SOILWATER CONSULTANTS

FINGALS PROJECT GEOCHEMICAL CHARACTERISATION

Prepared for:	**BLACK CAT SYNDICATE**
Date of Issue:	14 April 2022
Project No.:	BC8-004-1-03

Distribution:

[redacted]

DOCUMENT STATUS RECORD

Project Title:	FINGALS PROJECT GEOCHEMICAL CHARACTERISATION
Project No.:	BC8-004-1-03
Client:	BLACK CAT SYNDICATE

[redacted]

Revision Code*

A - Report issued for internal review

B - Draft report issued for client review

C - Final report issued to client

LIMITATIONS

The sole purpose of this report and the associated services performed by Soil Water Consultants (SWC) was to undertake geochemical characterisation for the deposits situated at the Fingal's Project. This work was conducted in accordance with the Scope of Work presented to the Black Cat Syndicate ('the Client'). SWC performed the services in a manner consistent with the normal level of care and expertise exercised by members of the earth sciences profession. Subject to the Scope of Work, the geochemical investigation was confined to the immediate areas of the three defined deposits. No extrapolation of the results and recommendations reported in this study should be made to areas external to this project area. In preparing this study, SWC has relied on relevant published reports and guidelines, and information provided by the Client. All information is presumed accurate and SWC has not attempted to verify the accuracy or completeness of such information. While normal assessments of data reliability have been made, SWC assumes no responsibility or liability for errors in this information. All conclusions and recommendations are the professional opinions of SWC personnel. SWC is not engaged in reporting for the purpose of advertising, sales, promoting or endorsement of any client interests. No warranties, expressed or implied, are made with respect to the data reported or to the findings, observations and conclusions expressed in this report. All data, findings, observations and conclusions are based solely upon site conditions at the time of the investigation and information provided by the Client. This report has been prepared on behalf of and for the exclusive use of the Client, its representatives and advisors. SWC accepts no liability or responsibility for the use of this report by any third party.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

Soil Water Consultants (SWC) was engaged by the Blackcat Syndicate (BC8) to carry out a geochemical characterisation of three defined deposits at the Fingal's Project, namely the Fingals Fortune, Baguss and Futi Baguss deposits (Figure 1.1). All three of these deposits have been previously mined by third party operators through the development of open cut pits with all three pits used to store tailings generated from ore processing. The two smaller pits (Futi and Bagus) are completely backfilled to surface (including rehabilitation material at surface) whilst the Fingals Fortune pit has been partially backfilled.

BC8 is currently in the process of expanding the gold ore resource base with the intention of re-starting mining in the area. This geochemical investigation therefore has two aims; supporting the eventual re-commencement of mining in the area by identifying the presence or absence of potential acid mine (AMD) or metalliferous (MD) drainage materials, or other problematic material types within waste rock material and supporting ongoing closure planning for existing infrastructure on-site such as the tailings storage facility (TSF) and existing waste dumps.

1.1 STUDY OBJECTIVES

The specific objectives of this work were to:

- Assess the current baseline geochemical conditions existing within the proposed development areas
- Identify the risk of AMD and/or MD developing within waste materials following disturbance.
- Undertake an Acid Base Account (ABA) to identify the environmental risks associated with disturbance of any AMD materials.
- Identify other potentially problematic waste material characteristics that may impact on the stability and sustainability of post-mine landforms.
- Assess geochemical conditions of the tailings material stored on-site, including metal content.
- Suggest management strategies for the handling and utilisation of the waste rock materials and tailings materials during mining and rehabilitation.

1.2 SCOPE OF WORK

The scope of work completed by SWC to meet the study objectives of this project included:

- Review of existing geological and assay drill data provided by BC8.
- Identification of representative drill holes providing sufficient lithological and spatial coverage within the deposit areas.
- Undertake and coordinate the initial laboratory screen analysis.
- Selection of waste rock and tailings samples for additional detailed laboratory analysis to confirm their ARD and MD status.
- Review of laboratory results and preparation of this report.

BLACK CAT SYNDICATE	Figure 1.1: Fingals Mining Area overview
FINGALS PROJECT GEOCHEMICAL CHARACTERISATION	

soilwater GROUP

2 STUDY METHODOLOGY

2.1 STUDY LOCATION

The Fingals Project area is located within the Kalgoorlie Terrane of the Eastern Goldfields Province, approximately 70 km southeast of the town of Kalgoorlie-Boulder.

2.2 DEPOSIT GEOLOGY

The project area is located in the Kalgoorlie Terrane of the Eastern Goldfields Province which is set in the Archaean Yilgarn Craton. The Kalgoorlie Terrane is defined by a set of greenstone belts which share a distinctive stratigraphic and deformation history, termed a tectono-stratigraphic terrane. The deformation history specific to the area commonly involves early thrusting, east-west shortening, culminating in left lateral strike slip faulting (Bateman 2001). It is separated from the Gindalbie Terrane to the northeast by the Moriarty Shear-Mount Monger Fault System and Menzies. This fault system transects the Fingals Project area.

The Kalgoorlie Terrane can be split into two distinct parts consisting of: a lower unit of felsic to intermediate volcanic, volcanogenic and intrusive rocks; and an upper unit of high magnesium basalt containing numerous units of fine-grained clastic sediment. The upper unit is intruded by ultramafic and mafic sills, and irregular bodies of quartz feldspar porphyry. A higher unit of clastic sediments containing BIF occurs to the east of the area.

The Gindalbie Terrane is comprised of a number of mafic to felsic units which are overlain by a thick ultramafic to mafic succession known as the Bulong Complex. Both sequences are folded into a broad, north-south plunging anticline feature known as the Bulong Anticline. Fingals Fortune overlies the western limb of this structural feature and covers a greenstone succession of komatiite dominated ultramafics which contain thin interlayered felsic tuffs. This succession is underlain by younger calc-alkaline type volcanic rocks with minor lenses of fine grained sediments.

The geological sequence at Fingals Fortune is comprised of mafic units of High-Mg basalts to pyroxenite gabbro composition, with intrusive dolerite sills running parallel to bedding with the whole sequence cross-cut by quartz-feldspar porphyries. A deep weathering profile exists across the area extending down to ~60m in places.

The main mineralisation targeted by the proposed development within the Fingals Fortune area is hosted by the sheared basalt within quartz veins which are structurally controlled and occur as a series of stacked west dipping lodes containing nuggetty gold mineralisation. The shear zones display intense hydrothermal alteration with bleached sericite and pyrite associated with silicification and carbonate alteration. In contrast the mineralisation within the satellite pits to the east of the main deposit area occur parallel to bedding as porphyry hosted mineralisation.

2.3 REVIEW OF EXISTING GEOLOGICAL DRILLING DATA

This section presents a breakdown of the existing geological data which has been gathered by BC8 across the deposit areas. Due to the differences in lithology and mineralisation style the drilling information has been divided into two areas, with the first covering the Fingals Fortune area (Fingals) and the second the Futi Baguss and Baguss areas (Fingals East).

2.3.1 FINGALS AREA

Approximately 1,450 holes have been drilled within the immediate surrounds of the Fingals area (Figure 2.1). The drilling has been conducted to depths of between 20 and 200m with samples variously collected as 1, 2m vertical composites. This data represents over 85,000 meters of drilling and logging. The number of samples logged for each lithology which comprised greater than 0.1% of the total samples logged is provided in Table 2.1.

Table 2.1: Summary of lithology data for Fingals Area

Lithology	No.	%	Lithology	No.	%
NLST	64	0.64	Tertiary Sediment	406	4.04
Residual Laterite	66	0.66	Felsic undifferentiated	12	0.12
Upper Saprolite	2,764	27.5	Felsic Schist	82	0.82
Saprolite	424	4.22	Intermediate Volcanic Rock	18	0.18
Lower Saprolite	504	5.02	Mafic undifferentiated	1,262	13.6
Saprock	1,106	11.0	Basalt	130	1.30
Siltstone	30	0.30	Mafic Schist	2,700	26.9
Tertiary Gravel	182	1.81	Quartz Vein	74	0.74
Tertiary Laterite	88	0.88			

The summary data drawn from the drilling database shows the deposit area has a deeply weathered profile, with a thin transported cover of tertiary sediments over a 30 – 60 m thick saprolite / saprock profile with less weathered basement rock underneath. The logged fresh rock materials are dominated by mafic volcanic sequences with minor felsic material. Together the mafic material unit types represent approximately 95% of the logged fresh rock material within the Fingals Area.

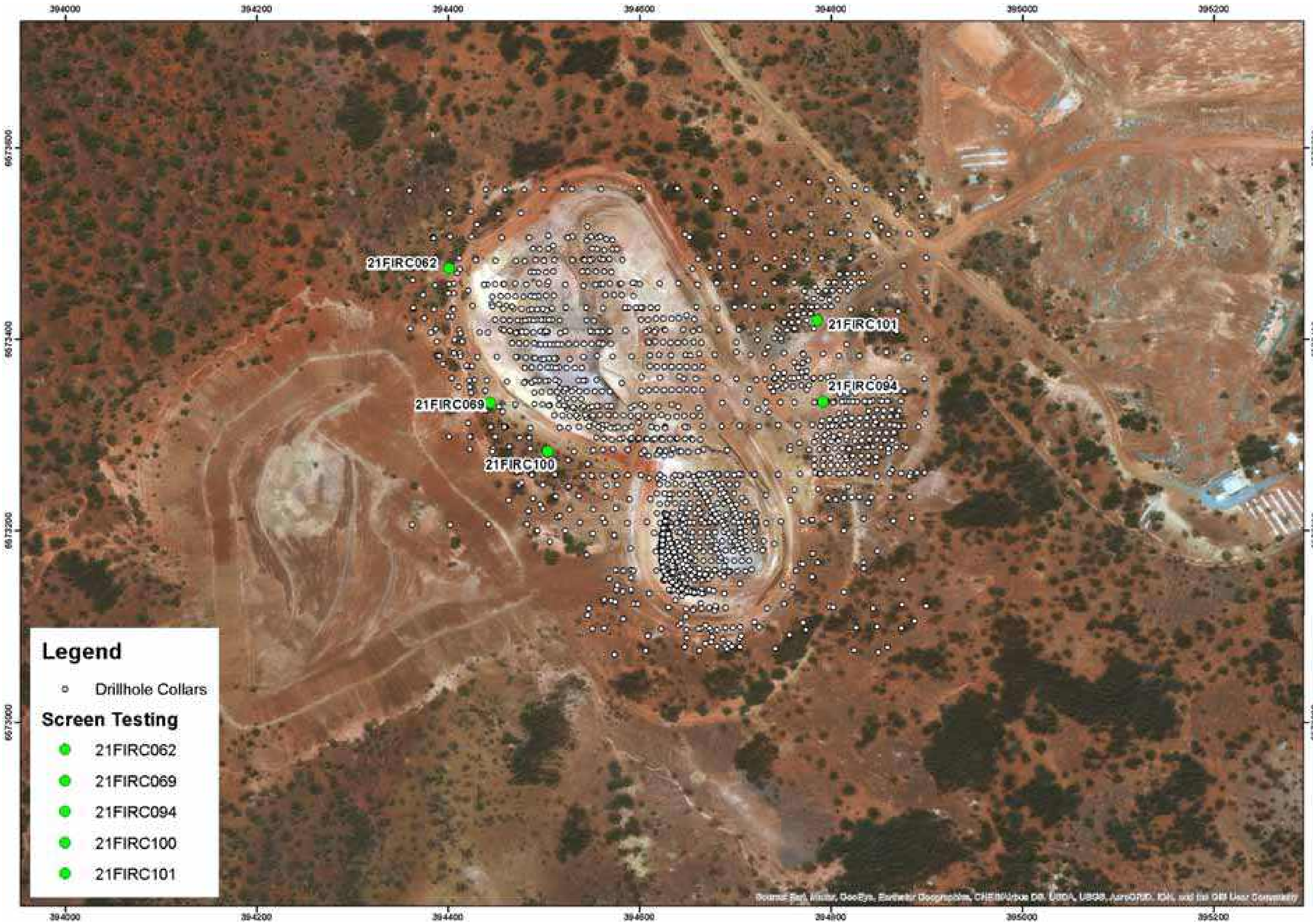
2.3.2 FINGALS EAST AREA

Approximately 1,700 holes have been drilled within the immediate surrounds of the Fingals East area (Figure 2.1). The drilling has been conducted to depths of between 2 and 150m with samples variously collected as 1, 2m vertical composites. This data represents over 37,000 meters of drilling and logging. The number of samples logged for each lithology which comprised greater than 0.1% of the total samples logged is provided in Table 2.2.

Table 2.2: Summary of lithology data for Fingals Area

Lithology	No.	%	Lithology	No.	%
NSTF	169	2.54	Tertiary Sediment	134	2.02
Residual Laterite	115	1.73	Felsic undifferentiated	18	0.27
Upper Saprolite	2,426	36.5	Felsic Schist	12	0.18
Lower Saprolite	187	2.81	Mafic undifferentiated	1,751	26.34
Saprock	625	9.40	Mafic Schist	1,015	15.27
Tertiary Gravel	131	1.97	MT	15	0.23
Tertiary Laterite	38	0.57	Quartz Vein	7	0.11

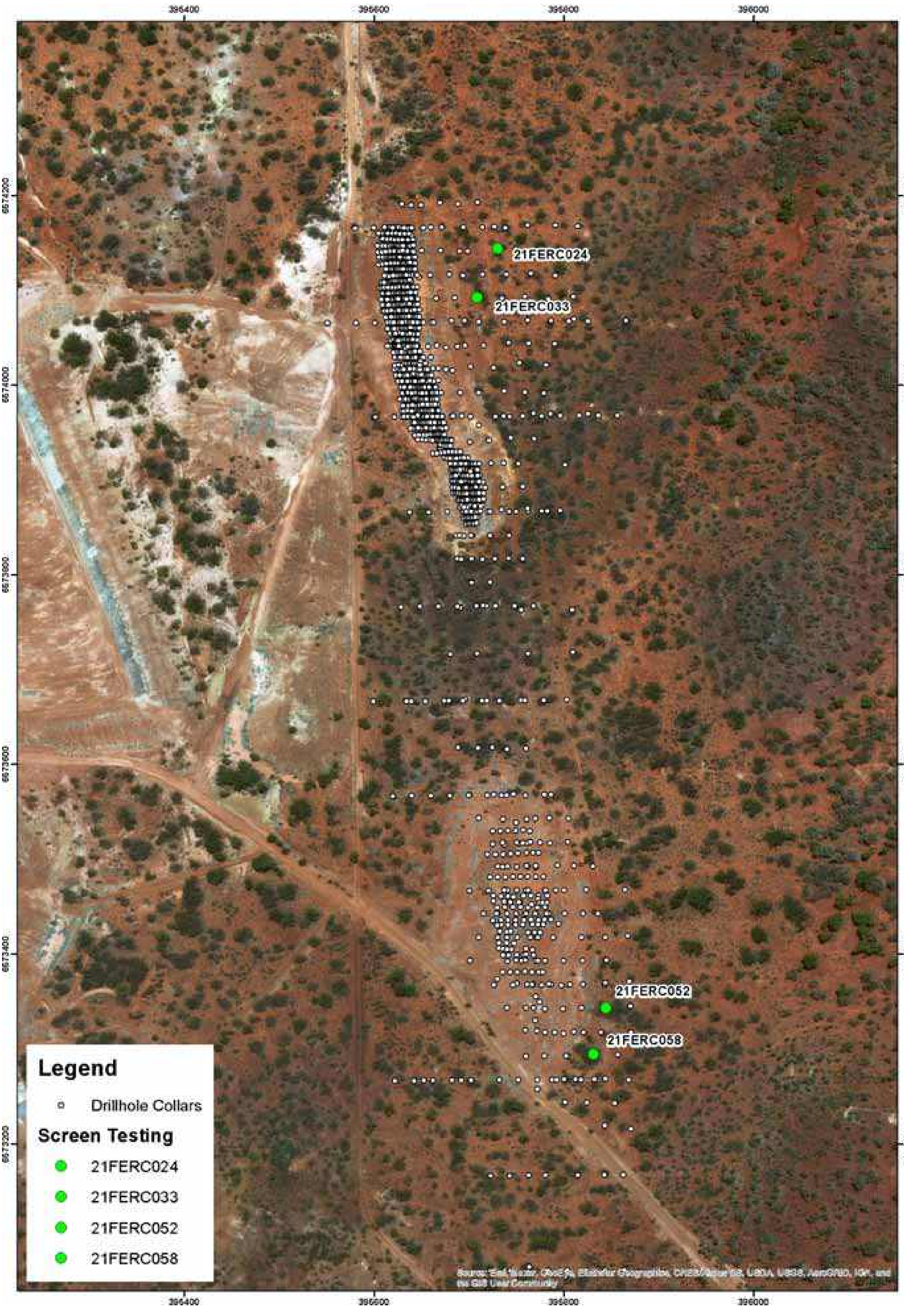
The summary data drawn from the drilling database shows the deposit area has a slightly shallower weathered profile than the western database area, with a thin transported cover of alluvial sediment over a 30 – 40 m thick saprolite / saprock profile with fresh basement rock underneath. Similar to the Fingals Area the basement rock materials are logged as predominantly mafic and mafic schists. Together these unit types represent more than 98% of the logged fresh rock material within the deposit area.



BLACK CAT SYNDICATE	Figure 2.1: Drillholes included in database analysis for Fingals area
FINGALS PROJECT GEOCHEMICAL CHARACTERISATION	

soilwater GROUP

PN: BC8-004-1-03 Prepared by: SC Date: 10/16/21 Reviewed by: ASP Date: 10/25/21 Revision: 1



BLACK CAT SYNDICATE	Figure 2.2: Drillholes included in database analysis for Fingals East area
FINGALS PROJECT GEOCHEMICAL CHARACTERISATION	

soilwater GROUP

PN: BC8-004-1-03 Prepared by: SC Date: 10/16/21 Reviewed by: ASP Date: 10/25/21 Revision: 1

2.4 SAMPLE SELECTION

Following the review of drilling data, samples from 9 drillholes were identified which together adequately represented the different geological units and weathering characteristics of the major waste lithologies within the deposit areas. A total of 389 samples were selected from the 9 drillholes in the form of 1 m vertical pulverised composites for screen analysis. Details of the 9 drillholes are provided in Table 2.3, whilst details of the 389 samples are provided in Table 2.4.

Table 2.3: Details of representative drillholes chosen for screen analysis

Deposit Area	Drillhole ID	Coordinates (GDA 94, Zone 51)		Drill depth (m)	No. Samples
		Easting	Northing		
Fingals Fortune	21FIRC062	394,401	6,573,474	65	33
	21FIRC069	394,444	6,573,333	125	62
	21FIRC094	394,791	6,573,334	50	25
	21FIRC100	394,504	6,573,282	168	84
	21FIRC101	394,785	6,573,420	60	31
Futi Baguss & Baguss	21FERC024	395,730	6,574,144	85	43
	12FERC033	395,708	6,574,092	75	38
	21FERC052	395,844	6,573,343	100	44
	21FERC058	395,831	6,573,294	85	29

Table 2.4: Summary of samples chosen for screen analysis

Lithology code	Description	Samples Selected	%	Lithology code	Description	Samples Selected	%
RLAT	Residual Laterite	3	0.77	TSL	Tertiary Silt	1	0.26
RSPU	Upper Saprolite	200	51.28	TSS	Tertiary Sand	12	3.08
RSPL	Lower Saprolite	13	3.33	FS	Felsic Schist	5	1.28
RSPR	Saprock	50	12.82	M	Mafic Undifferentiated	27	6.92
TGVL	Tertiary Gravel	15	3.85	MS	Mafic Schist	60	15.38
TLAT	Tertiary Laterite	4	1.03				

2.5 LABORATORY ANALYSIS

All samples selected during the review process underwent screen laboratory analysis to determine their basic chemical characteristics and provide key information on the likelihood of AMD occurrence. The following analysis was conducted:

- pH - 1:5 soil/water extraction. This parameter measures the existing acidity of the waste materials and determines if previous oxidation of sulphides has occurred and the potential buffering capacity of the materials.
- EC - 1:5 soil/water extraction. This parameter measures the level of salinity in the waste materials, which may reflect previous oxidation of sulphides.
- pH_{fox} - pH of the waste materials following the addition of 30 percent hydrogen peroxide to rapidly oxidise any sulphides present. The method followed is outlined in Stone et al. (1998).

Following the screen analysis and review of these results, 19 samples in total were chosen to undergo different selected detailed testing based on their inherent risk from the screen testing results to confirm their AMD and MD status. The detailed test work carried out on different samples was conducted at Envirolab Services and consisted of:

- Total Sulfur (S)
- Chromium Reducible-S (S_{CR})
- Static Net Acid Generation (NAG)
- Acid Neutralising Capacity (ANC)
- Total Organic and Inorganic Carbon (TOC/TIC)
- Total metals (As, Ba, Be, Cd, Co, Cr, Cu, Hg, Mn, Mo, Ni, Pb, Se and Zn)
- Static leach testing and metal mobility determination (As, Ba, Be, Cd, Co, Cr, Cu, Hg, Mn, Mo, Ni, Pb, Se and Zn)

All laboratory certificates of analysis and QA/QC data sheets are provided as an Appendix.

.

3 STUDY RESULTS

3.1 SCREEN TESTING

pH & pH_{OX}

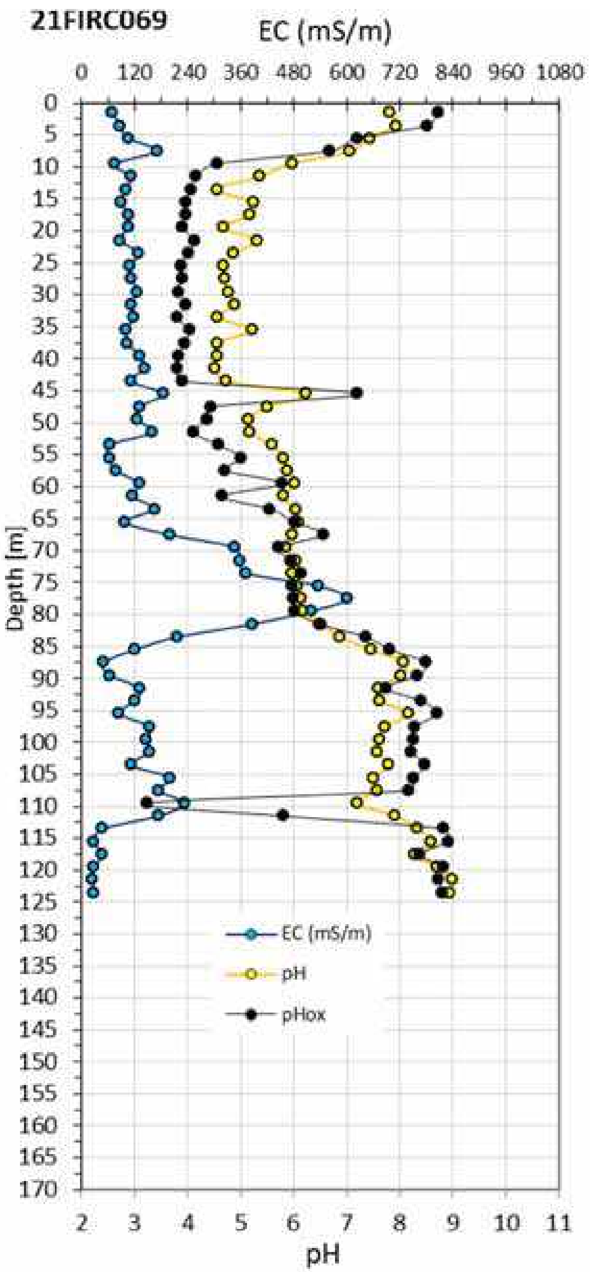
Depth profiles showing the screen test results for samples within the 9 representative drillholes sampled are provided in Figure 3.1 to Figure 3.3. The pH of all materials to be mined varies from 10.0 – 3.0, with an average of 6.4 (circum-neutral) however there are significant differences in the pH of materials with changes in depth within the three different deposit areas. This difference is driven in part by the deep and extensive weathering which the upper ~50m of the profile has undergone. The upper few meters of the typical profile revealed across the 9 different drillholes consists of transported alluvial material and generally displays a neutral to slightly alkaline pH, which quickly drops to an acidic pH within what is commonly logged as a 2-5m thick layer of ferruginous laterite gravels. The pH generally stays within a highly acidic range (pH 3-5) throughout the upper saprolite zone where the hydrolysis / oxidation of alumino-silicates and ferro-magnesian silicates has been extensive. The extent of the low pH values is slightly unusual (approaching pH 3 across broad segments) and could indicate previous oxidation of widespread iron sulfides (pyrite) with associated formation of stronger sulfuric acid. The pH then gradually increases with profile depth as the material becomes progressively less weathered (saprolite > saprock) until a depth of approximately 60 – 80 m where the boundary with the fresh basement rock is met. The pH of the predominately mafic basement rock material is generally alkaline (pH 8-9).

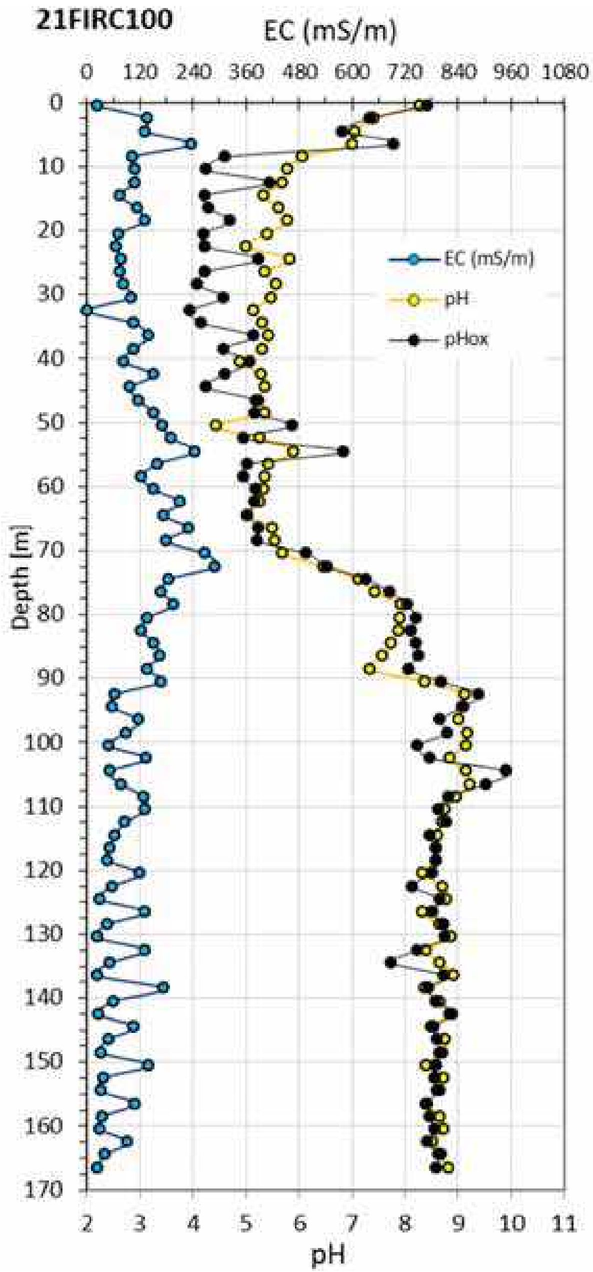
The pH_{OX} values obtained after decomposition by peroxide of the drilling samples varied from 10.5 – 2.9. For the majority of samples the pH_{FOX} value is within 1 pH unit of the pH value, indicating that little overall change in pH occurred in response to the forced oxidation. This is likely a result of high oxidation rates already occurring within the upper profile materials and indicates that ion formation in response to oxidation of fresher rock materials is likely to be relatively balanced.

The widespread testing of pH values across the deposit shows that the almost the entirety of saprolite zone reported pH values which are likely to be low enough to impact on rehabilitation species growth and germination rates should they be placed close to the surface of the WRL (i.e. top 5 m). In addition these clay rich materials are commonly highly prone to erosion and therefore should not be used near post-mine landform surfaces in the absence of additional management measures. The remainder of the materials, comprising the upper loose soil and sediments, ferruginous gravels and fresh to slightly weathered basement rock have suitable pH values for use in rehabilitation.

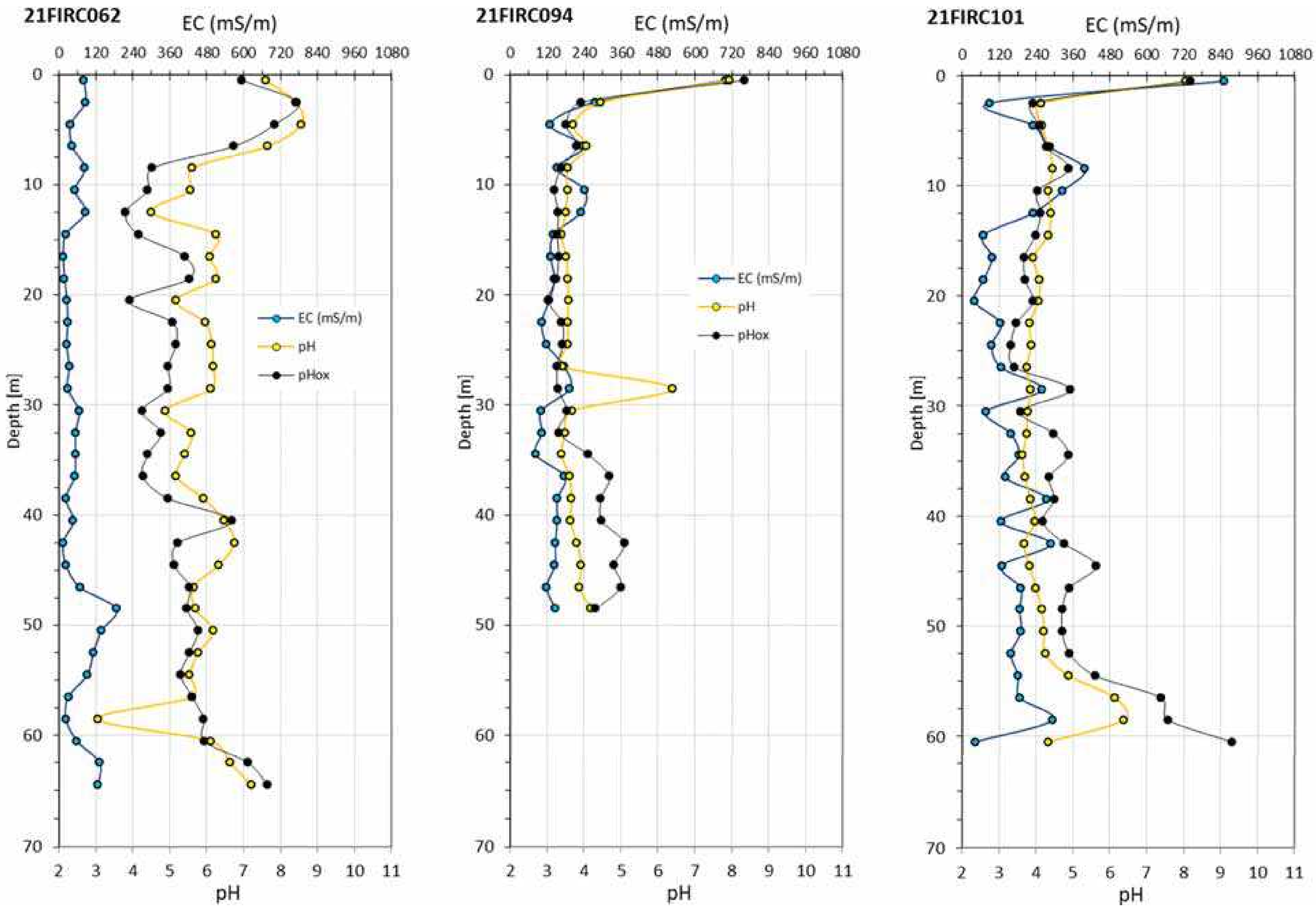
Electrical Conductivity

The salinity measured within the representative materials tested was generally low, with measured values ranging from 2 to 950 mS/m and averaging 140 mS/m. These values can be considered moderately saline (median value of 120 mS/m) and therefore do not pose a limitation to rehabilitation growth of vegetation species.

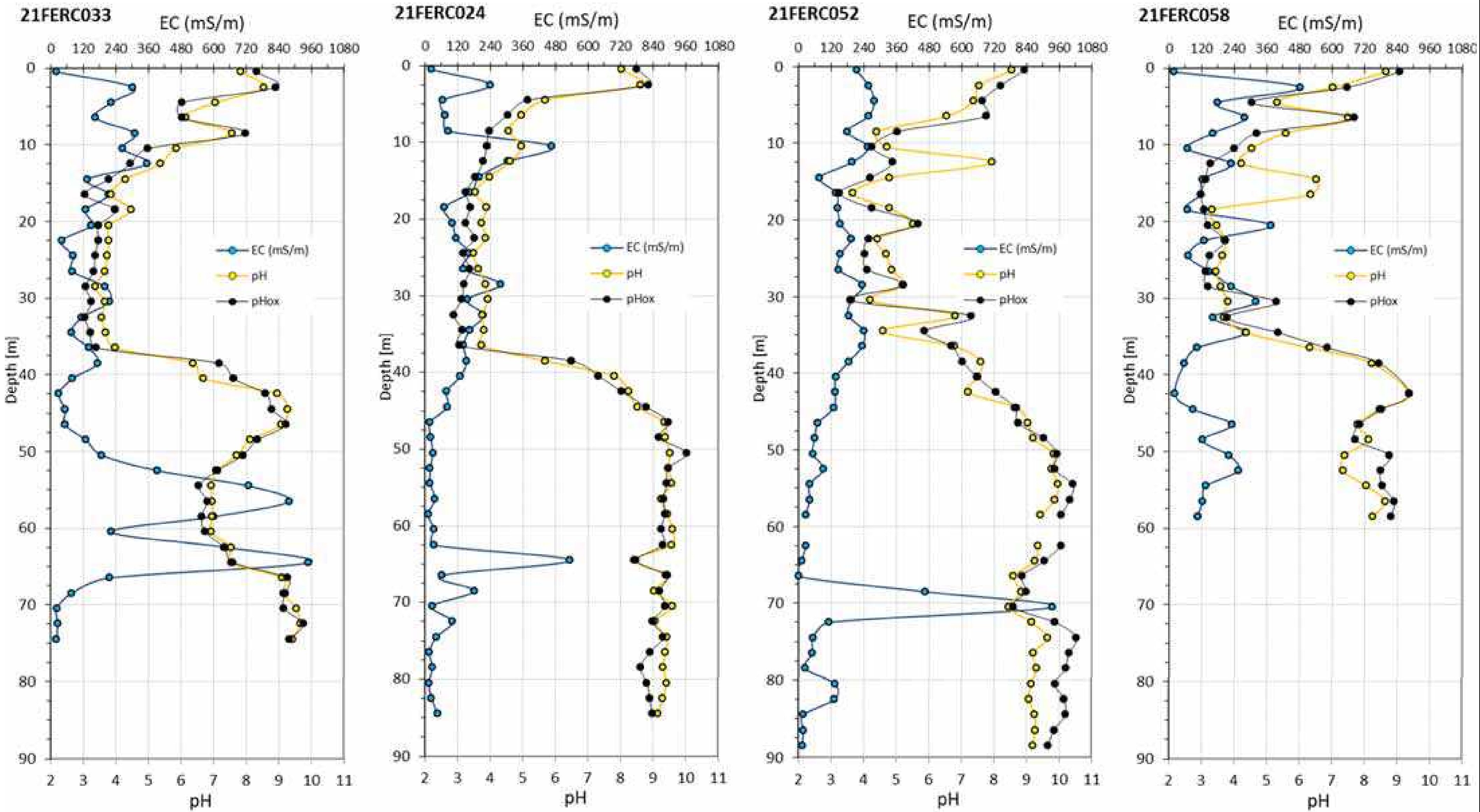




BLACK CAT SYNDICATE	Figure 3.1: pH, pH_{fox} & EC depth Fingals Fortune	soilwater GROUP
FINGALS PROJECT GEOCHEMICAL CHARACTERISATION		



BLACK CAT SYNDICATE	Figure 3.2: pH, pH_{fox} & EC depth profiles Fingals Fortune continued…
FINGALS PROJECT GEOCHEMICAL CHARACTERISATION	



BLACK CAT SYNDICATE	Figure 3.3: pH, pH_{fox} & EC depth profiles Futi Baguss & Baguss
FINGALS PROJECT GEOCHEMICAL CHARACTERISATION	

soilwater GROUP

3.2 SULPHUR SPECIATION

The 19 representative samples selected for detailed testing based on their screen testing results were analysed for Total Sulphur (S) and Chromium reducible (S_{CR}) content. This testing provides accurate data on the different portion of the Total S content which is present within each sample in the form of sulphate minerals (gypsum, jarosite etc.) and sulphide minerals (pyrite, chalcopyrite etc). Determination of the sulphur type is important as it is only the sulphide minerals which can release considerable amounts of acidity when oxidised and are the main drivers of AMD. The results of the sulphur speciation testing on the 19 representative samples tested are presented below in Table 3.1.

The Total S percentage from testing varied from 0.014 to 1.1%, whilst the majority of samples (16 of 19) reported chromium reducible sulphur contents lower than the detection limit of 0.005%. Of the three samples which had reportable concentrations, the proportion of S:S_{CR} was greater than 50%. The range of values across the data set can again largely be explained by weathering factors; in that samples from the upper more weathered profile (saprolite units) contained sulfur content in the form of oxidised sulphate whilst the sulfur content within samples from the fresh rock material deeper in the profile were largely in the form of sulphides.

Two of the samples tested exceeded the 0.3 sulphide percent guideline value which has been settled on by various sources (AMIRA, 2000) to guide the use of further investigation resources. These two samples were logged as schistose mafic rock at considerable depth within exploration drillholes at the Fingals Fortune deposit. Waste rock units with sulphide concentrations below this guideline value are seen as being incapable of sustaining sulphate and acid formation through normal weathering processes (Soregaroli and Lawrence, 1997). This assertion assumes that the remainder of the minerals within the bulk rock are not purely felsic in composition (i.e. quartz / clays; Price, 2009).

Table 3.1: Summary of sulphur speciation data for representative samples

Area	Drillhole ID	Depth (m)	Lithology	Total S (%)	S_{CR} (%)
Fingals East	21FERC033	12.5	RSPU	0.26	<0.005
	21FERC058	14.5	RSPU	0.44	<0.005
	21FERC052	20.5	RSPU	1.1	<0.005
	21FERC024	24.5	RSPU	0.25	<0.005
	21FERC058	34.5	RSPR	0.066	<0.005
	21FERC052	52.5	MS	0.014	<0.005
	21FERC033	54.5	RSPL	0.071	<0.005
	21FERC024	70.5	M	0.13	<0.005
Fingals	21FIRC094	14.5	RSPU	0.35	<0.005
	21FIRC101	22.5	RSPU	0.13	<0.005
	21FIRC069	29.5	RSPU	0.11	<0.005
	21FIRC100	38.5	RSPU	0.096	<0.005
	21FIRC062	40.5	RSPU	0.26	<0.005
	21FIRC094	40.5	RSPU	0.075	<0.005
	21FIRC101	54.5	RSPU	0.058	<0.005
	21FIRC100	84.5	RSPU	0.024	<0.005
	21FIRC069	109.5	MS	0.4	0.27

Area	Drillhole ID	Depth (m)	Lithology	Total S (%)	S_{CR} (%)
Fingals	21FIRC100	130.5	MS	0.039	0.069
	21FIRC100	144.5	MS	0.28	0.26

3.3 ACID NEUTRALISING CAPACITY

The contained buffering or acid neutralising capacity (ANC) of the 19 representative samples was analysed by back titration (HCl addition to sample, followed by back titration utilising NaOH to determine the amount of un-buffered acid) and determination of the inorganic carbon percentage within each sample.

The addition of HCl determines the ANC of the material, but can overestimate the readily available buffering potential as it includes neutralising effects of primary silicate minerals, the breakdown of which can be slow kinetically under circum-neutral conditions (White and Brantley, 1995) and can therefore be ineffective at neutralising acid generation in some circumstances. For this reason the total inorganic carbon (TIC) is used to calculate a Carbonate Neutralising Potential (CarbNP) which can be a more accurate measure of a materials ability to buffer acid generation under normal weathering conditions.

The measured ANC and TIC, along with the calculated CarbNP, of each sample is shown in Table 3.2.

Table 3.2: Measured buffering capacity of representative samples

Area	Drillhole ID	Depth (m)	Lithology	ANC (kg H_2SO_4/t)	TIC (%)	CarbNP (kg H_2SO_4/t)
Fingals East	21FERC033	12.5	RSPU	<0.5	0.02	1.6
	21FERC058	14.5	RSPU	<0.5	0.02	1.6
	21FERC052	20.5	RSPU	0.8	0.02	1.6
	21FERC024	24.5	RSPU	<0.5	<0.01	<0.8
	21FERC058	34.5	RSPR	0.7	0.01	0.8
	21FERC052	52.5	MS	180	1.6	130.6
	21FERC033	54.5	RSPL	2.5	<0.01	<0.8
	21FERC024	70.5	M	<0.5	0.01	0.8
Fingals	21FIRC094	14.5	RSPU	<0.5	0.02	1.6
	21FIRC101	22.5	RSPU	<0.5	0.02	1.6
	21FIRC069	29.5	RSPU	<0.5	0.03	2.4
	21FIRC100	38.5	RSPU	<0.5	0.02	1.6
	21FIRC062	40.5	RSPU	4.1	0.02	1.6
	21FIRC094	40.5	RSPU	<0.5	<0.01	<0.8
	21FIRC101	54.5	RSPU	<0.5	0.03	2.4
	21FIRC100	84.5	RSPU	11.6	0.02	1.6
	21FIRC069	109.5	MS	6.2	0.02	1.6
	21FIRC100	130.5	MS	182	1.8	146.9
	21FIRC100	144.5	MS	196	1.8	146.9

The results show that the majority of the samples tested reported very low total ANC and CarbNP values which were close to or below the limit of detection. These samples were uniformly obtained from the saprolite zone where these low ANC and TIC values are expected given the highly acidic nature of this portion of the profile, which would have consumed any minerals with this capacity. The less weathered mafic samples reported higher, through variable ANC and CarbNP values with an average of approximately 150 kg H_2SO_4/t equivalent.

3.4 ACID BASE ACCOUNT

An Acid Base Account (ABA) is the process of comparing the Maximum Potential Acidity (MPA) and ANC/CarbNP results for different samples and materials to determine the theoretical outcome of oxidation reactions in relation to potential acid production. The result of this comparison for the 19 representative samples is shown in Table 3.3. The MPA value has been calculated from both the measured Total S content and the chromium reducible S content and assumes that all of the reported S within each sample occurs in the form of iron pyrite (FeS_2) and oxidises according to the equation shown below. This oxidation reaction produces the maximum amount of acidity per molar weight of S of any sulphide species and therefore provides a 'worst case' scenario for predicting acid production. The net acid producing potential (NAPP) has been calculated using the measured chromium reducible sulphur content versus the ANC. Where values are below detection limits the calculation has assumed half the detection limit.

$$FeS_2 + \frac{15}{4}O_2 + \frac{7}{2}H_2O => Fe(OH)_2 + 2H_2SO_4$$

Table 3.3: Acid base account for representative samples

Area	Drillhole ID	Depth (m)	Lithology	MPA (Total S)*	MPA (SCR)*	CarbNP*	ANC*	NAPP* SCR
Fingals East	21FERC033	12.5	RSPU	7.96	<0.15	1.6	<0.5	-
	21FERC058	14.5	RSPU	13.46	<0.15	1.6	<0.5	-
	21FERC052	20.5	RSPU	33.66	<0.15	1.6	0.8	-0.7
	21FERC024	24.5	RSPU	7.65	<0.15	<0.8	<0.5	-
	21FERC058	34.5	RSPR	2.02	<0.15	0.8	0.7	-0.6
	21FERC052	52.5	MS	0.43	<0.15	130.6	180	-179.9
	21FERC033	54.5	RSPL	2.17	<0.15	<0.8	2.5	-2.4
	21FERC024	70.5	M	3.98	<0.15	0.8	<0.5	-
Fingals	21FIRC094	14.5	RSPU	10.71	<0.15	1.6	<0.5	-
	21FIRC101	22.5	RSPU	3.98	<0.15	1.6	<0.5	-
	21FIRC069	29.5	RSPU	3.37	<0.15	2.4	<0.5	-
	21FIRC100	38.5	RSPU	2.94	<0.15	1.6	<0.5	-
	21FIRC062	40.5	RSPU	7.96	<0.15	1.6	4.1	-4.0
	21FIRC094	40.5	RSPU	2.30	<0.15	<0.8	<0.5	-
	21FIRC101	54.5	RSPU	1.77	<0.15	2.4	<0.5	-
	21FIRC100	84.5	RSPU	0.73	<0.15	1.6	11.6	-11.5

Area	Drillhole ID	Depth (m)	Lithology	MPA (Total S)*	MPA (SCR)*	CarbNP*	ANC*	NAPP* SCR
Fingals	21FIRC069	109.5	MS	12.24	8.26	1.6	6.2	2.1
	21FIRC100	130.5	MS	1.19	2.11	146.9	182	-179.9
	21FIRC100	144.5	MS	8.57	7.96	146.9	196	-188.0

All values provided in kg H_2SO_4/t

The ABA results underline both the low buffering capacities and the generally low concentrations of sulphide minerals within the samples set, with 15 of the 19 samples tested reporting an effectively neutral (both values below detection limit) or slightly negative Net Acid Production Potential (NAPP) value. These 15 samples are the saprolite zone materials tested.

The remaining four samples are the fresh to slightly weathered mafic materials. Three of these materials reported a highly negative NAPP value, due to high ANC / CarbNP potentials. The last sample reported a slightly positive NAPP value, due to its moderate MPA and low acid buffering capacity. This result suggests some variability in the acid potential of the underlying basement mafic rock material.

In normal conditions expected within the WRL the acid produced will not have perfect accessibility to the surfaces of mineral grains which can act to neutralise the acid at different scales, with acid sometimes by-passing these minerals at the whole rock scale or potentially cut off from these grains by a barrier of precipitates (e.g. iron-oxyhydroxides). To allow for these effects, scientific investigation and field experience has shown materials which display an ANC/MPA ratio greater than two have a very low potential for AMD generation.

The ABA has been plotted in Figure 3.4. The plot emphasises two aspects of the sample data sets ABA. Firstly the variability within the mafic materials, and secondly the lack of both buffering and potentially acid generating minerals within the saprolitic material.

The weathered samples which contain negligible sulfide and ANC/CarbNP, plot close to the y axis and slightly above the line indicating an ANC/MPA ratio of 2. In contrast the less weathered mafic rock samples plot in a wide range, from high buffering and negligible sulfide contents (top left) to negligible buffering and moderate sulfide content (bottom right). All samples with the exception of the mafic schist from within drillhole 21FIRC069 are considered incapable of sustaining acid production under normal conditions.

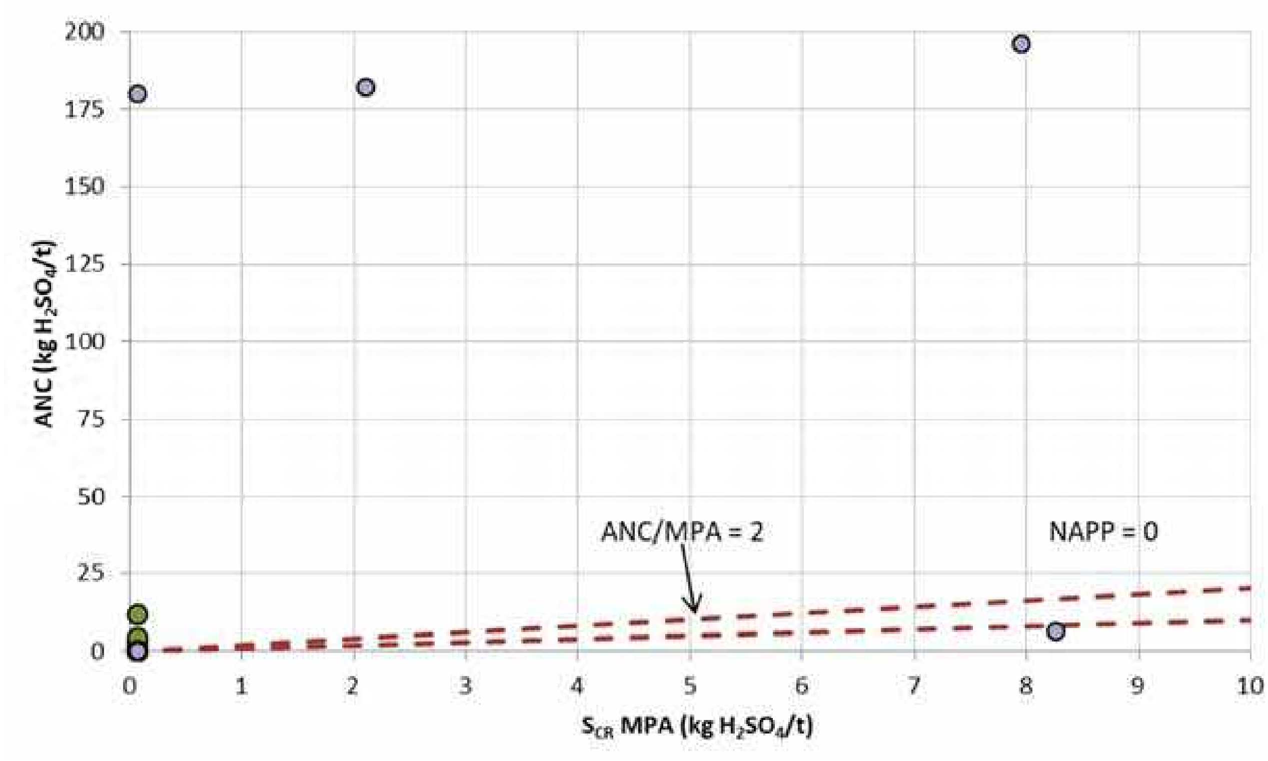


Figure 3.4: ABA plot for representative samples

3.5 GEOCHEMICAL CLASSFICATION

The results of static NAG testing via back titration of the 19 samples tested in this investigation are presented in Table 3.4. These results show the results of static net acid generation testing, with the final pH and acidity of the resultant liquor after forced oxidation and heating of the sample. An indication of the form of the acidity can be determined initially through titration of the NAG liquor to a pH of 4.5, then continuing the titration up to a pH of 7. The value below a pH of 4.5 is given by free acid (i.e. H_2SO_4/t or equivalent) along with soluble iron and aluminium, whilst the value at a pH of 7 also includes metallic ions that precipitate between pH 4.5 and 7.

Due to the uncertainties inherent in both the single addition NAG test, and the calculated ABA when applied individually, these two measurements are compared to provide a more accurate classification tool for use in managing potential AMD issues. The results from the static NAG testing are used in conjunction with the NAPP results (ABA) to allow a geochemical classification of the acid generating potential of a material. Samples are placed into one of three categories based on the following criteria:

- Non-acid forming (NAF) – Samples classified as NAF may have significant acid generating potential but contain sufficient readily available ANC to adequately buffer any acidity formed. A sample is classified as NAF when it has a negative NAPP and a final NAGpH ≥ 4.5.
- Potentially-acid forming (PAF) – Samples with a PAF classification present the risk of generating acidic drainage if oxidation (i.e. exposure to atmospheric conditions) occurs. A sample is classified as PAF when it has a positive NAPP and a final NAGpH < 4.5.

- Uncertain (UC) – An uncertain classification is used where there is a conflict between the NAPP and NAG test results (i.e. where the NAPP is positive and the NAGpH ≥ 4.5 or vice versa). Uncertain sample classification may require further investigation to determine the likely acid generation potential.
- Residual Acidity (RA) – This classification has been used where both acid forming and acid neutralisation tests were below detection limits, and the reported NAG pH is < 4.5.

The geochemical classification of the 19 representative samples tested is presented in Figure 3.5 and summarised in Table 3.4. The majority of the samples plot near the vertical border line which indicates a 0 net acid production capacity. This illustrates the general lack of both acid forming and acid neutralising minerals within most of the samples tested. One of the samples tested reported both a positive NAPP and had net acid generation pH values below 4.5. This mafic schist sample from within drillhole 21FIRC069 is therefore classified as PAF and is considered to have the capacity to generate low volumes of acidity upon oxidation.

The remaining three fresh mafic rock samples tested had a net acid generation pH value well above 4.5 and reported highly negative NAPP values. These samples are therefore classified as NAF and represent a considerable acid buffering potential. A number of samples received a fourth classification of RA (residual acidity) and were not plotted in Figure 3.5. This classification is intended to indicate samples of material which are likely to have undergone previous acid generation during the weathering process and have retained considerable residual acidity but have little or no potential to generate further acidity as a result of the mining process. All saprolite samples are either classified as NAF or RA.

Table 3.4: Results of static NAG testing

Area	Drillhole ID	Depth (m)	Lithology	NAG 4.5 (kg H_2SO_4/t)	NAG 7.0 (kg H_2SO_4/t)	NAGpH	NAPP* S_{CR}	Classification
	21FERC033	12.5	RSPU	<0.5	1.2	5	-	NAF
	21FERC058	14.5	RSPU	0.8	2.7	4	-	RA
	21FERC052	20.5	RSPU	<0.5	0.7	5.3	-0.7	NAF
	21FERC024	24.5	RSPU	<0.5	1.5	5.1	-	NAF
	21FERC058	34.5	RSPR	<0.5	<0.5	6.4	-0.6	NAF
	21FERC052	52.5	MS	<0.5	<0.5	9.7	-179.9	NAF
	21FERC033	54.5	RSPL	<0.5	<0.5	6.5	-2.4	NAF
	21FERC024	70.5	M	<0.5	3.3	4.1	-	RA
	21FIRC094	14.5	RSPU	0.6	4.7	4	-	RA
	21FIRC101	22.5	RSPU	<0.5	2.8	4.3	-	RA
	21FIRC069	29.5	RSPU	<0.5	4.7	4.2	-	RA
	21FIRC100	38.5	RSPU	<0.5	2.8	4.7	-	NAF
	21FIRC062	40.5	RSPU	<0.5	2.2	6.5	-4.0	NAF
	21FIRC094	40.5	RSPU	<0.5	1.1	5.2	-	NAF
	21FIRC101	54.5	RSPU	<0.5	<0.5	6.3	-	NAF
	21FIRC100	84.5	RSPU	<0.5	<0.5	7.8	-11.5	NAF
	21FIRC069	109.5	MS	5.9	8.9	3	2.1	PAF
	21FIRC100	130.5	MS	<0.5	<0.5	11.2	-179.9	NAF
	21FIRC100	144.5	MS	<0.5	<0.5	11.3	-188.0	NAF

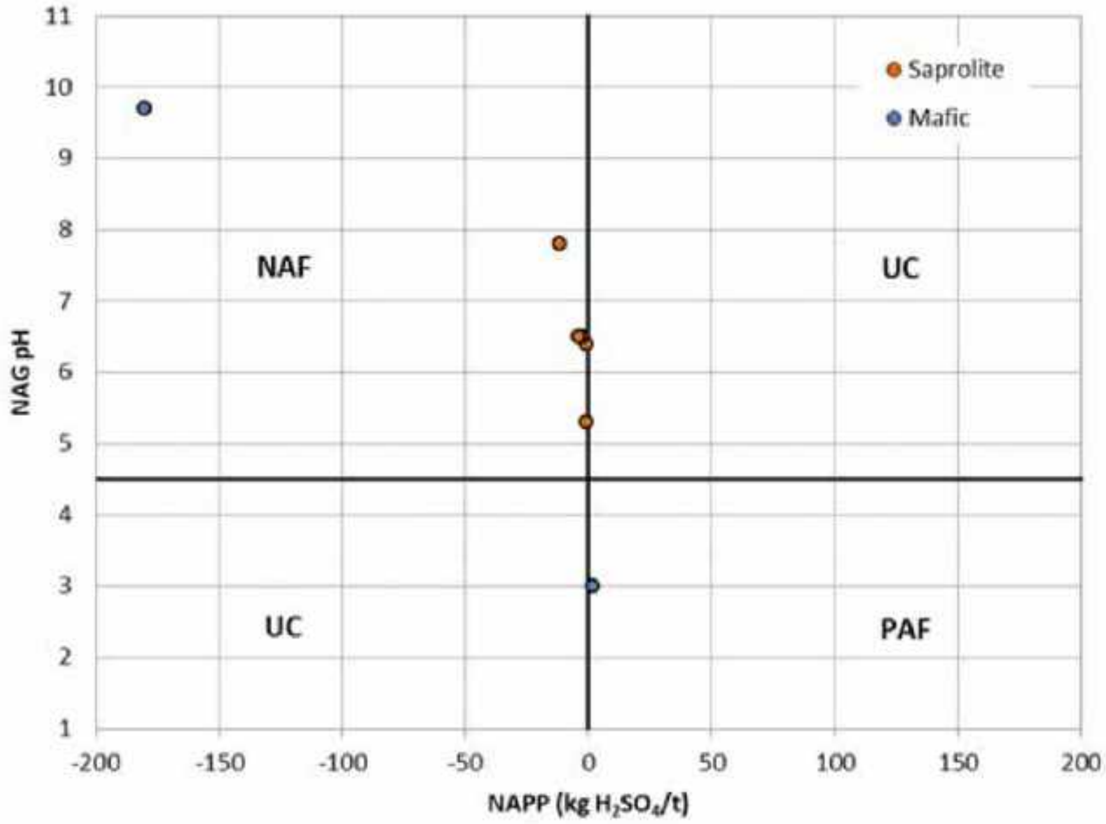


Figure 3.5: Geochemical classification of representative samples

3.6 WASTE VOLUME ASSESSMENT

As presented above the geology of the main Fingals Pit can be broadly split into two lithological types, a volcanic intermediate intrusive unit and basalt. Recent modelling information provided by Blackcat Syndicate geologists shows the following split of volumes planned to be excavated from the main Fingals Pit (Figure 3.6). The volumes of each of the modelled unique rock units are summarised in Table 3.5.

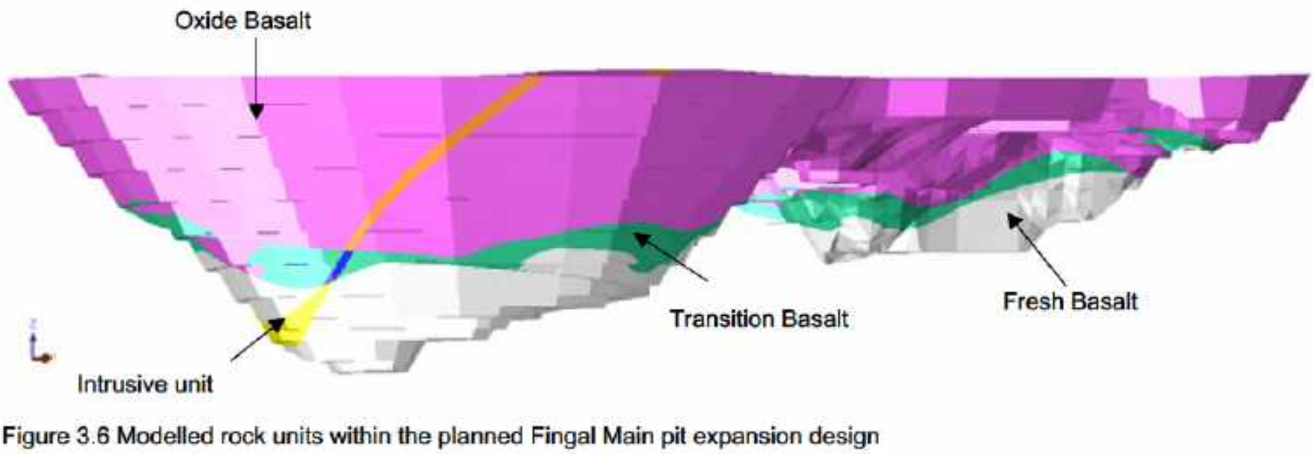


Figure 3.6 Modelled rock units within the planned Fingal Main pit expansion design

Table 3.5: Fingals Main Pit planned waste rock volumes

Weathering	Lithology	Volume (m^3)	% (Volume)	Tonnes	% (Tonnes)
Oxide	Intermediate volcanic intrusive	690,080	4.58	1,173,136	4.21
Transition		133,920	0.89	294,624	1.06
Fresh		162,870	1.08	456,036	1.64
Oxide	Basalt	11,724,000	77.76	19,930,800	71.59
Transition		1,072,200	7.11	2,358,840	8.47
Fresh		1,294,600	8.59	3,624,880	13.02
Total		15,077,670	100	27,838,316	100

The modelling shows a total of just over 15 million cubic meters of waste rock material will be mined from the Fingals Main Pit using the updated mine design. The basalt lithology type makes up the majority of the waste rock material to be moved (approximately 93%), with the highly weathered (oxide) portion of the basalt accounting for over 70% of all waste rock material.

Given the proportion that the fresh and transition basalt material represents of the overall waste rock (approximately 16% by volume) and the very low buffering capacity present within the remainder of the waste rock material it is recommended that further testing of transitional and fresh basalt material is undertaken to gain a better understanding of these unique rock units acid base account (ABA) classification as a whole.

Given the volume of basalt waste rock involved and the stage of the mining operation, it is recommended that a further 6 to 10 samples of intermediate and fresh basalt undergo ABA analysis. These samples should be sourced from within the planned pit shell wherever possible or from within adjacent pit walls.

3.7 METAL CONTENT

Element enrichment was determined using the Geochemical Abundance Index (GAI), through the equation below;

$$GAI = \log_2\left(\frac{C}{1.5 * ACA}\right),$$

with C= element content in sample (mg/kg) and ACA= average crustal abundance (Bowen, 1979). A GAI of 0 indicates that the content of the element is less than, or similar to, the average crustal abundance, a GAI of 3 corresponds to a 12-fold enrichment above the average crustal abundance, and a GAI of 6 indicates a 96-fold or greater enrichment above average crustal abundances. In general, a GAI >3 indicates significant enrichment.

Elemental compositions were compared against the Department of Environment and Conservation (DEC) Ecological Investigation Levels (EIL; DEC, 2010) to identify metals and metalloids that may, if present and mobile, pose a risk to the surrounding environment or to environmental values as a result of metaliferous drainage. The EIL used by the DEC are based primarily on the Environmental Investigation Levels listed in the Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC/NHMRC, 1992). They represent screening levels in which to provide a first-pass assessment for a site. It is important to note that these levels do not specifically apply to mineralised zones where soils may contain elevated metal and metalloid contents which exceed the EIL criteria in a naturally functioning ecosystem. Site specific information must therefore be used in conjunction with the EIL to assess the appropriateness of these criteria values. As a first pass at attempting to provide some additional background information the values obtained are compared to the ACA values to provide a context within which to interpret them.

The multi-element composition of the 19 selected samples is provided in Table 3.5, whilst their corresponding enrichment, compared to average global crustal abundances, is provided in Table 3.6. Values which are above a GAI of 3 have been highlighted in bold. The GAI values show that copper and chromium are slightly enriched in some samples and only arsenic and selenium are considered significantly enriched in two samples.

Elevated As concentrations are common in hydrothermal / lode type gold deposits as it is geochemically mobile under conditions which are generally thought to lead to gold mineralisation of this type (due to variable oxidation states) and commonly forms halos around these types of ore bodies, often in association with sulphides (i.e. arsenopyrite).

3.8 METAL MOBILITY

In order to investigate metal mobility under the likely conditions which may occur within the proposed waste landform after waste excavation, determination of the mobility of various elements was carried out by static extraction, using the Australian Standard Leaching Procedure (ASLP; AS4439). This bottle leach method used a mild acetic acid solution with a high solid to solution ratio (1:20) which results in a shift in equilibrium encouraging maximum desorption of the elements from the solid phase into solution. The results of the static leach testing on 9 chosen samples are shown in Table 3.8.

The results show the majority of metals tested were immobile under the mildly acidic leaching conditions, with As, Be, B Cd, Cr, Co, Hg, Ni, Pb and Se concentrations all close to or below the limit of reporting in all samples tested. Reported concentrations of the remaining metals showed low to moderate contents within the leachate.

The results of leach testing have been compared with both the domestic non-potable use water guidelines published by the Department of Health, and the long term irrigation water use guidelines published by ANZECC & ARMCANZ (2000). Whilst water which interacts with the waste landform will not see the use intended in either guideline; the irrigation water guidelines are indirectly relevant to the surrounding flora and fauna which may be impacted upon by runoff from the post-mine landform which will be created.

The comparison of the leaching analysis to the long term irrigation guideline shows that for most of the samples and metals tested the reported results are well below the guideline value. The exception to this is the manganese values, where 5 of the 9 samples met or exceeded the long term irrigation guideline, the mafic sample significantly exceeding it.

When interpreting the results of the bottle leach tests it is important to note that the testing procedure produces an aggressive leaching environments which is unlikely to be reproduced in the field. Whilst the testing environment is likely to exceed even a worst case scenario in real terms and the testing has shown the materials can be considered low risk, the results indicate that runoff from the waste landform should be controlled to prevent the potential transport of dissolved metals and the potential for build-up of concentrations of these metals within surrounding receptors.

Table 3.6: Multi-element composition of representative samples

Drillhole ID	Depth (m)	Lithology	As	Ba	Be	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Se	Zn
			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
21FERC033	12.5	RSPU	3	41	0.5	0.06	8.8	450	130	<0.1	500	0.5	70	0.7	<0.5	58
21FERC058	14.5	RSPU	4	10	0.4	0.02	5.3	450	150	<0.1	560	0.6	80	5	<0.5	51
21FERC052	20.5	RSPU	3	220	0.6	0.04	18	410	240	<0.1	700	0.8	71	25	<0.5	39
21FERC024	24.5	RSPU	2	100	0.6	0.02	26	370	150	<0.1	740	<0.1	110	3	<0.5	32
21FERC058	34.5	RSPR	4	32	0.9	0.1	60	490	280	<0.1	3600	2.4	210	9	<0.5	130
21FERC052	52.5	MS	4	28	0.3	0.18	48	280	140	<0.1	1900	3.3	110	2	<0.5	88
21FERC033	54.5	RSPL	7	40	0.8	0.13	62	360	180	<0.1	960	1.2	200	0.9	<0.5	83
21FERC024	70.5	M	5	32	0.3	0.05	6.9	330	110	<0.1	570	0.2	88	0.5	<0.5	48
21FIRC094	14.5	RSPU	4	11	0.3	0.04	5	350	110	<0.1	490	0.3	98	<0.5	<0.5	40
21FIRC101	22.5	RSPU	4	22	0.3	0.06	4.1	270	78	<0.1	340	0.2	95	0.6	<0.5	52
21FIRC069	29.5	RSPU	100	14	0.2	0.04	9.4	680	170	<0.1	110	0.6	74	1	<0.5	71
21FIRC100	38.5	RSPU	12	240	0.3	0.04	12	480	140	<0.1	340	0.3	94	0.7	<0.5	67
21FIRC062	40.5	RSPU	3	730	1.3	<0.02	8	47	49	<0.1	100	0.5	38	6	<0.5	53
21FIRC094	40.5	RSPU	2	6	0.4	0.06	48	150	120	<0.1	2600	0.3	170	1	<0.5	77
21FIRC101	54.5	RSPU	5	19	0.8	0.1	62	130	180	<0.1	2200	0.2	160	0.6	<0.5	91
21FIRC100	84.5	RSPU	8	60	0.8	0.16	48	350	130	<0.1	560	1.5	140	0.8	<0.5	90
21FIRC069	109.5	MS	31	250	1.3	0.12	34	200	210	0.2	560	2.2	83	3	4	52
21FIRC100	130.5	MS	12	35	0.3	0.15	40	310	98	<0.1	1400	0.8	100	0.6	<0.5	75
21FIRC100	144.5	MS	19	46	0.3	0.04	42	320	90	<0.1	1500	0.8	110	0.9	0.8	68
Ecological Investigation Levels*			20	300	-	3	50	400	100	1	500	40	60	600	-	200

*DEC, 2010

Table 3.7: Global abundance index data

Drillhole ID	Depth (m)	Lithology	As	Ba	Be	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Se	Zn
		ACA	1.8	425	2.8	0.15	25	102	60	0.085	950	1.2	84	14	0.12	70
21FERC033	12.5	RSPU	0	0	0	0	0	2	1	-	0	0	0	0	-	0
21FERC058	14.5	RSPU	1	0	0	0	0	2	1	-	0	0	0	0	-	0
21FERC052	20.5	RSPU	0	0	0	0	0	1	1	-	0	0	0	0	-	0
21FERC024	24.5	RSPU	0	0	0	0	0	1	1	-	0	-	0	0	-	0
21FERC058	34.5	RSPR	1	0	0	0	1	2	2	-	1	0	1	0	-	0
21FERC052	52.5	MS	1	0	0	0	0	1	1	-	0	1	0	0	-	0
21FERC033	54.5	RSPL	1	0	0	0	1	1	1	-	0	0	1	0	-	0
21FERC024	70.5	M	1	0	0	0	0	1	0	-	0	0	0	0	-	0
21FIRC094	14.5	RSPU	1	0	0	0	0	1	0	-	0	0	0	-	-	0
21FIRC101	22.5	RSPU	1	0	0	0	0	1	0	-	0	0	0	0	-	0
21FIRC069	29.5	RSPU	5	0	0	0	0	2	1	-	0	0	0	0	-	0
21FIRC100	38.5	RSPU	2	0	0	0	0	2	1	-	0	0	0	0	-	0
21FIRC062	40.5	RSPU	0	0	0	-	0	0	0	-	0	0	0	0	-	0
21FIRC094	40.5	RSPU	0	0	0	0	0	0	0	-	1	0	0	0	-	0
21FIRC101	54.5	RSPU	1	0	0	0	1	0	1	-	1	0	0	0	-	0
21FIRC100	84.5	RSPU	2	0	0	0	0	1	1	-	0	0	0	0	-	0
21FIRC069	109.5	MS	4	0	0	0	0	0	1	1	0	0	0	0	4	0
21FIRC100	130.5	MS	2	0	0	0	0	1	0	-	0	0	0	0	-	0
21FIRC100	144.5	MS	3	0	0	0	0	1	0	-	0	0	0	0	2	0

Table 3.8: Results of static leach testing (mild acetic acid)

Drillhole ID	Depth (m)	Lithology	As	Be	B	Cd	Cr	Co	Cu	Hg	Mn	Ni	Pb	Se	Zn
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
21FERC033	12.5	RSPU	<0.05	<0.01	0.6	<0.01	<0.005	0.01	<0.01	<0.00005	0.08	<0.02	<0.03	<0.12	0.03
21FERC052	20.5	RSPU	<0.05	<0.01	<0.2	<0.01	<0.005	0.01	<0.01	<0.00005	0.20	<0.02	<0.03	<0.12	<0.02
21FERC024	24.5	RSPU	<0.05	<0.01	<0.2	<0.01	<0.005	0.01	0.01	<0.00005	0.04	<0.02	<0.03	<0.12	<0.02
21FERC058	34.5	RSPR	<0.05	<0.01	0.2	<0.01	<0.005	0.02	0.08	<0.00005	0.84	0.03	<0.03	<0.12	0.05
21FIRC101	22.5	RSPU	<0.05	<0.01	0.2	<0.01	<0.005	0.01	<0.01	<0.00005	0.08	<0.02	<0.03	<0.12	<0.02
21FIRC069	29.5	RSPU	<0.05	<0.01	<0.2	<0.01	<0.005	<0.01	0.01	<0.00005	0.09	<0.02	<0.03	<0.12	0.02
21FIRC101	54.5	RSPU	<0.05	<0.01	0.5	<0.01	<0.005	0.02	0.22	<0.00005	1.20	0.03	<0.03	<0.12	0.10
21FIRC100	84.5	RSPU	<0.05	<0.01	<0.2	<0.01	<0.005	<0.01	<0.01	<0.00005	0.61	0.03	<0.03	<0.12	<0.02
21FIRC100	130.5	MS	0.08	<0.01	<0.2	<0.01	<0.005	<0.01	<0.01	<0.00005	4.60	0.02	<0.03	<0.12	<0.02
Domestic non-potable use*			0.07	-	40	0.02	0.5	-	20	0.0001	5	0.2	0.1	0.1	30
Long-term irrigation use*			0.1	0.1	0.5	0.01	-	0.05	0.2	0.0002	0.2	0.2	2	0.02	2

*ANZECC & ARMCANZ (2000)

4 CONCLUSIONS

A geochemical characterisation was undertaken for three defined deposits at the Fingal's Project to assess the potential for acid rock and metalliferous drainage to occur following further disturbance of waste rock, and to identify the distribution of other potential problematic waste rock materials that may impact on the success of rehabilitation activities and mine closure planning. The major findings from this investigation are:

- Screen testing conducted on representative drillholes has shown the weathered saprolitic regolith material display highly acidic pH levels which become more alkaline close to the weathered fresh rock interface, making this material unsuitable for use near the surface of post-mine landforms. This material should be placed greater than 5 m depth from the outer surface of the WRL
- The loose sediment and ferruginous laterite and basement fresh rock material are neutral to slightly alkaline and the entire profile displays generally low to moderate levels of salinity.
- The loose upper profile sediments, ferruginous laterite and basement fresh rock materials therefore should not restrict rehabilitation growth and revegetation success.
- Screen testing and sulphur speciation determination has shown that the occurrences of sulphides are restricted to fresh rock materials where weathering has not been extensive.
- The saprolitic material reported negligible buffering capacities, whilst the underlying mafic fresh rock reported widely varying buffering capacities.
- The results of ABA and geochemical classification have indicated that the potential for the development of AMD within the samples tested was mostly low. All saprolite samples are considered unable to produce additional acidity. The underlying mafic materials may contain some capacity to generate acidity however based on the data collected thus far; the overall volume of fresh mafic rock material is likely to represent a considerable store of buffering capacity.
- Based on the variability of the mafic material and its potential dominance in post-mine landforms, particularly at surface given the saprolite materials limitations, further ABA testing should be conducted on this material during project planning to confirm the likely bulk material characteristics from an ABA perspective.
- Multi-element composition and leaching trials have reported generally low concentrations both within the solid materials phase and the bottle test leachate. Concentrations of Arsenic were elevated in several samples and are expected to be present as trace arsenopyrite, whilst concentrations of Manganese were slightly above the guidelines for long term irrigation water use. Consequently the risk of MD following disturbance of waste materials is considered to be low.

5 REFERENCES

Ahern, C.R., Blunden, B., Sullivan, L.A. and McElnea, A.E. (2004). 'Soil Sampling, Handling, Preparation and Storage for Analysis of Dried Samples', In: Acid Sulphate Soils – laboratory Methods Guidelines May 2004, Department of natural Resources, Mines and Energy, Indooroopilly, Queensland, Australia.

ANZECC & ARMCANZ (2000). Australian Water Quality Guidelines for Fresh and Marine Water Quality.

ANZECC & NHMRC, (1992). Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites.

Bateman, R. (2001). *Geology of the Kalgoorlie Goldfield, Western Australia, and the Mines of Kalgoorlie Consolidated Gold Mines.*

Bowen, H.J.M. (1979). The Elemental Geochemistry of Rocks, Academic Press, London.

Berner, R.A. (1967). 'Thermodynamic stability of sedimentary iron sulphides', American Journal of Science, 265: 773 – 785.

Currey, H. J. M., Ritchie, P. J. and Murray, G. S. C. (1997) Management Strategies for Acid Rock Drainage at Kidstone Gold Mine, North Queensland. Third Australian Workshop on Acid Mine Drainage Proceedings, Australian Centre for Minesite Rehabilitation Research. (ed by McClean, RW and Bell, LC), pp. 93-102.

Department of Health (DoH) (2006). Contaminated Sites Reporting Guidelines for Chemicals in Groundwater.

DEC (2010). Assessment Levels for Soil, Sediment and Water, Contaminated Sites Management Series, Department of Environment and Conservation (DEC), Perth, Western Australia.

Hsu, P. H. (1989). Aluminium Oxides and Oxyhydroxides. In: Dixon, J.B and Weed, S.B. (Eds.) Minerals in Soil Environments (2nd Ed.). Soil Science Society of America, Madison, Wisconsin, USA, pp. 331-378.

Price, W. A. (2009) Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. MEND Report 1.20.1. CANMET Mining and Mineral Sciences Laboratories. Smithers, British Columbia, Canada.

Soregaroli, Brian A., and Richard W. Lawrence. "Waste rock characterization at Dublin Gulch: a case study." In Proceedings of the 4th international conference on acid rock drainage, Vancouver, pp. 631-645. 1997.

Stone, Y., Ahern, C. R. and Blunden, B. (1998) Acid Sulphate Soils Manual 1998. Acid Sulphate Soils Advisory Committee. In. Wollongbar, NSW.

White, A. F. and Brantley, S. L. (1995) Chemical weathering rates of silicate minerals: an overview. Chemical Weathering Rates of Silicate Minerals, 31, 1-22.

APPENDIX A
LABORATORY COA & QA/QC

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories
ABN 53 140 099 207

[redacted]

CERTIFICATE OF ANALYSIS 272843

Client Details

Client	Soilwater Group
Attention	[redacted]
Address	45 Gladstone Street, EAST PERTH, WA, 6005

Sample Details

Your Reference	**Fingals**
Number of Samples	19 Drilling Samples
Date samples received	25/11/2021
Date completed instructions received	25/11/2021

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	16/12/2021
Date of Issue	16/12/2021

NATA Accreditation Number 2901. This document shall not be reproduced except in full.

Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

[redacted]

Chromium Reducible Sulphur						
Our Reference		272843-1	272843-2	272843-3	272843-4	272843-5
Your Reference	UNITS	BCX158844	BCX161619	BCX161707	BCX179076	BCX179126
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample	Drilling sample
Chromium Reducible Sulfur	%w/w	<0.005	<0.005	0.27	<0.005	<0.005

Chromium Reducible Sulphur						
Our Reference		272843-6	272843-7	272843-8	272843-9	272843-10
Your Reference	UNITS	BCX179177	BCX179192	BCX233477	BCX233499	BCX233524
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample	Drilling sample
Chromium Reducible Sulfur	%w/w	0.069	0.26	<0.005	<0.005	<0.005

Chromium Reducible Sulphur						
Our Reference		272843-11	272843-12	272843-13	272843-14	272843-15
Your Reference	UNITS	BCX233549	BCX233568	BCX233586	BCX233613	BCX233624
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample	Drilling sample
Chromium Reducible Sulfur	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005

Chromium Reducible Sulphur					
Our Reference		272843-16	272843-17	272843-18	272843-19
Your Reference	UNITS	BCX233645	BCX233658	BCX233676	BCX233693
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample
Chromium Reducible Sulfur	%w/w	<0.005	<0.005	<0.005	<0.005

Acid Neutralisation Capacity*						
Our Reference		272843-1	272843-2	272843-3	272843-4	272843-5
Your Reference	UNITS	BCX158844	BCX161619	BCX161707	BCX179076	BCX179126
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date Prepared		25/11/2021	25/11/2021	25/11/2021	25/11/2021	25/11/2021
Date Analysed		30/11/2021	30/11/2021	30/11/2021	30/11/2021	30/11/2021
Fizz Rating		0	0	0	0	0
ANC	kg H2SO4/tonne	4.1	<0.5	6.2	<0.5	11.6
ANC	% CaCO3	0.42	<0.01	0.63	<0.01	1.2

Acid Neutralisation Capacity*						
Our Reference		272843-6	272843-7	272843-8	272843-9	272843-10
Your Reference	UNITS	BCX179177	BCX179192	BCX233477	BCX233499	BCX233524
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date Prepared		25/11/2021	25/11/2021	25/11/2021	25/11/2021	25/11/2021
Date Analysed		30/11/2021	30/11/2021	30/11/2021	30/11/2021	30/11/2021
Fizz Rating		3	3	0	0	0
ANC	kg H2SO4/tonne	182	196	<0.5	2.5	<0.5
ANC	% CaCO3	19	20	<0.01	0.26	<0.01

Acid Neutralisation Capacity*						
Our Reference		272843-11	272843-12	272843-13	272843-14	272843-15
Your Reference	UNITS	BCX233549	BCX233568	BCX233586	BCX233613	BCX233624
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date Prepared		25/11/2021	25/11/2021	25/11/2021	25/11/2021	25/11/2021
Date Analysed		30/11/2021	30/11/2021	30/11/2021	30/11/2021	30/11/2021
Fizz Rating		0	0	3	0	0
ANC	kg H2SO4/tonne	<0.5	0.8	180	<0.5	0.7
ANC	% CaCO3	<0.01	0.09	18	<0.01	0.07

Acid Neutralisation Capacity*					
Our Reference		272843-16	272843-17	272843-18	272843-19
Your Reference	UNITS	BCX233645	BCX233658	BCX233676	BCX233693
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date Prepared		25/11/2021	25/11/2021	25/11/2021	25/11/2021
Date Analysed		30/11/2021	30/11/2021	30/11/2021	30/11/2021
Fizz Rating		0	0	0	0
ANC	kg H2SO4/tonne	<0.5	<0.5	<0.5	<0.5
ANC	% CaCO3	<0.01	<0.01	<0.01	0.04

Net Acid Generation						
Our Reference		272843-1	272843-2	272843-3	272843-4	272843-5
Your Reference	UNITS	BCX158844	BCX161619	BCX161707	BCX179076	BCX179126
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date Prepared		25/11/2021	25/11/2021	25/11/2021	25/11/2021	25/11/2021
Date Analysed		30/11/2021	30/11/2021	30/11/2021	30/11/2021	30/11/2021
NAG pH	pH units	6.5	4.2	3.0	4.7	7.8
NAG pH 4.5	kg H2SO4/tonne	<0.5	<0.5	5.9	<0.5	<0.5
NAG pH 7.0	kg/H2SO4/tonne	2.2	4.7	8.9	2.8	<0.5

Net Acid Generation						
Our Reference		272843-6	272843-7	272843-8	272843-9	272843-10
Your Reference	UNITS	BCX179177	BCX179192	BCX233477	BCX233499	BCX233524
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date Prepared		25/11/2021	25/11/2021	25/11/2021	25/11/2021	25/11/2021
Date Analysed		30/11/2021	30/11/2021	30/11/2021	30/11/2021	30/11/2021
NAG pH	pH units	11.2	11.3	5.0	6.5	5.1
NAG pH 4.5	kg H2SO4/tonne	<0.5	<0.5	<0.5	<0.5	<0.5
NAG pH 7.0	kg/H2SO4/tonne	<0.5	<0.5	1.2	<0.5	1.5

Net Acid Generation						
Our Reference		272843-11	272843-12	272843-13	272843-14	272843-15
Your Reference	UNITS	BCX233549	BCX233568	BCX233586	BCX233613	BCX233624
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date Prepared		25/11/2021	25/11/2021	25/11/2021	25/11/2021	25/11/2021
Date Analysed		30/11/2021	30/11/2021	30/11/2021	30/11/2021	30/11/2021
NAG pH	pH units	4.1	5.3	9.7	4.0	6.4
NAG pH 4.5	kg H2SO4/tonne	<0.5	<0.5	<0.5	0.8	<0.5
NAG pH 7.0	kg/H2SO4/tonne	3.3	0.7	<0.5	2.7	<0.5

Net Acid Generation					
Our Reference		272843-16	272843-17	272843-18	272843-19
Your Reference	UNITS	BCX233645	BCX233658	BCX233676	BCX233693
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date Prepared		25/11/2021	25/11/2021	25/11/2021	25/11/2021
Date Analysed		30/11/2021	30/11/2021	30/11/2021	30/11/2021
NAG pH	pH units	4.0	5.2	4.3	6.3
NAG pH 4.5	kg H2SO4/tonne	0.6	<0.5	<0.5	<0.5
NAG pH 7.0	kg/H2SO4/tonne	4.7	1.1	2.8	<0.5

Miscellaneous Inorg - soil						
Our Reference		272843-1	272843-2	272843-3	272843-4	272843-5
Your Reference	UNITS	BCX158844	BCX161619	BCX161707	BCX179076	BCX179126
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date prepared	-	25/11/2021	25/11/2021	25/11/2021	25/11/2021	25/11/2021
Date analysed	-	16/12/2021	16/12/2021	16/12/2021	16/12/2021	16/12/2021
Total Inorganic Carbon in soil *	%	0.02	0.03	0.02	0.02	0.02
Total Organic Carbon in soil	%	0.05	0.10	0.02	0.02	0.02
Total Carbon*	%	0.066	0.13	0.035	0.038	0.035
Sulphur - Total*	%	0.26	0.11	0.40	0.096	0.024

Miscellaneous Inorg - soil						
Our Reference		272843-6	272843-7	272843-8	272843-9	272843-10
Your Reference	UNITS	BCX179177	BCX179192	BCX233477	BCX233499	BCX233524
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date prepared	-	25/11/2021	25/11/2021	25/11/2021	25/11/2021	25/11/2021
Date analysed	-	16/12/2021	16/12/2021	16/12/2021	16/12/2021	16/12/2021
Total Inorganic Carbon in soil *	%	1.8	1.8	0.02	<0.01	<0.01
Total Organic Carbon in soil	%	0.02	0.04	0.06	0.06	0.05
Total Carbon*	%	1.8	1.8	0.085	0.069	0.054
Sulphur - Total*	%	0.039	0.28	0.26	0.071	0.25

Miscellaneous Inorg - soil						
Our Reference		272843-11	272843-12	272843-13	272843-14	272843-15
Your Reference	UNITS	BCX233549	BCX233568	BCX233586	BCX233613	BCX233624
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date prepared	-	25/11/2021	25/11/2021	25/11/2021	25/11/2021	25/11/2021
Date analysed	-	16/12/2021	16/12/2021	16/12/2021	16/12/2021	16/12/2021
Total Inorganic Carbon in soil *	%	0.01	0.02	1.6	0.02	0.01
Total Organic Carbon in soil	%	0.06	0.04	0.10	0.07	0.07
Total Carbon*	%	0.078	0.063	1.7	0.092	0.083
Sulphur - Total*	%	0.13	1.1	0.014	0.44	0.066

Miscellaneous Inorg - soil					
Our Reference		272843-16	272843-17	272843-18	272843-19
Your Reference	UNITS	BCX233645	BCX233658	BCX233676	BCX233693
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date prepared	-	25/11/2021	25/11/2021	25/11/2021	25/11/2021
Date analysed	-	16/12/2021	16/12/2021	16/12/2021	16/12/2021
Total Inorganic Carbon in soil *	%	0.02	<0.01	0.02	0.03
Total Organic Carbon in soil	%	0.05	0.26	0.06	0.01
Total Carbon*	%	0.074	0.060	0.085	0.038
Sulphur - Total*	%	0.35	0.075	0.13	0.058

Metals - soil						
Our Reference		272843-1	272843-2	272843-3	272843-4	272843-5
Your Reference	UNITS	BCX158844	BCX161619	BCX161707	BCX179076	BCX179126
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date digested	-	15/12/2021	15/12/2021	15/12/2021	15/12/2021	15/12/2021
Date analysed	-	16/12/2021	16/12/2021	16/12/2021	16/12/2021	16/12/2021
Mercury	mg/kg	<0.1	<0.1	0.2	<0.1	<0.1

Metals - soil						
Our Reference		272843-6	272843-7	272843-8	272843-9	272843-10
Your Reference	UNITS	BCX179177	BCX179192	BCX233477	BCX233499	BCX233524
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date digested	-	15/12/2021	15/12/2021	15/12/2021	15/12/2021	15/12/2021
Date analysed	-	16/12/2021	16/12/2021	16/12/2021	16/12/2021	16/12/2021
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1

Metals - soil						
Our Reference		272843-11	272843-12	272843-13	272843-14	272843-15
Your Reference	UNITS	BCX233549	BCX233568	BCX233586	BCX233613	BCX233624
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date digested	-	15/12/2021	15/12/2021	15/12/2021	15/12/2021	15/12/2021
Date analysed	-	16/12/2021	16/12/2021	16/12/2021	16/12/2021	16/12/2021
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1

Metals - soil					
Our Reference		272843-16	272843-17	272843-18	272843-19
Your Reference	UNITS	BCX233645	BCX233658	BCX233676	BCX233693
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date digested	-	15/12/2021	15/12/2021	15/12/2021	15/12/2021
Date analysed	-	16/12/2021	16/12/2021	16/12/2021	16/12/2021
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1

Metals in rock						
Our Reference	UNITS	272843-1	272843-2	272843-3	272843-4	272843-5
Your Reference		BCX158844	BCX161619	BCX161707	BCX179076	BCX179126
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date digested	-	15/12/2021	15/12/2021	15/12/2021	15/12/2021	15/12/2021
Date analysed	-	15/12/2021	15/12/2021	15/12/2021	15/12/2021	15/12/2021
Arsenic	mg/kg	3	100	31	12	8
Barium	mg/kg	730	14	250	240	60
Beryllium	mg/kg	1.3	0.2	1.3	0.3	0.8
Cadmium	mg/kg	<0.02	0.04	0.12	0.04	0.16
Cobalt	mg/kg	8.0	9.4	34	12	48
Chromium	mg/kg	47	680	200	480	350
Copper	mg/kg	49	170	210	140	130
Manganese	mg/kg	100	110	560	340	560
Molybdenum	mg/kg	0.5	0.6	2.2	0.3	1.5
Nickel	mg/kg	38	74	83	94	140
Lead	mg/kg	6	1	3	0.7	0.8
Selenium	mg/kg	<0.5	<0.5	4	<0.5	<0.5
Zinc	mg/kg	53	71	52	67	90

Metals in rock						
Our Reference	UNITS	272843-6	272843-7	272843-8	272843-9	272843-10
Your Reference		BCX179177	BCX179192	BCX233477	BCX233499	BCX233524
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date digested	-	15/12/2021	15/12/2021	15/12/2021	15/12/2021	15/12/2021
Date analysed	-	15/12/2021	15/12/2021	15/12/2021	15/12/2021	15/12/2021
Arsenic	mg/kg	12	19	3	7	2
Barium	mg/kg	35	46	41	40	100
Beryllium	mg/kg	0.3	0.3	0.5	0.8	0.6
Cadmium	mg/kg	0.15	0.04	0.06	0.13	0.02
Cobalt	mg/kg	40	42	8.8	62	26
Chromium	mg/kg	310	320	450	360	370
Copper	mg/kg	98	90	130	180	150
Manganese	mg/kg	1,400	1,500	500	960	740
Molybdenum	mg/kg	0.8	0.8	0.5	1.2	<0.1
Nickel	mg/kg	100	110	70	200	110
Lead	mg/kg	0.6	0.9	0.7	0.9	3
Selenium	mg/kg	<0.5	0.8	<0.5	<0.5	<0.5
Zinc	mg/kg	75	68	58	83	32

Metals in rock						
Our Reference	UNITS	272843-11	272843-12	272843-13	272843-14	272843-15
Your Reference		BCX233549	BCX233568	BCX233586	BCX233613	BCX233624
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date digested	-	15/12/2021	15/12/2021	15/12/2021	15/12/2021	15/12/2021
Date analysed	-	15/12/2021	15/12/2021	15/12/2021	15/12/2021	15/12/2021
Arsenic	mg/kg	5	3	4	4	4
Barium	mg/kg	32	220	28	10	32
Beryllium	mg/kg	0.3	0.6	0.3	0.4	0.9
Cadmium	mg/kg	0.05	0.04	0.18	0.02	0.10
Cobalt	mg/kg	6.9	18	48	5.3	60
Chromium	mg/kg	330	410	280	450	490
Copper	mg/kg	110	240	140	150	280
Manganese	mg/kg	570	700	1,900	560	3,600
Molybdenum	mg/kg	0.2	0.8	3.3	0.6	2.4
Nickel	mg/kg	88	71	110	80	210
Lead	mg/kg	0.5	25	2	5	9
Selenium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc	mg/kg	48	39	88	51	130

Metals in rock					
Our Reference	UNITS	272843-16	272843-17	272843-18	272843-19
Your Reference		BCX233645	BCX233658	BCX233676	BCX233693
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date digested	-	15/12/2021	15/12/2021	15/12/2021	15/12/2021
Date analysed	-	15/12/2021	15/12/2021	15/12/2021	15/12/2021
Arsenic	mg/kg	4	2	4	5
Barium	mg/kg	11	6	22	19
Beryllium	mg/kg	0.3	0.4	0.3	0.8
Cadmium	mg/kg	0.04	0.06	0.06	0.10
Cobalt	mg/kg	5.0	48	4.1	62
Chromium	mg/kg	350	150	270	130
Copper	mg/kg	110	120	78	180
Manganese	mg/kg	490	2,600	340	2,200
Molybdenum	mg/kg	0.3	0.3	0.2	0.2
Nickel	mg/kg	98	170	95	160
Lead	mg/kg	<0.5	1	0.6	0.6
Selenium	mg/kg	<0.5	<0.5	<0.5	<0.5
Zinc	mg/kg	40	77	52	91

Metals in ASLP (pH 5.0)						
Our Reference		272843-2	272843-5	272843-6	272843-8	272843-10
Your Reference	UNITS	BCX161619	BCX179126	BCX179177	BCX233477	BCX233524
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date extracted	-	16/12/2021	16/12/2021	16/12/2021	16/12/2021	16/12/2021
Date analysed	-	16/12/2021	16/12/2021	16/12/2021	16/12/2021	16/12/2021
pH of final Leachate	pH units	5.2	5.5	6.4	4.9	4.9
Arsenic in ASLP pH 5.0	mg/L	<0.05	<0.05	0.08	<0.05	<0.05
Beryllium in ASLP pH 5.0	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Boron in ASLP pH 5.0	mg/L	<0.2	<0.2	<0.2	0.6	<0.2
Cadmium in ASLP pH 5.0	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium (VI) in ASLP pH 5.0	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt in ASLP pH 5.0	mg/L	<0.01	<0.01	<0.01	0.01	0.01
Copper in ASLP pH 5.0	mg/L	0.01	<0.01	<0.01	<0.01	0.01
Lead in ASLP pH 5.0	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03
Manganese in ASLP pH 5.0	mg/L	0.09	0.61	4.6	0.08	0.04
Mercury in ASLP pH 5.0	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Nickel in ASLP pH 5.0	mg/L	<0.02	0.03	0.02	<0.02	<0.02
Selenium in ASLP pH 5.0	mg/L	<0.12	<0.12	<0.12	<0.12	<0.12
Zinc in ASLP pH 5.0	mg/L	0.02	<0.02	<0.02	0.03	<0.02

Metals in ASLP (pH 5.0)					
Our Reference		272843-12	272843-15	272843-18	272843-19
Your Reference	UNITS	BCX233568	BCX233624	BCX233676	BCX233693
Type of sample		Drilling sample	Drilling sample	Drilling sample	Drilling sample
Date extracted	-	16/12/2021	16/12/2021	16/12/2021	16/12/2021
Date analysed	-	16/12/2021	16/12/2021	16/12/2021	16/12/2021
pH of final Leachate	pH units	5.3	4.9	4.9	4.9
Arsenic in ASLP pH 5.0	mg/L	<0.05	<0.05	<0.05	<0.05
Beryllium in ASLP pH 5.0	mg/L	<0.01	<0.01	<0.01	<0.01
Boron in ASLP pH 5.0	mg/L	<0.2	0.2	0.2	0.5
Cadmium in ASLP pH 5.0	mg/L	<0.01	<0.01	<0.01	<0.01
Chromium (VI) in ASLP pH 5.0	mg/L	<0.005	<0.005	<0.005	<0.005
Cobalt in ASLP pH 5.0	mg/L	0.01	0.02	0.01	0.02
Copper in ASLP pH 5.0	mg/L	<0.01	0.08	<0.01	0.22
Lead in ASLP pH 5.0	mg/L	<0.03	<0.03	<0.03	<0.03
Manganese in ASLP pH 5.0	mg/L	0.20	0.84	0.08	1.2
Mercury in ASLP pH 5.0	mg/L	<0.00005	<0.00005	<0.00005	<0.00005
Nickel in ASLP pH 5.0	mg/L	<0.02	0.03	<0.02	0.03
Selenium in ASLP pH 5.0	mg/L	<0.12	<0.12	<0.12	<0.12
Zinc in ASLP pH 5.0	mg/L	<0.02	0.05	<0.02	0.10

Method ID	Methodology Summary
AMD-001	Acid Mine Drainage determined by AMIRA International - Acid Rock Drainage Test Handbook.
AMD-002	This method is used for the determination of Total Sulphur and Total Carbon in soils and rocks via combustion and Non-Dispersive Infra-Red Detectors (NDIR), using a LECO 832 analyser.
Ext-053	Analysed by Genalysis, accreditation number 3244
INORG-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
INORG-068	Chromium Reducible Sulfur - Hydrogen Sulfide is quantified by iodometric titration after distillation to determine potential acidity. Based on Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.
INORG-118	Hexavalent Chromium by Ion Chromatographic separation and colourimetric determination.
METALS-020	Determination of various metals by ICP-AES.
METALS-021	Determination of Mercury by Cold Vapour AAS.
	For urine samples total Mercury is determined, however, mercury in urine is almost entirely in the inorganic form (CDC).

QUALITY CONTROL: Chromium Reducible Sulphur						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Chromium Reducible Sulfur	%w/w	0.005	INORG-068	<0.005	1	<0.005	<0.005	0	92	[NT]

QUALITY CONTROL: Chromium Reducible Sulphur						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Chromium Reducible Sulfur	%w/w	0.005	INORG-068	[NT]	11	<0.005	<0.005	0	[NT]	[NT]

QUALITY CONTROL: Acid Neutralisation Capacity*					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date Prepared				25/11/2021	1	25/11/2021	25/11/2021		25/11/2021	[NT]
Date Analysed				30/11/2021	1	30/11/2021	30/11/2021		30/11/2021	[NT]
Fizz Rating			AMD-001	[NT]	1	0	0		[NT]	[NT]
ANC	kg H2SO4/tonne	0.5	AMD-001	[NT]	1	4.1	4.2	2	105	[NT]
ANC	% CaCO3	0.01	AMD-001	[NT]	1	0.42	0.43	2	105	[NT]

QUALITY CONTROL: Acid Neutralisation Capacity*					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date Prepared				[NT]	11	25/11/2021	25/11/2021		[NT]	[NT]
Date Analysed				[NT]	11	30/11/2021	30/11/2021		[NT]	[NT]
Fizz Rating			AMD-001	[NT]	11	0	0		[NT]	[NT]
ANC	kg H2SO4/tonne	0.5	AMD-001	[NT]	11	<0.5	<0.5	0	[NT]	[NT]
ANC	% CaCO3	0.01	AMD-001	[NT]	11	<0.01	<0.01	0	[NT]	[NT]

QUALITY CONTROL: Net Acid Generation						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date Prepared				25/11/2021	1	25/11/2021	25/11/2021		25/11/2021	[NT]
Date Analysed				30/11/2021	1	30/11/2021	30/11/2021		30/11/2021	[NT]
NAG pH	pH units	0.1	AMD-001	[NT]	1	6.5	6.5	0	101	[NT]
NAG pH 4.5	kg H2SO4/tonne	0.5	AMD-001	[NT]	1	<0.5	<0.5	0	90	[NT]
NAG pH 7.0	kg/H2SO4/tonne	0.5	AMD-001	[NT]	1	2.2	2.0	10	97	[NT]

QUALITY CONTROL: Net Acid Generation						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date Prepared				[NT]	11	25/11/2021	25/11/2021		[NT]	[NT]
Date Analysed				[NT]	11	30/11/2021	30/11/2021		[NT]	[NT]
NAG pH	pH units	0.1	AMD-001	[NT]	11	4.1	4.0	2	[NT]	[NT]
NAG pH 4.5	kg H2SO4/tonne	0.5	AMD-001	[NT]	11	<0.5	<0.5	0	[NT]	[NT]
NAG pH 7.0	kg/H2SO4/tonne	0.5	AMD-001	[NT]	11	3.3	3.5	6	[NT]	[NT]

QUALITY CONTROL: Miscellaneous Inorg - soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			25/11/2021	1	25/11/2021	25/11/2021		25/11/2021	[NT]
Date analysed	-			16/12/2021	1	16/12/2021	16/12/2021		16/12/2021	[NT]
Total Inorganic Carbon in soil *	%	0.01	AMD-002	[NT]	1	0.02	0.03	40	[NT]	[NT]
Total Organic Carbon in soil	%	0.01	AMD-002	<0.01	1	0.05	0.04	22	92	[NT]
Total Carbon*	%	0.01	AMD-002	<0.01	1	0.066	0.067	2	97	[NT]
Sulphur - Total*	%	0.01	AMD-002	<0.01	1	0.26	0.26	0	101	[NT]

QUALITY CONTROL: Miscellaneous Inorg - soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	25/11/2021	25/11/2021		[NT]	[NT]
Date analysed	-			[NT]	11	16/12/2021	16/12/2021		[NT]	[NT]
Total Inorganic Carbon in soil *	%	0.01	AMD-002	[NT]	11	0.01	0.02	67	[NT]	[NT]
Total Organic Carbon in soil	%	0.01	AMD-002	[NT]	11	0.06	0.06	0	[NT]	[NT]
Total Carbon*	%	0.01	AMD-002	[NT]	11	0.078	0.076	3	[NT]	[NT]
Sulphur - Total*	%	0.01	AMD-002	[NT]	11	0.13	0.15	14	[NT]	[NT]

QUALITY CONTROL: Metals - soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	272843-2
Date digested	-			16/12/2021	1	15/12/2021	15/12/2021		16/12/2021	16/12/2021
Date analysed	-			16/12/2021	1	16/12/2021	16/12/2021		16/12/2021	16/12/2021
Mercury	mg/kg	0.1	METALS-021	<0.1	1	<0.1	<0.1	0	100	104

QUALITY CONTROL: Metals in rock					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date digested	-			15/12/2021	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Date analysed	-			15/12/2021	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

QUALITY CONTROL: Metals in ASLP (pH 5.0)						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date extracted	-			16/12/2021	2	16/12/2021	16/12/2021		16/12/2021	[NT]
Date analysed	-			16/12/2021	2	16/12/2021	16/12/2021		16/12/2021	[NT]
Arsenic in ASLP pH 5.0	mg/L	0.05	METALS-020	<0.05	2	<0.05	<0.05	0	104	[NT]
Beryllium in ASLP pH 5.0	mg/L	0.01	METALS-020	<0.01	2	<0.01	<0.01	0	99	[NT]
Boron in ASLP pH 5.0	mg/L	0.2	METALS-020	<0.2	2	<0.2	<0.2	0	95	[NT]
Cadmium in ASLP pH 5.0	mg/L	0.01	METALS-020	<0.01	2	<0.01	<0.01	0	97	[NT]
Chromium (VI) in ASLP pH 5.0	mg/L	0.005	INORG-118	<0.005	2	<0.005	<0.005	0	97	[NT]
Cobalt in ASLP pH 5.0	mg/L	0.01	METALS-020	<0.01	2	<0.01	<0.01	0	96	[NT]
Copper in ASLP pH 5.0	mg/L	0.01	METALS-020	<0.01	2	0.01	<0.01	0	107	[NT]
Lead in ASLP pH 5.0	mg/L	0.03	METALS-020	<0.03	2	<0.03	<0.03	0	96	[NT]
Manganese in ASLP pH 5.0	mg/L	0.01	METALS-020	<0.01	2	0.09	0.08	12	97	[NT]
Mercury in ASLP pH 5.0	mg/L	0.00005	METALS-021	<0.00005	2	<0.00005	<0.00005	0	85	[NT]
Nickel in ASLP pH 5.0	mg/L	0.02	METALS-020	<0.02	2	<0.02	<0.02	0	96	[NT]
Selenium in ASLP pH 5.0	mg/L	0.12	METALS-020	<0.12	2	<0.12	<0.12	0	102	[NT]
Zinc in ASLP pH 5.0	mg/L	0.02	METALS-020	<0.02	2	0.02	<0.02	0	97	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Report Comments

Please note three samples required re-milling due to presence of coarse material.

4 Acid Metals analysis conducted by Intertek Genalysis. Report 438.0/2126224.

ENVIRONMENTAL INNOVATIONS

[redacted]

w: www.envinnovations.com

MEMO

TO:	[redacted]	COMPANY:	Blackcat Syndicate	
FROM:	[redacted]	PROJECT TITLE:	Fingals Gold Project	
DATE:	16 June 2022	PROJECT & DOCUMENT NO:	BC8-004-1-3	005
SUBJECT:	Results of additional ARD testing on Fingals Basalt			

Peter,

Based on the results of previous acid rock drainage (ARD) testing carried out for the Fingals Project (SWC, 2021) and an assessment of the proportion of the different waste rock units which are planned to be mined there (EI, 2022), it was recommended that further testing of the intermediate and fresh basalt waste rock material be carried out. This memo presents the findings from this additional testing. 10 samples were chosen from these two waste rock units in consultation with Blackcat Syndicate geology staff, with the details summaries in Table 1. Details of the 3 samples which were tested in the initial assessment are included to allow comparison.

Table 1: Details of additional basalt samples selected for ARD assessment

Testing Round	Sample ID	Drillhole ID	Depth (m)	Lithology	Degree of weathering
First	BCX161707	21FIRC069	109.5	Basalt	Fresh
	BCX179177	21FIRC100	130.5	Basalt	Fresh
	BCX179192	21FIRC100	144.5	Basalt	Fresh
Second	EI-001	21FIRC006	67-78	Basalt	Transition
	EI-002	21FIRC109	100-120	Basalt	Fresh
	EI-003	21FIRC117	65-74	Basalt	Transition
	EI-004	21FIRC124	124-135	Basalt	Fresh
	EI-005	21FIRC127	115-125	Basalt	Fresh
	EI-006	21FIRC142	102-118	Basalt	Fresh
	EI-007	21FIRC153	102-118	Basalt	Fresh
	EI-008	21FIRC154	120-130	Basalt	Fresh shear zone
	EI-009	21FIRC154	90-102	Basalt	Transition
	EI-010	21FIRC169	87-97	Basalt	Fresh shear zone

Each of the 10 additional samples underwent the following analysis at MPL laboratories. The certificate of analysis for this testing is attached as an appendix to this report.

- Total Sulfur (S)
- Chromium Reducible-S (S_{CR})
- Static Net Acid Generation (NAG)
- Acid Neutralising Capacity (ANC)
- Total Organic and Inorganic Carbon (TOC/TIC)

The above analysis allows each sample to have a complete ABA analysis which provides the basis of an ARD classification.

SULFUR SPECIATION

The results of the sulfur speciation testing on all basalt samples from Fingals are presented below in Table 2.

Table 2: Sulfur speciation data for Basalt samples

Testing Round	Sample ID	Degree of weathering	Total S (%)	S_{CR} (%)
First	BCX161707	Fresh	0.40	0.27
	BCX179177	Fresh	0.039	0.069
	BCX179192	Fresh	0.28	0.26
Second	EI-001	Transition	0.015	<0.005
	EI-002	Fresh	0.064	0.055
	EI-003	Transition	0.01	<0.005
	EI-004	Fresh	0.049	0.053
	EI-005	Fresh	0.084	0.10
	EI-006	Fresh	0.057	0.038
	EI-007	Fresh	0.019	0.005
	EI-008	Fresh shear zone	0.072	0.056
	EI-009	Transition	<0.01	<0.005
	EI-010	Fresh shear zone	0.26	0.20

The total S percentages reported from the 10 additional 2nd round basalt samples showed a similar range to the initial samples, with a slightly lower average. The results of the 10 samples results in the average for the data set as a whole lowering from 0.24% to 0.11% total S and 0.20% to 0.09%[1] S_{CR}. The samples broadly followed the same proportion of total S reporting as sulfide S (S_{CR}) with most samples reporting the proportion of total S as S_{CR} at greater than 50%, which is as expected for rock material which has experienced little to no weathering.

None of the 10 additional samples exceeded the 0.3 percent guideline value (for either Total S or S_{CR}) which has been settled on by various sources (AMIRA, 2002) to guide the use of further resources in detailed investigations.

[1] In all cases where given values are below the limit of reporting (LOR), half the LOR has been used in statistical calculations

ACID NEUTRALISING CAPACITY

The contained acid neutralising potential (ANC) of the 10 samples was analysed by back titration (HCl addition to sample, followed by back titration utilising NaOH to determine the amount of un-buffered acid) In addition to this measurement, determination of the total and inorganic or carbonate (CO_3) carbon percentage within each sample was performed.

The addition of HCl determines the NP of the material, but can overestimate the readily available buffering potential as it can include neutralising effects of primary silicate minerals, the breakdown of which are generally slow kinetically under circum-neutral conditions (White and Brantley, 1995) and are therefore ineffective at effectively neutralising acid generation and maintaining a near neutral pH in most real-world scenarios. For this reason the carbonate content is used to calculate a carbonate Neutralising Potential (NP) which can be a more accurate measure of a materials ability to buffer acid generation under normal weathering conditions. The measured ANC along with the calculated NP for both measured total carbon and carbonate carbon (inorganic carbon) within all Fingals basalt samples shown in Table 2.

Table 2: Acid neutralising capacity results

Testing Round	Sample ID	Degree of weathering	ANC*	Total Carbon NP*	Total Inorganic Carbon NP*
First	BCX161707	Fresh	6.2	2.9	1.6
	BCX179177	Fresh	182	147.0	147.0
	BCX179192	Fresh	196	147.0	147.0
Second	EI-001	Transition	21.8	2.4	<0.8
	EI-002	Fresh	199	138.8	130.7
	EI-003	Transition	18.3	5.0	<0.8
	EI-004	Fresh	97.7	68.6	61.2
	EI-005	Fresh	190	130.7	122.5
	EI-006	Fresh	96.5	39.2	35.9
	EI-007	Fresh	114	63.7	61.2
	EI-008	Fresh shear zone	112	89.8	89.8
	EI-009	Transition	31.1	2.4	<0.8
	EI-010	Fresh shear zone	91	71.0	67.8

*Results are provided in kg H_2SO_4/t

The results show the additional basalt samples display a similar range of ANC and NP values as the previously tested samples, with the average ANC changing from 128 to 104 kg H_2SO_4/t, and the CO_3 NP average changing from 98 to 66 kg H_2SO_4/t. Although the average has shifted downwards somewhat the standard deviation has lowered dramatically owing to the larger and more consistent data set.

A comparison between the ANC and CO_3 NP results is useful to highlight the source and likely mineralogy of neutralisation potential. In particular, the dissolution of Fe (siderite) and Mn (rhodochrosite) carbonates initially consume acidity in a similar manner to calcite. However under aerobic conditions with pH > 3.5, the subsequent oxidation and hydrolysis of the Fe or Mn produces acidity equivalent to that consumed and therefore these carbonates do not contribute to acid neutralisation (Price, 2009). Figure 1 shows that the CO_3 NP is consistently lower than the measured acid titratable ANC, which is the most common response for ARD studies. This result suggests that the presence of large proportions of Fe and Mn CO_3 within the measured TIC is unlikely and that the CO_3 NP can be considered a fair estimation of the actual neutralisation potential within the samples. Conversely this data suggests that the ANC reported may overestimate the readily available buffering capacity through the inclusion of primary silicate minerals as previously discussed. Therefore the CO_3 NP values should be utilised to ensure ABA calculations are conservative.

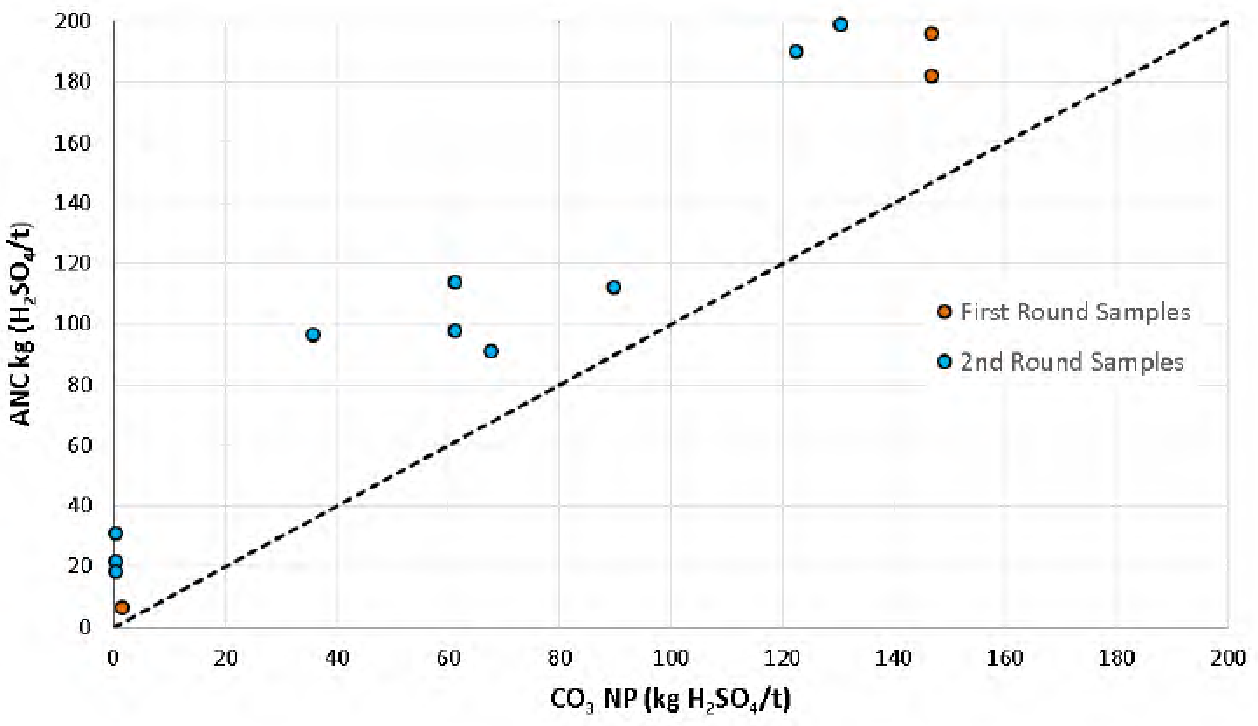


Figure 1: comparison of CO_3 NP to ANC values.

ACID BASE ACCOUNT

An acid base account (ABA) is the process of comparing the acid potential (AP) and ANC/NP results for different samples and materials to determine the theoretical outcome of oxidation reactions in relation to potential acid production. The results of this comparison for all Fingals basalt samples are listed in Table 3. The AP value has been calculated from the measured Total S content and assumes that all of the reported sulfur within each sample occurs in the form of iron pyrite (FeS_2) and oxidises according to the equation shown below. This oxidation reaction produces the maximum amount of acidity per molar weight of S of any sulphide species and therefore provides a 'worst case' scenario for predicting acid production.

$$FeS_2 + \frac{15}{4}O_2 + \frac{7}{2}H_2O => Fe(OH)_2 + 2H_2SO_4$$

Table 3: Acid base account summary

Testing Round	Sample ID	Degree of weathering	NAPP (ANC)	NAPP (TIC NP)
First	BCX161707	Fresh	6.0	10.6
	BCX179177	Fresh	-180.8	-145.8
	BCX179192	Fresh	-187.4	-138.4
Second	EI-001	Transition	-21.3	0.1
	EI-002	Fresh	-197.0	-128.7
	EI-003	Transition	-18.0	-0.1

Testing Round	Sample ID	Degree of weathering	NAPP (ANC)	NAPP (TIC NP)
Second	EI-004	Fresh	-96.2	-59.7
	EI-005	Fresh	-187.4	-119.9
	EI-006	Fresh	-94.8	-34.2
	EI-007	Fresh	-113.4	-60.7
	EI-008	Fresh shear zone	-109.8	-87.6
	EI-009	Transition	-31.1	-4.0
	EI-010	Fresh shear zone	-83.0	-59.8

In normal conditions expected within the WRL the acid produced will not have perfect accessibility to the surfaces of mineral grains which can act to neutralise the acid at different scales, with acid sometimes by-passing these minerals at the whole rock scale or potentially cut off from these grains by a barrier of precipitates (e.g. iron-oxyhydroxides). To allow for these effects, scientific investigation and field experience has shown materials which display an NP/MPA ratio greater than two have a very low potential for ARD generation.

The ABA comparison between CO_3 NP and Total S MPA has been plotted in Figure 2. The plot shows that the 2nd round samples either have very low MPA and NP values, with three of the seven samples plotting close to the origin or they have an NP/MPA ratio well above 3. This indicates that these samples are highly unlikely to be capable of sustaining acid production under normal weathering conditions.

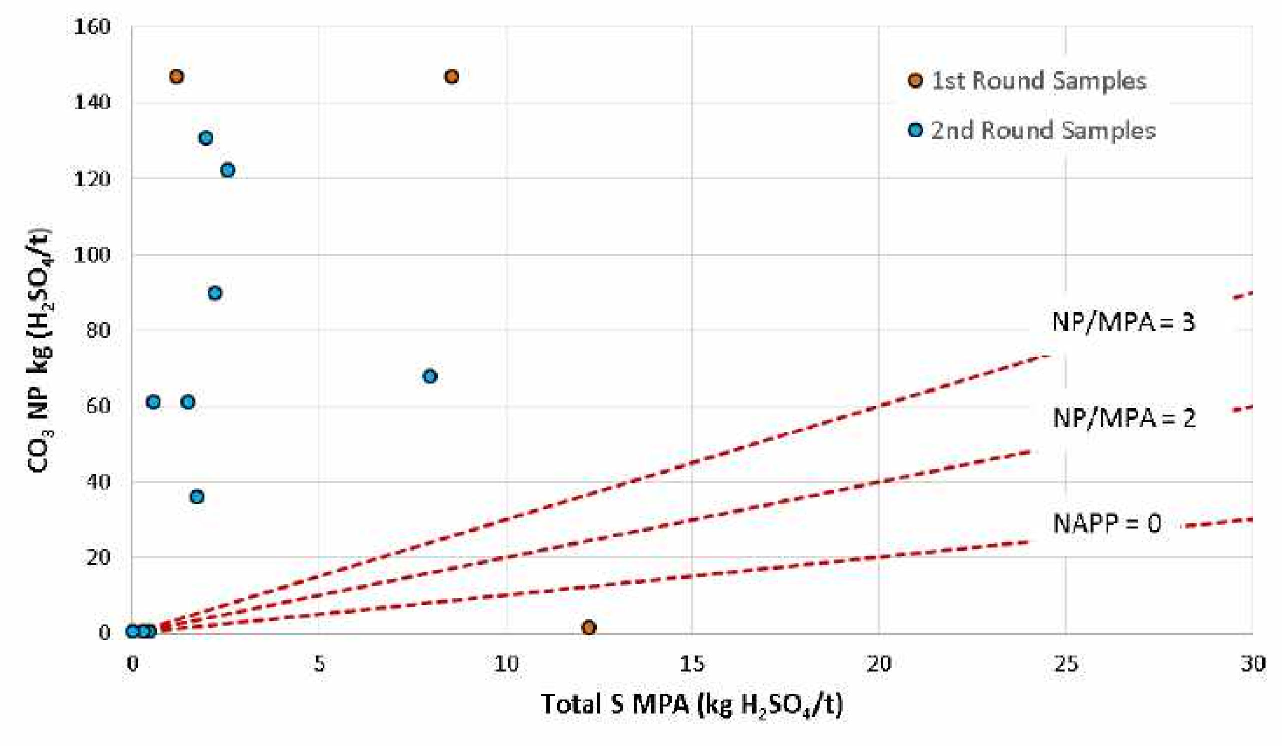


Figure 2: ABA comparison of CO_3 NP to Total S MPA.

GEOCHEMICAL CLASSIFICATION

The results of static NAG testing via back titration on all basalt samples tested from Fingals are presented in Table 4. These results show the results of static net acid generation testing, with the final pH and acidity of the resultant liquor after forced oxidation and heating of the sample. An indication of the form of the acidity can be determined initially through titration of the NAG liquor to a pH of 4.5, then continuing the titration up to a pH of 7. The value below a pH of 4.5 is given by free acid (i.e. H_2SO_4/t or equivalent) along with soluble iron and aluminium, whilst the value at a pH of 7 also includes metallic ions that precipitate between pH 4.5 and 7.

Due to the uncertainties inherent in both the single addition NAG test, and the calculated ABA when applied individually, these two measurements are compared to provide a more accurate classification tool for use in managing potential ARD issues. The results from the static NAG testing are used in conjunction with the NAPP results (ABA) to allow a geochemical classification of the acid generating potential of a material. Samples are placed into one of three categories based on the following criteria:

- Non-acid forming (NAF) – Samples classified as NAF may have significant acid generating potential but contain sufficient readily available ANC to adequately buffer any acidity formed. A sample is classified as NAF when it has a negative NAPP and a final NAGpH ≥ 4.5.
- Potentially-acid forming (PAF) – Samples with a PAF classification present the risk of generating acidic drainage if oxidation (i.e. exposure to atmospheric conditions) occurs. A sample is classified as PAF when it has a positive NAPP and a final NAGpH < 4.5.
- Uncertain (UC) – An uncertain classification is used where there is a conflict between the NAPP and NAG test results (i.e. where the NAPP is positive and the NAGpH ≥ 4.5 or vice versa). Uncertain sample classification may require further investigation to determine the likely acid generation potential.

The geochemical classification of all basalt samples tested from Fingals is presented in Figure 3 and summarised in Table 4. Three of the 2nd round samples plot near the vertical border line which indicates a close to neutral net acid production capacity. For these three samples this does not represent a balance of the two processed but is instead a reflection of a lack of both acid forming and acid neutralising minerals within these three samples. Of these three, two have a classification of non-acid forming (NAF) whilst the third is classified as uncertain (UC). However in practice all three should be considered neutral with regards to ABA management. The remaining seven samples tested in the 2nd round reported negative NAPP values and had net acid generation pH values well above 4.5, resulting in their NAF classifications.

Looking at the data set as a whole, it is clear that the additional 10 samples have moved the overall classification of basalt material at Fingals from uncertain (2 NAF and 1 PAF result) to dominantly non-acid forming (11 NAF, 1 uncertain and 1 PAF). Furthermore, the magnitude of the NAPP values makes it clear that on a bulk volume basis, the basalt is highly unlikely to be net acid forming, with the average NAPP value of – 64 kg H_2SO_4/t suggesting a considerable capacity within NAF basalt volumes to adequately buffer acid generation from PAF volumes of basalt which based on this assessment are now judged likely to be incapable of large acid generation even when considered in isolation and are likely to represent only a small proportion of the total volume (e.g. < 15%).

Table 4: Geochemical classification of basalt samples

Testing Round	Sample ID	Degree of weathering	NAG pH	NAG pH 4.5	NAG pH 7.0	NAPP (TIC NP)	Classification
First	BCX161707	Fresh	3	5.9	8.9	10.6	PAF
	BCX179177	Fresh	11.2	<0.5	<0.5	-145.8	NAF
	BCX179192	Fresh	11.3	<0.5	<0.5	-138.4	NAF
Second	EI-001	Transition	9.1	<0.5	<0.5	0.1	UC
	EI-002	Fresh	11.4	<0.5	<0.5	-128.7	NAF
	EI-003	Transition	8.9	<0.5	<0.5	-0.1	NAF
	EI-004	Fresh	11.2	<0.5	<0.5	-59.7	NAF
	EI-005	Fresh	11.4	<0.5	<0.5	-119.9	NAF
	EI-006	Fresh	11	<0.5	<0.5	-34.2	NAF
	EI-007	Fresh	9.95	<0.5	<0.5	-60.7	NAF
	EI-008	Fresh shear zone	11.2	<0.5	<0.5	-87.6	NAF
	EI-009	Transition	7.6	<0.5	<0.5	-4.0	NAF
	EI-010	Fresh shear zone	10.9	<0.5	<0.5	-59.8	NAF

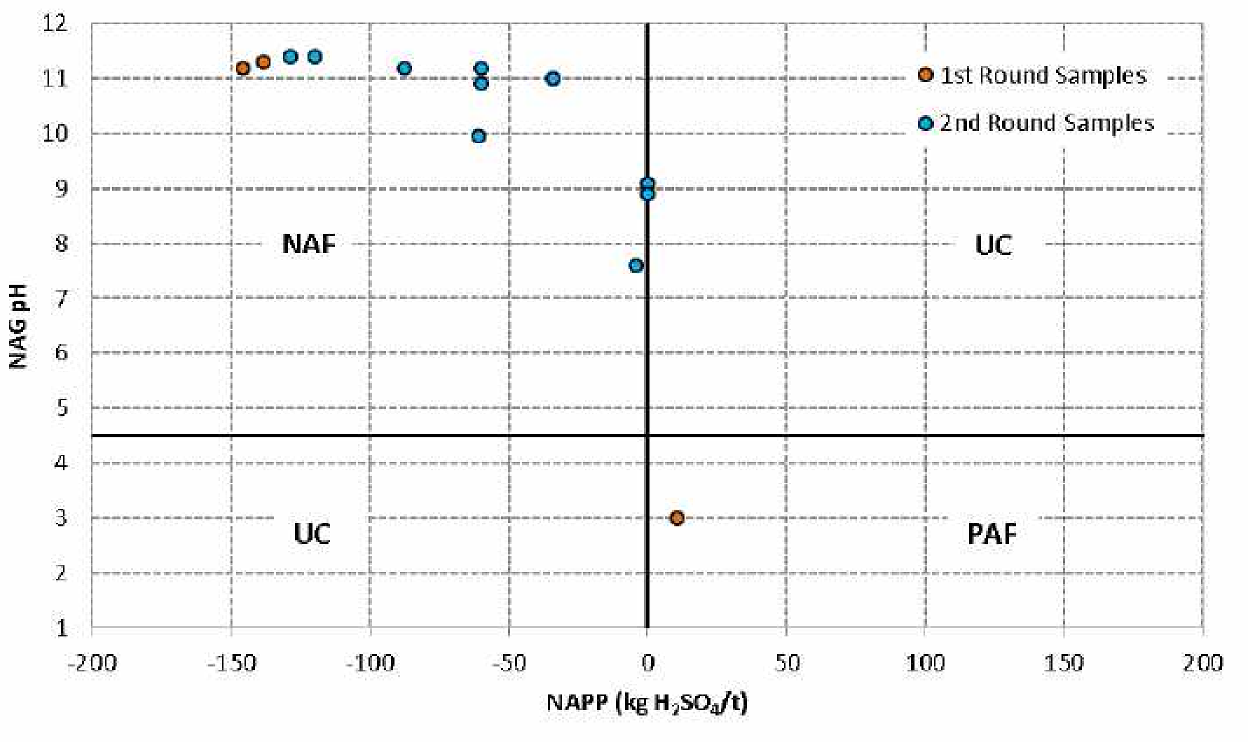


Figure 2: Geochemical classification plot.

CONCLUSIONS

Further testing of the basalt lithology at Fingals was undertaken to confirm its likely ARD status. The major findings from this additional testing are:

- The 10 additional basalt samples all contained low sulfur contents (<0.3%)
- The acid neutralising capacities of the basalt material should be based on their CO_3 NP potential to prevent overestimation. The CO_3 NP potential of all basalt samples tested from Fingals report an average of 67 kg H_2SO_4/t.
- Nine of the ten additional basalt samples received an ARD classification of non-acid forming (NAF) with the remaining sample classified as uncertain (UC). Three of these samples (including the UC sample) can be considered neutral with respect to ABA with negligible acid forming and acid buffering potentials.
- Considering the basalt material as one management unit, it is clear that the additional testing has reduced the inherent risk of this material from generating net positive acid (ARD), with 12 of the thirteen samples effectively NAF and the one PAF sample only reported to generate small volumes of acid.
- On a bulk volume basis, the basalt material at Fingals is considered unlikely to be net acid forming, with an average NAPP value of – 64 kg H2SO4/t.

Should you have any queries regarding these results, please do not hesitate to contact us.

Yours sincerely,

[redacted]

REFERENCES

AMIRA (2002). ARD Test Handbook. AMIRA P387A Project. Ian Wark Research Institute and Environmental Geochemistry International Pty Ltd.

Environmental Innovations (2022). Fingals Waste ARD Testing Summary. Unpublished memo report produced for Blackcat Syndicate.

SWC (2021). Fingals Geochemical Investigation. Unpublished report produced for Blackcat Syndicate.

APPENDIX A

LABORATORY COA

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories
ABN 53 140 099 207
[redacted]

CERTIFICATE OF ANALYSIS 282323

Client Details

Client	Soilwater Group
Attention	[redacted]lins
Address	45 Gladstone Street, EAST PERTH, WA, 6005

Sample Details

Your Reference	**Fingals Basalt AMD**
Number of Samples	Waste Rock
Date samples received	26/05/2022
Date completed instructions received	26/05/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	02/06/2022
Date of Issue	10/06/2022

NATA Accreditation Number 2901. This document shall not be reproduced except in full.

Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

[redacted]

Chromium Reducible Sulphur						
Our Reference		282323-1	282323-2	282323-3	282323-4	282323-5
Your Reference	UNITS	EI-001	EI-002	EI-003	EI-004	EI-005
Type of sample		Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock
Chromium Reducible Sulfur	%w/w	<0.005	0.055	<0.005	0.053	0.10

Chromium Reducible Sulphur						
Our Reference		282323-6	282323-7	282323-8	282323-9	282323-10
Your Reference	UNITS	EI-006	EI-007	EI-008	EI-009	EI-010
Type of sample		Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock
Chromium Reducible Sulfur	%w/w	0.038	0.005	0.056	<0.005	0.20

Acid Neutralisation Capacity*						
Our Reference	UNITS	282323-1	282323-2	282323-3	282323-4	282323-5
Your Reference		EI-001	EI-002	EI-003	EI-004	EI-005
Type of sample		Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock
Date Prepared		26/05/2022	26/05/2022	26/05/2022	26/05/2022	26/05/2022
Date Analysed		02/06/2022	02/06/2022	02/06/2022	02/06/2022	02/06/2022
Fizz Rating		1	3	1	3	3
ANC	kg H2SO4/tonne	21.8	199	18.3	97.7	190
ANC	% CaCO3	2.2	20	1.9	10	19

Acid Neutralisation Capacity*						
Our Reference	UNITS	282323-6	282323-7	282323-8	282323-9	282323-10
Your Reference		EI-006	EI-007	EI-008	EI-009	EI-010
Type of sample		Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock
Date Prepared		26/05/2022	26/05/2022	26/05/2022	26/05/2022	26/05/2022
Date Analysed		02/06/2022	02/06/2022	02/06/2022	02/06/2022	02/06/2022
Fizz Rating		3	3	3	1	3
ANC	kg H2SO4/tonne	96.5	114	112	31.1	91.0
ANC	% CaCO3	9.8	12	12	3.2	9.3

Net Acid Generation						
Our Reference		282323-1	282323-2	282323-3	282323-4	282323-5
Your Reference	UNITS	EI-001	EI-002	EI-003	EI-004	EI-005
Type of sample		Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock
Date Prepared		26/05/2022	26/05/2022	26/05/2022	26/05/2022	26/05/2022
Date Analysed		31/05/2022	31/05/2022	31/05/2022	31/05/2022	31/05/2022
NAG pH	pH units	9.1	11.4	8.9	11.2	11.4
NAG pH 4.5	kg H2SO4/tonne	<0.5	<0.5	<0.5	<0.5	<0.5
NAG pH 7.0	kg/H2SO4/tonne	<0.5	<0.5	<0.5	<0.5	<0.5

Net Acid Generation						
Our Reference		282323-6	282323-7	282323-8	282323-9	282323-10
Your Reference	UNITS	EI-006	EI-007	EI-008	EI-009	EI-010
Type of sample		Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock
Date Prepared		26/05/2022	26/05/2022	26/05/2022	26/05/2022	26/05/2022
Date Analysed		31/05/2022	31/05/2022	31/05/2022	31/05/2022	31/05/2022
NAG pH	pH units	11.0	9.95	11.2	7.6	10.9
NAG pH 4.5	kg H2SO4/tonne	<0.5	<0.5	<0.5	<0.5	<0.5
NAG pH 7.0	kg/H2SO4/tonne	<0.5	<0.5	<0.5	<0.5	<0.5

Miscellaneous Inorg - soil						
Our Reference		282323-1	282323-2	282323-3	282323-4	282323-5
Your Reference	UNITS	EI-001	EI-002	EI-003	EI-004	EI-005
Type of sample		Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock
Date prepared	-	26/05/2022	26/05/2022	26/05/2022	26/05/2022	26/05/2022
Date analysed	-	10/06/2022	10/06/2022	10/06/2022	10/06/2022	10/06/2022
Sulphur - Total	%	0.015	0.064	0.010	0.049	0.084
Total Carbon	%	0.029	1.7	0.061	0.84	1.6
Total Organic Carbon in soil	%	0.02	0.12	0.07	0.09	0.06
Total Inorganic Carbon in soil *	%	<0.01	1.6	<0.01	0.75	1.5

Miscellaneous Inorg - soil						
Our Reference		282323-6	282323-7	282323-8	282323-9	282323-10
Your Reference	UNITS	EI-006	EI-007	EI-008	EI-009	EI-010
Type of sample		Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock
Date prepared	-	26/05/2022	26/05/2022	26/05/2022	26/05/2022	26/05/2022
Date analysed	-	10/06/2022	10/06/2022	10/06/2022	10/06/2022	10/06/2022
Sulphur - Total	%	0.057	0.019	0.072	<0.01	0.26
Total Carbon	%	0.48	0.78	1.1	0.029	0.87
Total Organic Carbon in soil	%	0.04	0.03	0.03	0.02	0.04
Total Inorganic Carbon in soil *	%	0.44	0.75	1.1	<0.01	0.83

Method ID	Methodology Summary
AMD-001	Acid Mine Drainage determined by AMIRA International - Acid Rock Drainage Test Handbook.
AMD-002	This method is used for the determination of Total Sulphur and Total Carbon in soils and rocks via combustion and Non-Dispersive Infra-Red Detectors (NDIR), using a LECO 832 analyser.
INORG-068	Chromium Reducible Sulfur - Hydrogen Sulfide is quantified by iodometric titration after distillation to determine potential acidity. Based on Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.

QUALITY CONTROL: Chromium Reducible Sulphur					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Chromium Reducible Sulfur	%w/w	0.005	INORG-068	[NT]	1	<0.005	<0.005	0	98	[NT]

QUALITY CONTROL: Acid Neutralisation Capacity*						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date Prepared				26/05/2022	1	26/05/2022	26/05/2022		26/05/2022	[NT]
Date Analysed				02/06/2022	1	02/06/2022	02/06/2022		02/06/2022	[NT]
Fizz Rating			AMD-001	[NT]	1	1	1	0	[NT]	[NT]
ANC	kg H2SO4/tonne	0.5	AMD-001	[NT]	1	21.8	21.2	3	101	[NT]
ANC	% CaCO3	0.01	AMD-001	[NT]	1	2.2	2.2	0	101	[NT]

QUALITY CONTROL: Net Acid Generation						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date Prepared				26/05/2022	1	26/05/2022	26/05/2022		26/05/2022	[NT]
Date Analysed				31/05/2022	1	31/05/2022	31/05/2022		31/05/2022	[NT]
NAG pH	pH units	0.1	AMD-001	[NT]	1	9.1	9.1	0	94	[NT]
NAG pH 4.5	kg H2SO4/tonne	0.5	AMD-001	[NT]	1	<0.5	<0.5	0	94	[NT]
NAG pH 7.0	kg/H2SO4/tonne	0.5	AMD-001	[NT]	1	<0.5	<0.5	0	94	[NT]

Client Reference: Fingals Basalt AMD

QUALITY CONTROL: Miscellaneous Inorg - soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			26/05/2022	1	26/05/2022	26/05/2022		26/05/2022	[NT]
Date analysed	-			10/06/2022	1	10/06/2022	10/06/2022		10/06/2022	[NT]
Sulphur - Total	%	0.01	AMD-002	<0.01	1	0.015	0.015	0	105	[NT]
Total Carbon	%	0.01	AMD-002	<0.01	1	0.029	<0.01	97	92	[NT]
Total Organic Carbon in soil	%	0.01	AMD-002	<0.01	1	0.02	0.02	0	92	[NT]
Total Inorganic Carbon in soil *	%	0.01	AMD-002	<0.01	1	<0.01	<0.01	0	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.