenclature recommended by the International Mineralogical Association.