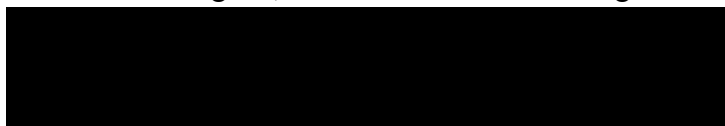


**GRAEME CAMPBELL & ASSOCIATES PTY LTD**

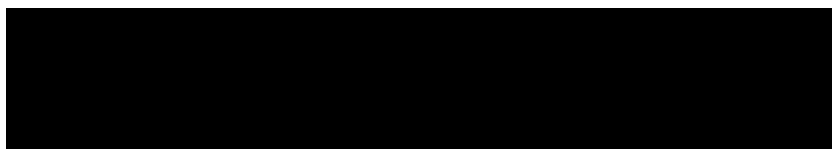
***Specialists in Materials Characterisation***

Integrated Geochemical and Physical Testing Service for Bedrocks, Regoliths and Soils of Diverse Lithological, Alteration and Weathering Assemblages



1

COMPANY: Australian Nickel Investments Pty Ltd



SUBJECT: Cosmos Project: Geochemical Characterisation of Tailings-Solids Sample Derived from **Odysseus Deposit** – Implications for Tailings Management

NO. PAGES (including this page): 37 DATE: 12th April 2022

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The testwork results obtained in this study are presented in **Tables 1-3**, and shown on **Figure 1**.

Photographs of the tailings-solids sample received for testing are shown on **Plate 1**; provenance details for the sample are presented in **Attachment I**.

Copies of the laboratory reports are presented in **Attachment II**.

## **1.0 TESTWORK OUTCOMES**

### **1.1 Acid-Base Chemistry**

The tailings-solids sample classifies as **Non-Acid Forming (NAF)**, reflective of 'trace-sulphides' (chiefly pyrrhotites and pentlandites) dispersed within an '**olivine/serpentine-enriched**' gangue (**Table 1** and **Figure 1**).

Determination of O<sub>2</sub>-Consumption Rate (OCR) at 30 °C indicates that the intrinsic reactivity of the 'trace-sulphide' suite is moderate (i.e. 'of-the-order' 1.0E-11 kg O<sub>2</sub>/kg/s).

---

## 1.2 Multi-Element Composition and Mineralogy

The tailings-solids sample was characterised by major/minor-element contents below, or close to, those typically recorded for soils, regoliths and bedrocks derived from non-mineralised terrain (**Table 2**). Though enrichments in Ni, Cr, and Mo were recorded they were modest, and within the range typically observed for tailings-solids derived from ultramafic-ores at WA nickel operations (Campbell, unpublished results since the late-1980s).

The tailings-solids sample comprised chiefly olivines and serpentines (lizardites) with sub-ordinate chlorites, vermiculites, Cr-magnetites, and chromites (**Table 3**). Traces of pyrrhotites and pentlandites also occurred.

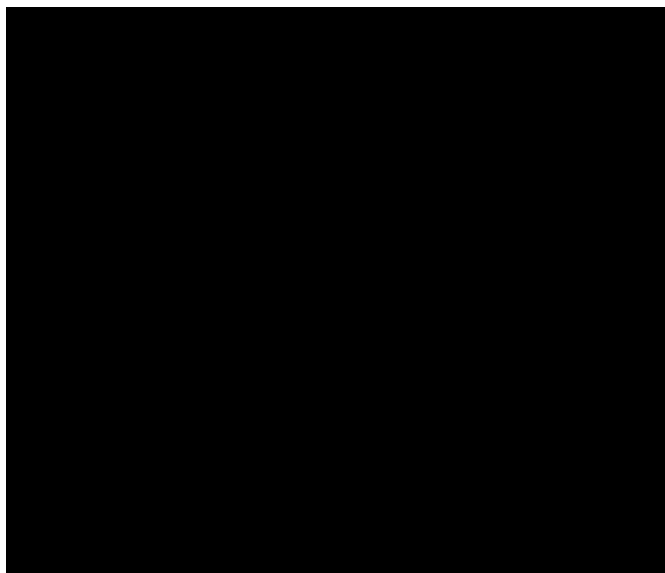
## 2.0 IMPLICATIONS FOR TAILINGS MANAGEMENT

Based on the findings of this study, the [tailings stream to be generated from the flotation of Odysseus ores should pose no environmental concerns for tailings management](#), and provide flexibility during operation of the TSF (e.g. winning consolidated beach-head-tailings for TSF-embankment raise via the upstream method).<sup>1</sup>

To confirm the findings of the current study, it is recommended that, following commissioning of the mill, a sample of the 'ex-mill' stream of tailings-slurry is geochemically characterised.

## 3.0 CLOSING

I trust the above is useful to you.



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<sup>1</sup> TSF = Tailings-Storage Facility

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## **TABLES**

**Table 1: Results for Acid-Base-Analysis (ABA) and Net-Acid-Generation (NAG) Testing**

SAMPLE_ ID	pH-(1:2)	EC-(1:2) [mS/cm]	TOTAL-S (%)	CRS (%)	TOTAL-C (%)	ACID- INSOL- C (%)	CO3-C (%)	CARB.- ANC (calc'd)	ANC- [pH4-5]	NAG-pH	ANC / MPA RATIO	AFP CATEGORY
	GCA	GCA	GLS	EAL	GLS	GLS	GLS	kg H2SO4/tonne	GCA			
GCA11993	9.3	1.20	0.92	0.784	0.13	0.01	0.12	10	84 (86)	9.3 (9.3)	2.9	NAF

**Notes:**

EC = Electrical-Conductivity; CRS = Cr(II)-Reducible-S; Acid-Insol.-C = Acid-Insoluble-C; ANC = Acid-Neutralisation Capacity;

NAG = Net-Acid Generation; MPA = Maximum-Potential Acidity; AFP = Acid-Formation Potential; NAF = Non-Acid Forming.

pH-(1:2) and EC-(1:2) values correspond to pH and EC measured on sample slurries prepared with deionised-water, and a solid:solution ratio of *ca.* 1:2 (w/w).

All results expressed on a dry-weight basis, except for pH-(1:2), EC-(1:2), and NAG-pH.

Values in parentheses represent duplicates.

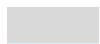
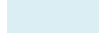
Calculated Carbonate-ANC values assume that all CO3-C is associated with Ca/Mg-carbonates (i.e. 'non-ferroan-carbonates').

**N.B.** Due to its '[olivine/serpentine-enriched](#)' gangue, the ANC value of the tailings-solids sample was determined via extraction at room-T using dilute acetic acid buffered at pH 4-5. For such tailings-gangue mineralogies use of the AMIRA (2002) method (viz. HCl addition to pH < 1 initially followed by heating at 80-90 oC) is **meaningless** for estimating the capacity for buffering at circum-neutral-pH.

**Table 2: Multi-Element-Analysis Results**

SAMPLE_ID	AFP	S	Ca	Mg	K	Na	Al	Fe	Ti	Si	As	Sb	Se	Mo	B	F
		%										mg/kg				
GCA11993	NAF	0.92	0.27	24.5	<0.01	<0.01	0.32	7.44	0.02	17.6	3.3	0.31	0.29	17.0	<50	113
<b>Average-Crustal Abundance (Bowen 1979)</b>											1.5	0.2	0.05	1.5	10	950

SAMPLE_ID	AFP	Cu	Zn	Cd	Pb	Hg	Ni	Cr	Co	Mn	Ag	Bi	P	Sr	Ba	Sn	V	Tl	Th	U
		mg/kg																		
GCA11993	NAF	750	56	0.10	3.7	0.013	3,200	1,400	60	1,100	0.15	0.24	27	7.8	4.8	0.7	24	0.08	0.23	0.10
<b>Average-Crustal Abundance (Bowen 1979)</b>		50	75	0.11	14	0.05	80	100	20	950	0.07	0.05	1,000	370	500	2.2	160	0.6	12	2.4

 signifies element content 10-100 times average-crustal abundance  
 signifies element content 100+ times average-crustal abundance

Reference: Bowen HJM, 1979, "Environmental Chemistry of the Elements", Academic Press, New York

**Table 3: Mineralogical Results**

<b>GCA11993</b>	
olivine serpentine (lizardite)	20-50 %
chlorite/vermiculite Cr-magnetite chromite	1-10 %
<b>pyrrhotite</b> <b>pentlandite</b>	< 1 %

Notes:

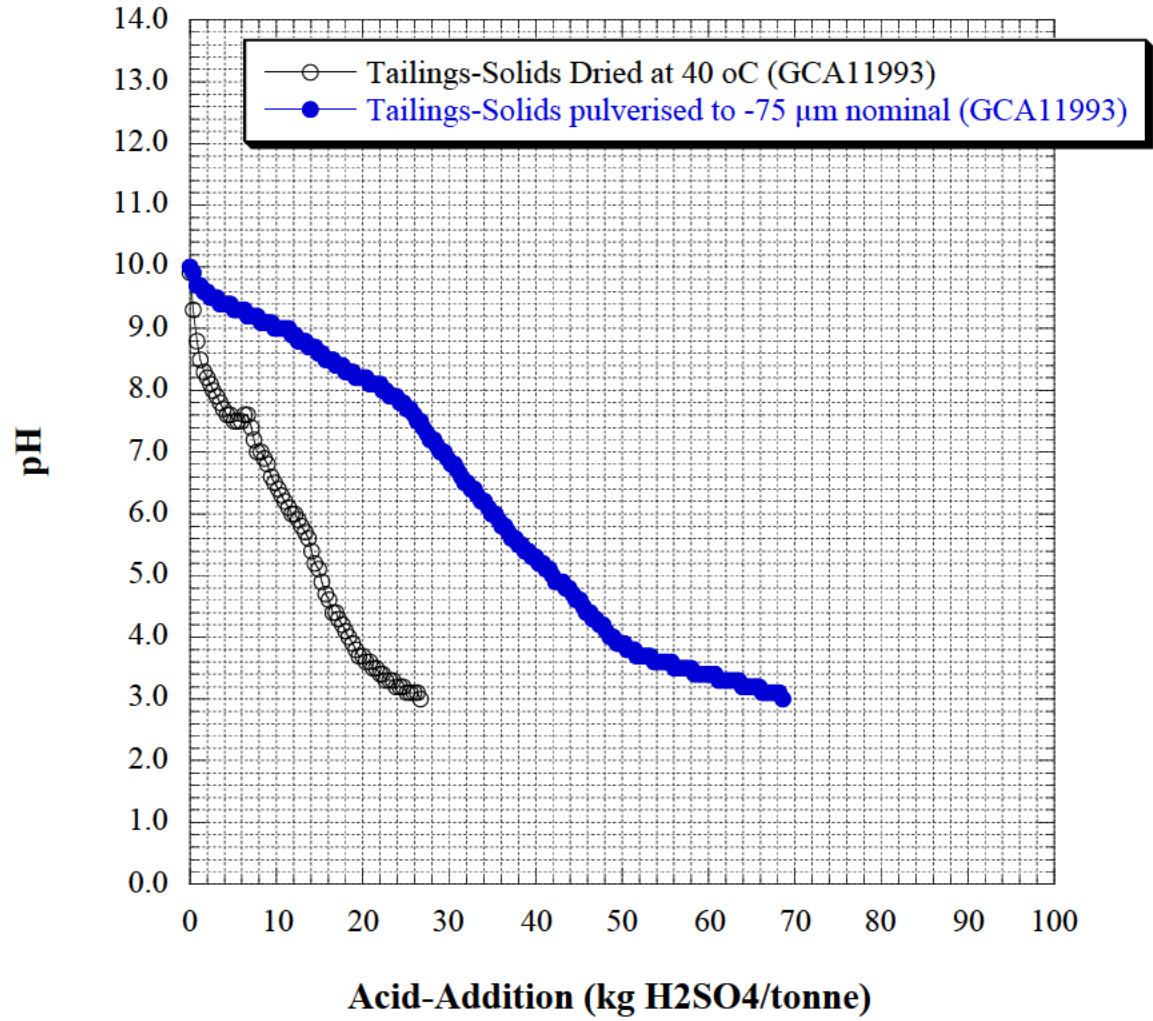
major = 20-50 %; accessory = 1-10 %; trace = less than 1 %

---

**FIGURE**

Figure 1

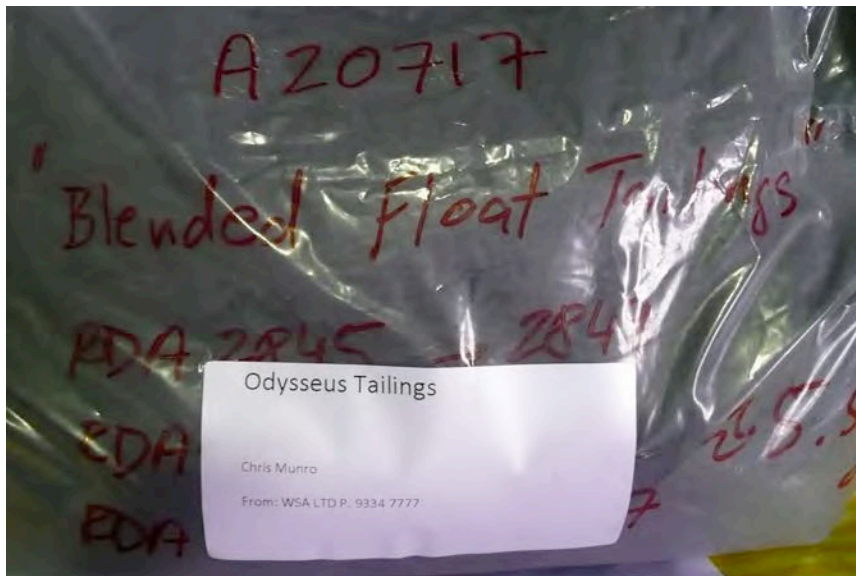
pH-Buffering Curves





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**PLATE**



**PLATE 1:** Tailings-Solids sample 'as-received' at GCA Testing Laboratory (Bridgetown) as provided by ANI.

---

**ATTACHMENT II**

**LABORATORY REPORTS**



DIAMANTINA  
LABORATORIES

Mineral Sand Processing and Mineralogy Specialists

1-2-2022

Your reference 2120/1

Mineralogy (PLM/XRD/SEM) of one tailing (GCA11993)

**RESULTS**

## POLISHED THIN SECTION/SEM/XRD

	GCA11993
Olivine *	Major
Lizardite **	Major
Chlorite/Vermiculite	Accessory
Cr-magnetite ***	Accessory
Chromite ***	Accessory
Pyrrhotite	Trace
Pentlandite	Trace

Notes.

\* Olivine (11% FeO Chrysotile)

\*\* Lizardite 1% FeO

\*\*\* Cr-magnetite/Chromite

There is a wide range of composition.

# MINERALS TEST REPORT

**CLIENT**

**CAMPBELL & ASSOCIATES PTY LIMITED**

**JOB INFORMATION**

JOB CODE : 143.0/2128130  
NO. SAMPLES : 7  
NO. ELEMENTS : 45  
CLIENT ORDER NO. : GCA2120/1 (Job 1 of 1)  
SAMPLE SUBMISSION NO. :  
PROJECT : COSMOS  
SAMPLE TYPE : Solid  
DATE RECEIVED : 21/12/2021  
DATE TESTED : 05/01/2022 - 02/02/2022  
DATE REPORTED : 04/02/2022  
DATE PRINTED : 10/02/2022

**REPORT NOTES**

1. Amended Report: NATA Notes Amended

Accredited for compliance with ISO/IEC 17025 - Testing.  
Company Accreditation Number 3244



This report relates specifically to the sample(s) tested that were drawn and/or provided by the client or their nominated third party to Intertek. The reported result(s) provide no warranty or verification on the sample(s) representing any specific goods and/or shipment. This report was prepared solely for the use of the client named in this report. Intertek accepts no responsibility for any loss, damage or liability suffered by a third party as a result of any reliance upon or use of this report. The results provided are not intended for commercial settlement purposes. Except where explicitly agreed in writing, all work and services performed by Intertek is subject to our standard Terms and Conditions which can be obtained at our website: [intertek.com/terms/](https://www.intertek.com/terms/)



## SIGNIFICANT FIGURES

It is common practice to report data derived from analytical instrumentation to a maximum of two or three significant figures. Some data reported herein may show more figures than this. The reporting of more than two or three figures in no way implies that figures beyond the least significant digit have significance.

For more information on the uncertainty on individual reported values, please contact the laboratory.

## MEASUREMENT OF UNCERTAINTY

Measurement of uncertainty estimates are available for most tests upon request.

## SAMPLE STORAGE

All solid samples (assay pulps, bulk pulps and residues) will be stored for 60 days without charge. Following this samples will be stored at a daily rate until clients written advice regarding return, collection or disposal is received. If storage information is not supplied on the submission, or arranged with the laboratory in writing the default will be to store the samples with the applicable charges. Storage is charged at \$4.00 per m3 per day, expenses related to the return or disposal of samples will be charged at cost. Current disposal cost is charged at \$150.00 per m3.

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

<b>LEGEND</b>	X	= Less than Detection Limit	NA	= Not Analysed
	SNR	= Sample Not Received	UA	= Unable to Assay
	LNR	= Lab Not Received	>	= Value beyond Limit of Method
	DTF	= Result still to come	+	= Extra Sample Received Not Listed
	I/S	= Insufficient Sample for Analysis		



ELEMENTS	Ag	Al	ANC	As	B	Ba
UNITS	ppm	ppm	kgH <sub>2</sub> SO <sub>4</sub> /t	ppm	ppm	ppm
DETECTION LIMIT	0.05	50	1	0.5	50	0.1
DIGEST	4A/	4A/	ANCx/	4A/	FP1/	4A/
ANALYTICAL FINISH	MS	OE	VOL	MS	OE	MS
<b>SAMPLE NUMBERS</b>						
0001 GCA11993	0.15	3154		3.3	X	4.8
0002 GCA11993 (4ml 0.5M HCl)			49			
0003 GCA11993 (8ml 0.5M HCl)			96			
0004 GCA11993 (20ml 0.5M HCl)			219			
0005 GCA11993 (40ml 0.5M HCl)			437			
0006 GCA11993 (40ml 1.0M HCl)			855			
0007 GCA11993 (60ml 1.0M HCl)			828			

<b>CHECKS</b>						
0001 GCA11993	0.14	3150		3.5	X	3.1
0002 GCA11993 (8ml 0.5M HCl)			96			

<b>STANDARDS</b>						
0001 OREAS 600b						
0002 OREAS 279						
0003 OREAS 174	X	3.38%		28.6		>5000.0
0004 OREAS 630b					X	
0005 OREAS 45f						
0006 AMIS0342						
0007 OREAS 97.01						
0008 Se 0.1ppm						
0009 Se 1.0 ppm						
0010 ANC-5			99			

<b>BLANKS</b>						
0001 Control Blank	X	X		X	X	X
0002 Control Blank			0			





ELEMENTS	Bi	C	C-Acinsol	C-CO3	Ca	Cd
UNITS	ppm	%	%	%	ppm	ppm
DETECTION LIMIT	0.01	0.01	0.01	0.01	50	0.02
DIGEST	4A/		C71/		4A/	4A/
ANALYTICAL FINISH	MS	/CSA	CSA	/CALC	OE	MS
SAMPLE NUMBERS						
0001 GCA11993	0.24	0.13	0.01	0.12	2649	0.10
0002 GCA11993 (4ml 0.5M HCl)						
0003 GCA11993 (8ml 0.5M HCl)						
0004 GCA11993 (20ml 0.5M HCl)						
0005 GCA11993 (40ml 0.5M HCl)						
0006 GCA11993 (40ml 1.0M HCl)						
0007 GCA11993 (60ml 1.0M HCl)						
CHECKS						
0001 GCA11993	0.25	0.13	0.01	0.12	2649	0.11
0002 GCA11993 (8ml 0.5M HCl)						
STANDARDS						
0001 OREAS 600b		0.23				
0002 OREAS 279			0.23			
0003 OREAS 174	0.35				2308	0.36
0004 OREAS 630b						
0005 OREAS 45f						
0006 AMIS0342						
0007 OREAS 97.01						
0008 Se 0.1ppm						
0009 Se 1.0 ppm						
0010 ANC-5						
BLANKS						
0001 Control Blank	X	X	X		X	X
0002 Control Blank						



ELEMENTS	CoolourChange		Cr	Cu	F	Fe
UNITS	ppm	NONE	ppm	ppm	ppm	%
DETECTION LIMIT	0.1	0	1	0.5	50	0.01
DIGEST	4A/	ANCx/	4A/	4A/	FC7/	4A/
ANALYTICAL FINISH	MS	QUAL	MS	MS	SIE	OE
SAMPLE NUMBERS						
0001 GCA11993	59.5	No	1358	750.4	113	7.44
0002 GCA11993 (4ml 0.5M HCl)		No				
0003 GCA11993 (8ml 0.5M HCl)		No				
0004 GCA11993 (20ml 0.5M HCl)		No				
0005 GCA11993 (40ml 0.5M HCl)		Yes				
0006 GCA11993 (40ml 1.0M HCl)		Yes				
0007 GCA11993 (60ml 1.0M HCl)		Yes				
CHECKS						
0001 GCA11993	59.6		2035	765.3	121	7.43
0002 GCA11993 (8ml 0.5M HCl)		No				
STANDARDS						
0001 OREAS 600b						
0002 OREAS 279						
0003 OREAS 174	73.3		102	101.2		20.04
0004 OREAS 630b						
0005 OREAS 45f						
0006 AMIS0342					1044	
0007 OREAS 97.01						
0008 Se 0.1ppm						
0009 Se 1.0 ppm						
0010 ANC-5						
BLANKS						
0001 Control Blank	X		X	X	X	X
0002 Control Blank						



ELEMENTS	Final-pH	Fizz-Rate	Hg	K	Mg	Mn
UNITS	NONE	NONE	ppb	ppm	ppm	ppm
DETECTION LIMIT	0.1	1	1	20	20	1
DIGEST	ANCx/	ANCx/	AR005/	4A/	4A/	4A/
ANALYTICAL FINISH	MTR	QUAL	MSHg	OE	OE	MS
<b>SAMPLE NUMBERS</b>						
0001 GCA11993			13	24	24.51%	1095
0002 GCA11993 (4ml 0.5M HCl)	8.6	X				
0003 GCA11993 (8ml 0.5M HCl)	8.5	X				
0004 GCA11993 (20ml 0.5M HCl)	4.8	X				
0005 GCA11993 (40ml 0.5M HCl)	3.7	X				
0006 GCA11993 (40ml 1.0M HCl)	1.5	X				
0007 GCA11993 (60ml 1.0M HCl)	0.7	X				
<b>CHECKS</b>						
0001 GCA11993			14	X	24.65%	1045
0002 GCA11993 (8ml 0.5M HCl)	8.4	X				
<b>STANDARDS</b>						
0001 OREAS 600b						
0002 OREAS 279						
0003 OREAS 174				6827	2239	>5.00%
0004 OREAS 630b						
0005 OREAS 45f			31			
0006 AMIS0342						
0007 OREAS 97.01						
0008 Se 0.1ppm						
0009 Se 1.0 ppm						
0010 ANC-5	0.9					
<b>BLANKS</b>						
0001 Control Blank			3	X	X	X
0002 Control Blank	1.0					



ELEMENTS	Mo	Na	Ni	P	Pb	VolAcid
UNITS	ppm	ppm	ppm	ppm	ppm	ml
DETECTION LIMIT	0.1	20	0.5	20	0.5	0
DIGEST	4A/	4A/	4A/	4A/	4A/	ANCx/
ANALYTICAL FINISH	MS	OE	MS	MS	MS	HCl-ml
<b>SAMPLE NUMBERS</b>						
0001 GCA11993	17.0	88	3189.6	27	3.7	
0002 GCA11993 (4ml 0.5M HCl)						4
0003 GCA11993 (8ml 0.5M HCl)						8
0004 GCA11993 (20ml 0.5M HCl)						20
0005 GCA11993 (40ml 0.5M HCl)						40
0006 GCA11993 (40ml 1.0M HCl)						40
0007 GCA11993 (60ml 1.0M HCl)						60
<b>CHECKS</b>						
0001 GCA11993	17.1	87	3222.1	33	4.0	
0002 GCA11993 (8ml 0.5M HCl)						8
<b>STANDARDS</b>						
0001 OREAS 600b						
0002 OREAS 279						
0003 OREAS 174	1.9	3126	155.6	439	279.8	
0004 OREAS 630b						
0005 OREAS 45f						
0006 AMIS0342						
0007 OREAS 97.01						
0008 Se 0.1ppm						
0009 Se 1.0 ppm						
0010 ANC-5						20
<b>BLANKS</b>						
0001 Control Blank	X	X	X	X	X	
0002 Control Blank						20



ELEMENTS	pH Drop	S	S	SG	Sb	Se
UNITS	NONE	%	ppm	NONE	ppm	ppm
DETECTION LIMIT	0.1	0.01	50	0.01	0.05	0.01
DIGEST	ANCx/		4A/	SGP/	4A/	SE1/
ANALYTICAL FINISH	MTR	/CSA	OE	PYC	MS	MS
SAMPLE NUMBERS						
0001 GCA11993		0.92	8975	I/S	0.31	0.29
0002 GCA11993 (4ml 0.5M HCl)						
0003 GCA11993 (8ml 0.5M HCl)						
0004 GCA11993 (20ml 0.5M HCl)	2.9					
0005 GCA11993 (40ml 0.5M HCl)	3.1					
0006 GCA11993 (40ml 1.0M HCl)	3.1					
0007 GCA11993 (60ml 1.0M HCl)	3.0					
CHECKS						
0001 GCA11993		0.92	9075	I/S	0.33	0.31
0002 GCA11993 (8ml 0.5M HCl)						
STANDARDS						
0001 OREAS 600b		0.30				
0002 OREAS 279						
0003 OREAS 174			178		1.75	
0004 OREAS 630b						
0005 OREAS 45f						
0006 AMIS0342						
0007 OREAS 97.01						0.64
0008 Se 0.1ppm						0.10
0009 Se 1.0 ppm						0.94
0010 ANC-5						
BLANKS						
0001 Control Blank		X	X		X	X
0002 Control Blank						



ELEMENTS	Si	Sn	Sr	Th	Ti	Tl
UNITS	%	ppm	ppm	ppm	ppm	ppm
DETECTION LIMIT	0.1	0.1	0.05	0.01	5	0.02
DIGEST	FP1/	4A/	4A/	4A/	4A/	4A/
ANALYTICAL FINISH	OE	MS	MS	MS	OE	MS
<b>SAMPLE NUMBERS</b>						
0001 GCA11993	17.6	0.7	7.77	0.23	161	0.08
0002 GCA11993 (4ml 0.5M HCl)						
0003 GCA11993 (8ml 0.5M HCl)						
0004 GCA11993 (20ml 0.5M HCl)						
0005 GCA11993 (40ml 0.5M HCl)						
0006 GCA11993 (40ml 1.0M HCl)						
0007 GCA11993 (60ml 1.0M HCl)						
<b>CHECKS</b>						
0001 GCA11993	17.9	0.7	7.83	0.25	162	0.08
0002 GCA11993 (8ml 0.5M HCl)						
<b>STANDARDS</b>						
0001 OREAS 600b						
0002 OREAS 279						
0003 OREAS 174		1.9	534.38	4.17	2160	0.27
0004 OREAS 630b	22.0					
0005 OREAS 45f						
0006 AMIS0342						
0007 OREAS 97.01						
0008 Se 0.1ppm						
0009 Se 1.0 ppm						
0010 ANC-5						
<b>BLANKS</b>						
0001 Control Blank	X	X	X	X	X	X
0002 Control Blank						



ELEMENTS	U	V	WTTOT	Zn
UNITS	ppm	ppm	g	ppm
DETECTION LIMIT	0.01	1	0.01	1
DIGEST	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	WT01	MS
SAMPLE NUMBERS				
0001 GCA11993	0.10	24	367.00	56
0002 GCA11993 (4ml 0.5M HCl)				
0003 GCA11993 (8ml 0.5M HCl)				
0004 GCA11993 (20ml 0.5M HCl)				
0005 GCA11993 (40ml 0.5M HCl)				
0006 GCA11993 (40ml 1.0M HCl)				
0007 GCA11993 (60ml 1.0M HCl)				
CHECKS				
0001 GCA11993	0.10	25		56
0002 GCA11993 (8ml 0.5M HCl)				
STANDARDS				
0001 OREAS 600b				
0002 OREAS 279				
0003 OREAS 174	1.25	131		96
0004 OREAS 630b				
0005 OREAS 45f				
0006 AMIS0342				
0007 OREAS 97.01				
0008 Se 0.1ppm				
0009 Se 1.0 ppm				
0010 ANC-5				
BLANKS				
0001 Control Blank	X	X		X
0002 Control Blank				



## METHOD CODE DESCRIPTION

Method Code Date Tested	Analysing Laboratory NATA Laboratory Accreditation	NATA Scope of Accreditation
<b>/CALC</b> 02/02/22 13:29	Intertek Genalysis Perth <b>3244 3237</b>	*
No digestion or other pre-treatment undertaken. Results Determined by calculation from other reported data.		
<b>/CSA</b> 02/02/22 13:29	Intertek Genalysis Perth <b>3244 3237</b>	<b>ENV_W061</b>
Induction Furnace Analysed by Infrared Spectrometry		
<b>4A/MS</b> 06/01/22 07:06	Intertek Genalysis Perth <b>3244 3237</b>	<b>MPL_W002, MS_IM_001</b>
Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Mass Spectrometry.		
<b>4A/OE</b> 06/01/22 07:06	Intertek Genalysis Perth <b>3244 3237</b>	<b>MPL_W002, ICP_IM_001</b>
Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.		
<b>ANCx/HCl-ml</b> 18/01/22 11:45	Intertek Genalysis Perth <b>3244 3237</b>	
Volume of HCl acid used		
<b>ANCx/MTR</b> 18/01/22 11:45	Intertek Genalysis Perth <b>3244 3237</b>	<b>ENV_W035</b>
Acid Neutralizing Capacity Digestion Procedure. Analysed with Electronic Meter Measurement		
<b>ANCx/QUAL</b> 18/01/22 11:45	Intertek Genalysis Perth <b>3244 3237</b>	<b>ENV_W035</b>
Acid Neutralizing Capacity Digestion Procedure. Analysed by Qualitative Inspection		
<b>ANCx/VOL</b> 18/01/22 11:45	Intertek Genalysis Perth <b>3244 3237</b>	<b>ENV_W035</b>
Acid Neutralizing Capacity Digestion Procedure. Analysed by Volumetric Technique.		



**METHOD CODE DESCRIPTION**

<b>Method Code Date Tested</b>	<b>Analysing Laboratory NATA Laboratory Accreditation</b>	<b>NATA Scope of Accreditation</b>
<b>AR005/MSHg 07/01/22 09:22</b>	Intertek Genalysis Perth <b>3244 3237</b>	*
	0.5 gram mini Aqua-Regia digest. Analysed by Inductively Coupled Plasma Mass Spectrometry.	
<b>C71/CSA 05/01/22 17:19</b>	Intertek Genalysis Perth <b>3244 3237</b>	<b>ENV_W063</b>
	Digestion by hot acid(s) and Induction Furnace Analysed by Infrared Spectrometry	
<b>FC7/SIE 06/01/22 07:06</b>	Intertek Genalysis Perth <b>3244 3237</b>	<b>ENV_W012</b>
	Alkaline fusion (Nickel crucible) specific for Fluorine. Analysed by Specific Ion Electrode.	
<b>FP1/OE 13/01/22 01:54</b>	Intertek Genalysis Perth <b>3244 3237</b>	<b>MPL_W011, MS_IM_001</b>
	Sodium peroxide fusion (Zirconia crucibles) and Hydrochloric acid to dissolve the melt. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.	
<b>SE1/MS 12/01/22 14:53</b>	Intertek Genalysis Perth <b>3244 3237</b>	<b>MPL_W005, MS_IM_001</b>
	Aqua-Regia digest followed by Precipitation and Concentration. Specific for Selenium. Analysed by Inductively Coupled Plasma Mass Spectrometry.	
<b>SGP/PYC 02/02/22 13:27</b>	Intertek Genalysis Perth <b>3244 3237</b>	*
	Analysed by Instrumental Technique using a gas displacement Pycnometer.	
<b>WT01 02/02/22 13:29</b>	Intertek Genalysis Perth <b>3244 3237</b>	*
	Reporting weights of samples	

\* Denotes not on Scope of Accreditation



## NATA ENDORSED DOCUMENT

### Analysing Laboratory: Intertek Genalysis Perth

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

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#### **Job: 143/2128130**

**Rev1:** Amendment for clarity on ANC method

**Project: COSMOS - GCA-Job-No. 2120/1**

#### **SAMPLES:**

1 tailings solid sample (approx. 400g), named GCA11993, was received on 21/12/21 via Toll (ref:8101687663).

#### **SAMPLE PREPARATION:**

The sample was pulverised to -75µm using the steel bowl. Approximately 50g retained for testing and remainder returned to GCA.

#### **ANALYSES:**

The samples were analysed for the following:

- 4A/MS sample was analysed for Ag, As, Ba, Bi, Cd, Co, Cr, Cu, Mn, Mo, Ni, P, Pb, Sb, Sn, Sr, Th, Tl, U, V and Zn
- 4A/OE sample was analysed for Al, Ca, Fe, K, Mg, Na, S and Ti
- FP1/OE sample was analysed for B and Si
- AR005/MSHg sample was analysed for Hg
- SE1/MS sample was analysed for Se
- Total-C, total-S by Carbon and Sulphur analyser (/CSA)
- C-Acinsol (acid insoluble carbon – C71/) by Carbon and Sulphur analyser after removal of carbonates and soluble organic carbon using hot hydrochloric acid.
- C-CO<sub>3</sub> Calculation C-CO<sub>3</sub> = Total C - C-Acinsol
- Fluoride analysis was performed by Carbonate fusion and dissolution (FC7/) and read by
- Selective ion electrode (/SIE)
- Acid Neutralising Capacity (ANC) is determined by HCl digest and back titration with NaOH, sample(s) in duplicate. ANC digests are undertaken at 150°C.
- Specific gravity (SG) is determined by Penta-Pycnometer (SGP/PYC)

#### **DIGESTIONS:**

MPL\_W002 (4A/), MPL\_W011 (FP1/), GL\_W009 (AR005/), MPL\_W005 (SE1/).

#### **ANALYTICAL FINISHES:**

MS\_IM\_001 (/MS), ICP\_IM\_001 (/OE), ENV\_W061 (/CSA), ENV\_W063 (C71), ENV\_W012 (FC7/SIE) and MPL\_W052 (SGP/PYC).

#### OBSRVATIONS:

##### *Applied HCl loading equivalentents*

*ml 0.5M HCl      Kg(H<sub>2</sub>SO<sub>4</sub>)/tonne*

*4                      50*

*8                      100*

*20                     250*

*40                     500*

*40 (1.0M)          1000*

*60 (1.0M)          1500*

4ml HCl additions: produced Final pHs above titration end point of 7.0 hence no further titration undertaken and consequently no H<sub>2</sub>O<sub>2</sub> addition and therefore no pH Drop or Colour change results recorded.

8ml HCl additions: produced Final pHs above titration end point of 7.0 hence no further titration undertaken and consequently no H<sub>2</sub>O<sub>2</sub> addition and therefore no pH Drop or Colour change results recorded.

20ml HCl additions: produced a pH Drop with the addition of hydrogen peroxide at the pH 5 stop gap, but no colour change.

40ml HCl additions: produced a greater pH Drop than with 20ml upon addition of hydrogen peroxide at the pH 5 stop gap, and a colour change.

40ml 1.0M HCl additions: produced a pH Drop identical to that of the 0.5M digest with the addition of hydrogen peroxide at the pH 5 stop gap, and a colour change.

60ml 1.0M HCl additions: produced a pH Drop equivalent to that of the previous 40ml digest with the addition of hydrogen peroxide at the pH 5 stop gap, and a colour change.

#### RESULTS:

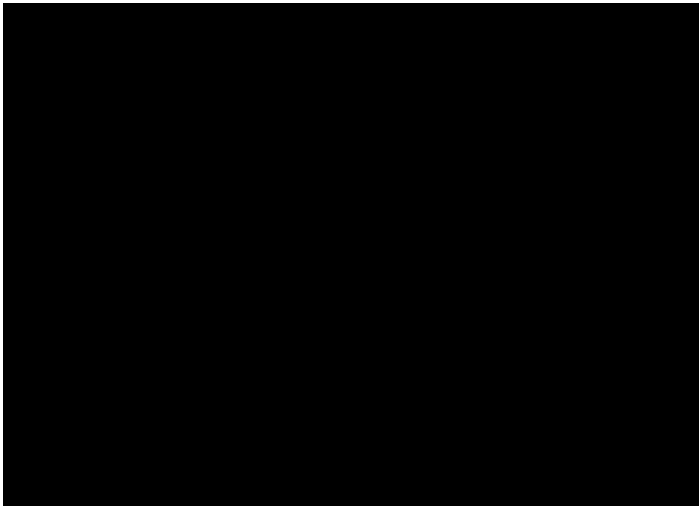
Insufficient sample available to permit determination of Specific Gravity.

Results are expressed in units: ppm (4A/OE, 4A/MS, FP1/OE, SE1/MS), % (FP1/OE, 4A/OE), ppb (AR005/MSHg).

The results included the assay of blanks and international reference standards: OREAS 174 (4A), OREAS 630b (FP1/OE), OREAS 45f (AR005/), OREAS600b (CSA), OREAS 279 (C71), AMIS 0342

(FC7).

In-House reference standards: Se 0.1ppm (SE1), Se 1.0 ppm (SE1) and OREAS 97.01 (SE1), ANC-5 (ANC).



Graeme Campbell and Associates Pty Ltd

EAL Lab ID	M5076
Number of Samples	1
Customer Job Reference	GCA-Job-No. 2120/1
Date Received	14/01/2022
Date Reported	21/01/2022



### 1.0 Introduction

The Chromium Reducible Sulfur (CRS) results below have been provided in accordance to the requirements of GCA for the analysis of sulfide in samples of waste rock, ore, tailings and soils. Samples submitted by GCA correspond to pulps (nominal 75  $\mu$ m) prepared by pulverising as per standard procedures for mining projects.

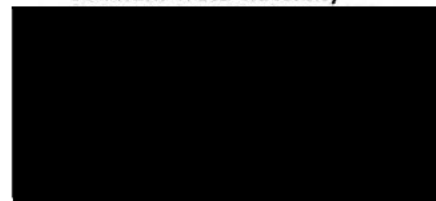
### 2.0 Chromium Reducible Sulfur (CRS)

Ring mill ground sample at a sample weight from around 0.05-0.5 g is added to a 150 mL quick fit flask with 1 g of Cr powder. Ethanol is used to wash down the sides of the quick fit flask. The flask is placed on the cold hotplate and locked into the condensers of the CRS unit. Forty millilitres of zinc acetate trapping solution is dispensed into a 100 mL erlenmeyer flask. A new pasturer pipette, attached to the top of the condenser is inserted into the trapping solution. The system is purged with argon gas for 3 min. Sixty millilitres of 5.65 M hydrochloric acid is slowly added to the sample flask. Once dispensed the hotplate is turned on and the system allowed to proceed for 35 min with cold water circulating through the condensers.

On completion, 1 mL of starch indicator solution is added to the trapping solution and 20 mL of 5.65 M hydrochloric acid washed down the side of the flask into the trap. An iodometric titration is quickly undertaken to a permanent blue endpoint with standardised 0.025 M Iodine Solution.

A 0.025 N Sodium thiosulfate solution is used daily to assess recovery; the expected value is 0.16% S.

Reference: Sullivan, L, Ward, N, Toppler, N and Lancaster, G 2018, *National Acid Sulfate Soils Guidance: National acid sulfate soils identification and laboratory methods manual*, Department of Agriculture and Water Resources, Canberra, ACT.



### 3.0 Results

Sample Identification	EAL Lab Code	Chromium Reducible Sulfur (% S <sub>cr</sub> )
<i>Method Info.</i>		<i>(In-house method S20)</i>
<b>GCA11993</b>	<i>M5076/1</i>	<b>0.784</b>

### 4.0 QA-QC

CHROMIUM REDUCIBLE SULFUR	Method	PQL	LCS % Recovery 0.25 N Sodium thiosulfate				
			Result	Recovery	Acceptance Limits %	Pass Limits	Units
Chromium Reducible Sulfur (%)	In-house method S20	< 0.005%	0.158	99%	90-105	Pass	%

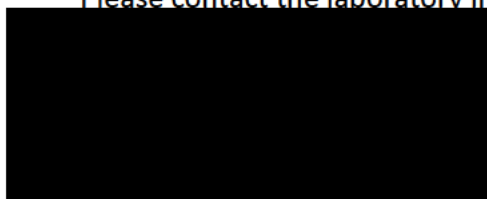
  

LCS % Recovery LSM (EAS1601-3)					
Result	Recovery	Acceptance Limits %	Pass Limits	Units	
0.604	95%	90-105	Pass	%	

#### Notes:

1. All analysis is reported on a dry weight (DW) basis.
2. Results refer to samples as received at the laboratory. This report is not to be reproduced except in full.
3. Analysis conducted between sample arrival date and reporting date.
4. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (refer [scu.edu.au/eal](http://scu.edu.au/eal) or on request).

Please contact the laboratory if you have any queries.







**Determination of Oxygen-Consumption Rate (OCR)**

	t = 0 weeks	t = 3 weeks	t = 9 weeks
Sample Details	GCA11993 16/12/21	GCA11993 4/1/2022	GCA11993 22/2/2022
Cell No.	F	F	F
<u>Test Specifications and Conditions</u>			
Damp-Solids (kg)	1.65	1.67	1.67
<b>GWC (%)</b>	<b>10.0</b>	<b>11.3</b>	<b>11.3</b>
Dry-Solids [DS] (kg)	1.50	1.50	1.50
Solids-SG	2.90	2.90	2.80
Dry-Solids Volume (L)	0.52	0.52	0.54
Pore-Fluid Volume (L)	0.15	0.17	0.17
Cell-Volume (L)	4.65	4.65	4.65
Inert-Spacer-Volume (L)	0.00	0.00	1.65
Gas Volume [GV] (L)	3.92	3.90	2.23
GV/DS Ratio (L/kg)	2.62	2.60	1.49
<b>Temperature (oC) [+/- 0.1]</b>	<b>30.0</b>	<b>30.0</b>	<b>30.0</b>
<u>Measurement with Quantek O2</u>			
<b>Reaction-Time (days)</b>	<b>3.8</b>	<b>5.0</b>	<b>5.0</b>
Reaction-Time (hrs)	92	119	120
<b>Measured O2-Conc. (%) [+/- 0.1]</b>	<b>19.4</b>	<b>20.0</b>	<b>19.9</b>
O2-Consumption (%) [+/- 0.2]	1.5	0.9	1.0
O2-Consumption (mg O2)	78.3	46.7	29.7
<b>OCR (kg O2/kg/s)</b>	<b>1.6E-10</b>	<b>7.3E-11</b>	<b>4.6E-11</b>
<u>Measurement with Nova 309</u>			
GV + Ext.-Dead-Vol. (L)	4.06	4.04	2.37
N2-Dilution Factor	0.966	0.965	0.941
<b>Measured O2-Conc. (%) [+/- 0.1]</b>	<b>18.4</b>	<b>19.0</b>	<b>18.5</b>
O2-Conc. (corrected) [%] (+/- 0.1)	19.1	19.7	19.7
O2-Consumption (%) [+/- 0.2]	1.8	1.2	1.2
O2-Consumption (mg O2)	96.2	63.3	36.9
<b>OCR (kg O2/kg/s)</b>	<b>1.9E-10</b>	<b>9.8E-11</b>	<b>5.7E-11</b>

Notes:

GWC = Gravimetric-Water Content; SG = Specific-Gravity

SG value is estimated.

**Dr GD Campbell**  
**6th April 2022**



**ACID-NEUTRALISATION-CAPACITY (ANC) TESTWORK USING DILUTE ACETIC-ACID (HAc) SOLUTION BUFFERED AT pH 4-5**

SAMPLE		Slurry-pH				NaOH-Titration (pH=7.0)		milli moles OH-Added	pH after H2O2 Added	ANC-[pH4-5] (kg H2SO4/tonne)
ID	WT (g)	<0.5 hr (t = 0)	3 hrs	6 hrs	24 hrs	Conc. (M)	Titre Volume (mL)			
GCA11993	2.01	4.13	4.59	4.65	4.95	0.10	27.05	2.71	> 6.0	86
GCA11993 d	2.08	4.13	4.55	4.68	4.91	0.10	26.55	2.66	> 6.0	84
Std-1	10.05	4.54	4.64	4.64	4.67	0.10	39.35	3.94	5.7	12
Blank		4.02	4.01	4.00	3.99	0.10	62.30	6.23	> 6.0	

Notes:

1. Testing performed on **dried tailings-solids** (i.e. testing not performed on pulps [-75 µm nominal]).
2. **pH4-HAc-Solution** has an Acidity of 1,600 (+/- 4) mg/L (as H2SO4) when titrated with NaOH solution to a pH=7.0 end-point. This solution has an EC value of approx. 600 µS/cm, and was prepared from A.R. glacial acetic acid via dilution with high-purity-deionised-water (HPDW), and partial neutralisation with NaOH solution to achieve the desired acidity level.
3. 200 mL of pH4-HAc-Solution added manually using a 100 mL glass-pipette (A class).
4. **0.10 M-NaOH** solution for back-titration is a certified reagent from Merck (viz. Titripur® reagents in hermetically-sealed Titripac® casks).
5. HAc-digestion step carried out using 500 mL glass-jars agitated (@ 180 rpm) on a Thermoline® orbital-shaker in a CT-room at **22-23 oC**; tops of the jars were covered with loosely-fitting lids to allow escape of any CO2(g) released from carbonate dissolution.
6. **Slurry-pH** values measured at different times during the reaction period of **24 hrs**.
7. Titration with NaOH performed manually using 50 mL glass burette with slurry stirred using magnetic stirrer-bar; the contents of the jars are emptied into a 400 mL glass-beaker to facilitate back-titration. Titration with 0.10 M-NaOH Titration with NaOH undertaken to a **pH=7.0 end-point**. Due to buffering by the HAc reagent, the pH-end-point was stable.
8. During the back-titration with NaOH solution, as the slurry-pH reaches approx. 6.0, three drops of **30 % H2O2 (v/v)** [adjusted to pH 4.5] are added to slurry to oxidise soluble-Fe(II) forms ('latent-acidity') and precipitation of Fe(III)/Al-oxyhydroxides, etc. The **minimum slurry-pH** attained following H2O2 addition is recorded.
9. ANC Standard **Std-1** is pulped Scharlau® sea-sand with a CO3-C value of 0.14 % (corresponding to 11.4 kg H2SO4/tonne as "CaCO3").
10. The **Blank** corresponds to the pH4-HAc-Solution stored in a glass-jar, and agitated as above. The difference between the amount (in millimoles) of NaOH added for the test-slurries, and the Blank, then permits calculation of the ANC-[pH4] value in kg H2SO4/tonne.

Dr GD Campbell  
10th January 2022

**Back-Titration with 0.10 M-NaOH Solution**



Laboratory Report

**pH-BUFFERING TESTWORK (GCA11993\_\_Dried-Tailings-Solids)**

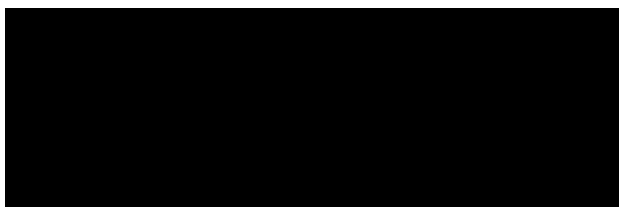
Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H2SO4/tonne)	pH	Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H2SO4/tonne)	pH
0.00	0.0	9.9	14.00	13.7	5.6
0.40	0.4	9.3	14.40	14.1	5.4
0.80	0.8	8.8	14.80	14.5	5.2
1.20	1.2	8.5	15.20	14.9	5.1
1.60	1.6	8.3	15.60	15.3	4.9
2.00	2.0	8.2	16.00	15.7	4.7
2.40	2.4	8.1	16.40	16.1	4.6
2.80	2.7	8.0	16.80	16.5	4.4
3.20	3.1	7.9	17.20	16.9	4.4
3.60	3.5	7.8	17.60	17.2	4.3
4.00	3.9	7.7	18.00	17.6	4.2
4.40	4.3	7.6	18.40	18.0	4.1
4.80	4.7	7.6	18.80	18.4	4.0
5.20	5.1	7.5	19.20	18.8	3.9
5.60	5.5	7.5	19.60	19.2	3.8
6.00	5.9	7.5	20.00	19.6	3.7
6.40	6.3	7.6	20.40	20.0	3.7
6.80	6.7	7.6	20.80	20.4	3.6
7.20	7.1	7.4	21.20	20.8	3.6
7.60	7.4	7.2	21.60	21.2	3.5
8.00	7.8	7.0	22.00	21.6	3.5
8.40	8.2	7.0	22.40	22.0	3.4
8.80	8.6	6.9	22.80	22.3	3.4
9.20	9.0	6.8	23.20	22.7	3.3
9.60	9.4	6.6	23.60	23.1	3.3
10.00	9.8	6.5	24.00	23.5	3.3
10.40	10.2	6.4	24.40	23.9	3.2
10.80	10.6	6.3	24.80	24.3	3.2
11.20	11.0	6.2	25.20	24.7	3.2
11.60	11.4	6.1	25.60	25.1	3.1
12.00	11.8	6.0	26.00	25.5	3.1
12.40	12.2	6.0	26.40	25.9	3.1
12.80	12.5	5.9	26.80	26.3	3.1
13.20	12.9	5.8	27.20	26.7	3.0
13.60	13.3	5.7			

**Notes:** Titration performed using Metrohm® 736 Titrino auto-titrator, and 0.05 M-H2SO4. Equilibration time between titrant additions is 15 minutes.

5.00 g of **dried-tailings-solids (i.e. not pulped to -75 µm nominal)** initially dispersed in *ca.* 150 mL of deionised-water. Test-suspension in contact with air in a CT-room @ 20 (+/1 1-2) oC, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = 6 mV (pH=7.00); slope-point = 172 mV (pH=4.00); 96.3 % of Nernstian response.



Laboratory Report

**pH-BUFFERING TESTWORK (GCA11993 Pulped-Tailings-Solids)**

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H2SO4/tonne)	pH	Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H2SO4/tonne)	pH
0.00	0.0	10.0	20.40	20.0	8.2
0.40	0.4	9.9	20.80	20.4	8.2
0.80	0.8	9.7	21.20	20.8	8.1
1.20	1.2	9.7	21.60	21.2	8.1
1.60	1.6	9.6	22.00	21.6	8.1
2.00	2.0	9.6	22.40	22.0	8.1
2.40	2.4	9.5	22.80	22.3	8.0
2.80	2.7	9.5	23.20	22.7	8.0
3.20	3.1	9.5	23.60	23.1	7.9
3.60	3.5	9.4	24.00	23.5	7.9
4.00	3.9	9.4	24.40	23.9	7.9
4.40	4.3	9.4	24.80	24.3	7.8
4.80	4.7	9.4	25.20	24.7	7.8
5.20	5.1	9.3	25.60	25.1	7.7
5.60	5.5	9.3	26.00	25.5	7.7
6.00	5.9	9.3	26.40	25.9	7.6
6.40	6.3	9.3	26.80	26.3	7.5
6.80	6.7	9.2	27.20	26.7	7.5
7.20	7.1	9.2	27.60	27.0	7.4
7.60	7.4	9.2	28.00	27.4	7.3
8.00	7.8	9.2	28.40	27.8	7.2
8.40	8.2	9.1	28.80	28.2	7.2
8.80	8.6	9.1	29.20	28.6	7.1
9.20	9.0	9.1	29.60	29.0	7.0
9.60	9.4	9.1	30.00	29.4	7.0
10.00	9.8	9.0	30.40	29.8	6.9
10.40	10.2	9.0	30.80	30.2	6.8
10.80	10.6	9.0	31.20	30.6	6.8
11.20	11.0	9.0	31.60	31.0	6.7
11.60	11.4	9.0	32.00	31.4	6.6
12.00	11.8	8.9	32.40	31.8	6.5
12.40	12.2	8.9	32.80	32.1	6.5
12.80	12.5	8.8	33.20	32.5	6.4
13.20	12.9	8.8	33.60	32.9	6.4
13.60	13.3	8.8	34.00	33.3	6.3
14.00	13.7	8.7	34.40	33.7	6.2
14.40	14.1	8.7	34.80	34.1	6.2
14.80	14.5	8.7	35.20	34.5	6.1
15.20	14.9	8.6	35.60	34.9	6.0
15.60	15.3	8.6	36.00	35.3	6.0
16.00	15.7	8.5	36.40	35.7	5.9
16.40	16.1	8.5	36.80	36.1	5.8
16.80	16.5	8.5	37.20	36.5	5.8
17.20	16.9	8.4	37.60	36.8	5.7
17.60	17.2	8.4	38.00	37.2	5.6
18.00	17.6	8.4	38.40	37.6	5.6
18.40	18.0	8.3	38.80	38.0	5.5
18.80	18.4	8.3	39.20	38.4	5.5
19.20	18.8	8.3	39.60	38.8	5.4
19.60	19.2	8.2	40.00	39.2	5.4
20.00	19.6	8.2	40.40	39.6	5.3

Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H2SO4/tonne)	pH	Cumulative Volume of Acid Added (mL)	Cumulative Acid Consumption (kg H2SO4/tonne)	pH
40.80	40.0	5.3	55.60	54.5	3.6
41.20	40.4	5.2	56.00	54.9	3.6
41.60	40.8	5.2	56.40	55.3	3.6
42.00	41.2	5.1	56.80	55.7	3.6
42.40	41.6	5.1	57.20	56.1	3.5
42.80	41.9	5.0	57.60	56.4	3.5
43.20	42.3	4.9	58.00	56.8	3.5
43.60	42.7	4.9	58.40	57.2	3.5
44.00	43.1	4.9	58.80	57.6	3.5
44.40	43.5	4.8	59.20	58.0	3.5
44.80	43.9	4.8	59.60	58.4	3.4
45.20	44.3	4.7	60.00	58.8	3.4
45.60	44.7	4.6	60.40	59.2	3.4
46.00	45.1	4.6	60.80	59.6	3.4
46.40	45.5	4.5	61.20	60.0	3.4
46.80	45.9	4.4	61.60	60.4	3.4
47.20	46.3	4.4	62.00	60.8	3.4
47.60	46.6	4.3	62.40	61.2	3.3
48.00	47.0	4.3	62.80	61.5	3.3
48.40	47.4	4.2	63.20	61.9	3.3
48.80	47.8	4.2	63.60	62.3	3.3
49.20	48.2	4.1	64.00	62.7	3.3
49.60	48.6	4.0	64.40	63.1	3.3
50.00	49.0	4.0	64.80	63.5	3.3
50.40	49.4	3.9	65.20	63.9	3.2
50.80	49.8	3.9	65.60	64.3	3.2
51.20	50.2	3.9	66.00	64.7	3.2
51.60	50.6	3.8	66.40	65.1	3.2
52.00	51.0	3.8	66.80	65.5	3.2
52.40	51.4	3.8	67.20	65.9	3.2
52.80	51.7	3.7	67.60	66.2	3.1
53.20	52.1	3.7	68.00	66.6	3.1
53.60	52.5	3.7	68.40	67.0	3.1
54.00	52.9	3.7	68.80	67.4	3.1
54.40	53.3	3.7	69.20	67.8	3.1
54.80	53.7	3.6	69.60	68.2	3.1
55.20	54.1	3.6	70.00	68.6	3.0

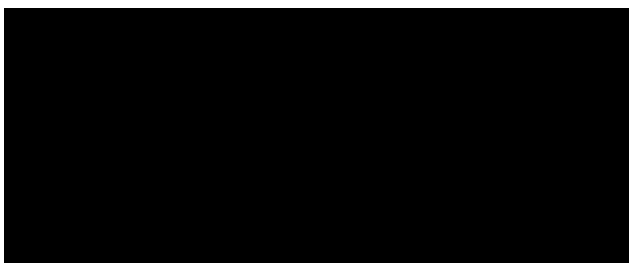
**Notes:** Titration performed using Metrohm® 736 Titrino auto-titrator, and 0.05 M-H2SO4. Equilibration time between titrant additions is 15 minutes.

5.00 g of pulped **tailings-solids (i.e. -75 µm nominal)** initially dispersed in *ca.* 150 mL of deionised-water.

Test-suspension in contact with air in a CT-room @ 20 (+/1 1-2) oC, and continuously stirred.

Calibration of pH-Glass Electrode:

Immediately prior to titration: asymmetry potential = 6 mV (pH=7.00); slope-point = 179 mV (pH=4.00); 97.6 % of Nernstian response.



## Laboratory Report

**NET-ACID-GENERATION (NAG) TESTWORK (SINGLE-ADDITION)**

Sample_ ID	Sample Weight (g)	Comments	pH of Test Suspension within approx. 10 mins	pH of Test- Suspension After O'Night Reaction [Before Boiling Steps]	pH of Test- Suspension After 1st- Boiling Step [Before Cu(II) Addition]	Test-Suspension Values After 2nd-Boiling Step [Cu(II) Added Before 2nd-Boiling Step]		Titre (mL) (0.1 M-NaOH)		NAG (kg H2SO4/tonne)		
						NAG- pH	NAG-EC ( $\mu$ S/cm)	To pH 4.5	pH 4.5 to pH 7.0	To pH 4.5	pH 4.5 to pH 7.0	To pH 7.0
GCA11993	2.98	reaction peaked overnight	7.6	9.2	9.5	9.3	228	-	-	<1	<1	<1
GCA1193 d	3.00	reaction peaked overnight	7.6	9.2	9.6	9.4	215	-	-	<1	<1	<1
Blank		no apparent reaction overnight	4.9	5.0	6.4	5.6	64	-	0.35			"<1"

**Notes:** Chem-Supply® A.R. 30 % H<sub>2</sub>O<sub>2</sub> employed ('apparent-pH' = 4.3). 15 % H<sub>2</sub>O<sub>2</sub> reagent corresponds to 1:1 (v/v) mixing with high-purity deionised-water (HPDW).

250 mL of peroxide solution is added to sample in in 500 mL conical Erlenmeyer beaker that is then covered with a watchglass. pH values of test-suspensions determined at different stages during testing. Following reaction overnight, the occurrence and vigour of reaction is judged according to degree of water condensation on the underside of the watchglass. The suspension-pH is measured, and the test-suspensions then boiled for *ca.* 1 hr. After allowing to cool, *ca.* 1 mL of 0.016 M-CuSO<sub>4</sub> is added, and the 2nd-boiling step carried out for *ca.* 1 hr. The added Cu(II) catalyses the decomposition of any residual, unreacted H<sub>2</sub>O<sub>2</sub> (AS 4969.12-2009).

Following determination of supernatant-EC and suspension-pH, the test-suspensions are titrated manually with standardised NaOH solution to respective pH4.5 and pH7.0 end-points.

The Blank corresponds to a "NAG-[pH7]" value less than 1 kg H<sub>2</sub>SO<sub>4</sub>/tonne for a sample weight of 3.00 gm. CuSO<sub>4</sub> was added to Blank. Boiling during 2nd-boiling step continued until it was visually evident that residual-H<sub>2</sub>O<sub>2</sub> in the Blank was negligible.

Separate Blank\* (results not reported) without CuSO<sub>4</sub> addition characterised by appreciable residual H<sub>2</sub>O<sub>2</sub> after completion of boiling steps, as expected.

Testing performed on **pulps** (nominal -75  $\mu$ m).

Dr GD Campbell      2nd March 2022

**NAG Testwork: 1st-Boiling Step [without Cu(II) addition] After Overnight Reaction**